EXPLORATION of CREATIVE LEARNING OPPORTUNITIES, through an INNOVATIVE STUDENT-CENTRED PODCASTING PEDAGOGY

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ABSTRACT

While anatomy and physiology (A & P) form foundational knowledge for several undergraduate health courses, many find the topic content-dense and challenging to learn (Munns, 2013). Moreover, it has been reported that modern students enjoy collaboration, are creative, are proficient with technology (Roberts et al., 2012), and prefer active-learning opportunities. Active learning also improves understanding and reduces failure rates (Freeman et al., 2014). Considering this, substantial effort was given to create an innovative, blended active-learning pedagogy using creativity and technology to support the learning of physiology. Student teams were immersed in a creative game-based scenario, a narrative titled “Uni-Apocalypse”, and were required to create “PodPoints” (Podcast-PowerPoints). These conveyed key physiology principles to construct a fictional “super-soldier” to save them from the Zombie apocalypse. 142 undergraduate students undertaking RBM1518 Human Physiology 1 Unit in 2019 participated and outcome results pertaining to assessment performance were compared with similar cohorts for the previous year (n = 167). Intervention effectiveness was assessed by comparing test results for 2019 and 2018 (no PodPoint use) and qualitative feedback. Statistical analysis (t-tests, $P < .05$) found no significant difference between the test scores for the two cohorts, however, a significant difference was seen in test scores for students doing well with PodPoints within their cohort. Notably, participation in the team PodPoint topics positively influenced whether students attempted the short answer questions (SAQs) of the final test and the results of them. The average SAQ topic scores that related to the students covering the PodPoint topics, were all greater than the mean class SAQ scores for all students not covering the PodPoint topics, with three of these being statistically significant ($P < .05$). Qualitative data was collected by surveys, questionnaires, and individual or small group interviews and underwent thematic analysis. Supportive student feedback was given across several constructs, including *satisfaction*, *learning*, *collaboration*, *creativity*, *engagement*, and *technology*. Triangulation of data corroborated the primary findings that the novel learning and assessment intervention had positively affected learning, student engagement, and creativity. As a first of its kind, the pilot delivery of this teaching and learning innovation has returned positive results warranting its application. Its ongoing use beyond the study period has continued to provide a beneficial learning experience and supports an evolving educational landscape.

DOCTOR OF PHILOSOPHY STUDENT DECLARATION

Declaration

I, Christopher John Lillico, declare that the Doctor of Philosophy thesis titled “Exploration of creative learning opportunities, through an innovative student-centered podcasting pedagogy” is no more than 83,000 words in length, including quotes and exclusive of figures, tables, appendices, and references. The thesis contains no material that has been submitted previously, in whole or in part, for the award of any other academic degree or diploma. Except where otherwise indicated, this thesis is my own work.

I have conducted this research in alignment with the Australian Code for the Responsible Conduct of Research and Victoria University’s Higher Degree by Research Policy and Procedures. The project was approved by the Victoria University Human Research Ethics Committee (VUHREC) - HRE19-010.

The author reports no conflicts of interest in this work.

Signature: 

Date: 31st October 2022

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Victoria University acknowledges, recognises and respects the Ancestors, Elders and families of the Bunurong/Boonwurrung, Wadawurrung, and Wurundjeri/Woiwurrung of the Kulin who are the traditional owners of University land in Victoria, and the Gadigal and Guring-gai of the Eora Nation who are the traditional owners of University land in Sydney.

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My candidature, like many, has faced many challenges and hurdles that sought to derail this project. My sincere gratitude is extended to all my supervisors for their unwavering support, patience, and guidance as they helped me to navigate these challenges. While I hope that this work adds something positive to the educational sector, from my perspective, much growth has already taken place. I thank you all for being a part of that.

I would like to also thank Dr. Fleming for his support to use the online "VARK (visual, auditory, read/write, kinaesthetic) Questionnaire" (©Version 8.01, 2019, VARK-Learn Limited, Christchurch, New Zealand) which was used to identify individual student communication styles.

A special, heartfelt thanks go to my partner and family, for their love and support, in all that I do.

DEDICATION

Finally, this is dedicated to every person that ponders the great “what if?” questions. Every adult has a little childlike imagination just waiting to surface – when it does, wonderous things can occur.

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LIST OF ABBREVIATIONS

The following table lists and defines the acronyms used throughout the thesis. The page on which each acronym is defined or first used is also given.

Abbreviation	Description	Page
PodPoint(s)	Podcast-PowerPoint(s)	1
PBL	Project-based learning	17
FC	Flipped classroom	17
TBL	Team-based learning	17
GBL	Game-based learning	17
ICTs	Information and communication technologies	20
CPS	Collaborative-problem solving	22
CPBL	Collaborative project-based learning	22
LWT	Learning with technology	22
IDEAL	Instructional Decisions to Enable Active Learning	22
ALS	Active Learning Strategies	22
IQ	Intelligence quotient	24
ZPD	Zone of Proximal Development	28
AL	Active learning	34
GW	Group work	38
CL	Collaborative learning	38
IBL	Inquiry-based learning	38
PASS	Peer-assisted study session	40
STEM	Science, technology, engineering, and mathematics	43
CLT	Communicative language teaching	50
EFL/ESL	“English as a Second Language” and “English as a Foreign Language”	50
CACI	Computer-aided course instructions	52
MCQ	Multiple choice question	56
Vodcasts	Video-on-demand podcasts / video podcasts	58
GEM	'Graduate Entry to Medicine'	58
IT	Information technology	60
Power Casting	PowerPoint and Podcasting format	71
GC1 & GC2	Victoria University graduate capacities	76
VUHREC	Victoria University Human Research Ethics Committee	78
VARK questionnaire	Visual, auditory, read/write, kinaesthetic questionnaire	80
ANOVA	Analysis of variance	89
TA	Thematic analysis	89
HBBM	Bachelor of Biomedicine	96
HBES	Bachelor of Biomedical & Exercise Science	96
HBBS	Bachelor of Biomedical Science	96
HBBT	Bachelor of Human Nutrition	96
HBAS	Bachelor of Applied Science	96
NBPH	Bachelor of Pharmaceutical & Health Science	96
ABPY	Bachelor of Psychology	96
SES	Socio-Economic Status	118
SEIFA	Socio-Economic Indexes for Areas	118
IRSD	Index of Relative Socio-economic Disadvantage	118

LIST OF ABBREVIATIONS cont.

IRSAD	Index of Relative Socio-economic Advantage and Disadvantage	118
IER	Index of Economic Resources	118
IEO	Index of Education and Occupation	118

DISSEMINATION & AWARDS

Dissemination and awards for this work so far include a presentation at:

- Victoria University's Learning & Teaching Symposium (2019);
- The Australian Conference on Science and Mathematics Education (ACSME) (2019);
- The global Reimagine Education Conference (virtual, 2020) where it was shortlisted for an award in the E-Learning category;
- The Games for Change Asia-Pacific conference (2021); and
- Excellence in Learning and Teaching Award Recipient 2022 - VU Staff Awards (Formerly Vice Chancellor's Award).

The further promotion included an article in Vitoria University's in-house, "The Vine" News blog (2019), a front-page article in the newspaper, Geelong Independent (2020), and a radio interview on the ABC Radio Drive Program (2020).

CHAPTER ONE:

1.0 INTRODUCTION

This chapter introduces an innovative teaching approach that was used to encourage the learning, engagement, and assessment performance of first-year, undergraduate human physiology students. PodPoints (Podcast-PowerPoints) were used to create a game-based learning scenario centered upon a fictional Zombie apocalypse narrative called "Uni-Apocalypse". While both the Podcast and PowerPoint technologies have found considerable use in the education system, they have not been specifically applied in this manner for physiology education. Nor have they been co-combined with a fictional narrative, such as this, that explored an imaginative mode of learning within an interactive game-like platform. In doing so, respectively well used, and established technologies, have been applied in a constructively fresh and innovative approach to supporting their learning and the active involvement of students in the construction of knowledge. This aligns highly with an evolving pedagogy – one whereby the methods and practices of modern teaching are acknowledging and meeting the needs of the modern learner.

The ensuing discourse in this chapter introduces the context of this work within the present educational landscape and sets the scene for the remainder of this thesis. It does so by briefly discussing its linkage with several pedagogical elements including constructivism, active learning, collaboration, technology, and creativity, and some work done in these areas. It introduces the use of podcasts in education and highlights a lack of their use in physiology. A greater expansion of these works then follows in the Literature Review. The theoretical positioning of the work is elucidated by introducing the core learning strategy – the novel teaching intervention. The chapter ends with a statement of significance, alongside how this work adds to the existing body of knowledge. Additionally, it should be noted that while this teaching approach continued to be applied in the post COVID-19 setting, this thesis reports on the pre-COVID-19 work.

1.1 Aligning Teaching Methods with the Modern Student

While anatomy and physiology (A & P) provide foundational knowledge for several undergraduate health degrees, many students find them content-heavy and challenging to learn (Munns, 2013). Various strategies are being explored to help promote learning of this foundational subject matter. Part of this changing pedagogy relates to the inclusion of active learning strategies, as well as constructivist teaching practices that better align with the GenZ

preferences (those born between 1997-2012 inclusive). Modern students enjoy collaboration, are creative, are proficient with technology (Roberts, Newman, and Schwartzstein, 2012), and prefer active learning opportunities.

However, traditional teaching, with the use of lectures and textbooks, has been the foundation of the didactic teaching model for decades. In fact, since the inception of the institution of the "University", well over 900 years ago, lectures have been the predominant mode of instruction (Brockliss, 1996). Because of the central role of the lecture in the teaching process (McGarr, 2009), Behr (1988) reported that most academic staff preferred to be identified by the title of "lecturer" (cited in McGarr, 2009). While this pedagogy has its strengths and successes, the inherent delivery format is now being replaced by other educational strategies. This is not surprising. Lectures provide a teacher-centric, passive transfer of information, with little or no opportunity for student interaction. It has now been acknowledged that the passive "lecture alone is largely incongruent with what we know about how people learn and contemporary college science education goals" (Leilani and Kreager, 2017, p.2086). Consequently, the lecture format is now being supplanted by teaching models that support the acquisition and the construction of knowledge through active learning processes (Michel, 2009). Many of these aims to promote education through greater participation and engagement of students in the learning process. Increased student interaction and "ownership" of learning reflect a transmutation of the processes underpinning the transfer of information. The passive transfer of information through teacher-centric approaches (passive learning), is being either supplemented or in some cases supplanted by pedagogical strategies that encourage active student acquisition and construction of knowledge (Harris & Welch Bacon, 2019).

The modern learning landscape now acknowledges that active learning strategies that position students as co-creators of knowledge are important to enhance student engagement in the learning process. This method aligns with the constructivist learning approach (Vygotsky, 1962; Piaget, 1968; Perry, 1999) and presents an alternative to pedagogies based upon behaviourism theory (Skinner, 1976). Moreover, Papert (1980), a student of Piaget, coined the term "constructionism" to combine the key elements of constructivism, with his inferences about learning (Sabelli, 2008). These included the tenet that active learning derives from the meaningful construction of artifacts, whereby the process of building supports the active construction of knowledge (Siko & Barbour (2012).

Student-centred education, such as active learning strategies are becoming prominent features of the contemporary educational landscape (Krahenbuh, 2016). Proponents of active learning believe that the learning process is enhanced by engaging the student in the active construction of knowledge, rather than the simple receipt of it. This strategy places the learner in the here and now, by participating in the transmission of knowledge through the experiential construction of it. Active learning builds on the base of preconceived knowledge and helps to

foster a sense of ownership of it. The process also helps to positively address classroom boredom and lack of engagement, something which is an ongoing concern within the present scholastic system (Eng, 2017). Active learning encompasses a plethora of student-centred learning pedagogies, such as problem and project-based learning (PBL), flipped classroom (FC) delivery, team-based learning (TBL), and game-based learning (GBL), just to name a few (Harris & Welch Bacon, 2019; Ummah et al., 2019). While the methods may vary, the intertwining pedagogical thread connecting them is that the instruction focuses on promoting student responsibility for their learning; the recurring goal being to foster deep learning and understanding (Michel et al., 2009). Moreover, they appear to be working. For example, it has been reported that within the didactic teaching model, active learning techniques can be used as successful methods to enhance students' knowledge and understanding (Harris & Welch Bacon, 2019). Harris & Welch Bacon (2019) further suggested that when the complexity increases, so do students' critical thinking and problem-solving skills. Collaborative active learning through student peer interactions and group-based work is one such multifaceted technique that adds complexity. Findings have shown that active learning strategies founded on team interactions and peer-to-peer presentations can enhance student engagement and importantly help to generate student enthusiasm for the subject material (Atayee et al., 2012; Allen et al., 2013; Steinhardt et al., 2017). To this end, and regarding the preceding discussion about active learning, several authors have reported that the modern student prefers flexible delivery, interactivity, experiential activities, and group collaboration (Baron and Maier, 2005; McNeely, 2005). Moreover, based on skill mastery, feedback, and engagement, tertiary students have identified that technology-enhanced approaches, cooperative learning approaches, and project-based approaches, are the top three preferred active learning strategies (Abuso, 2017).

The traditional teaching model has also fallen somewhat short of fostering creativity and imagination (Robinson, 2006). Following the analysis of normative data of Torrance Tests of Creative Thinking (TTCT) from 272,599 kindergarten through 12th-grade students and adults, it was reported that creative thinking scores have decreased (Kim, 2011). This contrasts with the intelligence quotient (IQ) scores that have been increasing worldwide for several decades (Flynn, 2007). It appears that despite creativity being a cornerstone that drives and motivates learning from a very early age, it is in effect being "schooled" out of us at the tertiary level (Robinson, 2006). Furthermore, effective learner engagement is an ongoing challenge within the present scholastic system. It has been reported that classroom boredom drains life within the universities of today (Eng, 2017). One challenge relates to forming a consensus on how best to promote and measure student engagement. While many reasons exist, a lack of creativity in the learning process can result in a lack of motivation and engagement to learn. Hanus & Fox (2015) define engagement as the degree of attention and absorption that a student gives to a task and question the likelihood of student engagement

when tasks are "imposed by the teacher". Moreover, student disengagement not only relates to the curriculum and its delivery format but also the nature of the present-day student. For example, Maag (2006) and Carlson (2005) hold the contention that the modern student, those who have been coined Millennial Learners / Gen Y / Net Gen (born 1981-1996), have grown up in a media-rich environment and exist in an information-centric driven world. As such, it has been proposed that this millennial generation, having been raised with technology, prefer a different way to learn (Munns, 2013). Specifically, this generation has been described as digitally literate, craves interactivity, prefers group collaboration, has short attention spans, requires structure and guidelines, is achievement-orientated, and appreciates experiential, visual, and kinaesthetic learning (Baron & Maier, 2005). The juxtaposition of this is now supported by technological advancements over the last two decades. With the inception and widespread use of Web 2.0 applications and high-speed internet access, there has been an ongoing interest in and use of social media-based educational resources (Kamel Boulos & Wheelert, 2007, Oloo & Omwenga, 2015). Indeed, the emergence of a new digital environment has afforded educational opportunities that can support students to learn information in a manner that may better suit them.

Thus, the educational landscape needs to adapt, whereby the teaching strategies need to better align with the millennial generation and advances in technology. Student engagement needs to be fostered through technologies that better match the newer generation's mind, as there are significantly different attitudes and expectations toward learning these days (Mahmud et al., 2019). Part of this relates to shifting the role of the educator – from one of "lecturer" or "teacher" to that of "facilitator" or "guide". This also helps to position the student as a co-creator of their learning experience. Consequently, the modern generation needs to be engaged through thoughtful pedagogical approaches that include collaborative and creative active learning processes. Additionally, these need to be aligned with present-day technologies. In part, the future efficacy of educational practice and learning outcomes is reliant on this.

1.2 The importance of technology and creativity for learning

The emergence of the digital era now affords educational opportunities that can support students to think, process, and learn information in a variety of new technologically supported ways. The role of technology in this learning process is pivotal, especially in the support of student engagement and active learning (Wanner, 2015). This is of no surprise, considering that the modern student, those who are labeled Millennial Learners, Gen Z, or Net Gen, have grown up in a media-rich environment and an information-centric driven world (Carlson, 2005; Maag, 2006). Millennial learners enjoy collaboration and are creative and proficient with technology (Twenge, 2009; Roberts et al., 2012). The youth of today demonstrate their

technological prowess and imagination by regularly creating and sharing a variety of content, such as online videos. Short video platforms, such as "TikTok", "YouTube", and "Instagram" applications are highly popular among millennials for creating and sharing entertaining or instructional content, with TikTok being labeled as a "petri dish for youth culture" (Patrick, 2018). Following its inception in 2016, Zhong (2018) described TikTok as a fast-growing video platform, with over half a billion users around the world. Recently it was reported that it now has 800 million active users, of which approximately 41 percent are aged between 16-24 years (Moshin, 2020). However, such platforms while facilitating creative social expression are not necessarily suitable for academia. Consequently, just as social technology so readily engages the younger mind to construct and express their creativity, so must the modern platforms in which formal learning takes place. This generation, having been raised with technology, prefers a different way of learning to that of the traditional methods used in the past (Munns, 2013), with engagement in the active creation of knowledge a cornerstone of this. Baker and Baker (2012) also acknowledged that creativity nurtures problem-solving through the generation of novel solutions and innovation and is a crucial graduate attribute of students. However, contrastingly, the effort to include student-centred creativity in education has been limited thus far. Stolaki & Economides (2018) suggest that the quandary of creativity enhancement in the higher education sector is a major individual, organisational, and societal challenge. This implies the need for a paradigm shift within the traditional pedagogy – to one that incorporates strategies such as active learning methods that especially include creativity, technology, and collaboration.

As highlighted, the digital age has given rise to many types of social media–based educational resources such as podcasts, wikis, blogs (Oloo & Omwenga, 2015), TikTok, YouTube, and others. All of these are promising tools with potential to connect with and foster learning with the digitally literate student. Distinctly, within the field of educational academia, educational podcasts (digital audio recordings for streaming and downloading) have the potential to be an excellent technological medium to promote student creativity and engagement in their process of learning (Popova et al., 2013; Forbes, 2015). Podcasts and other digital educational resources have gained popularity to support teaching and learning – they are highly convenient, portable, and cost-effective, and can provide readily accessible information in a timely and dynamic way (Fernandez et al., 2015; Paterson et al., 2015).

To date, within the field of physiology, there has been a growing use of teacher generated podcasting technology to either replace or supplement the traditional flow of information between the teacher and student. For example, Kalludi and co-workers (2015) looked at the use of podcasts as a supplementary teaching aid for first-year dental students; Mostyn and colleagues (2013) explored student experiences of using biology podcasts in nursing; and Munns (2013) introduced supplemental podcasting to support the learning of physiology for Physiotherapy, Occupational Therapy, and Sports and Exercise Science

students. However, much of the focus has been on using podcasts that are teacher-centred for instructional purposes, with some limited student involvement in their creation of them. Presently, there is a paucity whereby students are required to create podcasts for learning purposes and/or assessment tasks, especially where they have the freedom to "create them creatively" using an "artful" (imaginative and expressive), innovative approach. Two recent studies used active learning strategies that engaged undergraduate students in the artful creation of podcasts (Bolden and Nahachewsky, 2015; Pegrum et al., 2015). Pegrum and colleagues (2015) reported that well-designed creative student-centred podcasting tasks can motivate students, including those who are otherwise disengaged, through active knowledge building and engaged collaboration. They suggested that this potentiates the promotion of deeper learning and called for further research to substantiate this. The work of Pegrum and colleagues (2015) was in chemistry, while Bolden and Nahachewsky (2015) was in music. This approach has not been reported for use in physiology courses.

Additionally, the platforms on which podcasting is being delivered have rapidly evolved. Much of this relates to advances in technology and the way information is being distributed. Initially just considered as audio files, contemporary podcasts can include digital images and videos, which can be downloaded at the user's convenience to devices such as smartphones for later use (Chen & Malon, 2017). Recently, the term "PowerCasting" was coined to describe the use of PowerPoint to create podcasts and was described as a simple and creative alternative to traditional podcasting (Broskoske, 2019).

In addition, various gamified approaches have been employed to promote student motivation (Hanus & Fox, 2015), engagement (Barata et al., 2013), and other learning outcomes (Lee & Hammer, 2011). The term gamification was originally coined in 2002, and describes the process of using game-like features and incorporating them into non-game settings, while still affording gaming qualities to improve retention (Faiella & Ricciardi, 2015). Following a meta-analysis of gamification and learning, Sailer and Homner (2020) suggested that gamification is an effective method for instruction. Significant small effects of gamification on cognitive ($g = .49$, 95% CI [0.30, 0.69], $k = 19$, $N = 1686$), motivational ($g = .36$, 95% CI [0.18, 0.54], $k = 16$, $N = 2246$), and behavioural learning outcomes ($g = .25$, 95% CI [0.04, 0.46], $k = 9$, $N = 951$) were reported.

Modern technology readily affords the ability to create digital education gaming platforms that use a variety of approaches. This helps to promote learning in an engaging and entertaining environment across various age groups. However, often the cost associated with specialist gaming platforms and software precludes their use of them in many teaching institutions. Consequently, various approaches have been used to gamify learning that is easy to use, accessible, and cost-effective. For example, Leung, Kristofer & Harrison (2020) used 'physiology-based escape room' and 'murder mystery' activities to gamify learning. Moreover, since the inception and delivery of our work, new publications have added to this rapidly

evolving field which will be discussed later. Other contemporary gamified learning approaches include the use of PowerPoint to include game-like elements to foster student engagement, enjoyment, and learning. Mocanda & Mocanda (2014) suggested that *"gamification activities that utilize the capabilities of PowerPoint, can offer instructors a viable and stealthy, teaching and learning strategy that capitalizes on collaborative play to engage students"* (Moncada & Moncada, 2014, p18.). Future work can expand on what has been done, as well as investigate further means into how this extensive and commonly , and cost-effective technology (PowerPoint) can better engage students with active learning.

1.3 Moving forward

There is no doubt that information and communication technologies (ICTs) have the potential to be excellent media to promote student creativity, active engagement, and collaboration in the learning process. As discussed, Podcast technology is one such medium. Moreover, PowerPoint technology can be used as a simple, cost-effective, and creative alternative to traditional podcasting allowing the further inclusion of images alongside interactive elements. The use of such technology harnesses the potential to promote student engagement and improve learning, especially when combined with gamified like-elements and active participation. This positions the student as co-creator of the learning process. Scott (2015) contends that the contribution and thoughtful application of technology provides more learner-centred approaches, making personalised and collaborative learning possible. Additionally, the inclusion of game-like features has been shown to motivate, engage, and improve other student learning outcomes (Lee & Hammer, 2011; Barata et al., 2013; Hanus & Fox, 2015). Aligning elements of creativity, gamification, technology, active participation, and collaboration, should be therefore be considered a primary goal of modern education. One challenge, however, is how to apply all of this within the present educational setting.

1.3.1 Significance of this present work

Many bioscience subjects, such as anatomy (Notebaert, 2009), physiology (Munns, 2013), pathophysiology (Branney & Priego-Hernadez, 2018), human biology (Mostyn et al., (2013), and biochemistry (Wood, 1990) are content-dense and are considered difficult to teach by teachers and difficult to learn by students (Munns, 2013). Accordingly, there has been interest in finding pedagogical approaches to better address this. Numerous methods and investigations looking to enhance learning have been undertaken, giving rise to an evolving educational landscape. Part of this changing pedagogy relates to the inclusion of active learning strategies, as well as constructivist teaching practices (Wanner, 2015), that better align with the Millennial learning preferences (Steinhardt et al., 2017). Moreover, modern

students prefer creativity enhancement using technology and collaborative learning (Twenge, 2009; Roberts et al., 2012; Steinhardt et al., 2017; Stolaki & Economides, 2018). It has been reported that higher education students have identified technology-enhanced approaches, cooperative learning approaches, and project-based approaches, as the top three active learning strategies based on skill mastery, feedback, and engagement (Abuso, 2017).

The student-generated learning media in this present work centres on the use of Podcast and PowerPoint technologies. Concerning podcasts, during the early 2000s, educators seeing the potential benefits of this medium quickly adopted their use (Drew, 2017). However, while Alpay & Gulati (2010) view podcasts as a highly engaging and flexible resource, others see that the potential opportunities for their use in the construction of knowledge have yet to be realised (Fernandez et al, 2015). The three main categories of use of podcasts include the substitution of lecture content, the supplementary addition of material to enhance learning, and their creative use, whereby students are actively engaged in the creation of them (McGarr, 2009). However, of these, the least frequently applied application is the creative student-generated and active learning approach (McGarr, 2009). This approach may enhance the learning process by engaging the student in the construction and creative discovery of knowledge rather than the simple receipt of it. This would further help to foster ownership of the learning process as active learning engages students as partners and supports them take more accountability for their own learning (Gleason et al., 2011).

Recently, PowerCasting allows PowerPoint technology to be used as a simple and creative alternative to traditional podcasting. Furthermore, gamification, where gamified-like elements incorporated into PowerPoint presentations has also been used. These techniques spark new life into PowerPoint technology and afford opportunities to explore novel teaching methods to promote student engagement through active learning, creativity, and collaborative play. This work introduces an alternative descriptive term -- "PodPoints" -- a combination of Podcast and PowerPoint technology that were used to support a fictional Zombie apocalypse narrative called "Uni-Apocalypse". Within this narrative, students were required to use physiology knowledge to fictionally create a super-soldier to battle the Zombies. The findings of this present work suggest that PodPoints in conjunction with a fictional narrative can further add to an evolving educational tool kit. Instructors can readily incorporate them as an easy-to-use and cost-effective means to promote learning and engagement. While several investigations within the area of biosciences have looked at the effect of lecture-centered podcasting to either replace or supplement information, none have combined these two technologies in such a manner as described here. An extensive review of the relevant literature, including recent publications, is described in Chapter two. From this, it was found that a paucity exists where physiology students are actively engaged in the creation of the Podcasts either individually or collaboratively. What's more, there is a dearth of opportunity

whereby students have the freedom to ‘‘create them creatively”, and certainly none that have co-combined them with a fictional scenario and narrative, such as the "Uni-Apocalypse".

The novel teaching platform of this work comprised a "blended, active learning strategy" that incorporated a creative mode of learning. A combination of collaborative-problem solving (CPS), collaborative project-based learning (CPBL), learning with technology (LWT), and GBL was used to position student learning within a constructivist-constructionist pedagogical framework. It emphasized social interdependence as well as creative learning and addressed the call for further research.

This work also reflects and compares with the elements of Bloom's revised "cognitive taxonomy" (Anderson et al, 2001). Further discussion about Churches (2008) revised "Blooms Digital Taxonomy" occurs, as some elements within this present project align with the behaviors and actions of the present technological era and its conditions (Lightle, 2011). Additionally, this work reflects on another theoretical model of educational intervention using technology (Stolaki & Econinedes, 2018). Comparisons with Leilani and Kreager's (2017) "Instructional Decisions to Enable Active Learning" (IDEAL) theory and associated “Active Learning Strategies” (ALS) model are made, with some elements reflective of the instructional design process undertaken for this present work.

To the best of our knowledge, this work entails a unique pedological approach and is the first piece of research exploring the effect of a novel teaching platform promoting the student production of creative, game-based human physiology PodPoints, on first-year students' perceptions, engagement, and assessment performance. Therefore, the work presented here is unique and looks to add to the growing knowledge in this field. It is a constructively fresh approach to support learning. We believe it offers a highly transferable teaching strategy that can be applied across all disciplines of education and levels. It highly aligns with an evolving pedagogy, where the methods of teaching are acknowledging the needs of the modern student.

1.4 Introducing the ensuing chapters of this thesis

The ensuing chapters of this Thesis expand in detail on the work done on the inception, creation, delivery, and outcomes of our novel teaching intervention. **Chapter two** expands this introduction with a substantial literature review that relates to several elements that are incorporated into our work. Specifically, it reports on the work done in areas such as active learning, group collaboration, learning with technology, game-based learning, and creativity. It connects these with several respective learning strategies and models. An extensive discussion takes place on the use of educational podcasts in the tertiary sector and identifies relevant work done within the area of physiology. **Chapter three** then details the methodical approach taken to undertake the research project and its delivery and elucidates the

theoretical positioning of the work. **Chapter four** reports on the analysis of results, consolidates the findings, and gives meaning to them. Because of the volume of data collected and analysed this chapter is presented as four separate sections, each covering the associated findings with a follow-up discussion of them. The outcomes for the study aim, research questions, and objectives are discussed, as well as the positioning of our findings with other relevant work and literature. This thesis ends with **Chapter five** summarising the research implications, limitations, and suggestions for future directions.

CHAPTER TWO:

2.0 LITERATURE REVIEW

2.1 Introduction

The following discussion is a review of the literature that explores the educational work undertaken in the areas of active learning, including learning with technology, game-based learning, and group collaboration, and connects these with the relevant pedagogical and epistemological stance of this present work. Creativity and the application of technology, especially educational podcasts in the tertiary sector are explored in detail. Before these, a review of epistemology and learning is given.

2.2 Epistemology and learning

The search for truth, understanding, and knowledge has been the driver of many philosophical discussions. Philosophy itself is considered the father of all the fields of study that are looking to understand the nature of everything (John, 2018). Comprising four main branches of investigation, namely, metaphysics, epistemology, axiology, and logic, philosophy is a study of the fundamental questions of the universe and existence (John, 2018). Epistemology looks to explore an understanding of knowledge, by exploring its nature, origin, and scope (Moser, 2010).

Hofer and Pintrich (1997) describe epistemology as the area of philosophy exploring the nature and justification of human knowledge. They further suggest that an influence on the cognitive processes of thinking and reasoning occurs through a mix of theories and beliefs, and the modes of learning of how a person comes to know. Thus, an individual's "personal epistemological" academic stance guides the method of approach, design, and delivery format (Hofer and Pintrich, 1997). In doing so, Brown (1994) purports that an understanding of the school's purpose, the teacher roles, the topics, and the delivery formats are inherently represented within the philosophy of education. Epistemological stance and associated learning theories and related terms position themselves upon two core principles that are either associated with the "origin of knowledge" or the "acquisition of knowledge" (UCD Teaching & Learning, 2020). Briefly, these include objectivism, pragmatism, and interpretivism associated with the origin of knowledge, and empiricism and constructivism further associated with the acquisition of knowledge. Interpretivism is linked with constructivism and knowledge is viewed as a process of construction whereby a "constructed knowing" occurs for the individual or within a collaborative learning environment (UCD, 2020). These principal

epistemological stances form the foundations on which all learning theories and models, or psychological interpretations and views of teaching and learning can be traced (UCD, 2020).

The primary pedagogical stance and epistemology of this present work relate to a blended approach to promote active learning through the application of various cognitive skills within a constructivist and collaborative setting. Therefore, the following discussion positions itself through the epistemological lens of constructivism-constructionism and the collaborative learning environment.

2.3 Constructivism, constructionism, and experiential learning

Constructivism connects to the epistemological root of the acquisition of knowledge, whereby a person individually or within a collaborative social setting, constructs knowing through the processes of "doing". Essentially proponents of constructivism believe that learning takes place from experiences and ideas that build on and stem from prior knowledge (Krahenbuh, 2016). Originally established by the work of Kant (1724-1804), constructivism is concerned with the nature of knowledge and its creation (John, 2018), or in other words, offers an understanding of *"how people come to know what they know"* (Krahenbuh, 2016, p97). Significant later work done by Bruner (1961), Vygotsky (1962), Piaget (1968), and Perry (1999) further cemented the importance of constructionism in learning. Pivotal to the theory is that Piaget, as well as some other proponents of constructivism, believe that the process of learning is integrated into an existing framework of understanding, and in some cases, modifies it to accommodate new knowledge that can even contradict the previous understanding (Brame, 2016). Similarly, Bransford and co-workers describe constructivist learning theory as a process that may result in a new or enhanced understanding for individuals, by connecting existing knowledge and previous experiences with new ideas and experiences (Bransford et al., 1999).

Since its introduction, constructivism has become popular learning pedagogy with broad applications being explored across teaching and assessment practices. It is this diverse understanding and approach to constructivism that has led to some misalignment between the actual learning theory of constructivism and the pedagogical theory of it (Krahenbuh, 2016). Richardson (2003) though, acknowledges that all variations of constructivism affirm a central conviction that *"knowledge is not discovered but is rather constructed by the human mind"* (Krahenbuhl, 2016, p98). Bruner (1990) suggested that a learning setting that encourages students to engage in "meaning making", should be considered a pivotal aspect of constructivism, and described this as a constructionist-learning environment (Dullien (2005). Later in 1995, Brunning and co-workers (1995) further put forward four principles that they felt were central to the learning processes of the constructivist model (Krahenbuh, 2016). These were: learning is dependent on existing understanding; authentic learning tasks are

crucial for meaningful learning; social interaction plays a key role; and learners construct their meaning (Krahenbuh, 2016).

Vygotsky (1962), a powerful advocate for constructivism, was interested in how further learning takes place through the influence of social interactions with educators and peers, especially with the young. While Piaget and Perry acknowledged that an individual's learning is constructed by their interpretations and interactions with environmental stimuli, Vygotsky firmly believed that learning in the social context was co-constructed with language and culture playing immensely important roles in cognitive development (GSI Teaching and Resource Center, 2020). Central to this is Vygotsky's position that a person's linguistic ability allows them to overcome natural limitations, as both language, communication & culture, frame the perception of the experience and help to give an understanding of reality (GSI Teaching and Resource Center, 2020). He was a fervent social constructivist and proponent of social learning theories. His work led to the development of what Vygotsky called the "Zone of Proximal Development" (ZPD), which is a way to identify the existing level that a learner is at, and what needs to occur, for them to progress to the next stage of learning. Initially, the ZPD comprised three levels or zones of achievement, with a foundational level represented by what the learner can do, and with encouragement and support, the learner is exposed to things that they cannot do and elevated to the higher zone. The zone of proximal development represents the level that intersects the two; the gap between what is independently doable for the learner, and what they cannot do (Wright, 2016). Then with support, the concept is that the learner can develop the skills and ability to undertake the same task again independently without support; this raises their ZPD for that task and is subsequently repeated at a higher difficulty level to promote progression (Shabani et al., 2010). Figure 2.1 illustrates this notion.

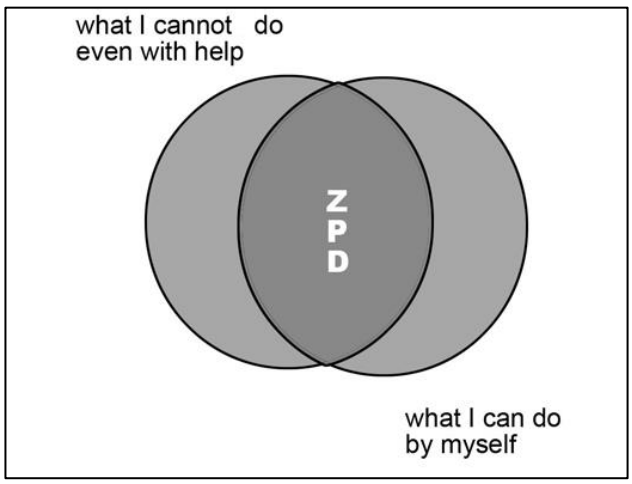


Figure 2.1. The Zone of Proximal Development

Vygotsky himself defined ZPD as *"the distance between the actual development level as determined by independent problem-solving and the level of potential development as determined through problem-solving under adult guidance or in collaboration with more capable peers"* (Vygotsky, 1978, p. 86). In other words, the progression of the learner from their current level to the next attainable level is possible via appropriate use of environmental tools and adult, or more capable peer facilitation (Shabani et al., 2010). Collaboration (or the social aspect) is a key component of this concept. Higher skilled people through collaborative endeavours help others to learn and reach new levels of understanding through the introduction of new concepts, psychological tools, and skills (Shabani et al., 2010).

Lewin (1935) had a similar contention about how individual learning is influenced by social interactions. Like Vygotsky, Lewin believed that interdependence among group members can occur when the goal is shared among the individuals (Leilani & Kreager, 2017). This view of group knowledge construction gave rise to what Lewin called, the "social interdependence theory". Deutsch (1949, 1962) further expanded on the primary relationships among group members indicating that *"the tension systems of different people arising from their goals may be either positively or negatively interrelated"* (Johnson & Johnson, 2011, p.41-42). Leilani & Kreager (2017) reported that Johnson and Johnson (2011) further extrapolated Deutsch's notions on this, by implying that any one of the following three states determines the interactions and outcomes that take place through social interdependence. Firstly, a positive interdependence occurs when a positive correlation exists among individuals' goal outcomes; that is, individuals feel that their ability to achieve their goal is directly linked to the success of the other members with whom they are cooperatively linked. Secondly, in contrast, a negative interdependence occurs when a negative correlation exists among individuals' goal outcomes; that is, individuals feel that their ability to achieve their goal is directly linked to the failure of the other members with whom they are cooperatively linked. Johnson and Johnson (2011) further explain the third 'no independence' condition, when '"no correlation" exists among individuals' goal outcomes; that is, individuals feel that their ability to achieve their goal is neither dependent upon the success nor failure of the other members with whom they are cooperatively linked.

Building on the constructivist philosophy, Papert (1980), a student of Piaget, acknowledged that abstract formal thinking, which is espoused by Piaget, supports knowledge construction (Silko & Barbour, 2012). Silko and Barbour (2012) highlighted that Papert championed for more recognition of concrete thinking in formal education. Papert further believed that learning extends from the meaningful construction of artefacts -- that is, through the process of building, where learners actively construct their meaning, active learning takes place (Silko & Barbour, 2012). Papert (1986) coined this active learning process as "constructionism". Initially proposed for science teacher education, constructionism looked to support the learning process through the making of artefacts or representations with

technology (Hoban et al., 2010). The term itself is a compendium, combining elements of Piaget's constructivist theory and Papert's inferences about learning (Sabelli, 2008). The constructivist view of learning is considered a reconstruction of, rather than a transmission of knowledge, while the constructionist standpoint regards learning as being most effective when the learner experiences it through constructing a meaningful product (Sabelli, 2008). Constructionism has also been considered *"an integration of constructivist views of learning and social views of learning"* (Hoban et al., 2010, p433). While some others have described constructionism simply as "learning-by-making", Papert professes it should be considered as being *"much richer and more multifaceted, and very much deeper in its implications"* (Papert & Hagel, 1991, p1.). Regardless, constructivism and constructionism have a significant inter-relationship - both recognise that learning is an active process resulting in a deep understanding of what is either constructed or reconstructed.

The experiential learning theory developed by the constructivist Kolb (1984), further espouses the "learning by doing" approach with later reflection on the experience giving added meaning. Much of Kolb's theory centres on the internal cognitive processes of the learner (McLeod, 2017), and that *"Learning is the process whereby knowledge is created through the transformation of experience"* (Kolb, 1984, p. 38). Kolb's learning theory suggests that learners engage through an experiential learning cycle, represented by a four-stage process of: 1) having a concrete experience, 2) having a reflective observation of the experience, followed by 3) the formation of abstract conceptualisation of that experience, and then the 4) active experimentation of it, where the learner applies them (McLeod, 2017). The learning process can take place at any entry point in this cycle as all are inter-related. Kolb's learning theory further details four distinct learning styles (accommodating, diverging, assimilating, converging) which are influenced by a variety of factors including the social environment, the educational experiences, and the basic cognitive structure of the individual (McLeod, 2017).

All the preceding review aided in the modelling, construction, and delivery of our present intervention. Further linkages are discussed in the later sections of this thesis. Of further influence for us was the earlier work of Bloom, to which this thesis now turns to.

2.3.1 Bloom's Taxonomy and constructivism

Mid-last century, Bloom and colleagues (1956), in the process to classify the educational objectives of students in the learning process, proposed a cognitive taxonomy that was consistent with critical thinking and the educational learning hierarchies at that time (cited in Nkhoma et al., 2016). This taxonomy highly aligns with a constructivist approach to learning. A primary driver was to construct a scheme of classification of cognitive skills extending from lower-order thinking skills that required a low degree of cognition, to those described as higher-order thinking skills that required greater cognitive processing, leading to deeper learning, and

understanding (Adams, 2015). The work, originally disseminated through the 1956 publication titled: Taxonomy of Educational Objectives: The Classification of Educational Goals (Bloom et al., 1956) has since helped educators to use learning objectives as tools and to create a curriculum that promotes student learning and the evaluation of such (Cochran et al., 2007). It has had a powerful influence on teaching and learning processes across all levels of education (Adams, 2015), and because of Bloom's ongoing work and support, it is come to be referred to as Bloom's taxonomy. Bloom's taxonomy is premised around three psychological domains of learning including, cognitive, mental skills (knowledge); psychomotor, manual, or physical skills (skills); and affective, growth in feelings or emotional areas (attitude or self) (Figure. 2.2) (Churches, 2001).

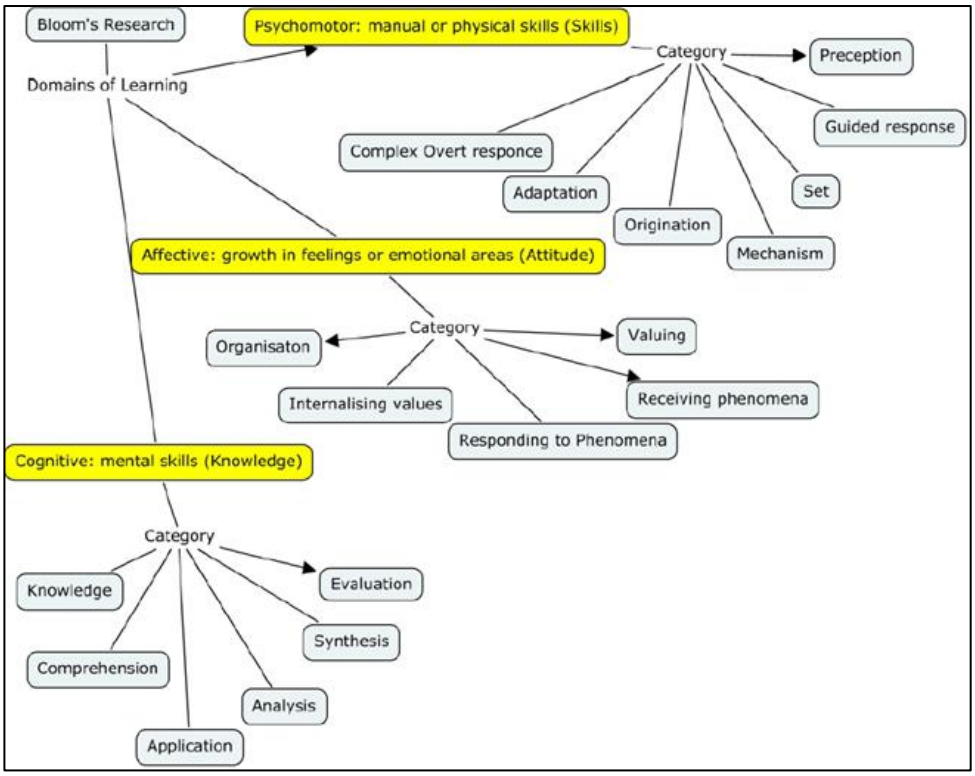


Figure 2.2. Bloom's taxonomy of educational objectives of the three psychological domains (Churches, 2001).

Concerning the cognitive domain (knowledge), it comprises six ascending categories of mental skills based upon the degree of difficulty, and inherent in the application of the taxonomy is that each domain should be understood and achieved before progressing to the next level (Mahmud et al., 2019). The architecture of the six levels in ascending order are: 1) knowledge, 2) comprehension, 3) application, 4) analysis, 5) synthesis, and 6) evaluation. (Figure. 2.3).

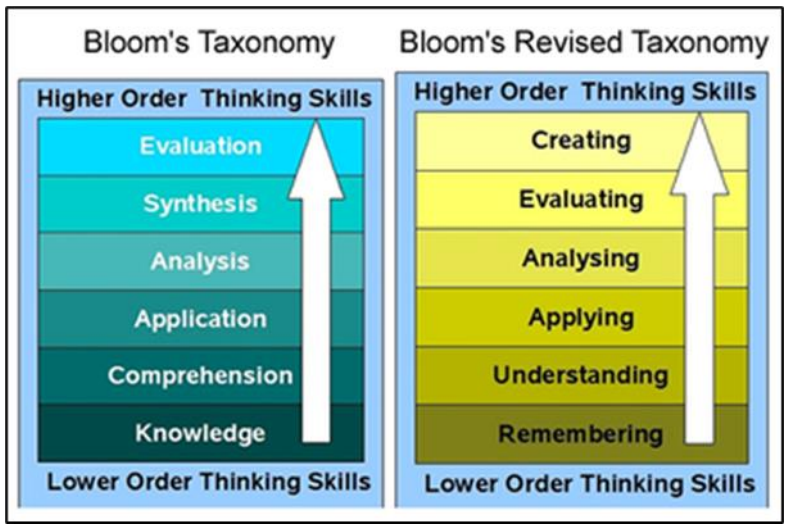


Figure 2.3. Bloom's Taxonomy and Bloom's Revised Taxonomy (Churches, 2001)

In 2001, Anderson and co-workers presented a "Bloom's Revised Taxonomy" that included changes to the wording given to the original six major categories in the cognitive domain (cited in Miller & Humford, 2014). Essentially, the changes related to the descriptive words of each category, from that of a noun to that of the verb form (Figure. 2.3). It is believed that these changes effectively improve student engagement in the learning process, by enhancing independent cognition and thinking through the inclusion of student-centred learning (Nkhoma et al., 2016). The revised taxonomy comprises a cumulative hierarchy of cognitive categories in which the six original nouns are replaced with the following verbs: “remembering”, “understanding”, “applying”, “analysing”, “evaluating”, and “creating” (Anderson et al., 2001). The process of learning effectively flows from the lower level of skills, such as remembering, to higher-order thinking by closely linking problem solving, with creativity and critical thinking (Nkhoma et al., 2016). In this manner, the higher cognitive processes of critical thinking and creativity support self-actualisation and provide the learner with meaningful learning events, fostering worthwhile learning outcomes for the student (Cochran et al., 2007). As the learner progresses through the cognitive categories, they develop skills and construct knowledge through the process of "doing"; the end goal is to have gained proficiency in the levels culminating in the ability to construct an artefact of new or original work (Langdon, 2017). This approach, otherwise referred to as "scaffolding", moves the learning through lower order skills such as, to 'remembering' (recalling, defining, listing, etc.), 'understanding' (defining, describing, identifying etc.), 'applying' (illustrating, using, calculating, etc.), and then on to those higher-order skills, such as 'analysing' (categorising, examining, deducing, etc.), 'evaluating' (comparing, contrasting, assessing, criticising), with 'creating' (generating, producing) at the top. When this takes place, the learning has resulted in competency across all categories and satisfies the highest learning outcome (Langdon, 2017). However, the scaffolding process does not dictate that a learner commences at the

lower levels of the taxonomy and sequentially progresses through, but rather engages at the level that best suits, as the lower taxonomic levels will be inherently covered within the scaffolded learning task (Langdon, 2017). In addition, the emphasis on the learners' cognitive processes, through the updated version of Bloom's Taxonomy include technology-enhanced activities (Cochran et., 2007). This is important to note because of the amount of technological advancement since the inception of Bloom's original taxonomy, as well as the revised taxonomy put forward by Anderson and colleagues in 2001.

The works done by Andrew Churches (2008) accounted for the developing technologies, by adding numerous related descriptions and terms to Bloom's revised taxonomy to create Bloom's Digital Taxonomy. These descriptions linked the verbs in the revised taxonomy with new ones, by considering the emerging behaviours and actions that reflected the technology, and how this could better enhance or support the learning experience. Several new terms associated with Bloom's revised taxonomic levels included googling, searching, blogging, uploading, twittering, networking, collaborating, posting, and podcasting, to name just a few (Churches, 2008). Figure 2.4 shows Blooms Digital Taxonomy constructed by Churches with the words, black in colour, denoting the recognised and existing verbs, and the words, blue in colour, representing the added digital verbs (Churches, 2008). Church further added collaboration as a separate element, recognising that it is an integral part of learning and takes place across many forms via technology. Consequently, Bloom's original taxonomy has been redeveloped over the years to better match the pedagogical and environmental conditions of the time and has helped to guide the direction of our present work.

Furthermore, some of the emerging pedagogies relate to the repositioning of the student. The traditional didactic model has slowly been changing. Students are no longer considered passive receivers of knowledge, but rather, co-constructors of it. This repositions the teacher from that of being an 'instructor', to one that 'facilitates' the learning that takes place. Perhaps Alison King, with her 1993 article titled, "From Sage on the Stage to Guide on the Side" best described this emerging view of teaching and learning. King acknowledged that the teaching system back then was outdated and would not be adequate to match the needs of the 21st Century. King further indicated the importance of aligning with a constructivist view of learning by saying, *"knowledge is a state of understanding and can only exist in the mind-of the individual knower; as such constructed by each knower through the process of trying to make sense of new information in terms of what that individual already knows"* (King, 1993, p.30).

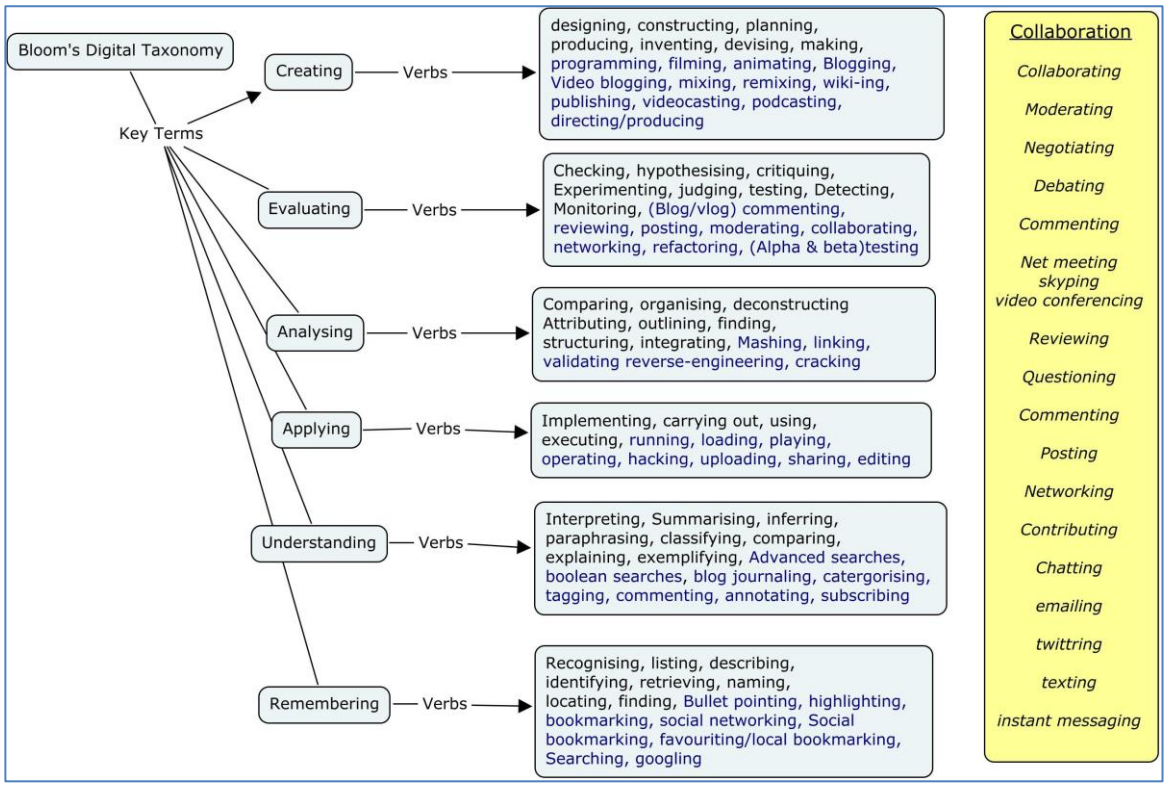


Figure 2.4. Bloom's Digital Taxonomy (Churches, 2008).

Means to support student construction of knowledge can include activities, discussion, and collaboration, all of which promote the act of doing (Freeman et al., 2014). These all allow learners to actively analyse, evaluate, and synthesise ideas, all of which utilises the higher-order thinking skills listed in Bloom's Taxonomy (Brame, 2016). Such approaches that foster active learning tasks put aside the need for teacher-centred instruction, and rather focus on the development of students' skills (Brame, 2016). While early educators such as John Dewey (1859-1952) and Maria Montessori (1870-1952) had significant influence, it is the seminal work of Bonwell and Eison (1991), titled Active Learning: Creating Excitement in the Classroom that has helped to promote active learning and/or student-centred learning within the present educational settings of today. This review now focuses on active learning, specifically regarding the blended, active learning strategy and its elements of interest in this present work.

2.4 Active learning

The call for greater student involvement in the learning process is being made by students and teachers alike. While passive learning has a heritage deeply imbued in the foundational modes of instructional teaching, more recent pedagogical stances recognize that students need greater active processes in acquiring knowledge (Michel et al. 2009). Proponents of active learning (AL) strategies purport that the active construction of knowledge, rather than

the simple receipt of it, fosters better learner engagement, and as such, offers an alternative to the traditional passive learning model. Motivation to learn is also enhanced using activities and materials that are thought-provoking (Abuso, 2017). According to Michel and colleagues (2009) "Active learning is a broadly inclusive term, used to describe several models of instruction that hold learners responsible for their own learning" (p.398). King (1996, p.31) on the other hand offers the following take: "active learning simply means getting involved with the information presented -- really thinking about it (analysing, synthesizing, evaluating) rather than just passively receiving it and memorizing it". In doing so, learners effectively engage in higher-order thinking skills, are motivated to learn, and are more likely to develop the desire for lifelong learning. Bolliger and Des Armier Jr (2013) claim that AL effectively engages students with the topic matter by fostering a "learning by doing approach". McGarr (2009) further describes the student-led learning approach, as one that fosters higher student engagement, as the learning is supported through the construction of knowledge, rather than simply the receipt of it. In this way, the teacher becomes more of a facilitator, and the student moves on from simply being a listener to that being a seeker. However, due to the diverse number of AL strategies used across various teaching and learning contexts, some conjecture about what active learning exactly is, and what it entails, exists (Leilani & Kreager, 2017). Nonetheless, regardless of the number of definitions, it has been reported that many educators support active learning environments, as they foster further learning beyond simple rote recall and memorisation (Abuso, 2017).

As previously inferred, Bonwell and Eison (1991) are fierce advocates of AL. Their early work helped to develop and solidify AL as a viable learning strategy (Michel et al. 2009). They defined active learning strategies as those,that involve students in *"doing things and thinking about what they are doing"* (Bonwell & Eison, 1991, p. 2). Bonwell and Eison also highlighted the importance of students engaging in the higher-order thinking skills of Bloom's Taxonomy, such as analysis, synthesis, and evaluation, as they believed them to be key components of active involvement. In this context, AL supports students to develop their objective critical thinking skills. However, this formation of objective judgement about the learning meshes with the subjective nature of the experience as well. In 2009, Michel and co-workers acknowledged that learning strategies that support the active acquisition and construction of knowledge effectively reposition the student experience from that of a passive receiver to an active participant (Michel et al., 2009). Such student-centred pedagogies help to bolster student engagement by positioning students as co-creators of knowledge, and when this takes place, a sense of ownership can ensue. This strategy places the learner in the here and now, by participating in the transmission of knowledge through the experiential construction of it.

Active learning encompasses a plethora of student-centred learning pedagogies, such as problem and project-based learning (PBL), flipped classroom (FC) delivery, collaborative,

or team-based learning (TBL), game-based learning (GBL), and several others (Harris & Welch Bacon, 2019; Ummah et al., 2019). Bonwell and Eison (1991) reported that some strategies used to promote AL included cooperative learning, debates and role-playing, visual learning, simulations and games, peer teaching, and others. All these learning strategies aim to bolster learning by engaging students in the process of information transfer through the experiential construction of it. In doing so, a deeper connection with the material being learned occurs through the critical analysis and use of other higher-order thinking skills, as well as the subjective experience of being individually responsible for the learning that takes place.

A variety of AL strategies and interventions have been recently undertaken with higher education students across several fields including, but not limited to, science, engineering, and mathematics (Freeman et al., 2014, Lima et al., 2017), pharmacy and law (Steinhart et al., 2017), nursing (Aljezawi et al., 2015; Adams et al., 2018), sustainability (Kalamas Hedden et al., 2017), physics (Deslauriers et al., 2011), and medicine (Khobragade et al., 2016). Harris and Welch-Bacon (2019) recently conducted an extensive systematic literature review and meta-analysis that looked to determine whether AL is more successful than passive learning for cognitive skill development for health care students. Cognitive skill development was categorized using Bloom's revised taxonomy with lower-order cognition defined by the lower three tiers: "remembering", "understanding", and "applying". High-order cognition was classified by the higher three tiers: “analyzing”, “evaluating”, and “creating”. A total of 1915 articles, published between 2007-2017, were reviewed and analysed. Of these, 154 studies met the search criteria that included AL interventions, and full-text evaluation of research objectives of interest. This comprised 85 investigations on lower-order cognition and 69 investigations on higher-order thinking skills. Conclusions were summarized according to the learning techniques used (Game-based Learning, Problem-based Learning, Flipped Classroom, Team-based Learning, Simulation, Case-based Learning, and others), and their impact of them on the learning outcomes of interest. Two principal findings were discussed. Firstly, a total of 61 (72%) of the 85 studies on lower-order cognition indicated that recall, understanding, and/or application of the course material had improved with active learning. Secondly, 58 (84%) of the 69 studies on higher-order thinking indicated greater support for AL over passive teaching in favour of improving students' confidence in, or the performance of, analytical, evaluative, and creative skills. In comparison to passive-learning, AL is often more beneficial for both lower- and higher-order cognition skills; and that within the didactic teaching model, AL techniques can be used as successful methods to enhance students' knowledge and understanding (Harris and Welch-Bacon, 2019).

Another integrated review of the literature conducted by Leilani and Kreager (2017) reported on the types of in-class activities that supported AL in the higher education science classroom settings. A meta-review of the methodology of 337-articles gleamed four over-arching categories of in-class activities that represented AL. These were: 1) individual non-

polling activities, 2) in-class polling activities, 3) whole-class discussion or activities, and 4) in-class group activities. The researchers framed their theoretical approach on constructivist and social interdependence theory. Following the initial objective to determine what in-class activities instructors used to support AL, they evaluated how those in-class activities were implemented, and then analysed how these all related to existing learning theories for the trends and patterns observed. This work gave rise to a proposed theoretical framework and a learning model to help conceptualise the levels for the various definitions and general concepts of what AL is, as well as how these levels connect with, and aid to inform, instructional decision-making using in-class activities. They called this theoretical framework the "instructional decisions to enable active learning" (IDEAL) theory, and the model the "Active Learning Strategies" (ALS) model. The IDEAL theory is situated around the relationships of three active-learning concepts and levels of instructional decision-making comprising: an activity defined as a lower-order instructional decision-making concept; a strategy as a mid-level concept; and an approach is a high-order concept, categorised by instructional decisions made to support AL that are of high level (Leilani & Kreager, 2017). Positioned within this theoretical framework, as a component is the ALS model. Simply put, the ALS model links the in-class activities and instructional practices with AL strategies based on the degree of social interdependence (Leilani & Kreager, 2017). Part of the impetus to undertake their work related to the discord and lack of clarity around the application of AL strategies. It was noted that while extensive use of the term "active learning" occurs across the educational sector, there has been no consensus that agrees on an explicit definition provided, leaving the concept open for interpretation and sometimes to confusion. In addition, as mentioned, Michel and colleagues described AL as *"...a broadly inclusive term, used to describe several models of instruction"* (Michel et al., 2009, p.398). Accordingly, the IDEAL theory and ALS model are highly beneficial to inform instructors on the types and means of social interdependence learning strategies that can be employed to promote AL within college science courses (Leilani and Kreager, 2017). The way the IDEAL theory and ALS model supported our work is discussed further in the thesis.

In another earlier large-scale meta-analysis, Freeman and colleagues (2014) compared Science, Technology, Engineering & Mathematics (STEM) courses delivered using traditional lecturing versus AL approaches. The disciplines included biology, chemistry, computer science, engineering, geology, math, physics, and psychology. Their investigation compromised an extensive review and analysis of 225 studies (both published and unpublished) to determine the *"efficacy of constructivist versus exposition-centred course designs"* (Freeman et al. 2014, p. 8410). Student performance was gauged by analysis of data reporting examination scores or failure rates across the conditions. They reported that under active learning (n = 158 studies), student performance increased by 0.47 standard deviations and that under the traditional lecturing format, the odds ratio for failing was 1.95 (n = 67

studies). This indicated that traditional lecturing resulted in the likelihood of students failing at a rate of 1.5 times greater than those students participating in the AL environment. The AL sections showed an average examination score improvement of approximately 6%. From this, they questioned the ongoing use of the traditional lecture format and surmised that STEM instructors, based on the findings, may start to question the use of traditional lecturing as a daily practice.

In 2017, Abuso used a descriptive method research design to gather information from tertiary students at an education college across 11 education courses. A survey instrument comprising 24 items provided feedback on three core components of active learning, including skill mastery, feedback, and engagement. The aim was to describe and explore from the data what the best teaching behaviour and AL approaches were. Results indicated that the students identified the top three AL strategies as technology-enhanced approaches, cooperative learning approaches, and project-based approaches.

Recently, to help bolster the undergraduate experience for first year students, Victoria University, Australia, implemented an innovative approach that is *"flexible, immersive, inclusive and is designed specifically to provide excellent educational outcomes such as employability, retention, and completion for the 21st century student"* (McCluskey et al.,2019, p.3). Dubbed the "VU Block Model" the model condenses the traditional 12-week and 4-week exam period into four four-week blocks over a longer 16-week period for each semester. In this Block model students undertake one unit, as opposed to the several concurrently studied with the traditional delivery. Block model Workshops facilitate a collaborative AL experience with teaching and learning materials readily available for students supporting a flipped model. Briefly, the flipped classroom facilitates the AL experience whereby students have prior access to the unit materials and undertake learning tasks before the associated classroom discussion and activities occur. The flipped classroom model is discussed in further detail shortly. Since its inception in 2018 the VU Block model program has been very well received and has proven to be an effective AL strategy, positively impacting on student engagement, learning, and satisfaction (McCluskey et al.,2019).

Klein and colleagues (2019) investigated the effect of the VU Block model program on the academic results of 94 repeating science students, that had failed at least twice in the units Psychology 1B and 'Functional Anatomy of the Trunk' between the period of 2014 – 2018. During this time *"a clear downward trend in student grades between the years 2014 and 2017"* was noted (Klein et al. 2019, p53). Results demonstrated that this downward trend was reversed following the students re-taking the units in 2018 via the 4-week Block model -- a significant increase in grades was observed between the 2017 and the 2018 cohort, $t(370) = -10.14$, $P < 0.001$ (Klein et al., 2019). Furthermore, a survey instrument returned positive feedback from the students indicating *"that they believed the different delivery of the units was a contributing factor to their success"* (Klein et al. 2019, p55). Thematic analysis of the

qualitative data produced the following four predominant themes: student-centered learning, engagement and depth of learning, perceived levels of achievement, and finally student/teacher relationship.

2.4.1 Collaborative learning

The importance of cooperative learning within the AL environment has been mentioned several times so far. Descriptive terms for strategies promoting student learning through collaboration include but are not limited to, TBL, group work (GW), team-based learning (TBL), inquiry-based learning (IBL), collaborative-problem solving (CPS), and collaborative learning (CL). It has been reported that the CL setting affords opportunities where students can work together to problem solve (Duane & Satre, 2013), and to develop critical thinking and collaboration skills (Lusk & Conklin, 2003). Research has shown that both academic and social educational outcomes can be promoted through CL (Johnson et al., 2007; Slavin, 1996). Following a review of several studies, Dearnley and colleagues (2018) reported that when CL facilitates a shift from passive participation, to one of active involvement, greater thinking and problem-solving ability occurs for those involved. Such outcomes incorporate the higher-order thinking skills of Bloom's Taxonomy, are reflective of Vygotsky's ZPD in the collaborative setting, and acknowledge Lewin's "social interdependence theory". What's more, the interactive and sometimes multifaceted interactions taking place with collaborative work add complexity, that further relies on higher-order thinking skills. Student engagement and motivation to learn and construct is often enhanced by AL strategies utilizing teamwork and peer-to-peer interactions (Allen et al., 2013; Steinhardt et al., 2017)." This is especially true for collaborative problem-based or group-work projects.

Commonly, groups working together for a common learning goal is referred to as collaborative project-based learning (CPBL) activity. CPBL carries the constructive potential to develop social, communication, and learning skills for students across several subject domains (Banks & Barlex, 2014), and positions well with a social constructivist learning approach. More recently, the term collaborative-problem solving (CPS) has been used to describe the process of learners, with equivalent roles, yet individual problem-solving capacities, coming together in a socially collaborative process to solve a problem (Spikol et al., 2017). These socially constructivist approaches inherently rely upon the collaboration that takes place between group members, have the potential to help promote the 21st-century skills required by young students (Banks & Barlex, 2014), and form part of graduate student capabilities. CPS can be complex due to the number of dimensions underlying the concept and relates to the context (resources) that are provided to support the CPS process (Luckin, 2010). Spikol and colleagues (2017) offer the following description: *"A CPS task can be thought of as a set of features that represent a gap or crossroads where the way forward to*

solve the problem is to an extent unknown and must be generated and/or co-constructed by two or more participants" (Spikol et al., 2017, p. 264). They also further suggest, that "CPS might be as much about identifying a possible solution as about identifying and producing the solution" (p.264). Indeed, it has been acknowledged for a while that student involvement and hands-on projects involving teamwork are fruitful pedagogical approaches (McKeachie, 1994; Kayes et al., 2005). More recently, within computer science-education, CL with a small group and open-ended engagement has been used to support learners to make unique solutions to the tasks at hand (Spikol et al., 2017). Additionally, the VU Block model, previously mentioned, fosters CL via the workshops undertaken by small classroom group numbers.

It has also been reported that peer teaching is an effective tool to foster learning and knowledge acquisition in a collaborative setting (Srivastava et al., 2015). In a recent study, Srivastava and colleagues (2015) used peer teaching as a means to promote learning and pedagogical skills amongst first-year medical undergraduate students in physiology. They concluded that peer teaching could further enhance the learning process. However, due to the perceived potential that students may misinform each other, some reservation has been expressed by others using this format (Rifkin et al., 2012). In contrast, some have reported no negative effects from students creating work to teach others, and believe that under the right conditions, it carries the potential to enhance students' understanding and retention of information (Pegrum, 2015). Concerning the present topic of inquiry, several researchers have reported positive group interaction and outcomes for students involved in the collaborative development of podcasts (Lee et al., 2008; Kemp et al., 2011; Bolliger and Des Armier Jr, 2013; Pegrum, 2015; Sinnayah et al., 2019).

Additionally, Hryciw and co-workers (2013) utilsed a peer-assisted study session (PASS) program to support the learning experience for predominantly mature-aged students returning to Paramedicine. Second year paramedic students (with outstanding academic performance in their first-year bioscience results) acted as mentors and facilitated small group study sessions (two mentors for up to 25 students). The student mentors received a 2-day training to support the process. In a follow up comparison of the student grades, an increase in academic performance with concomitant decrease in fail rate was observed in the group of students receiving the mentorship, compared with those students that did not. The students participating in the PASS program believed that *"the program improved their study skills and gave them confidence in their approach to studying"* (Hryciw et al., 2013, p80).

In a later investigation, Tangalakis and colleagues (2017) investigated the effect of PASS to enhance the learning strategies and social inclusion in undergraduate students from low socioeconomic backgrounds studying physiology in the Paramedicine and Biomedical Sciences degrees. One hundred and nine students of a total 392 students across both disciplines volunteered to participate. Weekly PASS sessions were again facilitated by second year students who had successfully completed the related subjects the previous year

(minimum 80% grade). The results supported the findings of the earlier work conducted by Hryciw et al. (2013) with the PASS program increasing academic performance and reducing the number of students that failed. Students viewed the PASS program as a positive experience believing that the program had promoted confidence and afforded them transferrable skills that could be utilised in other subjects in their degrees.

2.4.2 The flipped classroom model

The flipped classroom model also deserves an accolade, as part of the recent transformative pedagogies that have produced some encouraging results. This teaching strategy aims to address the concerns that have been observed and reported over the years regarding student engagement and performance by fostering critical thinking skills through self-directed, inquiry-based learning (Hepworth & Walton, 2009, cited in Shen, 2018). In this model, students have prior access to the learning material to gain a base knowledge and understanding of the learning before classroom discussion, exercises, and further exploration of it. Again, this encourages active student participation in the learning process, with the teacher facilitating and guiding it. This flipped classroom approach moves the learning environment from that of being teacher-centred to student-centred (FLN, 2014). Positive outcomes such as improved student interaction, enhanced teacher-student rapport, and ownership of learning often results.

The flipped-classroom teaching environment has been reported to foster engagement in the learning process and enhance learning outcomes (Gorrres-Martens et al., (2016). Some recent investigations in this area include those conducted by Lai & Hwang, 2016; Ozdamili & Asikoy, 2016; McLean et al., 2016; Zamzami & Haliji, 2016; Gopalan & Klann, 2017; Gough et al., 2017; and Shen, 2018). For example, Gopalan & Klann (2017) investigated the effect of combining flipped teaching with modified team-based learning on student performance in physiology. A partial flipped study design was used, whereby students received the learning information in two groups – one flipped, using a combination of pre-class learning and in-class activities including modified TBL; and the other un-flipped, using a combination of pre-class learning and traditional lectures. It was found that the flipped teaching model enhanced student performance by 17.5% and student feedback indicated that a large majority felt better prepared for class with the flipped class learning method. It was concluded that the findings suggested that a combination of flipped class teaching and TBL, is more effective than the traditional didactic lecture. Furthermore, students have reported developing independent learning strategies, spending more time on tasks, and feeling that they had engaged in deep and AL by participating in the flipped class learning model approach (McLean et al., 2016).

2.4.3 Active learning summary

To sum up, AL strategies vary according to the instructor's understanding of the concept and the types of activities then used. The core element though is the empowerment of the learner via active participation in the learning experience. This constructivist process leads to greater individual engagement and is further supported through social interdependence, especially when collaboration occurs for a common goal. It is apparent that student-centred AL approaches in flipped classroom settings, and learning in groups, all support learning by encouraging students to take part in the creation of their knowledge, as well as that of others. Recently, regarding social interdependence learning strategies, the IDEAL theory and ALS model were created to help guide instructors on the types, and ways that activities can be employed to promote AL. Furthermore, there is consensus that AL achieves the higher-order thinking skills of Bloom's Taxonomy. Additionally, it is noteworthy that the ability to 'create' has been placed at the top of the levels of Bloom's Revised Taxonomy.

As previously mentioned, King, 1993 wrote a seminal article titled "From Sage on the Stage to Guide on the Side" that has continued to ignite discussion and exploration of teaching and learning. One question put forward by King, was, "how do we get from transmission of information to construction of meaning"? The answer partly lies with the active engagement of the learner, either individually or collaboratively participating in the construction of knowledge through an authentic experience. The discovery, construction, and sometimes reconstruction of knowledge should then be used to guide the exploration of the new; that is the knowledge of something should foster the generation of further questions and the actions to answer them. An ongoing cycle of knowledge construction can then take place through the simple, yet powerful processes of 'asking', 'seeking', and then 'asking' some more. One role of the teacher is to step aside, become the guide, and let the students explore their creativity. Nonetheless, despite creativity being a cornerstone that motivates and underpins the learning process, the traditional didactic model, has fallen somewhat short in fostering creativity and imagination in the learning process (Robinson, 2006). There is, however, a growing movement introducing change. Creativity underscored the work reported in this thesis and will hopefully add to this movement. So, what is creativity and why is it important in education?

2.5 Creativity, learning, and education

Creativity, learning, and education are intertwined in a manner whereby any one of them can be a starting point, as well as the endpoint of the relationship. Creativity, however, holds a special place – it connects between how learning should take place and what the education system should foster. As such, the enhancement of creativity should be a prominent

educational objective (Stolaki et al., 2018). Creativity was a cornerstone of our work reported in this thesis.

Robinson (2006) defines creativity as the important process of having original ideas of value, which more than not, arise via the interaction of the diverse, dynamic, and distinct qualities that underpin intelligence. Zhao (cited in Richardson et al., 2017), a renowned academic and author of "World Class Learners: Educating Creative and Entrepreneurial Students", also acknowledges the importance of creativity. He believes creativity to be a multi-faceted construct with three principal aspects related to cognitive ability, the ability to enact, and its social value. Like Robinson (2006), Zhao believes that the ability of the mind to view and combine a diversity of things allows us to come up with something novel that can be of benefit to others. The result of this cognitive ability then needs to be enacted upon, which Zhao argues is a linking step that requires courage to confront the challenges of uncertainty and vulnerability. This is often one of the hurdles faced in the real world by those who have a creative mindset. Robinson (2006) attests the education system has a preoccupation with a standardised hierarchy of subjects, that place the arts and humanities well below the science, mathematics, and language disciplines. Just recently, based on statistics showing a decline in student participation in the science, technology, engineering, and mathematics (STEM) subjects, the Australian Federal government, recommended changes to promote the recruitment of specialist teachers in high schools. Presently, STEM subjects are generally being delivered by teachers with no specialisation in these areas (Rowe, 2018). Part of the proposed solutions included using the threat of funding cuts to compel universities to focus more on STEM-specialist graduates by altering entry prerequisites (Little, 2018). This pressure likely coerced universities to change their focus in certain areas. Back in 2009, Brigstock reported that university funding, particularly in the United Kingdom, Canada, and Australia was partially reliant on producing 'work ready' STEM graduates. This recent Australian government stance has received a mixed reception from experts in the field (Little, 2018), and certainly exemplifies Robinson's (2006) viewpoint that the system essentially educates people out of their creative mindset and prioritises STEM education. Work ready graduates also need to be creative.

Robinson (2006) also argues that the corporate world follows suit, as mistakes are frowned upon and stigmatised. The result is an employee that fears the act of creatively pursuing anything novel that might challenge the norm; corporations of today do not reward failure (Robinson, 2006). This is in stark contrast with the belief that failure underpins success. Mistakes clarify what has not worked, while at the same time having the potential of highlighting a new direction forward. Creativity is a process of uncovering something new of value, which more than not, grows from the learning associated with previous failed attempts or ideas. While creativity does not explicitly go hand in hand with failure, Robinson (2006) stresses that nothing of original value will arise if you are not prepared to be wrong. The old

Chinese proverb, *"Failure is the mother of success"* (quoted in Bossman, 2015), and famous quotes such as *"Anyone who has never made a mistake has never tried anything new"* (Albert Einstein quoted in Chemical Communications, 2012), and *"Most people have attained their greatest success just one step beyond their greatest failure"* (Napoleon Hill quoted in Napoleon Hill Quotes, n.d.) all reflect this. In another quote by Henry Ford, he said, *"Failure provides the opportunity to begin again, more intelligently"* (quoted in Brauer, 2018). The significance of the relationship between failing, opportunity, and advancement is highlighted. In fact, history is replete with examples whereby mistakes have led to new discoveries or success stories. Several millionaire entrepreneurs learned from their failures and turned things around following bankruptcy. Some include Stan Lee, Walt Disney, Donald Trump, George Foreman, Henry Ford, and Phineas T. Barnum. It appears that creativity is linked to entrepreneurial success (Amabile, 1997, Kern, 2010) and is now a desirable attribute that employers look for in their employees (Pace & Branock, 2010). In a survey of 1,500 chief executives, conducted by IBM's Institute for Business Value, it was reported that creativity was the most valuable attribute of a leader (Listman, 2016). Creativity should therefore be celebrated as an important attribute and not looked upon as the precursor of failure. In the corporate sector, its value as an important asset needs to be recognised and utilised, and in the education system, it should receive just as much focus as the present mainstream subjects. Creativity was a corner stone for our work that this thesis reports on – firstly it was used with the inception and creation of the teaching intervention and then secondly, expressed through the work that students produced.

Richardson and co-workers (2017) conducted an interview with the distinguished educational scholar, Zhao. They reported that Zhao proposed that creativity itself, because of its essential relationship with human existence, could be considered the genesis of all learning regardless of area or discipline (Richardson et al, 2017). However, despite this standpoint, Zhao also expressed the unreserved view that the current education system does not value it (Richardson et al, 2017). Like Robinson (2006), Zhao strongly expressed that the present scholastic system has a preoccupation with a core group of subjects and the standardised testing of them. He contends that this results in students being rewarded for convergent thinking (moving towards one correct answer or solution), while at the same time discouraging the divergent thinking process that underpins creativity (moving towards multiple solutions and new questions) (Richardson et al, 2017). This type of education inadequately prepares the student to meet the needs of the future. Ongoing changes and advancements on the global scale require creative individuals who are aware of the effects of globalisation and how to navigate them (Richardson et al, 2017). Scheepers and Maree (2015) reflect this sentiment and suggested that novel and adaptive thinking is a critical future skill in the present high-tech globally connected world. As this type of thinking is supported by the creative mindset (Davies et al., 2011), it would be reasonable to expect that creativity is supported throughout the

education system, as well as in the corporate world. However, it is not, at least to the extent that the mainstream STEM subjects are currently taught. The educational framework presently undervalues the role of creativity and the arts in general (Abbs, 2003; Taylor, 1996). This contrasts with Baker and Baker's (2012) belief that creativity fosters problem solving, the generation of novel solutions, and innovation, and is a crucial graduate attribute.

Another factor relates to the educator's understanding, belief, and perspective of creativity. Mullet and colleagues (2016) stated that teachers generally hold an incomplete concept of creativity - some believe that all students have some degree of creativity, while others believed it to be innate in only some of the students. Amabile (1996), a well-known scholar in the field of psychology of creativity, strongly believes that everyone is born with an innate creative ability. The famous artist, Pablo Picasso also believes that creativity begins at an early age. One of his many quotes is *"Every child is an artist. The problem is to remain an artist once he grows up"*. This infers that the maturation process, whereby the child develops adult-like qualities can result in the loss of the inner artist. While many factors, including developmental, personal, psychological, social, and environmental can influence the development of creativity, the educational system plays its part. Robinson (2006) passionately believes that people don't 'grow into creativity' but 'grow out of it', and rather are essentially 'educated out of it'. This presents a challenging situation for those educators looking to promote creativity, as the present global education system leaves little avenue, support, or reward for those looking to nurture it (Kim, 2011). Sir Ken Robinson's 2006 TED Talk titled "Do Schools Kill Creativity?" with just under 93 million views (at the time of writing this thesis), has been the most widely viewed TED episode to date and has extensively been distributed throughout the web. Robinson has been referenced several times throughout this thesis as he is considered a visionary leader and crusader for changes in the modern education system. He strongly acknowledges the importance that creativity has in the learning process and that the present scholastic system needs to drastically change and celebrate creativity, rather than 'squander' it.

Couros (2015) also presented a passionate stance about the need to acknowledge creativity in the learning process and that teaching needs to support the learner in exploring the "innovators mindset". However, he also points out that there is a reluctance to embrace new opportunities that can bring about change in the education system. For example, bolstered by the advancements in technology, Couros contends that this recent change in education provides the opportunity to do something amazing; yet many students are uninspired and believe that traditional education is irrelevant. There is a mismatch between the use of technology and learning, and how to best apply it in the education system. Corous describes this as 'twenty-first-century schools with twentieth-century learning'. He further highlights the concern, whereby students' inquisitive nature and wonder are pushed aside, to allow instructors to "get through" the curriculum. The author of this thesis reflects on a personal

account when this exact situation occurred. While undertaking an applied science degree in human biology, he approached a lecturer with several "what if" questions. Even though the lecturer was keen to enter the discussion, he advised that the questions be shelved and to concentrate on the set topic matter. From that point onwards, the author used a diary to record all his "what if" ponderings. To foster creativity, qualities driving discovery, such as inquisitiveness, wonder, and curiosity need the freedom to be explored. The inception of a novel idea often arises from a question or pondering. To support the innovative expression by students Corous (2014) summarised eight key characteristics he believes that educators need to adopt. These include the need to be empathetic, problem finders, risk-takers, networked, observant, creators, resilient, and reflective. He further argues, that to truly develop creative students, the "Innovator's Mindset" needs to be adopted at all levels to embody these characteristics. This not only include the educators themselves, but also the leaders. In doing so, a culture whereby these characteristics are not only accepted but also encouraged will be achieved (Corous, 2014).

Like Corous, Amabile (1996) purports that creativity and innovation can be enhanced through educational interventions. In line with this, Scott and colleagues (2004), following a meta-analysis of studies that looked to enhance creativity, suggested that the creative attribute may be more flexible and adaptable in adults than once previously believed (Scott et al., 2004). In a randomized controlled pilot study, Kienitz and co-workers (2014) studied the effect of a 5-week targeted intervention to increase creative capacity and performance on thirty-six adult students and working professionals. After testing to measure creativity before and then following the intervention, a greater increase had occurred with two primary factors of the standardised assessment in those who undertook the 5-week creativity capacity-building program. In conclusion it was noted that creativity functions independently of personality traits and is a fluid construct that can be enhanced through targeted intervention programs.

The fact that creativity can be enhanced is extremely important in developing a "can do" attitude for educators and students alike and fosters a positive psychological perspective towards learning. However, as previously noted, the present education system has fallen somewhat short in fostering creativity and imagination in the learning process. One task then is to link the psychological principles underpinning learning with the creative mindset and to then allow this to be further expressed and enhanced through education, work, and living in general.

2.6 The psychology of learning and the creative mindset

The primary aim of education should be to support the expression of both the innate and developed qualities of the individual in the learning process -- in this way, education should be a celebration of the person and not the institution. Back in 1943, Dewey in his book titled

'The child and the curriculum and the school and society', suggested that children naturally display four primary impulses which relate to compulsions: to inquire (asking questions to seek answers); to communicate (to voice and share with others); to construct (to create); and to express (share views, feelings, and identity) (Richardson et al, 2017). Dewey's contention was, to support learning, the curriculum needs to be grounded upon these instinctive impulses, rather than set learning disciplines and memorisation tasks (Richardson et al, 2017). As mentioned, Zhao (cited in Richardson, 2017) strongly attests that human behaviour and learning are founded on the innate desire to create, that has an essential relationship with human existence. He believes that the psychology underpinning the emotional drive to create relates to the human desire to pursue self-actualization and self-transcendence -- the need to be of value to others (Richardson et al, 2017). This connects strongly with the theoretical model of human needs introduced by Maslow (1943, 1954). The model, titled 'Maslow's hierarchy of needs' classified human needs, both physical and psychological, along a hierarchy that related to goal attainment, and it was only possible to attain the next level when the previous one had been satisfied. These needs in order of hierarchy included physiological, safety and security, belongingness and love, esteem, and self-actualisation. Maslow (1969a) later extended the model by adding self-transcendence as a motivational goal following self-actualisation (Koltko-Rivera, 2006). Zhao also strongly marries the human need for fulfilment, through the process of self-actualisation and self-transcendence with the emotional innateness of the creative impulse (cited in Richardson et al, 2017). Richardson and colleagues (2017) suggested that by working with this underlying motivator of human psychology, people would become more creative and further strengthen the foundations for society. However, this present literature review has strongly illustrated the discord with this. In particular, the rift between the curricula of the present education system and the lack of acknowledgment given to creativity's role in the learning process has been emphasised. The problem lies not with the psychology of the individual, but more so, with the psychology of the whole, especially that of the educational institutions.

In 2014, Miller and Dumford reported on the outcomes of exploring the creative cognitive processes in higher education. They acknowledged that the education system, being a forerunner for the future workforce should apply more attention to creativity. Furthermore, an understanding of the cognitive processes associated with creativity and deep learning, and how the education system can better provide opportunities to nurture it are needed. Consequently, they investigated to determine whether students relied on the creative cognitive processes in higher education settings and others, as well as seeing how these processes relate to deep learning approaches. Following the 2010 National Survey of Student Engagement of 8,724 students at 17 institutions, they reported that several different creative cognitive processes are used daily, with two distinctive types: deliberate creative processes and intuitive creative processes. Further analysis found significant positive relationships

between deep learning approaches and the two predominant types of creative processes reported. They suggested that this finding implies that creativity is associated with other beneficial elements of learning and student engagement in higher education. They also highlighted that this finding further supports Anderson and colleagues (2001) revision of Bloom's taxonomy, has placed to 'create' at the highest level of the hierarchy of cognitive categories. They concluded that the higher cognitive process of creativity should be considered a teachable skill that supports mental acuity in students, and as such, creative cognitive processes can be employed across numerous disciplines within the higher education sector.

Higher-order thinking, such as critical thinking and creativity also supports metacognition. Metacognition can be defined as having awareness and regulation of one's cognitive processes (Brown, 1987), and provides a central perspective (Winne & Hadwin, 1998) for developing creative problem-solving approaches (Hargrove & Nietfeld, 2015). It has also been described as the cognitive processes of 'thinking about thinking', 'having knowledge about knowledge', and 'having reflection about actions' (Weinert, 1987). All of this involves a degree of self-awareness and self-regulation of the learning process. The emphasis on self-regulated learning and proactive academic skill development, as part of the metacognitive learning strategy, has be shown to improve problem-solving ability (Delcos & Harrington, 1991), mathematics (Desoete et al., 2003), reading comprehension (Pressley et al., 2006), and writing (Harris et al., 2009) (Hargrove & Nietfeld, 2015).

As previously highlighted, the ability of a person to assess their thinking and learning is not merely an intrinsic quality, as it can be taught and cultivated through education (Scott, 2015). This viewpoint is in line with Amabile's (1996) contention that everyone is born with an innate creative ability, and it can further be enhanced through educational interventions (Scheepers & Maree, 2015). In Hargove and Nietfeld's 2015 investigation on the impact of specific metacognitive instruction on creative problem solving, it was found that a 16-week course improved the treated students' creative problem-solving ability. This was defined by higher scores on fluency, originality measures, and 'Metacognitive Awareness Inventory Scores'. The finding was clear -- that creative problem solving could be enhanced by educational interventions that teach creativity, within a metacognitive framework. Metacognition has been widely applied to help science students gain knowledge, understanding and awareness, and control of the individual learning process (Baird 1990, cited in Mazumder, 2010). How a person gains and develops metacognition is varied. Schraw and Moshman (1995) suggest that this occurs through cultural learning, individual construction, and peer interaction. However, the attribute for a person to develop a reflective stance about the nature of his or her cognitive ability, and how knowledge can be extended using this reflection (Hargrove & Nietfeld, 2015), is a key skill that enhances the learning process. Indeed, Mazumder (2010) suggests that the goal of metacognition enhancement is

to facilitate student learning by empowering students to constructively self-assess and evaluate their knowledge.

The innate desire to inquire, seek, and imagine is a powerful driver of the creative process. It is reflected in the part of the human psyche that emotively strives for the attainment of self-actualization and self-transcendence. While considering imagination, Vygotsky (2004) reasoned two factors -- the intellectual and the emotional -- are both equally necessary for the creative process, as feeling, alongside thought, gives rise to human creativity. With higher-order thinking such as critical thinking, creativity, and awareness of self, deep learning can take place. When the emotional factor, underpinning human creativity is expressed, "artful learning" results. Some enlightening work has been conducted through the lens of deep and meaningful learning, with creative engagement and artful and playful learning underpinning it. For example, Booth (2013) claimed that each student, regardless of the subject area, has latent artistry that teachers can use to 'spark creative engagement'. Yet he finds himself, among other Art educators, on the 'periphery' of the conversation on education -- the system values technology and engineering far above the arts. In his paper, titled "A Recipe for Artful Schooling", Booth describes three essential elements that should be central to any discussion about creativity and learning: Intrinsic Motivation; The Essential Skills of Creativity; and Inquiry-Based Learning. Booth suggests that all of these provide a ‘recipe of elements’ that can improve the 'anaemic education diet'. Presently, much of the education system is based upon a teaching model that uses extrinsic motivators, such as assignments and tests, to get students to learn and regurgitate information, and when decreed, to meet the set requirements of the assessment task (Booth, 2013). Booth, however, believes that the fundamental act of learning lies in the ability to create or to learn from experience, that fosters a personally relevant connection. He further suggests that this can only take place when the learner chooses and invests to truly learn and understand through intrinsic motivation. When the learner adopts this internal perspective, true understanding can be manifested in the learning process. Booth believes that all disciplines, including STEM and the arts require this type of creative engagement. Another essential element relates to the skills that students possess to foster creativity. As indicated, Booth believes that teachers have the responsibility of guiding the students' potential for creativity, and when done, the spark of creative engagement for any subject area can be achieved. These skills include Brainstorming, Divergent Thinking, Metaphoric Thinking, Flexible Thinking, Multisensory Engagement, and Empathy. The final element of Booth's recipe relates to the skills associated with the development of inquiry-based learning. He purports that students through the course of their lives and careers will be confronted with complex questions and scenarios, however, the present education system does a poor job of preparing them for this. Booth explains that art education, when given freedom, exemplifies good inquiry-based learning, as it encompasses highly productive, creative, and problem-solving processes. He suggests that the artistic process carries the

essential skills of learning, and further calls for the education system as a whole to adopt these elements and to listen to what art educators have to say. In doing so, Booth believes that every institution can gain an understanding of how to develop a curriculum that supports the crucial development of a creatively invested learner.

Some further research and other work in this area include that of McKenna (2013); Cacciattolo & McKenna (2012); Chemi (2015); and Clarke & Basilio (2018). In 2013, Tarquam McKenna discussed the role of art education and whether it matters. The following key elements were explored:

- The centrality of creative information and the arts in society;
- Art contribution to successful schooling outcomes for students;
- The relationship between student empathy, awareness, and wholeness, and the arts;
- Connecting the arts with active engagement, sensory experience, perceptivity, risk-taking, and imagination; and lastly
- How the arts for disengaged students can enhance the learning environment.

McKenna holds the firm contention that the 'arts' provide a deep learning nexus, with much to learn from them, as well as through them. He further asserts that the arts, being the lifeblood of society, unequivocally provides a philosophical and psychological framework. However, McKenna also recognises that the arts do not have a dominant presence in the education system. The problem with this is that the qualities, experiences, and learning that can arise from creativity and imagination are pushed aside, or at the very least, just given a token acknowledgment by the educators. McKenna concludes that to engage the disengaged students, education must foster "artful learning". A large part of this relates to the teachers and the curriculum. McKenna calls out for teachers themselves to engage with art, and allow it to construct meaningful experiences that help to further explore knowledge and learning, as well as life. Furthermore, Cacciattolo worked with McKenna (2012) to look at the role of communicative language teaching (CLT) in teaching and learning. Emphasis was given on how “English as a Second Language” and “English as a Foreign Language” (EFL/ESL) instructors can develop activities and outcomes to foster engagement of the learners in purposeful and authentic ways. In what was called 'Artful CLT', the authors contended that it goes beyond the mechanical way of teaching language by employing communicative modes of knowing and being, as well as encouraging learners to use language pragmatically. They discussed the positive aspects of allowing language to be used playfully so that the learning aligned more with the natural language and functionality of students' normal daily situations. Moreover, it is believed that student voices and expression of personal experiences are better facilitated by instructors who encourage 'spontaneous dialogue', role-playing, and group activities (Cacciattolo & McKenna, 2012). The non-restrictive philosophy of Artful CLT

provides a greater opportunity of constructing a learning environment that is supportive of student input (Cacciattolo & McKenna, 2012).

In 2015, Chemi reported on the results of a case-based investigation conducted between 2008-2011, involving 35 Danish schools. Chemi was interested in addressing the relationship between the arts, positive emotions, and learning through a qualitative study that had a focus on a positive psychological approach. Like Cacciattolo and McKenna, Chemi espoused the positive attributes of learning with an artful mindset. Results showed that art's contribution to learning is more than just a supplemental to academic learning, but rather provides the opportunity for formal, meaningful learning. Furthermore, the experience of positive emotions and cognitive intensity associated with artistic activities has encouraging outcomes for student learning, development, and well-being (Chemi, 2015).

Of recent interest, following the recognition that the art curricula in schools have been constantly undervalued for decades, Clarke and Basilio (2018) investigated the potential linkage between the engagement of students in the arts, playfulness, and their wellbeing. Two-hundred and seventy-five, secondary students were administered a series of validated instruments to measure students' subjective well-being and playfulness in school. Results indicated that life satisfaction and connectedness at school exist with playfulness. Moreover, the older pupils engaging in the performing arts were found to have higher subjective wellbeing than their counterparts did. They further suggested that policymakers should promote the delivery of arts education at a high standard to foster student wellbeing, rather than continuing to sideline it. Imagine, if this took place!

In Middleton's 2016 paper on "Room for imagining – the playful mind", part of his opening statement is 'Imagining is an under-used idea in higher education…'. Constructed on the many years of education and academic innovation, Middleton strongly argues there is a significant relationship between imagination and the creative dimension of learning. He claims that imagining is idea playing and that learning can be likened to the fun associated with throwing stones at bottles on walls, that he compares to the continual intellectual process of formulating a hypothesis and attempting to knock them down (Middleton, 2016). As such, Middleton puts forward the notion that the playful mind, as a significant element of learning needs to be fostered within the teaching process, including university, and not just left for the playground.

The process of learning material in a playful and creatively expressive manner returned positive findings in a recent investigation conducted by Steinhardt and colleagues (2017). They utilised three AL strategies involving creative expression to engage students in learning, applying, and teaching legal and substance abuse topics. The three strategies involved students conveying topic matter either by creating short films using a movie genre, by presenting short stories about comic book characters with genetic mutations, or by composing and performing rave dances depicting the mechanism of action of a specific drug. The aim

was to use group activities tailored to millennial preferences to increase their engagement in learning. When the student engagement with the subject material was supported the students performed well on the associated assessment tasks (examination questions and graded assignments). Students provided positive feedback indicating satisfaction and enjoyment with the creative, critical thinking, and collaborative aspects of the activities. One concluding remark was that *"Creativity and teamwork resulted in educational events enjoyed by the entire class"* (Steinhardt et al., 2017, p.3).

As can be seen, artful learning encompasses several elements that support creativity, imagination, and meaningful education. Its facilitation and use in the classroom have afforded students with a natural, non-mechanistic way of expressing information, engaging with, and gaining a personal connection with the learning process. However, there has been a slow adoption linking creativity and student-centred learning with technology. In fact, Stolaki & Economides (2018) suggest that the quandary of creativity enhancement in the higher education sector is a major individual, organisational and societal challenge. So how can technology and creativity be used to promote learning? This thesis now turns to the topic of technology and education and gives a review of some of the work done that further informed our work.

2.7 Technology and education

Modern youth regularly demonstrate their technical skills and creativity by producing and sharing a variety of multi-media content, such as short online videos. Generally, these are aesthetically pleasing productions, using a combination of images, audio, words, music, or humour for entertainment. Student-generated multimedia has also been applied for entertainment; however, because of advances in technology and ease of access, it is easy for students to make them as a new means of learning content knowledge (Hoban et al., 2010). Concerning the present research project, several investigations have looked at the use of technology in the form of web learning, e-learning, and online learning to teach physiology to a variety of undergraduate health science students. For example, earlier investigations include Taradi and co-workers (2005) that looked at a blended, problem-based learning using a Web platform to support student learning in acid-based physiology and McFarlin (2008) that investigated the effect of a hybrid-online delivery method for the teaching of exercise physiology. Taradi and colleagues (2005) reported significant positive effects in test scores, as well as student feedback following the use of the technology. Likewise, McFarlin (2008) reported that the transition from a traditional lecture format to that of a hybrid one inclusive of technology, significantly enhanced student learning as demonstrated by a 9.9% mean increase in overall student grades.

More recent investigations include that of Raupach and colleagues (2010), Felder and colleagues (2012), and Anderson & Kirchbaum (2017). Following the application of web-assisted problem-based learning, Raupach and colleagues (2010) reported significant increases in factual knowledge in students enrolled in an undergraduate cardio-respiratory subject. In contrast, Felder and co-workers, following comparison of traditional paper book delivery of course information, and that of a computer-aided course instructions (CACI) e-learning format, found no improvement following the use of the CACI teaching format. However, students preferred the CACI format, and the researchers concluded that based on this perspective, the introduction of it seemed justified.

Anderson and Kirchbaum (2017) looked at comparing student performance and satisfaction for a mostly online hybrid course, with that of a mostly in-class hybrid course in learning physiology. They also reported equal learning outcomes for the two teaching formats, but also that student satisfaction among most online students had improved significantly. Anderson and Kirchbaum (2017) proposed that best practices for learning physiology could arise, by combining the flexible approach of in-class learning, with that of the online delivery format.

In another contemporary study conducted by Klein and colleagues (2019), they examined the use of computer programs specifically designed to support the learning of anatomy for undergraduate health science students. The computer resources comprised three learning programs that were designed as in-class support activities to support student-centred inquiry-based learning. These were delivered within the newly adopted VU "Block Teaching Model" already described. The objective was to examine student engagement and experience. One hundred and seventy-nine (179) first-year students participated in the study and an 18-question survey covering the constructs of interest were used to obtain feedback from 58 respondents. The data indicated that all three programs were considered to make a positive contribution to learning, with one, An@tomedia Online, proving useful in studying gross anatomy with the understanding of laboratory-based prosecuted cadaveric material.

Furthermore, the digital age has given rise to several types of social media–based educational resources such as podcasts, wikis, blogs, and others (Oloo & Omwenga, 2015). All of these are providing promising tools to connect with and foster learning with digitally literate students. Educational podcasts are a cost-effective tool that can be used to effectively distribute core information in a manner that suits this (Fernandez et al., 2015). As such, podcasts provide the potential to create highly engaging and flexible resources for student learning and development; one that is challenging traditional communication methods (Alpay & Gulati, 2010). So, what are podcasts?

2.7.1 Podcasts

Initially, podcasts were audio files, but more recently have evolved to include digital images, slides, and videos that can be accessed online for immediate streaming and viewing or downloaded to a portable media device such as a smartphone or computer for later use (Chen & Malon, 2017). The term 'podcasting' itself refers to their distribution. Podcasts and other digital educational resources have gained popularity to accelerate knowledge translation. They have proven to be a cost-effective tool that disseminates easily accessible information in a timely and dynamic way, all at the users' convenience (Paterson et al., 2015; Fernandez et al., 2015). Podcasting technology now is extremely versatile and has become an attractive tool for the modern mobile learner -- it can supply a raft of information ranging from small, succinct summaries of journal articles to that for complex topics and debates (Chen & Malon, 2017). Alongside the freedom for podcasts to be viewed at a self-directed pace, they can be repeatedly accessed providing clarification and reinforcement of information. They also provide the user the ability to multi-task - to undertake other activities such as driving a car or doing other non-demanding or simple repetitive chores while listening to them. They are particularly useful for those who prefer a visual or auditory learning style (Chen & Malon, 2017). Recently Edison Research (2018) published an annual study of this medium titled "The Podcast Consumer, 2018". They reported that the number of monthly listeners increased from 24% to 26% over a year, and an estimated 180 million people in the United States are aware of the medium, and as such, an estimated 124 million have listened to them. They further reported that users are: generally aged between 18-54 years of age, employed full-time, and well educated. Males are also slightly more likely to listen to them. In 2018 it was reported that, on average, the time "weekly podcast users" listened to them over the week was just over 6.5-hours (Edison Research, 2018). In Australia for the same year, statistics were similar, however, Australians were more likely to be aware of this medium (Edison Research Australia, 2018). For the following year (2019), it was reported that approximately 51% of Americans, aged 12 years and older had listened to an audio podcast within the past month, with the number increasing annually (Pew Research Center, 2019).

There is no doubt that ICTs such as podcasts have the potential to be an excellent medium to promote student creativity, engagement, and participation in the learning process. One challenge, however, is how to best apply them to the educational setting to accomplish this.

2.7.1.1 Educational Podcasts

In 2006, Donnelly and Berge reported that the dissemination of course content, presentation of classroom material, and study enhancement are three identified academic applications of

podcasts (Donnelly & Berge, 2006). Various types of podcasts based upon delivery format (e.g.: audio, video-audio, audio/images/slides) and content topic matter have been used (Fernandez et al, 2015). The three main categories of use of podcasts include the substitution of lecture content, the supplementary addition of material to enhance learning, and the creative use, whereby students are actively engaged in the creation of them (McGarr, 2009). Likewise, Drew (2017) reported that others have identified podcast use as either substitutional (recordings of in-class content), supplemental (review of in-class content), or integrated (unique content podcasts, such as interviews, podcast-only lessons, and roundtable discussions).

2.7.1.2 Teacher-centred podcasts

Initially, educational podcasting centred on the recording of lecture content for the students to access as either a form of substitution or review (Bongey et al., 2008), and to assist mainstream traditional teaching (Almeida-Aguiar & Carvalho, 2016). Some of the early teacher-centred (lecturer-generated) podcast investigations include the effect of short podcasts to reinforce lectures (Clark et al., 2007), the effectiveness of podcast revision lectures on students (Evans, 2008), the effect of primer lecture podcasts on the student experience (Popova et al, 2013), and the evaluation of students' acceptance and receptiveness to educational podcasts (Almeida-Aguiar & Carvalho, 2016). Table 2.1 provides a summary of these.

Table 2.1. Teacher-centred (produced) podcast studies.

Author and year	Course and students	Program details	Results and recommendations
Clark and colleagues (2007)	Postgraduate students in 'Management and Organisations' in Faculty of Economics and Business. Mixed.	Teacher generated, short, 10-minutes audio-only podcasts to supplement lectures and reinforce content.	Students reported their engagement with the podcasts was a valuable aspect of their learning experience and recommended for the continued use of podcasts in the course. No effect on academic performance was reported.
Evans (2008)	First-year undergraduate students in 'Business and Management' studying an ICT course	A series of three, 5-minute revision podcasts for exam preparation, covering the learning outcomes and clarifications	Students believed the podcasts to be a superior revision tool in comparison to their textbooks and notes. Students felt that they were more receptive to learning the material using this medium. It allowed flexibility for access (when, where, how). No effect on academic performance was reported.

Table 2.1. cont.

Popova and colleagues (2013)	Undergraduate psychology students	6 Pre-lecture (primer) podcasts, available 2-days before lectures	The primer podcasts facilitated student engagement and understanding of the lecture content and allowed reflection on the topics and on what the students understood. No effect on academic performance was reported.
Almeida-Aguiar & Carvalho (2016)	Undergraduate second-year students studying 'Hereditary and Evolution'	8 supplementary (informative and feedback) Podcasts up to 5-minutes duration.	Podcasts a an extremely valuable tool for learning engagement with all students listening to them. Feedback was provided on preferred podcast design parameters and showed receptiveness for use for other courses. No effect on academic performance was reported.

Within the field of human biosciences, specifically physiology, several investigations have looked at the use of teacher-centred podcasting as a teaching and learning tool among dental (Kalludi et al., 2013), nursing (Vogt et al., 2010; Mostyn et al., 2013; Barnes (2015), exercise science (Abt and Barry), medical, and other allied health students. A brief review of these follows.

Kalludi and co-workers (2013) looked at the efficacy and perceived utility of podcasts as a supplementary teaching aid among eighty (80) first-year dental students. For the intervention group (group 1), five short (2-minute), supplementary podcasts covering two physiology topics were given to the 40 students in addition to the normal 'study session' reading from textbooks. Multiple choice questions (MCQ) and follow-up feedback questionnaires were then given. Results showed significant differences between the intervention and control group mean MCQ scores. An independent sample t-test found that the group that listened to the podcasts did significantly better (reported as, $p = 0.000$) than the 40 students that didn't. Group 1 had a mean score of 7.95 out of 13, while group 2 scored a mean of 6.05 out of 13. Moreover, the researchers reported that approximately 91 percent of the students that listened to the podcasts found them useful, as they provided a means of repeatedly reviewing the lecture content at their convenience. However, a significant percentage (63 percent) of the students believed that a lack of images in the podcasts was a disadvantage. In a follow-up investigation in 2015, Kalludi and colleagues addressed this and used a similar study design to determine the efficacy and perception of a revision video podcast (images) in learning physiology on 100 first-year dental students. All students first participated in a didactic lecture class. Students in group A (46) then listened to a 12-minute video podcast followed by the MCQ test. The structured video podcast specifically highlighted

the concepts of the topics that were covered in the preceding lecture. Students in group B (54) had a study session where they read from textbooks for 20-minutes. It was determined that the group of students that undertook the video podcast session performed significantly better (p-value reported as 0.021) in the MCQ follow-up test compared to the group of students that only underwent revision using a textbook. They also stated that most students had a positive view of the use of video podcasting supplementation. However, it was not made clear whether the students in group B received instruction on what areas of the textbook to specifically concentrate on to read, unlike the structured video podcast that presented the highlights and concepts of the topics covered by the lecture. If not, this could be construed as a confounding variable that influenced the outcome.

Several investigations have also examined the effectiveness of podcasting as a teaching and learning aid in the field of Nursing. In 2010, Vogt and co-workers published findings on the impact of podcasting on the learning and satisfaction of undergraduate nursing students. A group of 2007 nursing students received teaching via the traditional lecture format, whereas another group of students in 2008 received the same content presented by podcast. Both groups undertook the same exam questions. While results showed no significant difference in the exam results between the two groups, the students did report overall satisfaction with the podcasting experience, with "portability" and "flexibility" being touted as positive attributes. Although, it should be noted that the podcast intervention replaced the lecture content and was not supplemental to it. It was also questioned whether an increase in learning, as justified by improved exam scores is required, or whether positive student satisfaction and engagement with the podcast is enough to warrant this technology as an effective teaching method.

Also, in the field of Nursing, Mostyn and colleagues (2013) explored student experiences of using biology podcasts in nursing training. They acknowledged that students often regard the biological science subject as one of the most challenging components of the nursing curriculum. A total of nine biological science podcasts were recorded and made available to 189-first year students as supplementary learning tools. Follow-up surveys and focus groups were undertaken to gain both quantitative and qualitative insight. From this, it was found that most students accessed at least one podcast, and the students reported having a positive experience with them and deemed them especially useful in terms of revision. While there were some issues with background noise in live recordings, as well as some students reporting a lack of awareness of their availability of them, the nursing students believed the podcasts to be helpful for their learning. This study, however, did not investigate the impact of this learning and revision tool on assessment performance.

In a more recent investigation, Barnes (2015) examined 49 first-semester nursing students' technology acceptance of podcasting as a tool for nursing skill acquisition. Whilst physiology topics were not specifically addressed, the project evaluated the perceived

competence of the three nursing skills: obtaining 'vital signs', inserting a 'Foley catheter', and performing a 'sterile dressing change' following podcast use. From the findings of 'Perceived Usefulness and Ease of Use Scales' and follow-up surveys, the author concluded that the students perceived competence with respect to the three nursing skills had improved and that the students found the podcasts both useful and easy to use.

Other investigations have looked at the effect of podcast use on first-year undergraduate exercise physiology students, students studying gynaecology, cohorts of allied health students, and undergraduate medical education students. In 2007, Abt and Barry using a pre-post random allocation research design with a podcast group and control group found only trivial to positively small differences in exam scores between the groups. The researchers used the effect size statistic and 90% Confidence Intervals to anlalyse the data. The control group improved their exam performance by 43%, while the podcast group improved by 46%. The difference between the groups on the post-test was a mean effect size of 0.19 (90% CI: -0.16 to 0.53 [trivial to positively small]) (Abt, 2007). The intervention included six exercise physiology podcasts delivered over six weeks, while at the same time, the control group was provided with the exact transcript of the podcasts in printed format. It was concluded that while the supplementary material delivered either in the form of a podcast or written transcript helped exercise science students improve their knowledge in exercise physiology, the podcasts provided little quantitative benefit beyond the written text in that discipline area (Abt & Barry, 2007). No qualitative data or analysis was undertaken.

Likewise, Munns (2013) introduced supplemental podcasting on top of the traditional lecture teaching to support the learning of physiology for a cohort of 215 students enrolled in Physiotherapy, Occupational Therapy, and Sports and Exercise Science degree programs. A questionnaire, final written exam, and MCQ test were used to determine both qualitative and quantitative outcomes. The assessment performance was measured against the results of the students for the previous year in which podcasting was not available. It was discovered, that while 64% of students believed that either their learning was moderately or greatly enhanced by the supplementary podcasts, the assessment performance did not reflect this -- there was no significant difference in the results between those students who had access to the podcasts and the previous students that did not. While podcasting increased student satisfaction and perception of learning it did not directly translate to increase performance on summative assessment outcomes (Munns, 2013).

Much of the interest in using podcasts in biosciences has come from their widespread use in medical education, particularly in the specialty areas of emergency medicine and critical care (Chen & Melon, 2017). For example, an investigation by MacDonald and colleagues (2013) looked at describing the purpose of developing "early brain and biological development and addictions" podcast series for first- and second-year medical students. Some other early investigations include the evaluation of podcast use and content needs among anaesthesia

residents (Matava et al., 2013), the effectiveness of podcasts in teaching clinical microbiology among medical students (O'Neill et al., 2010), and the effect of a video podcast series compared to conventional medical resources for the internal medicine clerkship (Narula et al., 2012).

More recently, in a pilot study conducted by Edmond and colleagues (2016), it was found that the use of video podcasts in teaching three common ear, nose and throat conditions, was just as successful as the traditional learning resources (handouts). Both forms of teaching improved student scores for the forty-one second-year students for the set assessment tasks. It was concluded that both tools were equally beneficial in enhancing the students learning experience. In addition, a 5-point Likert-scale questionnaire demonstrated that the students appreciated the repeated access to the information for review purposes and indicated that the podcast technology should be used more in their curriculum.

Prakash and co-workers (2017) also explored the use of technology as a supplemental teaching tool for 94 medical students learning biochemistry. It has been said that biochemistry is difficult to teach and is considered a difficult subject to study by medical students (Wood, 1990). Considering this, eight short audio-visual podcasts (3-minutes) were made available for students following didactic lectures on two topics on biochemistry. While follow-up assessments found no overall difference in the scores between students based on the general podcast use, a pairwise comparison revealed better scores amongst the students who accessed the podcasts for both topics. Moreover, one primary aim of the study was to determine the perceptions of medical students towards the use of short-duration podcasts. Student feedback from a self-reported questionnaire revealed that the podcasts were deemed a useful supplementary learning tool that aided them in revision and assessment preparation.

Rae & McCarty (2017) also utilized “video-on-demand” (vodcasts) to facilitate learning physiology for 73 first-year undergraduate 'Graduate Entry to Medicine' (GEM) students. The students were allowed to view a series of nine pre-recorded full-length vodcasts of the lecture content before the delivery of nine physiology lectures. Comparisons were made for the exam performance (using identical questions) between the cohort that had viewed the vodcasts, and a group of students enrolled in the same class the previous year that didn't have access to them. It was found that the students utilising the vodcasts achieved significantly higher grades in various examination formats in comparison to the control group. Students reported having liked the vodcasts and that watching them prior to the lectures facilitated an understanding of the lecture content, and as such considered them to be valuable learning tools.

Furthermore, Lien and colleagues (2018) acknowledged that podcasts might be useful for knowledge acquisition in undergraduate medical education. In 2018, they reported the findings of an investigation to determine if there were any differences in knowledge acquisition between the use of podcasts and blog posts. Following random allocation to either a podcast or blog group or then receipt of the learning materials (on asthma and toxicology), students

were given 4-weeks to complete follow-up assessments at their convenience. Results showed that both groups significantly improved their test scores (Lien et al., 2018); however, there was no significant difference in knowledge acquisition between the two teaching and learning modalities.

An additional recent study outside of medicine, but still engaging in learning about the body, looked at further enhancing the learning experience for the students with technology by addressing student interactivity and engagement. Chen and colleagues (2017) identified that others have reported that there is no difference between the traditional lecture and video podcasts of the material in student learning. They subsequently conducted a crossover randomised controlled trial, on a cohort of 150 undergraduate students from Health Science, Nursing, Midwifery, and Engineering courses on learning anatomy and physiology. The purpose was to determine the effectiveness of using interactive videos and animations for knowledge acquisition for the students. Both groups undertook MCQ pre-and post-tests to determine outcome measures of retention learning and transfer of learning. An ANOVA determined the statistical significance of inter-group differences. A questionnaire was also used to canvas qualitative feedback from the students. The study findings provided supportive evidence regarding the application of interactive videos as an educational tool in teaching anatomy and physiology.

As can be seen, some investigations have explored teacher-centred podcasting technology to enhance knowledge attainment and student engagement for a variety of undergraduate student cohorts. However, despite the growing popularity and use of podcasting in the educational sector, it has been reported that one key concern, relates to how this medium can better be used to enhance the student learning experience (Drew, 2017). Part of the solution pertains to having the students produce them.

2.7.1.3 Student-centred podcasts

Several authors support the view that the dissemination of learner-generated content more so reflects the true potential of podcasting (Miller, 2006; Lee et al, 2008; Armstrong et al, 2009). Almeida-Aguiar and Carvalho (2016) have described podcasting as a resourceful and effective pedagogical tool, and one that has merit as an application in student-centred learning situations. Therefore, while it appears that the growing interest in lecturer-derived educational podcasts has been adopted at the higher institutional level, a further benefit may be derived from the active, student-centred learning approach, including student-generated podcasts. However, the design of the podcast task, including methodology and assessment, is often customised to the course teaching matter and subject objectives. Indeed, it has been questioned that the adoption of tailoring podcasts to simply record lecture material, or define points to reinforce the lecturer's voice, is regressive rather than one that fosters unique

learning and creative opportunities (Abdous et al, 2012; Hew & Cheung, 2012). In fact, due to the scarcity of integrated podcasts that deliver unique content matter, Drew (2017) further suggests that Fernandez and colleagues (2015) view podcasts as *"a new tool offering opportunities to build new knowledge"* (Fernandez et al., 2015, p. 311) has not yet been realised. In addition, Malatji (2014) recommends that the process of facilitation, rather than teaching should be used, as it fosters critical thinking and student engagement and responsibility for their learning. Bolliger & Des Armier Jr (2013) supports this view, and suggested that student engagement, through the specific production of digital audio file assignments as one potential innovative integration strategy.

Concerning this, several studies have sought to improve the learning experience through student-generated podcasts across varied discipline areas and groups of students. Among these were some earlier investigations conducted by Lee and colleagues (2008), Petrovic and colleagues (2008), McLean and White (2009), Middleton (2009), Lazzari (2009), and Armstrong and colleagues (2009). Table 2.2 presents a review of these.

Table 2.2. Early student-centred (produced) podcast studies.

Author and year	Course and students	Program details	Results& recommendations
Lee and colleagues (2008)	Undergraduate and postgraduate Information Technology (IT) students.	Eight undergraduate students created short (3-5-minute) digital audio clips, for listening by IT students and others	Follow-up focus groups determined that the student produced podcasts turned out be a powerful tool to stimulate both individual and collective learning. No data was collected for effects on academic performance.
Armstrong and colleagues (2008)	Undergraduate Management Information Systems (MIS) students	Student teams produced interview-style podcasts of experts or knowledgeable individuals in the chosen research topic areas.	Students believed the project met the eight educational objectives, including communication skills, collaboration, creativity, technical skills, literacy skills, critical analysis skills, confidence and other. No effect on academic performance was reported.
Lazzari (2009)	Undergraduate students enrolled in Multimedia Communication and Human-Computer Interaction.	1. Teacher produced supplemental informative podcasts covering lesson and textbook (5-15 minute). 2. Student teams produced podcasts on a topic not covered by the lecturer for multimedia communication.	Full-time students involved in the production of podcasting lessons outperformed their peers of the previous year that did not have access to this teaching tool. Author concluded that the significant improvement in grades was due to the new educational, student-created podcasting method. The students demonstrated a better understanding of the theoretical aspects of the course as well as more effective practical skills.

Cont. Table 2.2.

McLean & White (2009)	Undergarduate students studying '19th-century British Fiction and Introduction to Journalism Writing'.	1. Teacher produced 15-minute podcasts and vodcasts to complement lectures. 2. Instructor guided Student groups to produce two podcast topics: "Recycling in Howard County" and the "Dimensions of Alzheimer's disease".	Primary data collected was instructor feedback. While the second instructor had challenges with student training, equipment scheduling, and sharing, she felt that the project exposed students to a valuable tool for the sharing and archiving of research. The first instructor also found the podcasts and vodcasts a useful tool for the delivery of supporting teaching material and decided to continue to use them in the curriculum.
Middleton (2009)	25 Learning & Teaching Institute instructors and subst of students, Sheffield Hallam University, Sheffield, UK	Mixed student-generated media including vox pops & audio conversations, and task setting. Podcasting remained a central application.	Data collected concerned instructor feedback as the work was framed around the research question: "How did academic staff in a UK university apply their emerging understanding of educational podcasting as a mediums to engage their students?" Analysis of the follow-up interviews found that while technical confidence for staff should be further supported, it was concluded that audio media carries the potential to support academic creativity in engaging students.

Some of the more recent investigations include the following. Alpay and Gulati (2010) explored the effect of student-led podcasting on engineering education for the construction of a new podcasting resource. The investigation had a solid student-centred focus, with student-generated podcasts forming a new student and community resource for supporting learning and communication across the Faculty of Engineering. The aim was achieved, as the successful setup of the unit had occurred. The project provided an innovative communication tool for student engagement and their involvement in educational topics, debates, and developments.

In the area of geomorphology, Kemp and co-workers (2011) looked at the practical and pedagogic implications of student-produced podcasts in a second-year undergraduate field and practical project on drainage-basin geomorphology. Forty to sixty students undertaking the 'Geography Environmental Management and Sports Studies' Honours programs, in 2008 and 2010, were placed into groups of 5-6 students and produced 10-minute, radio-style interview podcasts. They used simple language to explore a range of important

and social environmental issues. Follow-up student questionnaires were used to determine student perceptions. It was reported that the novel, student-produced podcasts were successful in engaging students, promoting group work, promoting IT skills & communication, and fostering a deeper understanding of the context of geomorphic data. Kemp and co-workers (2011) indicated that this medium offers efficient teaching of oral communication, with opportunities for distance and self-directed learning.

In the field of chemistry, Bartle and colleagues (2011) had a large cohort (n = 352) of undergraduate chemistry students in groups of three, producing podcasts on two chemistry topics. The podcasting task was allocated a 5% assessment weighting. The aim was to use this technology to improve student motivation, enhance science communications skills, and to foster a deep approach to learning. The students using a pre-established rubric designed to acknowledge skills essential to science communication were involved in the marking of the podcasts. The podcasts were also graded by the unit coordinator and the researchers reported that many scored highly on this assessment task, with most students scoring three or greater out of five marks. Anonymous student feedback was collected by survey, containing Likert-scale and open-ended questions, as well as from the general comments made by students in discussion threads on the university student learning management system. A thematic analysis of the qualitative data found that the students had positive perceptions of the podcasting task and found it motivating (Bartle et al., 2011). Although the examination results for questions that related to the podcasting topics had not yet been fully analysed, preliminary results indicated that they may have promoted a greater understanding of the associated concepts. Considering the student feedback and the preliminary exam results it was suggested that deep learning had taken place. This application, was promoted as a feasible and effective assignment tool for further use in large, introductory sciences classes (Bartle et al., 2011).

Later in 2013, Bolliger and Des Armier Jr, reported the results of exploring AL in the online learning environment via the integration of student-generated audio files in an advanced graduate-level instructional technology course. The investigators noted that while the use of instructor-produced audio files has been integrated into variety of settings and environments, few educators, had required students to produce and share them with peers. The purpose of their investigation was to gain an understanding of graduate students' perceptions of the integration of student-generated audio files concerning perceived satisfaction, engagement, learning, and others. Twenty-two participants completed an online survey containing 32 questions comprising 15 Likert-scale items, 10 open-ended questions, and 7 demographic questions. The questions were developed from the literature and included the following constructs: *satisfaction*, *engagement*, *connectedness*, *utilisation*, *student learning*, and *general concerns*. Analysis of the results showed that the students believed that the integration of student-generated audio files cultivated their involvement, supported their

working with others, and increased their learning (Bolliger & Des Armier Jr, 2013). The investigators further highlighted the need for the application of this teaching tool to be done so with caution, particularly with students with limited technology skills. They identified that those who are not IT (Information Technology) savvy may experience cognitive overload with this learning medium, that could cause major challenges for instructors.

Furthermore, Pegrum and colleagues (2015), using student-derived podcasts, found that the examination performance of several hundred first-year chemistry undergraduate students significantly improved for one topic of interest. From this, they suggested that the use of creative podcasting is a potential way to help promote a deep learning approach. They further indicated that more research is needed in this area. Further review of their work takes place in this thesis under the 'creative podcasts' section.

In the following year, Middleton (2016) reported the findings of a literature review and a case study on final-year undergraduate computing students. He challenged the teacher-centred pedagogical understanding of podcasting and explored several diverse methods that aimed to enhance student-centred AL through podcasting. He found that the case study demonstrated how the use of audio, meaningfully connected tutors, students, and others in what he defined as a "rich learning space". Middleton (2016) concluded by acknowledging that while the general recording of lectures helps to supplement and reinforce traditional pedagogy, it was clear, that the recorded voice can provide further benefit to help transform it. Middleton (2016) suggested that this audio-rich media format can be extended beyond its existing use and should inspire innovators to confidently identify new opportunities for student-centred AL.

Kapoor and colleagues (2018) evaluated medical student-led podcasts in a large cohort. Thirty-five video podcasts were developed by 5th-year medical students with later evaluation of them by 122, 3rd, 4th, and 5th-year medical students. The podcasts comprised three to fourteen-minute duration recordings covering medical diagnostic skills and knowledge, including clinical presentation, underpinning basic sciences, diagnostic approach, and evidence-based treatment lines. An anonymized student survey provided quantitative data about five key statements related to podcast 'clarity', 'length', 'content', 'learning effectiveness, and 'comparison to other learning resources'. Three additional questions provided qualitative feedback on the best and worst aspects of the podcasts and areas for improvement. The quantitative data were tabulated, and a thematic analysis of the qualitative data was undertaken to identify common, recurring themes. Results showed, that while the were some mixed views in comparing this teaching media with traditional learning methods, most of the students found the podcasts to be effective in terms of clarity, academic detail, and learning (Kapoor et al., 2018). Students indicated that podcasting use is an efficient way to learn and recognise it as a successful tool supporting self-directed learning. It was concluded that podcasts that contain engaging voices and images, especially in an interview-style format, helped maintain student engagement.

Mathany & Dodd (2018) investigated student-created podcasting using an interview format as an assignment task. Based upon prior reports that podcasting assignments helped to foster student engagement, learning, skill enhancement, and problem-solving abilities the work introduced a podcast assignment whereby students conducted interviews, with a current varsity student-athlete, coach, or administrator to compare theoretical concepts to the life experiences and outcomes of those being interviewed. An additional learning outcome of the assignment was for students to produce a podcast appropriate for public use. The eighteen students were enrolled in a first-year seminar course titled Varsity Athletics: Cost, Culture, and Consequence. A post-survey instrument was used to collect feedback from the students. Students believed that the assignment had value and that it had supported their learning, while the instructors felt that it "allowed students to achieve learning outcomes, improve oral communication skills, and engage with course content" (Mathany & Dodd, 2018; p.65).

Recently, Hall and Jones (2021) investigated looking at the use of student-generated podcasts to facilitate health education for traditionally aged college students. Forty-five students participating in a Health Psychology course made 12 podcasts. However, Hall and Jones (2021) presented a different perspective and explored the students' perceptions and experiences in creating the podcasts. Predominant student reflections indicated the following three principal themes in the feedback: 1) the challenges of learning new digital tools in a digital environment; 2) the technicalities of technology; and 3) active learning in the moment.

Another recent investigation found that small group student-produced podcasts were preferred by the students over other assessment mediums, such as video or written academic text for inter professional learning (IPL) (Almendingen et al., 2021). Students from teacher education, health, and social care education were allowed to select from the three assessment tasks. Results showed that 75.2% of the students submitted podcasts, another 23.7% submitted written academic texts, and a small number (0.8%) submitted videos (Almendingen et al., 2021). The authors reported *"the students and most of their supervisors' preferred podcasts as assignment tool over written text or videos"* (Almendingen et al., 2021, p.1).

The previous literature strongly illustrates that podcasting as a learning medium provides a useful supplemental resource for conventional teaching. More importantly, with an innovative application, it offers the ability to engage students as co-creators of their learning experience. This has been shown to produce both neutral and positive quantitative outcomes concerning assessment performance. However, there is a plethora of positive feedback gleaned from qualitative analysis of students' perceptions of them, both as passive users and active creators. It has further been demonstrated that students prefer to create podcasts over other assessment mediums, such as video or written academic text videos (Almendingen et al., 2021).

Nevertheless, there remains a lack of creative use for podcasts, especially in the student-centred AL environment. Part of this relates to cultivating creativity in the learning

process. Gibson (2010) reported that Florida (2002) linked creativity to technological innovation and economic prosperity. Florida (2002) strongly argued that higher education institutions should foster creativity in students. However, seven years later, McGarr (2009) reported that the least frequently applied podcasting application was the creative student-generated and AL approach. This was reflected by the findings of other researchers reporting a lack of research focusing on student-produced podcasts (Armstrong, 2009). There is also a shared belief that the true potential of this tool is expressed only when it is used to create knowledge through learner-generated content (Atkinson, 2006; Miller, 2006; Lee et al., 2008). Moreover, the creation of podcasts also allows students to collaboratively develop knowledge, express individuality, and connection with others (Bolden & Nahachewsky, 2015). Armstrong (2009) also reported that student production of podcasts affords development in skills associated with teamwork, communication, technical competence, organisation, planning, and research.

2.7.1.4 Alternative podcasts and their potential

Podcasting platforms are evolving. As mentioned, while podcasts were initially just considered audio files, contemporary productions can include digital images, slides, and videos that can be downloaded to devices such as a smartphone or computers for later use (Chen & Malon, 2017). For example, advances in technology have allowed video content to be inserted into podcasts giving rise to the term "Vodcast" -- essentially the video version of podcasting. As discussed, Kalludi and colleagues (2015) used this medium to support the learning of physiology for first-year dental students. This was done so based on the student feedback received in a similar podcasting investigation previously conducted by the same research team. Sixty-three percent (63%) of the students felt that a lack of images in the podcasts was a disadvantage. Following the use of the video podcast, results showed that the students that had used them outperformed the students that didn't in a follow-up MCQ test. Moreover, most of the students had a positive view of the use of the video podcasting approach. In fact, within the health sciences, it has been reported that vodcasting has gained popularity and application within the medical field as a teaching strategy; however, it is also noted that the medium is still seen as a passive modality when the learners do not actively engage with the content (Pettit, 2018). Reasons are many, including the quick nature of the millennial student to become bored and to ignore some learning resources when a myriad are on offer (Pettit, 2018). As such instructors should create vodcasts acknowledging student preferences, *"particularly those known to facilitate multimedia engagement and learning"* (Pettit, 2018, p539). To better apply the technology to encourage student participation, Pettit put forward ten suggestions (tips) outlining specific strategies for the creation of engaging screen capture vodcasts to stimulate AL (Pettit, 2018). These are listed in Table 2.3.

Table 2.3. Ten tips to promote AL with vodcasts.

Tip 1	Motivate consumption (use)
Tip 2	Facilitate multimedia learning
Tip 3	Incorporate pauses
Tip 4	Cue note-taking
Tip 5	Give auditory instruction for active learning
Tip 6	Provide a guided study tool
Tip 7	Create animated interactions
Tip 8	Embedded hyperlinks to interactive cases or games
Tip 9	Provide blank figures and tables for review
Tip 10	Include practice questions for reinforcement and review

Although these tips are intended to help facilitate instructors with beneficial design elements for teaching vodcasts. Some of these helped to inform our present work. Further description of this occurs in Chapter 3.

Of further interest and linkage with this present work is "PowerCasting". Recently coined by Steve Broskoske, the term PowerCasting was used to describe a simple and creative alternative to traditional podcasting, whereby instructors can readily insert a lecture recording within a PowerPoint presentation (Broskoske, 2019). The PowerCasting term derives from a combination of the PowerPoint and podcasting terminology. Broskoske proposed that PowerCasting was a simple means to add podcasting elements to existing teaching by utilising existing presentations, and further allowed focus on content, and not on the tool (such as additional podcasting applications and technologies). However, very little research can be found applying PowerCasting as a teaching and learning tool. The term has not widely been adopted within the educational sector. Perhaps because of its simplicity and the age of the PowerPoint application itself, it has been overlooked, and its potential has not yet fully been realised.

Notwithstanding the studies identified in this review, there has been a slow pedagogical movement forward linking creativity and student-centred learning with technology. Following an extensive review of the relevant literature, the present author notes a paucity of cases whereby students were actively engaged in student-centred creation of podcasts; especially ones promoting creativity. As discussed, while the traditional pedagogical approach in the higher education sector has value, the intrinsic delivery format has failed to adequately cultivate creativity and imagination in the learning process. So, what has been done in this area?

2.8 Pedagogical approaches linking creativity and student-centred learning with technology

While the pedagogical movement connecting creativity and student-centred learning with technology is limited, from the teacher-centric, instructional perspective, there has been sound work done. Additionally, in some instances, there have been efforts to promote a co-constructivist approach for students, while others have looked to directly foster creativity skills for students. For instance, Stolaki and Economides (2018), acknowledged that "creativity enhancement is an education objective" (p. 195), and undertook a study designed to enhance it for undergraduate students in a systems information course. They titled this research: “The Creativity Challenge Game: An educational intervention for creativity enhancement with the integration of Information and Communication Technologies (ICTs)”. One hundred and thirty-four students participated in the intervention. It comprised the use of social media technology in the form of Facebook and a collaborative team structure. It was delivered as a game-like competitive environment, with students participating in the generation of the questions, and then the answering them. Academic outcomes were linked to exam results and creativity outcomes were measured via several pre-post divergent thinking tests. Data showed significant increases in measures of fluency, flexibility, elaboration, and originality. The authors concluded that the pedagogical strategy overall was effective in encouraging creativity.

While it is beyond the scope of this present work to review all literature in this area, the focus is given to work that has taken place using the technology of interest for this present work, namely, the PowerPoint and Podcasting technologies.

2.8.1 Creative PowerPoints and Gamification

The PowerPoint application was released by Microsoft in 1987, and while some early trepidation existed with its initial use (Clark, 2008); it was quickly adopted globally, and today is synonymously associated with lecture presentations, boardroom meetings, and seminars alike. For many years now, the application has essentially been used in all undergraduate classrooms. Potentially for many instances, it has been over-used. Students following slide-intensive presentations or lectures have commonly embraced the catchphrase, "Death by PowerPoint" (Winn, 2003). An exceeding overuse of many slides containing teacher-generated information can indeed sully the appeal of a once visually exciting and engaging tool; even more so, when the content displayed on the slide is just repeated verbatim by the teacher. An effort has been made to address this. The following briefly presents some of the endeavours in this area.

To provide guidance for instructors on the design characteristic of PowerPoint, Berk (2012) published a paper titled How to Create "Thriller" PowerPoints® in the Classroom! This work was done to address the reputation for this medium, "being less than engaging in this

era of learner-centred teaching" (Berk, 2012, p.141). Berk complied and described 30 specific practical ways for educators to facilitate interest and attention for students. Some of the practical applications suggested the incorporation of movement, music, and videos within the slides, to help establish and hold on to students' focus to foster deep learning.

Clark (2008) also recognised the flaws with the overuse and teacher-centred use of PowerPoint. Following on the work of Gilroy (1998), an earlier advocate for the need for change, Clark suggested that this technology could still play an important role to revitalise lectures. Specifically, Clark was interested in using PowerPoint to promote a constructivist-learning environment. Later research by Inoue-Smith (2016) reflected a similar stance. Following an investigation of college-based case studies and PowerPoint effectiveness, Inoue-Smith suggested that by switching the use of PowerPoint, from a teacher-centred focus to that of an interactive, student-centred one, both the students and the teacher's needs are met. Similarly, Wanner (2015) acknowledged that students crave interaction and student-centred approaches to technology. He subsequently employed an innovative teaching method to promote student engagement through AL, using a blend of just-in-time teaching and PowerPoint technology. Others have explored using PowerPoint beyond its simple use as a teacher-centred instructional platform and have included stimulating "game-like" elements in their construction of them.

As discussed, gamification is the term used when game-like features are incorporated into non-game settings and provide gaming qualities to foster retention (Faiella & Ricciardi, 2015). Within the field of education, various gamified approaches have been employed to promote student motivation (Hanus & Fox, 2015), engagement (Barata et al., 2013), and other learning outcomes (Lee & Hammer, 2011). As indicated, engagement itself has been an ongoing concern within the educational system. As engagement is not guaranteed, the inclusion and integration of gamified elements, in part, incorporates the essence of "what really matters from the world of video games" into learning activities, thereby hopefully "increasing the level of engagement of" (Hanus & Fox, (2015). While not directly related to PowerPoint, the impact and potential of games used for education and others were recently celebrated at the 2021 Games for Change Asia-Pacific Conference. This conference occurred after our work (reported in this thesis) and gave us opportunity to showcase it. The event brought together various individuals, organisations, and industries showcasing the games that drive change by supporting learning, health, various social aspects, and more. Notably, some conference presentations used portmanteau terms such as 'Edutainment' and 'Edufication' in their titles, reflecting linkages between education, entertainment, and gamification. In particular, the presentation of "Edutainment: serious gaming in planning education" by Associate Professor Christian Moro (Bond University, Queensland, Australia), showcased the success of an App adventure game called *“The King's Request: Anatomy and Physiology Revision Game”* as an example of a “serious game”. Instead of recreational purposes, serious games more so focus

on education (Moro et al., 2020). The King's Request game was created in-house by Dr. Christian Moro as a revision tool to support the learning for health science and medical course students, and to help mitigate the sheer volume of information the students had to engage with. It involved students moving through the levels of the game by answering questions embedded in it. To determine the impact of this game on the learning experiences, 37 first-semester Biomedical Sciences students used it and progressed through the levels by answering the 20 questions that reflected the content covered in a semester 1 Physiology and Anatomy period (Moro et al. 2020). Following its use student feedback indicated increased motivation and engagement when "learning from games as an information delivery mode" (Moro et al., 2020, p506).

Figure 2.5 shows screenshots of the game.

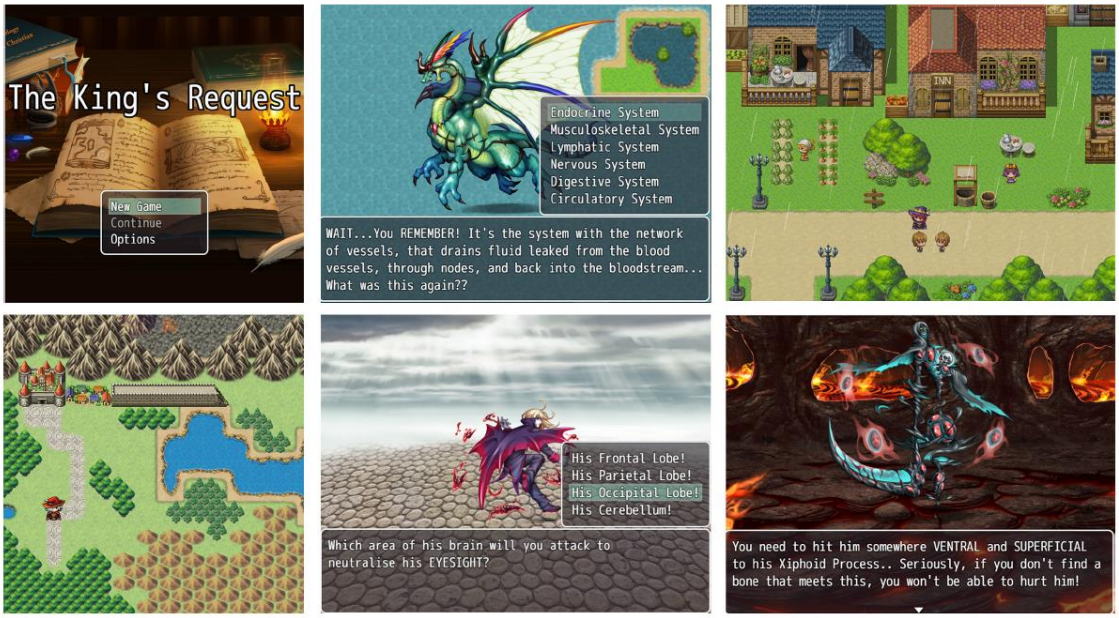


Figure 2.5. Screenshots of "The King's Request: Anatomy and Physiology Revision Game" (source: Moro et al., 2020, p506)

However, there are many reasons why gaming in education, particularly the tertiary sector has not yet been fully utilised. Often the cost, alongside the need for programming knowledge and game-based software applications and platforms, precludes its use. Hence, many teachers look to other means, such as PowerPoint to gamify learning. Several recent learning strategies combining PowerPoints with gamified-like elements have been used to foster student engagement, and have provided simple, accessible, and cost-effective alternatives.

To help engage students, Siko & Barbour (2012) used PowerPoint technology as a tool for game-design instruction and provided templates for students to download and add information (questions and answers). They called this format "homemade PowerPoint games".

These games were based upon a "theme" or hypothetical situation, whereby questions were designed to move the user through the slides depending upon what answer was selected. The goal was to reach the end slide. This provided a constructionist platform that allowed students to be actively involved in the construction of them as well as participate in an interactive learning activity.

PowerPoint technology has also been used to create teaching models based on popular board games or television programs. For example, game-based learning with quiz-style PowerPoint games like "Jeopardy", "Wheel of Fortune" and "Who Wants to be a Millionaire?" has been used to promote student engagement with course content, and critical thinking and learning outcomes across various academic disciplines (Squire, 2019). Moncada and Moncada (2014) used PowerPoint technology to create a quiz-like game called "Fund Identification Challenge and Computer Fraud Challenge" that was also derived from a popular television program called "Hollywood Squares" (a hybrid adaptation of "Tic Tac Toe"). Following the intervention, it was said: *"gamification activities that utilize the capabilities of PowerPoint, can offer instructors a viable, stealthy, teaching and learning strategy that capitalizes on collaborative play to engage students"* (Moncada & Moncada, 2014, p18.).

While the PowerPoint application was not designed or intended to be a gamified platform for educational content and delivery, several points support its use in this manner. Firstly, both students and instructors are comfortable with its use. Secondly, it is a readily available resource that can insert images, sounds, GIFs, the recorded voice, and animations and hyperlinks. Thirdly, it is not cost prohibitive, and fourthly, it requires little effort to set-up for the individual and institution alike (Siko and Barbour, 2012). Additionally, the PowerPoint software provides a reasonable solution for the problems and concerns related to other "multimedia-rich, interactive instructional game" platforms that can be challenging, and time intensive to set up (Moncada & Moncada (2014). Presently there are several online game-like platforms providing readily made PowerPoint templates of similar design for instructors to download and apply in the instructional setting -- for example, https://www.lifewire.com/free-powerpoint-games-for-teachers-1358169

Possibly one of the challenges for the education system is to "discover that play, after all, is the highest form of inquiry" (Moncada & Moncada, 2014, p. 18). In the words of another, well-known, influential scientist of the 20th Century, "Play is the highest form of research" (Albert Einstein quoted in Souto-Manning, 2017). The preceding discussion has demonstrated the growing interest in using gamified strategies to support student engagement and learning, especially with the use of PowerPoint. While some promising work has been done, future work can expand on it and investigate further means into how this extensive and commonly utilised and cost-effective technology can better engage students, especially through the process of AL.

Attention is now given to the application of podcasting technology that has been utilised to enhance student learning constructively and creatively.

2.8.2 Creative Podcasts

To date, there has been a lack of investigation in this area. An extensive review of the relevant literature, while demonstrating a plethora of studies based upon the teacher-centred application of podcasts, has demonstrated a comparative lack where students are actively engaged in the creation of the Podcasts, either individually, or within a group setting. Even more so, there is a dearth of opportunity whereby students have the freedom to create them using an artful approach to learning. Nor have they been produced using an alternative PowerPoint and Podcasting format, such as Power Casting. Indubitably, unlike the present work reported here, no other podcasting study involving the student construction of them has utilised a fictional scenario and narrative to support the learning of physiology. Of the limited work done in this area, two recent studies have used AL strategies to engage undergraduate students in the artful creation of podcasts -- one by Bolden and Nahachewsky (2015) in music, and the other by Pegrum and colleagues (2015) in chemistry. Additionally, while not directly involving podcasting technology, Kraal and colleagues (2021) employed the use of 'Student Produced Audio Narrative' (SPAN) assignments on students' perceptions and attitudes toward science in introductory geoscience courses. Students had a degree of creative freedom, having the ability to choose the topic and the narrative style.

Bolden & Nahachewsky (2015) undertook a qualitative investigation on podcast creation as transformative music engagement for students in an undergraduate music education course. Nine participants were interviewed about the podcasting experience, in which they shared reflections about significant interactions with music throughout their lives. In this manner, they used voice to connect with personal experiences that were both reflective and sharable. Learning is a process of personally instilling experiences with meaning and that the podcast construction supported that (Bolden & Nahachewsky, 2015). The students were able to create and share unique representations of their learning and about themselves creatively and expressively. Qualitative data was collected via semi-structured interviews ranging in duration between 30-60-minutes, and follow-up qualitative thematic analysis consisted of coding and sorting of the information according to topics, themes, and issues relevant to the investigation. The investigators reported that the artful learning that took place provided meaningful knowledge construction for the students. The podcast technology allowed them to convey aspects of themselves (their music and their stories) through the importing and exporting nature of the medium. In conclusion, the study demonstrated the usefulness of podcasting technology as a highly effective means allowing students to reflect on, analyse, and convey significant personal experiences with music. They authors inferred

the potential for it to be used to enhance other aspects of the course. Several key outcomes were noted concerning the potential of podcasts for learners:

1) to reconnect to experiences that can inform and serve as a foundation for personally meaningful knowledge construction;
2) to exercise creativity and self-expression, allowing learning and of themselves and sharing of that;
3) to connect to others and engagement in collaborative knowledge development;
4) to communicate meaning within the disparate elements by combining text and music; and
5) to expand mental capacity.

Perhaps one of the most heartening outcomes was that *"students took pride in their work and felt a strong sense of personal ownership over it"* (Bolden & Nahachewsky, 2015, p.29). One participant provided the following feedback:

> *"I put more time in it than I originally wanted to or allotted. But I just did, like I stayed up really late and worked on it to get it done and I gave myself a-bunch of chunks of time to keep working on it. I found it was way more a learning experience [than other assignments] and I prefer that – like if someone said I could've done something easier and gotten an A but I wouldn't have learned as much, I still would've done the podcast"* Grace (Bolden & Nahachewsky, 2015, p.17).

Pegrum and colleagues (2015) found both positive qualitative and quantitative outcomes on student performance, for engagement and assessment performance following the production of podcasts. Based upon previous reports that student performance can improve following deep learning approaches that promote active understanding of meaning, the investigators employed a student podcasting assignment that required students to explore of two fundamental chemistry topics - either "acids & bases" or "oxidation & reduction." A large cohort, comprising 352 first-year undergraduate chemistry students participated. An artful learning style was partially supported, and student-centred learning using technology occurred through the production of student-led podcasts. Students were encouraged to creatively approach the task, such as presenting analogies or practical applications of the topic matter. For example, one student group, that had previously demonstrated disinterest in the unit content, used an analogy founded on the Twilight film saga. They used the "Bella" and "Edward" film characters as representatives of the content of their topic. The group produced a podcast on the topic of "oxidation & reduction" reactions, that told the story of the reaction

between two atoms (Bella and Edward) and their "desire" to share electrons (Pegrum et al., 2015). When the results across two years of comparable questions to the podcasting topics, there was a statistically significant ($P < .001$) improvement following participation in the podcasting task for questions that related to the "acids & bases" topic, but not on the other. Pegrum and colleagues (2015) concluded that creative, student-centred podcasting can motivate students, including those otherwise disengaged, and affords the potential to promote new, deeper learning and understanding of some of the topic material. They found that creative podcasting may enhance learning outcomes, as exemplified by exam performance, and that it presented no negative impacts for the students. They further suggested that their findings should encourage others to adopt creative approaches, such as podcasting, that have a discernible positive impact on student learning.

Two primary implications for future practice and/or policy were made:

1) to encourage students to adopt a deep learning approach, it is worth employing appropriately structured creative podcasting tasks; and
2) large undergraduate science units, that may have budget constraints and limited staff, should consider using creative podcasting as it can improve outcomes for students by promoting creativity and contextualization.

In another relevant paper, Webb (2012) looked at how pedagogy and the use of ICTs may need to adapt. This was done regarding the contemporary, shifting conceptions about knowledge acquisition and the learning process. Among others, Webb suggested the means to support educators to develop their pedagogical practices to better align with 21st-century learning. He highlighted the need to examine how learning is conceptualised in the modern era, as there is now access to vast internet-based information. Webb (2012) also recognised that further balance between individual learning and group participation is required, as well as the need for learners to be allowed to develop expertise in their chosen domains. Two pedagogical approaches discussed by Webb included one that was described as learner-led and the other as learning-led. The former approach encourages independent learning as the students are supported to discover, explore, and pursue interests within collaborative settings. The learning-led approach relates to the traditional teaching method, whereby the teacher educates learners according to a set curriculum. To support overall coherence in the learning environment, Webb (2012) attests that the movement and flow of information between these two approaches need to occur, and in doing so, the sharing of pedagogy better supports learning and development.

Scott (2015) shares this sentiment and emerging global changes require a new model of learning -- a transforming pedagogy to better support the development of twenty-first-century skills. Scott recognises the limitations and ineffective widespread use of the lecture

model and argues a rethinking of the pedagogy needs to take place. Despite the widespread agreement that student skill development for critical thinking, effective communication, innovation, and collaborative problem solving are needed, Scott claims that the present education model has rarely adapted to address. To do so, Scott suggests that the pedagogical approaches need to undergo drastic change. This in part relates to recognising that learning is a lifetime process, and Scott suggests that the pedagogic approaches supporting personalised learning, participation, collaborative learning, project-based learning, and others can support this. The future of learning will be embedded in the curriculum that challenges the now. The ICTs have a role to play; contribution and thoughtful application of technology will provide more learner-centred approaches, making personalised learning possible (Scott, 2015).

Moreover, as previously mentioned, Middleton (2016) conducted a literature review and case study, challenging the traditional view that educational podcasting's value solely lies in its sole application as a teacher-centred tool. He explored a range of diverse methods for podcasting that enhanced and redefined the media as one that also promotes student-centred AL. As mentioned, he defined the scope for podcasting as a rich learning space, by connecting with others, and concluded that the use of voice needs to be re-evaluated to recognise its worth as a flexible, manageable, immediate, powerful, engaging medium.

2.9 Literature review conclusion

This review has demonstrated that there is much interest in finding pedagogical approaches that better address disengagement, motivation, learning, student needs, and the changing conditions of the modern learning environment. Educational strategies are beginning to challenge the traditional didactic model -- not by the replacement of such, but more so, through its evolution of it. Much of this relates to the adoption of AL strategies, as well as constructivist teaching practices (Wanner, 2015) that are more in line with millennial preferences (Steinhardt et al., 2017). Creativity enhancement using technology and collaborative learning are also a part of it (Steinhardt et al., 2017; Twenge, 2009; Roberts et al., 2012; Stolaki & Economides, 2018). Advances in technology provide a perfect opportunity to explore this. An extensive review of the literature elucidates that there has been a somewhat successful and growing use of podcasting technology to either replace or supplement the traditional flow of information between teacher and student. There is, however, a lack of student-centred learning, especially whereby students are required to create them (Armstrong et al., 2008), especially in physiology. In addition, it has been shown that students have not had the opportunity to “create them creatively”. As discussed, creativity is underpinned by several components including those related to emotion, imagination, ownership, expression, experience, critical analysis, higher-order thinking, and deep and artful learning. As such, in this 21st century where

technology is advancing daily, the opportunity to combine these with ICT and learning is unlimited.

The challenge lies in how to address the incompatible use of technology in the present learning environment, and how to adopt pedagogic perspectives that actively support creativity enhancement across the educational sector. In successfully doing so, a modern curriculum that supports the crucial development of a creatively invested learner will occur (Booth, 2013).

2.10 Intent for the present work

For an effective pedagogy that offers students the ability to self-govern their learning experience, it is essential for research to apply and then assess the experiences, effectiveness, and outcomes for both students and teachers alike (Bolden & Nahachewsky, 2015).Without doubt, there is a need for further work in this area. Accordingly, based upon the findings discussed in this review, considerable thought went into designing a teaching and learning intervention that could align with several of the emerging themes of evolving educational practice. The focus was given to designing an AL strategy that combined student-centred learning, technology, and collaboration. The promotion of student creativity and engagement was also highly regarded. Further influence was borne from the observations and experiences that 1) students crave interaction and active participation; that 2) there is a lack of creativity and imagination in the learning process, and lastly 3) that students can be disengaged and unmotivated learners. To this end, the effort was given to create an innovative and affordable, blended AL pedagogy to support the learning of physiology. Foremost was the promotion of active participation of students in their learning process, by combining technology, creativity, collaboration, and game-like elements – a zombie apocalypse narrative, called "Uni-Apocalypse". Novel use of the Microsoft Office PowerPoint application provided a versatile, readily accessible, and cost-effective platform to convey audio (Podcast), images, and information in a gamified-like manner (PowerPoint). This positioned the students within a constructivist-constructionist pedagogical framework that highlighted creativity and technology to support learning. Additionally, via the collaborative requirement taking place through teamwork, further linkage with a social constructivist position was made.

2.10.1 The novel teaching intervention

The study intervention comprised a novel pedagogy and student project task promoting the student creation of educational human physiology "PodPoints" – a combination of Podcast and PowerPoint technology. It was adopted as part of the learning and assessment curriculum for the RBM1518 Human Physiology 1 unit in 2019. This student project was supported by the creative game-based learning scenario - the "Uni-Apocalypse" narrative, and a series of

interactive teacher-generated PodPoints that imparted project instructions while adding game-like elements. This was delivered within the relatively new teaching model, referred to as the "Block Model" that was recently adopted by the First Year College at Victoria University, Melbourne, Australia (McCluskey, Weldon, & Smallridge, 2019) (previously described). The intervention aligned with the flipped classroom delivery model for the teaching unit and combined several key learning and teaching strategies such as AL, creativity in the learning process, collaboration & communication, and technology. Further details about the novel teaching intervention are covered in chapter three.

2.10.2 Study aim and objectives

The purpose of this project was to design, deliver and assess an innovative, blended AL and assessment pedagogy using readily available, cost-effective technology, combined with elements of creativity and gamification to support the learning of physiology for first-year undergraduate students. It was done to help engage the students by using a little imagination and creativity. It also aims to allow them to highlight theirs. Furthermore, it was anticipated that this novel approach would provide a rich learning space, with new opportunities for the students to think, process, and learn information in a manner that better suited them.

The primary objectives were to evaluate the effects of this on the learning experience and outcomes for the students. To do so, the study inquiry was driven from a realist perspective, with one research question investigating student perceptions, including levels of engagement, and quantitatively, with one descriptive research question addressing assessment performance and engagement. The two research questions are:

RQ1. How does the intervention affect assessment performance?

RQ2. What are the user perceptions of the novel teaching intervention with respect to the following constructs of interest: satisfaction, creativity, learning, critical thinking, communication, collaboration, engagement, and technology?

The thesis now turns to explaining the methodology used to assess the research questions.

CHAPTER THREE:

3.0 METHODOLOGY

3.1 Research design and method summary

An innovative program was created and delivered face-to-face to support the learning and experience of 142 first-year undergraduate physiology students enrolled in RBM1518 Human Physiology 1 in 2019 at Victoria University, Melbourne, Australia. This work occurred in the pre COVID-19 setting. It comprised a blended AL pedagogy that used "PodPoint" technology (using PowerPoint to create a Podcast), combined with a fictional Zombie Apocalypse scenario to creatively support student engagement, assessment, and the overall student experience. A quasi-experimental, mixed-methods research design (see Figure 3.1) was used to obtain: (1) quantitative data related to demographics and assessment performance, and (2) mixed quantitative and qualitative data pertaining to student engagement and perception on eight (8) constructs of interest. These constructs of interest were identified *a priori*, driven by previous research and theory, and comprised *satisfaction*, *creativity*, *learning*, *critical thinking*, *communication*, *collaboration*, *engagement*, and *technology*. Student demographics, including the postcodes for each of the degrees for the 2019 cohort were graded according to the low “Socio-Economic Status” (SES) postcode measure. The project was approved by the Victoria University Human Research Ethics Committee (VUHREC) - HRE19-010. Informed consent was obtained from all participants and the involvement in the research component was voluntary.

3.1.1 The Unit

The RBM1518 Human Physiology 1 unit is delivered in year 1, semester 1 through Victoria University's innovative Block teaching model. Students study one unit at a time, intensively over 4 weeks. Small classes (30 students) with interactive sessions - including three 3hr workshops (replacing lectures), one computer lab, and three 2hr laboratory classes per week for four weeks - support student learning and interaction using a flipped classroom model. The unit supports first-year undergraduate students across several Biomedical and health science degrees (as shown in Table 4.1) that require a foundation of knowledge in physiology. The unit was coordinated and delivered by the same unit convenor, and other than the introduction of the PodPoint project that replaced worksheet tasks, the assessment and teaching remained the same for both cohorts. The third Lab session (2hrs) each week for 3 weeks was allocated to the team task, where students could work on their podcast in the classroom with me present to discuss progress and any technical issues.

RESEARCH DESIGN: Quasi-experimental, convergent parallel mixed-methods approach
Research interests: Assessment Performance / Student Perception / Student Engagement

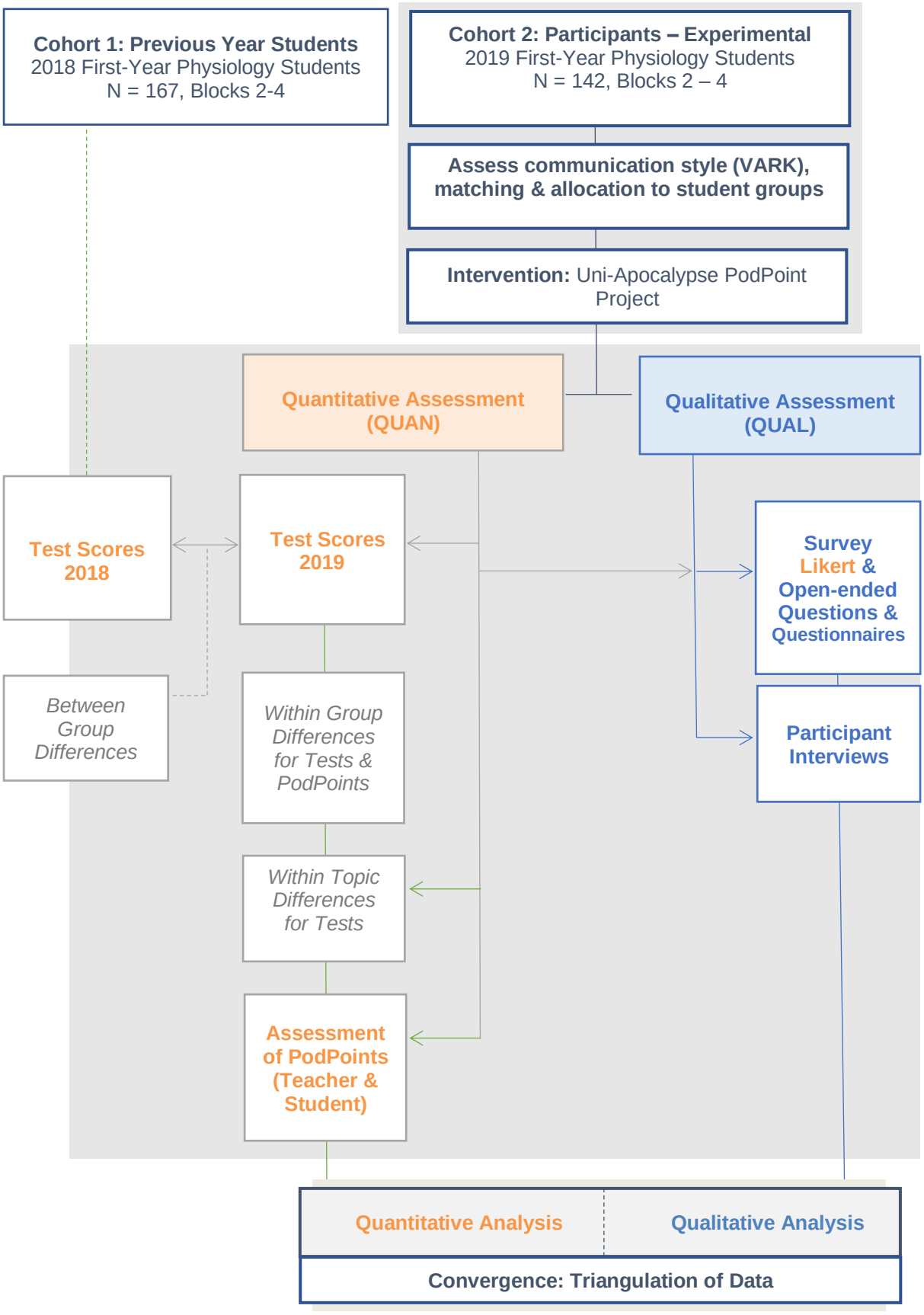


Figure 3.1. The study research process and design.

3.1.2 Participants

A total of 309 first-year undergraduate students undertaking the unit RBM1518 Human Physiology 1 in consecutive years, 2018 (Cohort 1) and 2019 (cohort 2) served as the control and intervention groups respectively. They comprised students from several health science degrees studying physiology enrolled across Blocks 2, 3 and 4. The final numbers and related details for each group are reported in the chapter 4 of this thesis (results). The 2019 participants were recruited during the associated teaching period and participation was entirely voluntary.

3.1.3 VARK Questionnaire and allocation of student teams

The online "VARK (visual, auditory, read/write, kinaesthetic) Questionnaire" (©Version 8.01, 2019, VARK-Learn Limited, Christchurch, New Zealand) (https://vark-learn.com/the-vark-questionnaire/) was used to identify individual student communication styles (profiles). While communication styles were not included as a construct of interest, determination of such, using VARK supported the allocation of students to teams allowing each communication style to be represented. VARK can be likened to a "communication questionnaire" – how a person prefers the receipt of information and then how they like to convey it, in other words, their preferred communication mode. It highlights the preference on how they like to get information and give information in the learning process. As such, it is not a learning style inventory, but rather an aspect of it. This was explained to the students and the purpose of it. Prior approval for its use had been obtained from its creator, Dr. Fleming. Dr. Fleming has expressed concern regarding the literature that had mislabelled the use of VARK as a learning style, rather than a communication style. He believes that communication is only one part of a learning style, and it is beyond the scope of VARK to address all of its aspects.

In 2019, 142 students completed the questionnaire and received a VARK result for individual student communication modality profiles. Profiles included either a mild to strong communication preference for “visual” (*V*), “auditory” (*A*), “read/write” (*R*), and “kinaesthetic” modes (*K*), or combinations of them (Appendix – Figure 1a, VARK Profiles). Approximately nineteen percent (18.9%) of the VARK results were single profile (mild to strong *V*, mild to strong *A*, mild *R*, and mild to strong *K*). Just over eleven percent (11.2%) were bimodal multi profiles, including *AR*, *AK*, *RK*, *VK*, and *RK*. Seven percent (7%) were trimodal multi profiles (*VAR*, *VAK*, *ARK*), and 62.9% were multimodal profiles (*VARK*). A very small number of students that didn’t complete the questionnaire were allocated a multimodal (VARK) profile. This was done as it is reported to be the predominant type via the VARK literature and was also demonstrated with the present results. Because of the enrolled numbers for each Block, and the additional loss, when some students withdrew from the unit, the differences between

group sizes varied (two to four members). One group (Gr12) in Block 4 (2019) started with 18 students, 2 withdrew, leaving 16 students that were divided across the eight team PodPoint topics. All students completing the VARK questionnaire for this group were bimodal multi profiles, with most being multimodal profiles (*VARK*). This allowed for each team to have at least one member that was a multimodal VARK profile. Following team allocation, the instructor discussed the importance of teamwork, how to effectively work as a team, and how to manage and schedule the project tasks. Student teams were also instructed to write their team "PodPoint project charter" – rules of working as a team, what they expected from each other, and how they would respect and support each other.

3.1.4 Intervention

The intervention comprised a learning and assessment strategy that promoted the team-based student creation of educational human physiology PodPoints. It was supported by a creative game-based learning scenario (the narrative), titled, "Uni-Apocalypse", delivered as the PodPoint Project. Figure 3.2 below was used as part of a visual guide for students to understand the sequential process for the project. Student teams were required to complete the task as part of their assessment for the unit, and then participate in the peer review of other students' work. It was also marked by the teacher and the complete activity had a weighting of 20% of their final unit mark. In a similar fashion, Mclean & White (2009) allocated a 15% weighting to a student generated podcast activity as part of their final grade.

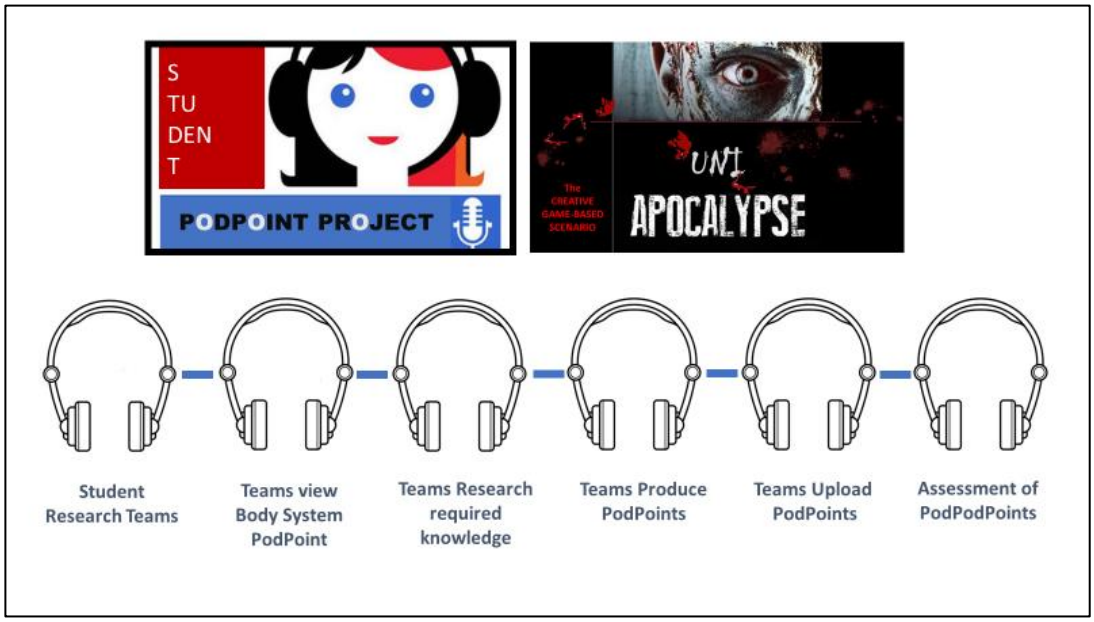


Figure 3.2. Uni-Apocalypse PodPoint Project.

The Uni-Apocalypse narrative immersed the students in a fictional plot in which a global zombie apocalypse had occurred, and the university was under threat by a zombie horde. Figure 3.3 shows the narrative that was given to the students.

THE APOCALYPSE IS UPON US…

All that you have seen in the end-of-the world films, read in books, and watched on television is now true! Unbeknownst to the general population, secret government experiments, headed by the Centre for Disease Control and Prevention (CDC) have gone terribly wrong, and a virulent zombie strain has inadvertently been released with catastrophic results…nowhere is safe…

Right now, our university is UNDER ATTACK by a ZOMBIE HORDE…we are completely surrounded…there is no escape. Our only hope lies in the brilliant minds of the - academics. Headed by the genius of "Mad Professor Hayes" and his eccentric but brilliant colleagues, a research-team is frantically working to salvage, and put together the body parts and wet specimens found in the anatomy lab; with one purpose in mind - to create a "SUPER-SOLIDER" - one that has no fear, has incredible strength, and has the ability, to save us all…

THERE ARE PROBLEMS THOUGH.

The team are having major setbacks. Some of the specialist researchers have been turned and unfortunately certain vital knowledge has been lost with them. As such, the team is struggling to develop the neural and muscular machinery needed to animate it. They are also having trouble understanding how a particular endocrine gland supports the super soldier during the stress response when fighting zombies. Furthermore, after battling the zombies, the super-soldier will be re-charged by a glucose drip, but the team are unsure what organ regulates blood-glucose levels and how. There is also a chance that a "Z-vaccine", one that protects it from the zombie bite, can be developed. But the team has also fallen far short in doing this.

WE NEED YOUR HELP!

This is our last ditched attempt to create our super-soldier. We are calling out to the gifted minds of all students…help us understand the concepts and knowledge so desperately needed.

SAVE YOURSELF – SAVE US ALL!

Figure 3.3. The Uni-Apocalypse narrative.

To save everyone, a fictional "super-soldier" was constructed from cadaver body parts from the anatomy department. However, some key physiology knowledge required to animate the super-soldier was lost as some professors had turned (into zombies). Within this narrative, the students were required to locate a hidden "safe" containing the "Professor's Journal" in one of the teacher-generated PodPoint files. This journal detailed the "lost knowledge" -- the required key physiology information that students had to research. In teams, the students used the unit teaching materials, the prescribed textbook, and learning resources to reconstruct this knowledge and conveyed it back to the rest of the class and the teacher in the form of the

student-generated PodPoints (one per team). Body-system topics included the human nervous system, the muscular system, the endocrine system, and the immune system, each covering two key topics of physiology (Table 3.1).

Table.3.1. Body system topics and associated key physiology principles.

Body System Topics	Key Physiology Principles
The Nervous body-system	The action potential
	The neuromuscular junction
The Muscular body-system	Skeletal muscle structure
	Sliding filament mechanism
The Endocrine body-system	Adrenal response to stress
	Pancreatic control of blood nutrients
The Immune body-system	Inflammatory response to tissue damage
	Immunity and vaccination

The topics included two key physiology principles per associated body system. The same topics were also covered in the unit workshops. Subsequently, the related physiology information was covered twice -- once in the formal workshop by the teacher, and then again, by the students with their independent PodPoint work. Moreover, depending on the PodPoint topic and the timetabled teaching schedule for the workshops, some students were shown the information well ahead of others. However, most students independently researched the PodPoint topic matter, before receiving the teaching of it in the respective workshops. This very much aligned with the flipped classroom model adopted by Victoria University's Block Teaching model.

3.1.5 The PowerPoint application

The PowerPoint application (Microsoft Office 365 Pro Plus) was used to produce all PodPoints. This was available as a free download to all students from the VU learning site (VU Collaborate). PowerPoint was chosen because of its long-term application in the education sector, ease of use, familiarity, availability, and cost-effectiveness. Furthermore, the application's ability to combine audio and images independently, without the need for any other podcasting equipment, application, or software made it ideally suited. However, students were free to record audio on another device, such as a smartphone, and inset that audio into the PowerPoint for the podcast component. In this manner, PowerPoint allowed for the inclusion of vital diagrams and graphs with the combination of the recorded voice to convey the information on the different physiology topics. It further allowed for an interactive, gamified-like format that could be aligned with the Uni-Apocalypse story. Students were provided with teacher instruction on how to use PowerPoint -- how to insert images, hyperlinks, sounds, slide transitions, and voice (audio). The "PodPoint Project Student Guide" also contained

website links for short PowerPoint YouTube tutorials on PowerPoint fundamentals, as well as other links to short Microsoft PowerPoint instructional videos. Students further had the option to participate in a separate "Study Essentials" Multimedia workshop elective ("Screencasting and Narration") available through VU's Learning Hub, to support technical skill development in this area. However, for Block 2 (2019), students reported having problems enrolling in this elective due to it not being listed on the administration platform. This was rectified for the additional Blocks.

3.1.6 The teaching package and student support materials

A comprehensive teaching package and student support materials were created by me to assist in the delivery of the project. It is estimated that approximately 120 hours were spent on this. It comprised: The "Uni-Apocalypse" narrative; an "Introduction to the PodPoint Project PowerPoint"; two "Teacher-generated PodPoint Examples" (Example 1 & 2); a teacher-generated "PodPoint Body System series" covering the four body systems (Nervous System PodPoint, Muscular System PodPoint, Endocrine System PodPoint, Immune System PodPoint"); the "Professor's Journal" (a teacher-generated 'notebook'); the "PodPoint Project Student Guide", a "PodPoint Project Images File", the "Required Physiology Knowledge Sheets" for each of the topics, the "Scenario Suggestion Sheets" for each of the topics; a "PodPoint Project Step-by-Step Process sheet -- Working as a team!", and a "PodPoint Project Marking Rubric". Table 3.2 lists these as well as links for the viewing them and associated instructions.

Table.3.2. The teaching package and student support materials.

Teaching Package Item	Location/Links	Instructions
"Uni-Apocalypse" narrative PodPoint	https://phd-research.webs.com/ Located on "PodPoints" Tab	Open the website link and click on the associated image. Download PodPoint. Open as Read Only and play as a slide show with sound on. Transitions automatically, no need to click through.
Teacher-generated PodPoint – Example 1	https://phd-research.webs.com/ Located on "PodPoints" Tab	Open the website link and click on the associated image. Download PodPoint. Open as Read Only and play as a slide show with sound on. Automatically plays.
Teacher-generated PodPoint – Example 2	https://phd-research.webs.com/ Located on "PodPoints" Tab	Open the website link and click on the associated image. Download PodPoint. Open as Read Only and play as a slide show with sound on. Automatically plays with some user interaction (click to play).

Table.3.2. continued.

"PodPoint Body System series". (A shortened version of the "Nervous System PodPoint example" is shown. Another three were produced).	https://phd-research.webs.com/ Located on "PodPoints" Tab	Open the website link and click on the associated image. Download PodPoint. Open as Read Only and play as a slide show with sound on. Automatically plays with some user interaction (click to play).
"PodPoint Project Student Guide"	https://phd-research.webs.com/ Located on "Other Project Materials" Tab	Open the website link and click on the associated image. View the PDF document.
"PodPoint Project Introduction" (PowerPoint)	https://phd-research.webs.com/ Located on "Other Project Materials" Tab	Open the website link and click on the associated image. Download PowerPoint
"PodPoint Project Images File"	https://phd-research.webs.com/ Located on "Other Project Materials" Tab	Open the website link and click on the associated image. View the PDF document.
"Required Physiology Knowledge Sheets" for each of the topics	https://phd-research.webs.com/ Located on "Other Project Materials" Tab	Open the website link and click on the associated image. View the PDF document.
"Scenario Suggestion Sheets" for each of the topics	https://phd-research.webs.com/ Located on "Other Project Materials" Tab	Open the website link and click on the associated image. View the PDF document.
"PodPoint Project Step-by-Step Process sheet -- Working as a team!"	https://phd-research.webs.com/ Located on "Other Project Materials" Tab	Open the website link and click on the associated image. View the PDF document.
"PodPoint Project Marking Rubric"	https://phd-research.webs.com/ Located on "Other Project Materials" Tab	Open the website link and click on the associated image. View the PDF document.

The PodPoint Project student guide imparted instructions and key guidelines, including details about the creative scenario, the four physiology topics, how to make a PowerPoint, a step-by-step PodPoint project list, and the assessment and marking criteria. Example PodPoints were also created and made available for viewing by the students. The separate "PodPoint Project Images File" provided students with the required unit textbook images to insert into their PodPoints (the use of the textbook images was approved by the publisher: Cengage). The "PodPoint Project Step-by-Step Process sheet -- Working as a team" gave a one-page summary on how to effectively complete the task as a team. All materials aligned with the unit teaching content and the prescribed unit textbook and afforded all the information and learning necessary to complete the task. The content of the support materials also

reinforced each other -- there was exact alignment and some repetition of important information and instructions. For example, the "PodPoint Project Step-by-Step Process sheet -- Working as a team" document summarised the step-by-step project list found in the "PodPoint Project Student Guide". The "Required Physiology Knowledge Sheets" also did this, and further aligned with the information recorded in the "Professor's Journal" (to be discussed shortly).Thus, the teaching package and student support materials provided a sound understanding of what the task required, and how to effectively complete it. Students could exclusively use these resources (and prescribed text) to find the required key physiology information, or if they wished, research and include other external or internet-based sources. Such information, however, was assessed on accuracy and needed to be referenced as per the instructions in the PodPoint Project Student Guide.

3.1.7 The project task requirements

Students first viewed a teacher-generated 'Introductory' PodPoint titled "Uni-Apocalypse". This went for approximately 3-minutes and introduced the students to the narrative and the project requirements. I then followed up with a discussion about this. Students then completed the online "VARK (visual, auditory, read/write, kinaesthetic) Questionnaire" that supported the allocation of students to teams and physiology topics (further discussion shortly). Afterward, the student teams viewed one of the four "Body-system" teacher-generated PodPoints that specifically related to their allocated physiology topic (10-12 minutes). Students viewed these four teacher-generated PodPoints as slide shows and interactively navigated their way through them by clicking on arrows or images that were hyperlinked to other slides. To navigate through the PodPoints, students were required to avoid Zombies, use a map to locate the Professors office, kill him (as he had turned into a Zombie), retrieve a pre-recorded DVD hanging around his neck, and play it on a computer. This DVD recording was made by the professor (before he had turned into a Zombie), and detailed the team requirements, and the "lost" physiology information that the team was required to research and to get back to the base team to help construct the super-soldier. Furthermore, within this PodPoint, students were required to locate a safe that contained the "Professor's Journal" (a teacher-generated ‘notebook’). The safe itself, was protected by a number code, that equalled the number of letters in the answer to the following question: what is the term given, referring to the maintenance of a relatively stable internal environment of the body? (Answer: homeostasis, number code equalled 11). Incorrect attempts were hyperlinked to other slides and allowed the students to return to the safe for further attempts. When the number 11 was entered, the safe opened, allowing access to the professor's journal. Figure 3.4 illustrates some of the slides for one of the teacher-generated PodPoints including the image of the safe containing the journal.

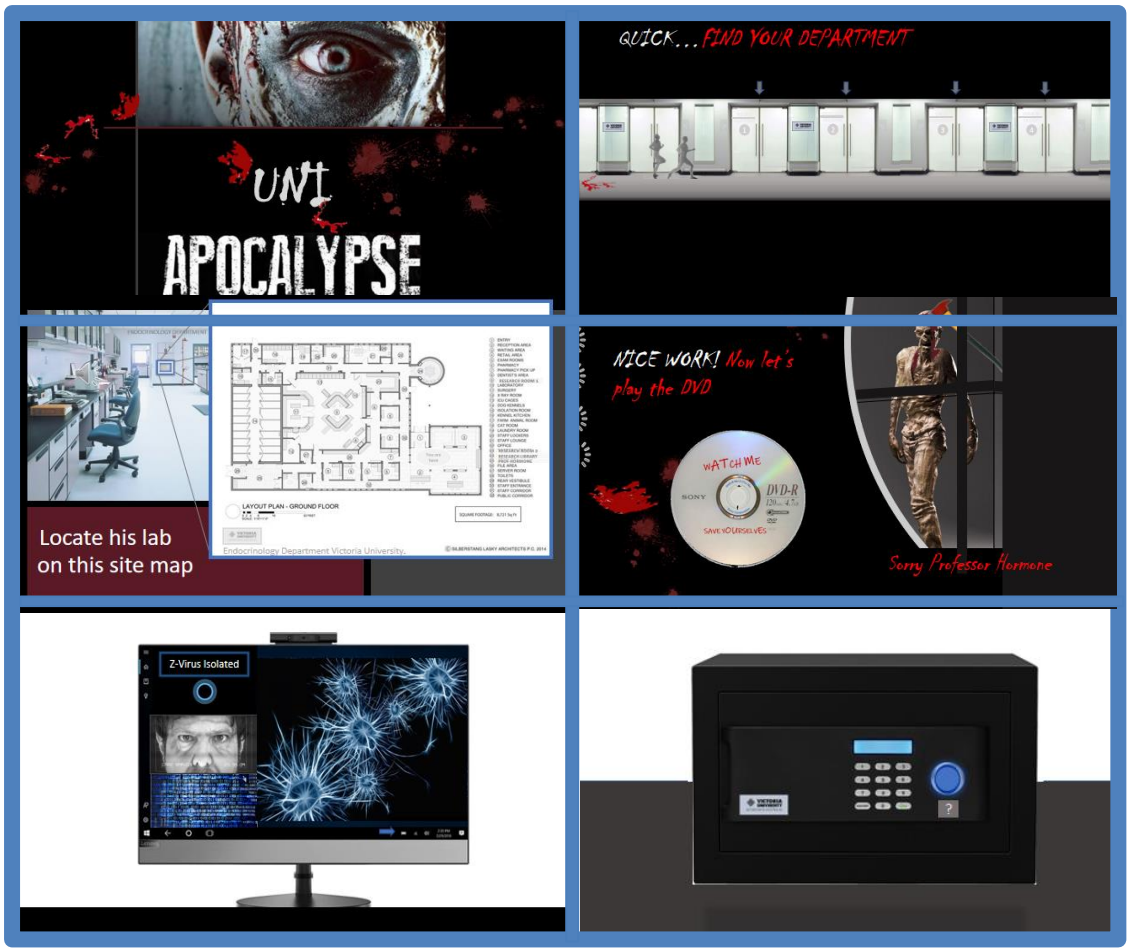


Figure 3.4. Example images of one of the teacher-generated PodPoints.

This journal contained all the details about the lost knowledge that their team was required to research, each covering the two physiology topics for the respective body system. Figure 3.5 below illustrates a page from one of these journals.

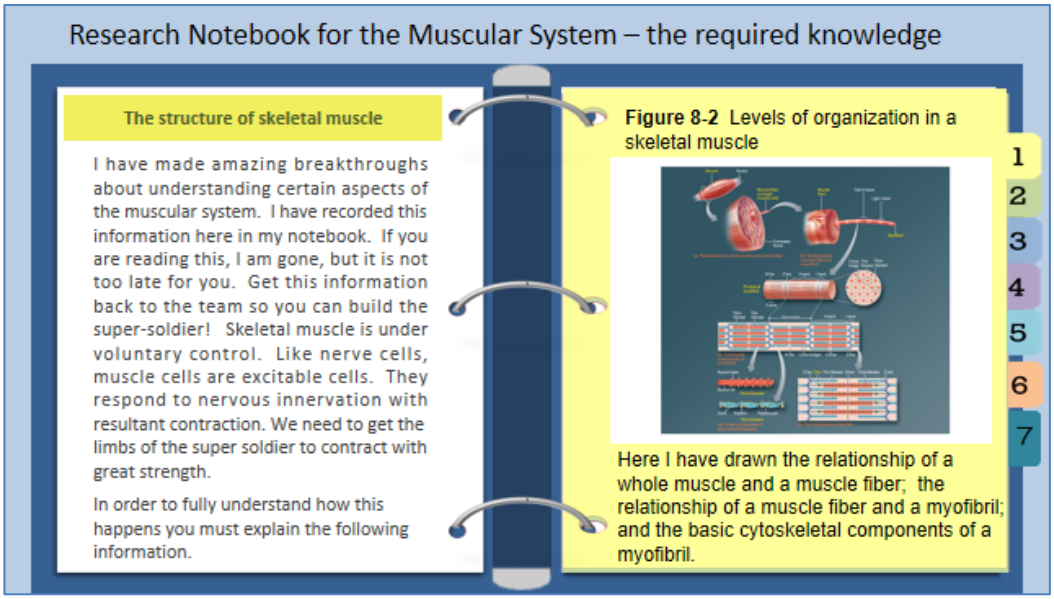


Figure 3.5. Example page of the Professor's Journal for the Muscular System.

Students were encouraged to approach the task creatively. They could either use one of the scenario suggestions or create their team scenario that aligned with the Uni-Apocalypse narrative and convey the physiology knowledge back to the class in the form of their team PodPoint. As part of this, students were further required to suggest how this knowledge could 1) fictionally enhance to powers of the super-soldier, and 2) help to create a fictional weapon that could be used by the super-soldier against the zombies. Both suggestions, while being fictional, had to specifically relate to the physiology topics for each team. The "Scenario suggestion sheets" supported students with suggestions for potential scenarios for all topics, as well as ways for how the knowledge could be applied to both enhance the super-soldier's powers and weaponise them against the Zombies. Twenty percent (20%) of the total PodPoint mark was allocated for creativity. However, while the project supported and encouraged creative expression, it was stressed that the primary intent was to support the learning of physiology and that the Uni-Apocalypse project was designed to creatively foster this. This was reflected in the allocation of marks, with 50% of the total mark from the teacher and student feedback related to the physiology knowledge that was reported. Moreover, students were also instructed to learn their topic matter first (encouraged as a team) as an initial step of the task, before designing the team PodPoint.

Student teams were required to produce one team PodPoint on their allocated physiology topic. Over weeks 1-3, students had 7 hours of class contact time in the form of one 60-minute introductory laboratory (including an allocation to teams), and three, 2-hour PodPoint laboratory sessions to work on their team task. Students also worked on the task outside of class contact hours. I delivered all sessions providing guidance and instruction for every team. As mentioned, the PodPoint Project Student Guide also provided detailed step-by-step instructions on how to construct the PodPoint, as well as a marking rubric and table detailing the assessment requirements.

3.1.8 PodPoint assessment

Assessment of the PodPoints occurred in week 4 of the block. Students viewed all PodPoints as a classroom activity and were involved in the partial assessment of them. Each team was allocated another team PodPoint to mark and used a marking rubric provided by the teacher. This rubric is directly aligned with the marking criteria outlined in the PodPoint Project Student Guide. A brief follow-up class discussion led by the teacher occurred after viewing each of the PodPoints. The team PodPoint was worth 20% of the students' final mark for the unit. Five percent (5%) of this mark is related to student evaluation of it (peer evaluation), with the remaining 15% assessed by the teacher. All team members received the same mark for the one-team PodPoint - a composite of the student and teacher marking. However, following student feedback about potential concerns with teamwork dynamics in Block 3, 2019 (derived

from a teamwork questionnaire), Block 4 students were required to list the work that each team member had contributed to the PodPoint on the last slide of their work. Allocation of marks was based on student contribution, which in 99% of situations was the same across all team members. Other unit assessment tasks included 3 tests (combination of written & MCQs) (60%) and 2 practicals (20%) undertaken over the 4 weeks.

3.2 Data collection and analysis

Descriptive statistics related to student number, gender, and degree type were procured from the VU Collaborate unit site via instructor access.

Quantitative data comparison of student assessment performance was determined by student t-tests. This comprised an ambispective comparison of the mean test scores for the intervention groups for Blocks 2, 3, and 4 in 2019 with the student results from the previous year (2018) in which the PodPoint Project was not available (a similar method was used by Munns, 2013; Lazzari, 2009; Pegrum et al., 2015). Student t-tests were also used for within cohort analysis of PodPoint results and test outcomes (including Short Answer Questions) for the 2019 group.

A one-way between subjects ANOVA compared the effect of the degree type on PodPoint performance, with a follow-up Bonferroni post hoc comparison. Final Test Short Answer Questions Scores (SAQs) vs PodPoint Topics (2019 Cohort) comparisons were determined by Student t-tests. Pearson product-moment correlation coefficient of two sets of variables defining relationships between participation rates for SAQs and participation in the corresponding PodPoint topics were determined. Further quantitative and qualitative data from the students (2019 Cohort) was obtained from a survey instrument, questionnaires, and small semi-structured interviews. This additional quantitative data was tabulated and graphed.

The open-ended questions from the survey, and the additional qualitative data obtained from the questionnaires and small semi-structured interviews were qualitatively analyzed using thematic analysis (TA). The qualitative inquiry was driven by a top-down (theory-driven), deductive approach (described by Maguire & Delahunt, 2017; Xu & Zammit, 2020), with several constructs of interest forming the initial key categories respective to research question one. Clarke & Brauns (2006) 6-step framework further guided the approach to uncover recurring semantic themes nuanced within the data. Further interpretation to undercover the meanings and relationships of this data was made, with an overall TA comparing and categorizing predominant themes (and sub-themes) across feedback for the survey, questionnaires, and interviews. Full TA involved the identification of codes, the generation of themes and sub-themes, the collation of these into predominant construct themes, and the generation of final end-themes. These final end-themes represented the end

findings of the students' experiences and perceptions of the novel teaching and assessment intervention.

Triangulation and comparison of the quantitative and qualitative findings were done to corroborate the findings and to provide a more comprehensive understanding of the impact of the intervention (Chiang & Chan, 2014 and Demir & Pismek, 2018 used a similar approach analysing mixed data). Firstly, this entailed the comparison of the quantitative primary findings of student feedback for each of the constructs of interest procured from the survey Likert scale statements, and the TA findings for the predominant construct themes that were generated from the four qualitative data collecting instruments. This was followed by the comparison of the quantitative outcomes for student assessment performance (test question results & engagement, PodPoints), and the predominant qualitative findings for two of the principal constructs of interest directly related to assessment performance – the learning construct and the engagement construct.

Other assessment results pertaining to practical reports was collected, alongside overall grades for each cohort. Any data related to non-completion of assessment tasks (tests, practicals, PodPoints) was excluded from analysis. All data was coded to ensure anonymity and confidentiality and stored on a hard drive with password protection. All physical forms were scanned and stored electronically and secured in a lockable filing cabinet at the site of the principal investigator. Back-up data was created and coded using two physical external hard drives, several USB-memory sticks, and Victoria University OneDrive.

3.2.1 Survey and Questionnaires

An anonymous opinion-based survey instrument (via Qualtrics) was undertaken at the end of the PodPoint Project during week 4 for each block. Invitation to participate was sent via email to all the students with a link. Participation was voluntary and it was explained that non-participation did not impact in any way on the student's assessment results -- participation in the research for the collection of data was independent of student grades. The survey consisted of 3 demographic questions related to degree type, gender, and age; 27 opinion-based statements using five point, Likert-scale items (ranging from 1 strongly disagree to 5 strongly agree), and two open-ended questions. Edmond and colleagues (2016) and Klein and co-workers (2019) used similar Likert-scale surveys to gather student feedback. The open questions were: Q31 "What was the best aspect of your experience with this teaching innovation?", and Q32 "Do you have any additional comments or feedback?" Table 3.3 lists the questions associated with the survey instrument.

Table.3.3. The survey instrument.

Survey instrument	
Q1	What is the name of the degree you are currently enrolled in?
Q2	What is your gender?
Q3	What is your age?
Q4	Making PodPoints in this unit was a satisfying experience
Q5	I enjoyed working as part of a team
Q6	I enjoyed viewing and learning from other teams' PodPoints
Q7	Overall, I am satisfied with the PodPoint teaching and learning innovation
Q8	The use of student-generated PodPoints increased my motivation to be involved
Q9	I worked hard on the PodPoint task
Q10	I felt I made a valuable contribution to the outcome of the PodPoint task
Q11	The "Uni-Apocalypse" scenario (story) motivated me to engage with the unit topic matter
Q12	The PodPoint technology helped me to engage with the unit topic matter
Q13	Understanding my VARK preferred communication style helped me to engage with others
Q14	Making the team PodPoint helped me to interact with my peers
Q15	Making the PodPoint helped me better engage with the teachers
Q16	The "Uni-Apocalypse" scenario (story) motivated me to learn
Q17	The PodPoint task helped develop my creativity
Q18	I wish more instructors would explore creative learning opportunities, like this, in their courses
Q19	The PodPoint technology supported my learning of the unit material
Q20	Understanding my VARK preferred communication style helped my learning
Q21	This teaching and learning innovation developed my critical thinking skills
Q22	This teaching and learning innovation helped me understand myself and others
Q23	Viewing and assessing other teams' PodPoints helped my learning of the topic material
Q24	Working in a team helped me develop my communication skills
Q25	Team collaboration and discussion were an important part of the learning process
Q26	Overall, the other members of my team made valuable contributions
Q27	I found the PodPoints PowerPoint technology easy to use
Q28	I feel that the PodPoint task has improved my skills to use technology
Q29	I think the use of technology in education is important for the student of today
Q30	I wish more instructors would utilize PodPoints technology in their courses
Q31	Please provide feedback for the following: What was the best aspect of your experience with this teaching innovation?
Q32	Do you have any additional comments or feedback?

Eight constructs of interest including *satisfaction*, *engagement*, *creativity*, *learning*, *critical thinking*, *communication*, *collaboration*, and *technology* were addressed by the Likert-scale statements. Several of these statements crossed over as they are related to one or more of the constructs of interest. Table 3.4 lists the constructs and associated Likert-scale statements.

Table 3.4. Survey Likert-scale statements and constructs of interest.

Likert-scale questions and associated constructs	
Satisfaction construct	
Q4	Making PodPoints in this unit was a satisfying experience
Q5	I enjoyed working as part of a team
Q6	I enjoyed viewing and learning from other teams' PodPoints
Q7	Overall, I am satisfied with the podcasting teaching and learning innovation
Q9	I worked hard on the PodPoint task
Q10	I felt I made a valuable contribution to the outcome of the PodPoint task
Engagement construct	
Q8	The use of student-generated PodPoints increased my motivation to be involved
Q9	I worked hard on the PodPoint task
Q10	I felt I made a valuable contribution to the outcome of the PodPoint task
Q11	The "Uni-Apocalypse" scenario (story) motivated me to engage with the unit topic matter
Q12	The PodPoints PowerPoint technology helped me to engage with the unit topic matter
Q13	Understanding my VARK preferred communication style helped me to engage with others
Q14	Making the team PodPoint helped me to interact with my peers
Q15	Making the PodPoints helped me better engage with the teachers
Q16	The "Uni-Apocalypse" scenario (story) motivated me to learn
Creativity construct	
Q11	The "Uni-Apocalypse" scenario (story) motivated me to engage with the unit topic matter
Q16	The "Uni-Apocalypse" scenario (story) motivated me to learn
Q17	The PodPoint task helped develop my creativity
Q18	I wish more instructors would explore creative learning opportunities, like this, in their courses
Learning construct	
Q6	I enjoyed viewing and learning from other teams' PodPoints
Q16	The "Uni-Apocalypse" scenario (story) motivated me to learn
Q18	I wish more instructors would explore creative learning opportunities, like this, in their courses
Q19	The PodPoint technology supported my learning of the unit material
Q20	Understanding my VARK preferred communication style helped my learning
Q23	Viewing and assessing other teams' PodPoints helped my learning of the topic material
Q25	Team collaboration and discussion were an important part of the learning process
Q28	I feel that the PodPoint task has improved my skills to use technology
Critical thinking construct	
Q20	Understanding my VARK preferred communication style helped my learning
Q21	This teaching and learning innovation developed my critical thinking skills
Q22	This teaching and learning innovation helped me understand myself and others
Q26	Overall, the other members of my team made valuable contributions

Table 3.4. continued.

Communication construct	
Q13	Understanding my VARK preferred communication style helped me to engage with others
Q14	Making the team PodPoint helped me to interact with my peers
Q15	Making the PodPoint helped me better engage with the teachers
Q20	Understanding my VARK preferred communication style helped my learning
Q22	This teaching and learning innovation helped me understand myself and others
Q24	Working in a team helped me develop my communication skills
Collaboration construct	
Q5	I enjoyed working as part of a team
Q13	Understanding my VARK preferred communication style helped me to engage with others
Q14	Making the team PodPoint helped me to interact with my peers
Q23	Viewing and assessing other teams' PodPoints helped my learning of the topic material
Q24	Working in a team helped me develop my communication skills
Q25	Team collaboration and discussion were an important part of the learning process
Q26	Overall, the other members of my team made valuable contributions
Technology construct	
Q8	The use of student-generated PodPoints increased my motivation to be involved
Q12	The PodPoint technology helped me to engage with the unit topic matter
Q17	The PodPoint task helped develop my creativity
Q19	The PodPoint technology supported my learning of the unit material
Q27	I found the PodPoints PowerPoint technology easy to use
Q28	I feel that the PodPoint task has improved my skills to use technology
Q29	I think the use of technology in education is important for the student of today
Q30	I wish more instructors would utilize PodPoints technology in their courses

Two short anonymous questionnaires (via Qualtrics), one "individual", and one "teamwork", were used to ascertain student perceptions on the constructs of interest and levels of engagement. These were used in Blocks 3 and 4 in 2019 only. The individual questionnaire was introduced in lieu of interviews for Block 3 and continued to be used for Block 4 data collection. It comprised six pre-structured questions inviting feedback on seven of the constructs of interest, including learning, engagement, creativity, technology, collaboration, critical thinking, and communication. Additionally, another two questions invited feedback, first on instructor engagement, and then one open-ended question – "Do you have any further comments or feedback?" (Table 3.5).

Table 3.5. Individual student feedback questionnaire and constructs of interest.

Constructs	**Individual Student Feedback Questionnaire**
Learning	Q1 - Did the teaching innovation promote your learning? If so, How?
Engagement	Q2 - Did it help to motivate and engage you with the topic material? If so, how?

Table 3.5. continued.

Creativity	Q3 - Do you think the teaching innovation promoted your creativity in the learning process? If so, how?
Technology	Q4 - How did you find the use of the podcasting/PowerPoint technology?
Collaboration	Q5 - How did you find working in teams?
Critical Thinking & Communication	Q6 - What do you think about doing your own VARK analysis? Was if helpful to understand your communication style?
Engagement & Critical Thinking	Q7 - Was the instructor helpful?
Open ended	Q8 - Do you have any further comments or feedback?

The teamwork questionnaire was introduced in Block 3 and 4 following Block 2 student feedback about potential concerns with teamwork dynamics (Table 3.6). Upon critical reflection of the feedback, this data collecting instrument was created to gain a better understanding of this. It comprised 11 questions including two administrative questions. Seven questions pertained to the constructs of interest, one question inviting suggestions on how to enhance teamwork, and one final open-ended question: "Do you have any further feedback?" It was used as an investigative tool to shed further light on teamwork dynamics for these two Blocks. In week 4, at the end of the PodPoint Project, an email was sent to all students inviting them to participate in both questionnaires. Participation was entirely voluntary, and feedback remained anonymous unless the student identified themselves or participated in the interviews. However, names or any other identifying attributes have not been reported within the study data, ensuing anonymity.

Table 3.6. Teamwork questionnaire and constructs of interest.

Constructs	**Teamwork Feedback Questionnaire**
Group #	Q1 - Please select your class group number from the drop-down box.
PodPoint Topic	Q2 - Please select your PodPoint team topic from the drop-down box.
Satisfaction	Q3 - Overall, please describe your experience in working as a team
Satisfaction, Engagement & Critical Thinking	Q4 - Do you feel that you made a valuable contribution to the outcome of the PodPoint task? If so, how?
Engagement, Learning & Collaboration	Q5 - Do you feel that working as a part of the team helped you to engage with the topic material? If so, how?
Collaboration & Learning	Q6 - Please describe whether you felt if team collaboration and discussion was an important part of the learning process.
Collaboration & Communication	Q7 - Do you think that working in the team has helped you develop skills that will allow you to communicate and work with others in the future? If so, how?
Collaboration	Q8 - Do you feel that the other members of your team made valuable contributions?

Table 3.6. continued.

Teamwork	Q9 - What were the positives and negatives of working in a team?
Suggestions to enhance teamwork	Q10 - Do you suggest any changes that could enhance future working as a team?
Open ended	Q11 - Do you have any further feedback?

3.2.2 Interviews

In week 4, the students received an invitation to participate in an interview to gain a deeper insight of their perceptions. It was made clear that attendance was voluntary and in no way was related to the outcome of student grades. Depending upon student numbers and availability, with participant consent, the interviews were conducted either individually, or in small groups (1-9). I conducted all the interviews. They comprised short (15-30 minute), semi-structured interviews with the student volunteers. While forty students agreed to undertake the interview (as groups) for Block 3, 2019, the interviews were unable to proceed due to unforeseen circumstances (illness of the interviewer). As mentioned, the individual questionnaire was introduced in lieu of this. Seven (7) leading interview questions invited feedback on the constructs of interest, with one question entirely open: “Do you have any further comments or feedback?” (Table 3.7). The question, “Was the instructor helpful?” was not asked during the interviews, as the same instructor that facilitated the PodPoint laboratory sessions (me) also conducted the interviews. It was deemed more appropriate to gather this information via the individual questionnaire ensuring student privacy and comfort. Participants gave permission for the interviews to be recorded and transcribed with follow-up analysis by the interviewer.

Table 3.7. Interview questions and constructs of interest.

Constructs	**Interview Questions**
Learning	Q1 - Did the teaching innovation promote your learning? If so, How?
Engagement	Q2 - Did it help to motivate and engage you with the topic material? If so, how?
Creativity	Q3 - Do you think the teaching innovation promoted your creativity in the learning process? If so, how?
Technology	Q4 - How did you find the use of the podcasting/PowerPoint technology?
Collaboration	Q5 - How did you find working in teams?
Critical Thinking & Communication	Q6 - What do you think about doing your own VARK analysis? Was if helpful to understand your communication style?
Open ended	Q7 - Do you have any further comments or feedback?

CHAPTER FOUR:

4.0 RESULTS

4.1 Final participant details

In the 2018 group, 167 students out of 173 were included in the study data set (for tests) - 6 students were excluded due to non-completion of all the required tests. Of the 151 students enrolled in the unit in the 2019 group, a total of 142 students were included in the data set (for tests), as 9 students were excluded due to non-completion of all tests and/or PodPoint assessment. Descriptive statistics for cohort numbers, gender, and degree types are detailed below and presented in Table 4.1.

Table 4.1. 2018 & 2019 Cohorts – number, gender, and degree type.

COHORTS	**Cohort 1 (2018) n = 167**	**Cohort 2 (2019) n = 142**
Gender and Number	Male (76, 45.5%) Female (91, 54.5%)	Male (50, 35.2%) Female (92, 64.8%)
Degree / Discipline		
Bachelor of Biomedicine (HBBM)	16 (9.5%)	16 (11.3%)
Bachelor of Biomedical & Exercise Science (HBES)	17 (10.2%)	17 (12%)
Bachelor of Biomedical Science (HBBS)	112 (67.1%)	76 (53.5%)
Bachelor of Human Nutrition (HBNT)	17 (10.2%)	30 (21.1%)
Bachelor of Applied Science (HBAS)	2 (1.2%)	1 (0.7%)
Bachelor of Pharmaceutical & Health Science (NBPH)	3 (1.8%)	1 (0.7%)
Bachelor of Psychology (ABPY)		1 (0.7%)
	100.0%	100.0%

To facilitate the presentation and analysis of the large body of data collected for this present work, the remainder of this chapter is divided into the following four sections:

SECTION 1. PodPoint outcomes & discussion
SECTION 2. Quantitative data analysis & discussion
SECTION 2. Qualitative data analysis & discussion
SECTION 4. Triangulation of data & discussion

The follow-up discussion for each section connects the results with the study aim and research questions, as well as the positioning of our findings with other relevant work and literature.

4.2 Section 1 - PodPoint outcomes and discussion

4.2.1 PodPoint work

Fifty-two team PodPoints were created by the 2019 students over one semester. Four of the topics across blocks 3 & 4 were not done due to lack of student numbers, or the non-completion of the task by students. A high degree of creativity was expressed by the students. For example, a variety of story lines, images, sounds, and interactives were used producing game-like elements within the PodPoints. Figure 4.1 showcases some of the students work. Two of the students PodPoints are available to be downloaded for viewing from https://phd-research.webs.com with other PhD project support materials.

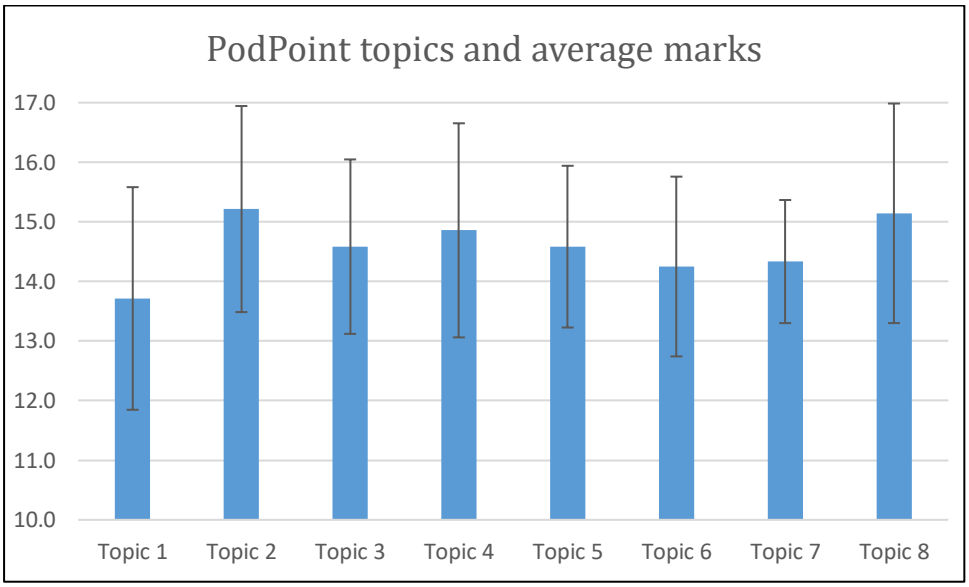
Figure 4.1. Example images of the student-generated PodPoints.

Additionally, often near, or at the end of the PodPoints, students further expressed their creativity by making suggestions as to how the required physiology knowledge could fictionally, 1) enhance the powers of the super-soldier, and 2) help to create a weapon that could be used by the super-soldier against the zombies. Table 4.2 lists some of these creative suggestions.

Table 4.2. Student suggestions to enhance the super-soldier or battle the zombies.

Ways to enhance the super-soldiers' powers	Ways to weaponize the physiology knowledge against the zombies
Increase the number of large, myelinated motor neurons activating skeletal muscle. Increase myelin synthesis to enhance speed.	Create a chemical weapon that targets the myelin in Zombies and dissolve it resulting in compromised nerve conduction.
Myofibrillar hypertrophy: increase the number of myofibrils within the skeletal muscle to increase strength. By increasing the number of muscles fibres and cross-sectional muscle area strength will increase. Chemicals.	Create a dart filled with a neurochemical that induces a neurodegenerative disease to slow action potential propagation along the nerve fibres.
Cause mutation of the MSTN Gene to reduce myostatin production in skeletal muscle. (Myostatin inhibits muscle growth causing a drastic increase in muscle growth.	Anti-zombie gun contains cortisol darts to breakdown muscle tissue in Zombies, including the contractile proteins or Z-lines in the sarcomeres.
Higher amount of large motor neurons activating muscles. Enhanced release of the neurotransmitter Ach to enhance contractions in the muscle fibres	Create a "Rigor Mortis Weapon that shoots chemicals into Zombies to dissolve the ATP available for muscle contraction & relaxation, causing a rigor mortis like state.
Induce T-Lymphocyte production in Super-Soldier to battle Z-Virus if it enters its body. Also give massive injects of interferon to inhibit virus replication in cells.	Develop a glucocorticoid serum with high concentrations of cortisol to promote muscle tissue degradation and demobilize the zombie.
Strength of force produced by a muscle depends on the number of cross bridges attached to it. Create a super-soldier with more cross bridges inside its sarcomeres, it may have the strength to overpower the zombies.	Use octopuses' toxin (Tetrodotoxin) to manufacture bullets and darts to interfere with the nerve transmission in Zombies at the neuromuscular junction.
Inject the Super-Soldier with large doses of epinephrine to enhance sympathetic activation before it battles Zombies. Enhances arousal of CNS, releases energy and prepares it for action.	Provide super-soldier with high doses of anti-inflammatory drugs to reduce chronic states of inflammation that might occur through ongoing trauma battling zombies.
Inject extra insulin into the super-soldier during the absorptive state to increase uptake of glucose, amino-acids and other nutrients for enhanced structural repair, reducing recover/recharge time (from around 5-8 hours to 2-5). Use drip to deliver high levels of glucose, amino acids and fats combined with insulin for nutrient uptake and improved structural repair.	Create a chemical weapon that would inhibit the sarcoplasmic reticulum from releasing calcium, and also the hydrolysis of ATP - it could be used to block the muscle movement of the zombies, because of lack of calcium to activate muscle contraction and lack of ATP to drive it.
Create a cytotoxic drug that will eliminate mast cells, therefore limiting histamines driving the inflammatory state. The super-soldier will not be affected by pain, swelling, heat and dilation that are normally driven by inflammation due to mechanical trauma (sustained battling Zombies).	Chemicals like colistin sulphate, cinnamaldehyde exposed to Zombies, will increase massive degranulation of mast cells. It will create aggressive systemic mastocytosis, which will damage the internal organ of zombies and kill them effectively.
GPC and the key amino acids L-arginine and L-glutamine to stimulate and rev up growth hormone production, leading to faster recuperation and increased lean body mass. Growth hormone stimulation also helps re-build stronger new muscle cells and aids sex hormones like testosterone in this function.	A dart with a vile of hyperactive mast cells can be created to throw at the zombies, this would make their whole bodies very inflamed which would slow down the way they move and make them weaker.

Across the 52 PodPoints, the students effectively and creatively conveyed the required physiology knowledge. This was reflected by the average PodPoint mark of 73.3% (SD = 7.9), that was greater than the mean marks for the other assessment items. Interestingly, the highest single PodPoint mark (90%) was given to a team covering the “Immunity and Vaccination” topic, while the lowest PodPoint mark (60%) was given to another team, in another group also covering the same topic. Another two teams in different groups, covering the “Action Potential” topic also received 60% for their PodPoints. On average, for all PodPoints, the two team topics that students scored the highest marks for, included "The Neuromuscular Junction" (76%) and "Immunity and Vaccination" (75.5%). The topic, on average, that the students scored the least on was the "Action Potential" at 68.5%. However, a one-way between subject’s ANOVA found no significant difference at the $p<0.05$ level for the eight conditions (eight topics) [$F(7, 51) = 0.65$, $p = 0.72$]. Additionally, two teams covered the two topics for their associated body system instead of the required one. Figure 4.2 graphs the PodPoint topics and associated average marks.



Topics legend	
1.The action potential	5.Adrenal response to stress
2.The neuromuscular junction	6.Pancreatic control of blood nutrients
3.Skeletal muscle structure	7.Inflammatory response to tissue damage
4.Sliding filament mechanism	8.Immunity and vaccination

Figure 4.2. PodPoint topics and associated marks.

On average, PodPoint file size was 47.2MB, with the largest file being 221.4MB for "The Neuromuscular Junction" topic, and the smallest file being 5.1MB for "The Action Potential" topic. Seven of the PodPoints files were over 100MB (the recommended maximum file size was 60MB). On average, PodPoints comprised 24-slides, with the most slides (64)

being for a PodPoint covering the "The Sliding Filament Mechanism" topic, and the least number of slides (6), equally being for "The Action Potential" and “Pancreatic control of blood nutrients" topics. Follow-up analysis, using Pearson product-moment correlation coefficient comparison found that no correlation (r = 0.0084, *p* = .95) existed between PodPoint file size and PodPoint marks, however, there is a significant moderate positive relationship between the number of PodPoint slides and the PodPoint marks, r(50) = 0.49, *P* < .001 (Figure 4.3). The PodPoint that received the highest mark (90%) comprised 21-slides. Table 4.3 details the team topics, the respective PodPoint file sizes, the number of slides per PodPoint, and the associated marks for them.

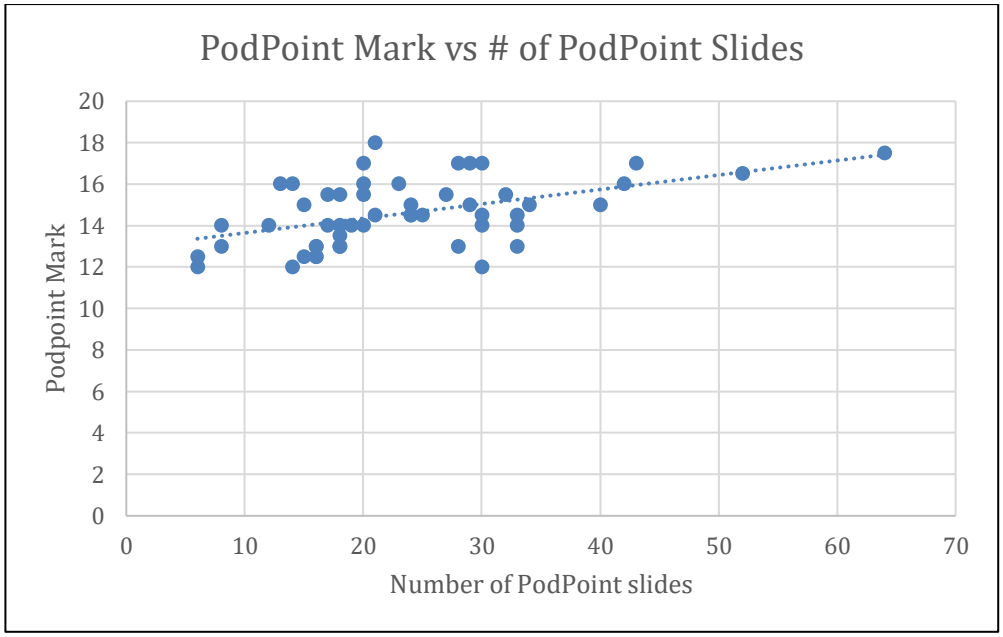


Figure 4.3. PodPoint mark vs # of PodPoint slides.

Table 4.3. PodPoint topics, associated file details, and marks.

Topic	Block & Group #	Size of File (MB)	Number of slides	Mark Out of 20
The Action Potential	2-1	21.9	6	12
	2-7	33.4	18	13
	3-9a	99.8	34	15
68.5% average mark	3-9b	18.8	30	12
	3-15	5.1	16	12.5
	4-6	32.8	24	14.5
	4-12	33.1	30	17
		35.0	22.6	13.7

Table 4.3. continued.

The Neuromuscular Junction	2-1	42.1	13	16
	2-7	26.6	20	17
	3-9a	121	33	13
76% average mark	3-9b	45.7	43	17
	3-15	221.4	16	13
	4-6	6.7	25	14.5
	4-12	20.9	23	16
		69.2	24.7	15.2
Skeletal Muscle Structure	2-1	20.3	16	12.5
	2-7	21.9	21	14.5
	3-9a	119.7	33	14
73% average mark	3-9b	24.9	29	17
	3-15	Not done		
	4-6	15.2	24	14.5
	4-12	15.4	15	15
		36.2	23.0	14.6
The Sliding Filament Mechanism	2-1	20.6	15	12.5
	2-7	162.6	42	16
	3-9a	85.1	64	17.5
74.5% average mark	3-9b	30.1	14	16
	3-15	17.2	12	14
	4-6	17.9	24	15
	4-12	15.3	8	13
		49.8	25.6	14.9
Adrenal response to stress	2-1	25.3	40	15
	2-7	100.2	33	14.5
	3-9a	129.1	28	13
73% average mark	3-9b	21.8	20	14
	3-15	26.2	28	17
	4-6	49.9	30	14
	4-12	Not done		
		58.8	29.8	14.6
Pancreatic control of blood nutrients	2-1	42.7	17	15.5
	2-7	49.7	16	13
	3-9a	81.1	17	14
73% average mark	3-9b	13.7	19	14
	3-15	61.7	6	12.5
	4-6	28.5	52	16.5
	4-12	Not done		
		46.2	21.2	14.3

Table 4.3. continued.

Inflammatory response to tissue damage	2-1	12.6	18	13.5
	2-7	10.8	30	14.5
	3-9a	23.3	18	13
71.5% average mark	3-9b	17.5	27	15.5
	3-15	44.5	18	15.5
	4-6	Not done		
	4-12	5.7	8	14
		19.1	19.8	14.3
Immunity and vaccination	2-1	13.2	14	12
	2-7	61.5	32	15.5
	3-9a	37.6	21	18
75.5% average mark	3-9b	20.6	18	14
	3-15	74.7	20	16
	4-6	193.8	29	15
	4-12	13.2	20	15.5
		59.2	22.0	15.1

4.2.2 PodPoint Discussion

Predominantly the students' experience with creating the PodPoints was a positive one. The teams did well, reflected by the average PodPoint mark of 73.3% which was greater than the mean marks for the other assessment items. However, it should be noted that the PodPoint project task was a team effort, unlike the other assessment tasks, and all team members received the same PodPoint mark.

Concerning the associated PodPoint topics and marks, results suggest that the students found the "Immunity & Vaccination" and "The Neuromuscular Junction" PodPoint topic the easiest topics to cover while having more challenges with the "Action Potential" PodPoint topic. These assumptions are supported by the findings that the largest team PodPoint size file (221.4MB), with a significant degree of effort, was one for the "The Neuromuscular Junction" topic, and the smallest file was 5.1MB, for "The Action Potential" topic. Likewise, the least number of slides (6), was for one of the "The Action Potential" topic PodPoints. While there was no significant effect of the total eight physiology PodPoint topics on their results, indicating equality across the entire allocated topics, a moderate positive relationship was found for the number of PodPoint slides versus PodPoint marks. It would be interesting to see whether this trend of difference in learning exists across other investigations for the student learning of different physiology topics.

With regards to PodPoint design and structure, most students followed the design guidelines and requirements outlined in the PodPoint Project Student Guide and included

appropriate images, GIFs, sounds, music, and voice recordings. A small number, however, was too long (over 12-minutes), included video, and two teams covered both physiology topics instead of their allocated one. Some technical issues were also encountered, especially when students did not use the required Microsoft 365 PowerPoint Application, but instead used an online document format (Google docs). Furthermore, some compatibility issues with PowerPoint functions were noted when students used Apple Mac instead of a PC. Students lost marks if they didn't follow the design guidelines and requirements listed in the PodPoint Student Guide (marking rubric). Some of the main reasons why marks were lost included: not covering all of the required physiology information; voice recordings being too low, not clear, and audible; overshadowed by loud background music or sounds; too much text on the slides with too little recorded voice; not providing suggestions on how to use the knowledge to enhance the super-soldiers powers, or how to weaponize it against the zombies; the use of video; excessively large files; lack of references for the images, music, and sounds sourced outside of the unit materials; and for poor student feedback received on teamwork dynamics. Sometimes too much text was used, the diagrams were too small, and the information flow was disjointed, or was repeated over other slides indicating a lack of teamwork and planning.

Students were encouraged and supported to approach the PodPoint task creatively, with 20% of the overall team PodPoint mark allocated for this. In the end, a high degree of creativity was expressed by the students for this work. For example, while some of the teams used the teacher-provided scenario suggestion as a template for their team PodPoint, others came up with their team scenario that aligned with the Uni-Apocalypse narrative. Some of the characters used to deliver these narratives included the use of simple stick figures that were drawn by hand, photographed, and inserted into the slides, to more involved characters such as Barbie and Ken (Barbie had to "save" Ken). The character "Captain America", and other superhero figures were used to help battle the fictional zombies. The "Simpsons" characters were used as well as cartoon images of professors. One team creatively used several Lego characters (e.g.: fireman, policeman, soldier) to represent the different body cells involved in immunity. Pegrum and colleagues (2015) similarly encouraged students to creatively approach a podcasting assignment that required students to explore one of two fundamental chemistry topics. In their investigation, one student group chose to portray the topic of "oxidation & reduction" reactions using the Twilight file characters "Bella" and "Edward". It was reported that creative, student-centered podcasting can motivate students, including those otherwise disengaged. The findings of our present work indicate that this was also the case.

Other ways on how students' creativity was expressed included the use of a variety of images. Some images and GIFs (sourced from the internet) used to support the scenarios included: human body images and body parts; zombies; zombie hoards; post-apocalyptic scenes; internal building areas; lifts, corridors, doors; research labs; laboratory equipment; maps; computers and screens; electronic door keypads; safes & vaults; scientists; and

futuristic soldiers and weapons. These images were combined with the physiology images sourced from the unit materials, the unit textbook, the PodPoint Project Images File, and internet images. One team covering the neuromuscular junction topic extensively used the drawing and animation functions of the PowerPoint application to create images and interactive slides detailing the physiology concepts. The students enjoyed viewing the PodPoints with the images helping to immerse them in the Uni-Apocalypse narrative. Likewise, Kalludi and colleagues (2015) after receiving significant feedback from students, incorporated images in podcasts to better engage them in the learning of physiology. The students reported to favour the use of video (images) podcasting.

Several gamified approaches were used by the students in the creation of the PodPoints. As discussed, gamification has been explored across the educational sector to foster learning through user enjoyment and engagement. For example, recently Samuel and co-workers (2022) used digital gamification in the form of mobile games as an innovative pedagogy for the learning of anatomy and physiology for nursing students. Following their use, students reported improvements in learning, motivation, and attentiveness among others in comparison to traditional tasks. The use of this medium greatly enhanced the students' achievements and positive attitudes. Similar outcomes with student attitudes and engagement were also observed in our work. Following the viewing of one of the teacher-produced PodPoints (which imparted the Uni-Apocalypse narrative and student project instructions), one student verbally exclaimed to the laboratory instructor that it was "like playing a video game…I can't wait to be involved" (in the project). Other recent investigations looking to enhance student learning in anatomy and physiology include that of Moro and colleagues (2020), and Diaz-Castro and co-workers (2021). Both incorporated the need for students to either answer anatomy and physiology questions (Moro et al., 2020), or quizzes related to body systems to progress through the levels of the game (Diaz-Castro et al., 2021). The questions and activities within each of these studies reflected the learning content of the associated subjects. Both studies reported positive student feedback with the call being made for more use of gamification as a learning tool. However, their pedagogy was centered on the use of games as an information delivery tool to enhance learning. Additionally, the platforms used were not PowerPoint, unlike our present work. Mocanda & Mocanda (2014) proposed that game-like elements incorporated into PowerPoints offer viable teaching and learning tools to foster student engagement through collaborative play. Consequently, we believe that our work has also afforded students similar gamified experiences to that of the work of Moro and colleagues (2021) and Diaz-Castro and co-workers (2021), as well as demonstrating the versatility and capabilities of PowerPoint. Furthermore, our work promoted student engagement through their active participation in the creation and gamification of the PodPoints.

For example, with our present work, one student team covering the sliding filament mechanism topic incorporated the physiology matter into a puzzle-like format. Viewers were

required to navigate their way through the PodPoint to unlock four pieces of a puzzle to construct all the information together. In comparison, another team covering the same topic took photographs of the actual university campus including passages, doorways, stairs, lifts, and rooms, and inserted these into the PodPoint. This PodPoint commenced with an image of a person holding an iPhone receiving a text message. The PodPoint viewer opened the message that detailed instructions to meet the other team members in a specific lab room on campus. Interactive links and arrows on the photographs in the PodPoint then guided the viewer around the campus, with wrong choices for directions having consequences (such as Zombies). If the incorrect direction was selected, the viewer was given a second opportunity to retrace their steps and select the correct path to take. The objective was to find all the correct paths to the lab and then locate a computer that contained the stored physiology information. Some other PodPoints used interactive questions with the responses guiding the selection of choices that then navigated the viewer through the slide show. Some of these questions tested the understanding of the physiology knowledge presented in the PodPoint for the viewer. These sometimes required the selection of answer options that were hyperlinked to other slides in the PodPoint. Other presentations used the multiple-choice question format. For example, for one team covering the neuromuscular junction topic, to progress through the PodPoint slide show, users had to unlock a door that required a numerical password to be entered into a keypad. The question to obtain the code was: “How many pairs of spinal nerves are in the spinal cord?” (answer = 31). Wrong answers allowed more attempts to take place. Other PodPoint presentations included the need to find maps to locate certain rooms, including vaults that had further keycode access, or to find USB memory sticks or CDs/ DVDs that had physiology information recorded on them. Furthermore, in some of the PodPoints, Zombies appeared, and viewers were required to click on a weapon (such as an axe, hammer, or baseball bat), to defeat the Zombies and navigate safely to the next slide.

The student PodPoint work often concluded with a variety of creative student suggestions as to how the required physiology knowledge could fictionally increase the powers of the super-soldier, and ways on how to battle the zombies. Some examples of these student suggestions have already been listed in table in table 4.2. These suggestions had to specifically relate to the teams allocated physiology topics. For the most part, these suggestions were fictional, however, this activity allowed students to expand on their learning and apply that knowledge to critically apply a creative solution by asking the ‘what if?’ questions. This allowed students the opportunity to think outside the square and to explore the potential impact of the learned physiology knowledge in an engaging and creative learning space. Therefore, there were no right or wrong suggestions, however, the suggestions put forward, while not necessarily able to be achieved in the real-world setting, needed to align with the theory underpinning them. That is, if they were implemented within this fictional

narrative, their outcomes would need to make sense according to the knowledge learned. The student suggestions were briefly discussed in class by the teacher following the viewing of each of the student PodPoint. A similar requirement was reflected in the games used by Diaz-Castro and colleagues (2021). To facilitate the learning of physiology concepts, a game-based learning, in the form an educational thematic escape rooms was used. Students were required to advance by using clues and undertaking quizzes and tasks on human body systems (themes) to maintain homeostasis. This was done to prevent being trapped which would cause an irreversible pathophysiological situation. Like our work, that required students to apply their learned knowledge, so too did the students work their way through these educational thematic escape rooms.

> *"To achieve their freedom, they had to demonstrate enough knowledge about of physiological regulation that allowed them to review and consolidate the concepts…otherwise they were trapped, and they were able to lead the human body to an irreversible pathophysiological situation, in addition to demonstrating not having acquired the necessary knowledge to successfully pass the subject."* (p.1411, Diaz-Castro et al., 2021).

More specifically, in line with our present work, Pegrum and colleagues (2015) called for further creative approaches, such as podcasting, to be used because of the positive impact it has on student creativity, contextualization, and deep learning. It was suggested that future practice should use appropriately structured creative podcasting tasks, especially when budget constraints or limited resources such as staffing exist. We believe that our work can also add to the growing list of teacher-researchers doing so.

Others have identified the benefits of engaging students using multimedia platforms including both podcasts and vodcasts. Pettit (2018) put forward 10 tips on ways to promote active learning using the latter. Whilst these tips are intended to help facilitate instructors with beneficial design elements for teaching vodcasts (instructional), some of these tips are mirrored in our present work, both within the teacher-generated PodPoints, and in those produced by the students. These include "Tip 2 Facilitate multimedia learning", "Tip 3 Incorporate pauses", "Tip 5 Give auditory instruction for active learning", "Tip 7 Create animated interactions", and "Tip 8 Embed hyperlinks to interactive cases or games". Additionally, our work acknowledged Tip 6 – "Provide a guided study tool". We produced a comprehensive "PodPoint Project Student Guide" that contained information on the project requirements and detailed instructions on how the actively produce the PodPoint.

The novel application of PowerPoint with our present work provided a resourceful, creative, and cost-effective tool for teaching information to be conveyed. It also served as a versatile platform for student teams to collaborate and to create and distribute audio, images, and information in a gamified-like manner.

Our work successfully positioned student learning within a constructivist-constructionist pedagogical framework that highlighted creativity. As such, this research is deeply rooted within constructivist philosophy (Piaget, 1968; Perry, 1999), with social interdependence linking further to a social constructivist position through its collaborative approach (Vygotsky, 1962; Lewin, 1935). The students' active construction and re-construction of knowledge in this study supported the movement from low-order learning (such as listening to the teacher) to high-order learning (the construction of the PodPoint product). This greater cognitive processing involved higher-order thinking skills that fostered deeper learning, engagement, and understanding. Similarly, Pande and Bharathi (2020) investigated the principles of constructivist learning theory within the teaching-learning framework of the 'Design Thinking' process. They indicated that their work was inspired by prior work done by Rorty and Rorty (1991), Von Glasersfeld (1998), and Savery and Duffy (1995) (all cited in Pande & Bharathi, 2020). Pande and Bharathi (2020) reported that this work highly acknowledged the heart of the constructivist learning approach – which is the "need for a paradigm shift from instructor-led knowledge creation to participant-led/participant-centered knowledge creation through collaboration" (Pande & Bharathi, 2020, p. 2). This present work strongly echoes this. The students have moved from simply being the passive receivers of knowledge to being the co-constructors of it. Furthermore, elements of this work are cemented within a social constructivist position. The collaborative effort of the students to produce the PodPoints as a team effort reflects this. Vygotsky (1978) viewed a social constructivist learning approach as learning taking place by collaboration with a more capable peer. This indeed did take place within the production of some of the student-generated PodPoints, whereby some higher-skilled and more knowledgeable students helped guide the learning of other team members, either with the topic matter or with the use of the PowerPoint technology. Shabani and colleagues (2010) suggest that those with higher skills, through collaborative efforts, can assist others to learn and achieve new levels of understanding through the internalization of new concepts, psychological tools, and skills. Leilani and Kreager (2017) mirror this view attesting that deep learning and knowledge construction are promoted when individuals not only actively and independently engage with the process, but collectively with others as well. Considering this, our present work with the active, team-based creation of the PodPoints afforded an opportunity whereby both individual and collective learning were stimulated. Lee and colleagues (2008) also suggested that the collaborative development of podcasts supported the social processes of perspective-taking and negotiation of meaning that underpin knowledge creation.

Additionally, our project mirrors elements of Leilani and Kreager's (2017) work, whereby constructivism and social interdependence provided a foundational basis for the theoretical framework. Specifically, their "instructional decisions to enable active learning" (IDEAL) theory and associated "Active Learning Strategies" (ALS) model were useful for our

present work. As a general summary, the IDEAL theory and ALS model are helpful for AL within the collaborative learning environment providing a foundational guide to undertaking AL strategies within the classroom. All three levels of instructional decision-making elements proposed by Leilani and Kreager (2017) have been considered within the pedagogical framework underpinning the design of our study intervention. These AL concepts included: defining the Uni-Apocalypse activity as part of the lower-order instructional decision-making concept process; conceiving a project strategy that aligned with the unit curriculum as a mid-level concept; and finally, a practical project approach, entertaining a high-order concept to effectively deliver the work to the students – the PodPoint project package. These instructional decisions, according to Leilani & Kreager (2017) are done so to support AL strategies of a high level that support social interdependence.

Linkage with “Bloom’s Revised Taxonomy” (Anderson et al., 2001), and Churches (2008) updated “Bloom's Digital Taxonomy” also strongly exists. The present project promoted student collaboration to actively create a product (the team PodPoint) using technology. This comprised students either entering in at or iterating back and forth, between the various levels of the hierarchy of cognitive categories described in Bloom’s Revised Taxonomy. In the production of the team PodPoints, students applied “remembering”, “understanding”, “applying”, “analysing”, “evaluating”, and “creating” (Anderson et al., 2001). The creation of the PodPoints allowed students to progress through the cognitive categories, develop skills, and construct knowledge. Ultimately, through the process of "doing" and the creation of a product the students have demonstrated proficiency in the levels. In this manner, student learning and engagement flowed back and forth between the lower level of skills to that of higher-order thinking, something that Nkhoma and colleagues (2016) described as a process of closely linking problem-solving, with creativity and critical thinking. The culmination of this effort resulted in the construction of a new artifact/product (the team PodPoint) that is reflective of skill development and proficiency of the associated cognitive levels (Langdon (2017). This in combination with the higher-order skills associated with creativity and critical thinking, provided the students with a meaningful educational experience that resulted in worthwhile learning outcomes (Cochran et al., 2007). These higher-order thinking skills were strongly utilised when the students devised ways to fictionally enhance the powers of the super-soldier and when they put forward creative suggestions on how to kill or weaken the zombies.

Much of the present student feedback concerning the learning and satisfaction constructs reflects this. In a similar fashion, Steinhardt and colleagues (2017) in their work to investigate AL strategies for legal topics and substance abuse with pharmacy students focused their learning objectives on the higher levels of Bloom’s Taxonomy, with the project requiring including ‘application’, ‘analysis’, ‘synthesis’, and ‘evaluation’ of the substantive material of interest. Likewise, Hall and Jones (2012) reported that one of the major strengths of podcasts is strengthening the metacognitive and reflective skills of students, that can assist

them in the planning, thinking, and creative processes, all of which reflect progression through the cognitive categories towards the higher levels of Bloom's Taxonomy.

For our present work, students demonstrated this process of progression, or "scaffolding", as their learning moved through lower-order skills culminating in 'creating' the finished PodPoint product. Langdon (2017) attested that when this takes place, a demonstration of competency across all categories results, that satisfies the highest learning outcome. However, Langdon (2017) also acknowledged that the learner does not always automatically commence at the lowest levels of the taxonomy followed by sequential progression - instead, learners tend to engage at the level(s) that best suit them. This was seen as the case for our present work. The students were 1st-year undergraduate students undertaking foundational physiology units, with the majority having no, or little previous exposure to knowledge about body systems. As such, the students were required to create a product while obtaining knowledge and understanding to do so. This meant that some students commenced their learning at the lower-order skills level and then moved through the cognitive categories, sometimes going back and forth between them. This process was supported through collaboration and peer learning, alongside instructor facilitation. It was observed that some other students that had some prior learning in the body system areas (from year 12-subjects), engaged at a higher level of the taxonomy and were better positioned to help other team members with the learning of the topic matter. Student feedback reflected this (discussed shortly). It is therefore pleasing to see that our novel teaching intervention afforded the students the opportunity to use an active learning process that promoted progression through the cognitive categories comprising "Bloom's Revised Taxonomy". This is an important pedagogical outcome that mirrors the principal findings of an extensive literature review and meta-analysis undertaken by Harris and Welch-Bacon (2019) to determine whether AL is more successful than passive learning for cognitive skill development for health care students. The researchers found that in comparison to passive learning, AL is often more beneficial for both lower- and higher-order cognition skills. They reported that the lower-order cognition skills related to 'recalling', 'understanding', and/or 'application' of the course material improve with AL and that higher-order thinking skills related to students' confidence in, or performance of, 'analytical', 'evaluative', and 'creative skills' improved with AL. Active-learning was found to be superior to passive learning methods in enhancing students' knowledge and understanding (Harris and Welch-Bacon, 2019).

Additionally, Churches (2008) updated Bloom's Digital Taxonomy adequately accounted for the descriptions associated with the use of the present-day technologies underpinning the student work seen with our research. Some additional terminology, that could be entered under the "creating" key term of this updated Bloom's Digital Taxonomy for this present work include "Google Docs". At times, students used this online word processor to allow live collaboration and work sharing between the team members.

For inquisitive minds to construct and express their creativity, so too, must the modern platforms in which learning takes place. Baker and Baker (2012) also acknowledged that creativity nurtures problem-solving through the generation of novel solutions and innovation and is a crucial graduate attribute of students. However, Robinson (2006) argued that the traditional teaching model has also fallen somewhat short in fostering creativity and imagination in the learning process. Consequently, just as the PodPoint technology was used as the platform to bolster student learning and engagement, so too, was it used to foster creativity. The innovative PodPoint project creatively combined active student engagement, technology, collaboration, and game-like elements, all of which were supported by an imaginative “Uni-Apocalypse” scenario. Importantly, this further allowed students to explore and showcase their creativity., the theoretical framework of this work inexorably cemented the element of creativity, entwined within the constructivist epistemology (Runco, 2007). Students were immersed in the fictional Zombie narrative and were required to use their creativity to collaboratively construct a product, thus aligning with Papert’s view of knowledge creation. The positive outcomes for the expression of student creativity through this work are also reflective of the results seen in the academic work undertaken by Stolaki & Econinedes (2018). They created an educational intervention using technology and a cooperative reward structure in the form of a game called “Creativity Challenge” and concluded that the pedagogical strategy was effective in encouraging creativity by demonstrating significant increases in pre- and post-measures of fluency, flexibility, elaboration, and originality. Therefore, the positive findings of this work and others further support the proposition that creative educational strategies are of benefit and should be further explored. Indeed, Couros (2015) holds a firm, passionate stance on the need for the education system to acknowledge creativity, and that teaching needs to support the learner in exploring the “innovators mindset”. Couros contends that recent changes in education and technology provide the opportunity to do something amazing; yet also claims that students remain uninspired, believing that traditional education is irrelevant. This, in conjunction with the view of Stolaki & Economides (2018) that the dilemma of creativity enhancement in the higher education sector is a major individual, organizational, and societal challenge, implies the need for a paradigm shift within traditional pedagogy. New, effective strategies such as creative and AL methods that especially include technology and group collaboration are needed.

4.3 Section 2 - Quantitative data analysis and discussion

4.3.1 Tests and Grades

Statistical analysis (t-tests, P <0.05) found no significant differences between the overall mean test scores for the 2018 and 2019 cohorts (Figure 4.4).

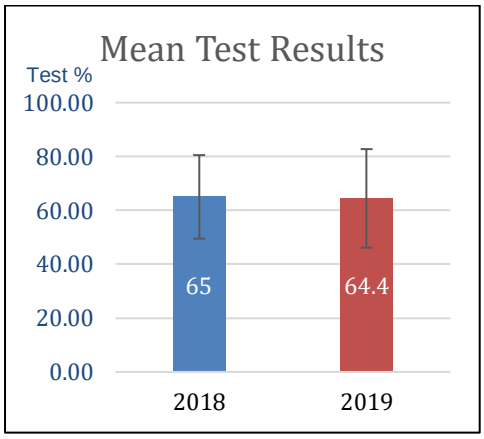


Figure 4.4. Mean test results for 2018 vs 2019.

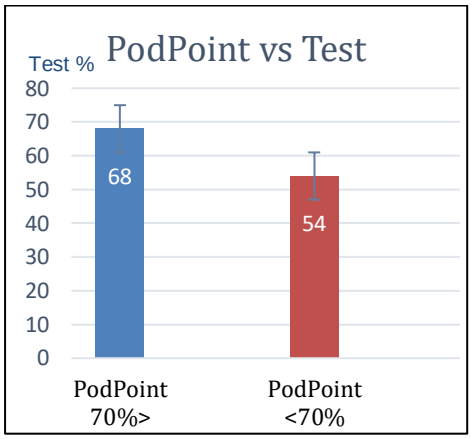


Figure 4.5. PodPoint vs Test.

A significant difference, however, was found between Block 3 overall test scores for 2018 vs 2019 (p = 0.032). Block 3 2018 attained a higher mean score (65%) vs Block 3 in 2019 (59%). No significance difference between final mean unit grades for the 2018 (M = 68.8, SD = 12.7) and 2019 (M = 66.8, SD = 13.2) cohorts were observed.

4.3.2 PodPoint vs Test and Practical

In 2019, 151 students were graded for PodPoints with 145 included in the analysis (6 students were excluded due to non-completion of the task or received an extension to complete the task). The overall mean test score for all tests for the 2019 cohort was 64.4 (SD = 18.2), and the overall mean score for the practicals was 66.4% (SD = 11.8). The average mark for the PodPoint tasks was greater than the other assessment tasks (tests and practicals) and proved to be statistically significant for the mean test scores (P < 0.001) and the mean practical scores (P < 0.001). However, it should be noted that the PodPoint assessment task was a team project, whereas the other assessment tasks were individual assessment tasks. Interestingly, a t-test demonstrated a significance difference (P < 0.001) in the test results for those students (n = 104) who received a PodPoint mark of 70% or higher (M = 68, SD = 17.2), compared to those students (n = 38) who received a PodPoint mark of 69% or lower (Figure 4.5). This, although might be related to the academic nature of the students, rather than any enhanced learning taking place from the single PodPoint topic.

4.3.3 Degree vs PodPoint

A one-way between subject's ANOVA compared the effect of the degree type on PodPoint performance in the HBBM, HBES, HBBS, and HBNT groups of students for the 2019 cohort (n = 138). Three degrees were excluded due to insufficient numbers (HBAS, n = 1; NBPH, n = 1; ABPY, n =1). There was a significant effect of degree type ($P < .001$) on PodPoint results, with post hoc comparisons using the Bonferroni corrected post-test t-test, demonstrating that the PodPoint scores for the HBBM (M = 77, SD = 7.5, $P < .001$), HBES (M = 76, SD = 7.7, p = .0014), HBBS (M = 74, SD = 7.6, $P < .001$) groups were significantly different to the HBNT (M = 68, SD = 7.06). However, the PodPoint results for the HBBM, HBES, and HBBS groups did not differ significantly (Figure 4.6). This may reflect inherent differences in student ability, as the current university entry requirement score was also in the order of HBBM, HBES, HBBS, and HBNT. It could further be related to the socio-economic demographics for the students enrolled in each degree. A follow up discussion of this occurs later.

4.3.4 Degree vs Test

The exact same differences were observed when comparing the type of degree and test results (Figure 4.7) that was also noted in the 2018 cohort.

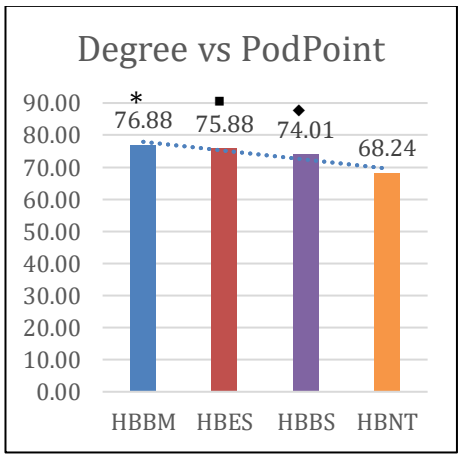


Figure 4.6. Degree vs PodPoint.

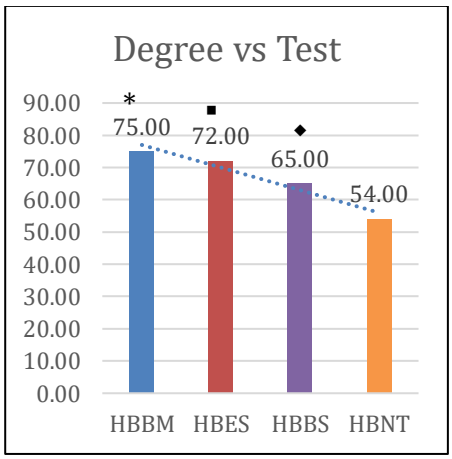


Figure 4.7. Degree vs Test.

4.3.5 Final Test Short Answer Questions Scores vs PodPoint Topics (2019 Cohort)

One hundred and forty student results for the short answer questions (SAQ) from the final test for the 2019 cohort were analysed. Five written short answer questions, each graded out of 5-marks, covered knowledge on the Action Potential, the Sympathetic & Parasympathetic Nervous System, Neuromuscular Junction, Glucose Regulation, and Muscle Contraction topics. These questions corresponded with 2019 team PodPoint topics reported in table 4.4.

The 2019 Team PodPoint Topics related to “Immunity & Vaccination”, “Inflammatory response to tissue damage”, and “Muscle Structure” were not covered by the SAQs.

Table. 4.4. Short Answer Questions (SAQs) and respective PodPoint team topics.

SAQ Topics	Respective PodPoint team topics
Action Potential	The action potential
Sympathetic & Parasympathetic NS	Adrenal response to stress (Adrenals)
Neuromuscular Junction	The neuromuscular junction (NMJ)
Muscle Contraction	Sliding filament mechanism (Sliding Filament)
Glucose Regulation	Pancreatic control of blood nutrients (Pancreas)

Table 4.5 shows the results for the mean SAQ scores for the students across the following three conditions: 1) the total average class SAQ scores, 2) the mean SAQ scores for all students covering the related PodPoint topics, and 3), the mean class SAQ scores for all students not covering the PodPoint topics. The highest total mean SAQ class score occurred for the Glucose Regulation SAQ and the lowest score for the muscle contraction SAQ.

Table 4.5. Mean SAQ scores across the three conditions.

	Total mean class SAQ scores for all students per topic (out of 5-marks)				
SAQ Topic	Action Potential	Symp & Para NS	NMJ	Muscle Contraction	Glucose Regulation
Mark/5	2.60	1.91	2.20	1.39	3.29
%	52.0%	38.2%	44.0%	27.8%	65.8%
Ranking	2	4	3	5	1
	Mean team SAQ scores for all students covering the related PodPoint topics (out of 5-marks)				
SAQ Topic	Action Potential	Symp & Para NS	NMJ	Muscle Contraction	Glucose Regulation
Mark/5	2.70	2.79	3.18	2.69	3.79
%	54.0%	55.8%	63.6%	53.8%	75.8%
n	22	14	20	18	19
SD	1.9	1.6	1.9	1.7	1.2
Ranking	4	3	2	5	1
	Mean class SAQ scores for all students not covering the related PodPoint topics (out of 5-marks)				
SAQ Topic	Action Potential	Symp & Para NS	NMJ	Muscle Contraction	Glucose Regulation
Mark/5	2.58	1.81	2.04	1.20	3.21
n	118	126	120	122	121
SD	1.6	1.8	1.9	1.7	1.6
%	51.6%	36.2%	40.8%	24.0%	64.2%
Ranking	2	4	3	5	1

As can be seen, the average SAQ topic scores that related to the students covering the PodPoint topics, were all greater than the mean class SAQ scores for all students not covering the PodPoint topics. When compared to all other students SAQ scores that didn't cover the related PodPoint topics, a significance difference (*P* = .049) was seen for the SAQ scores for those students that participated in the related PodPoint topics for the Adrenals; the Neuromuscular Junction (*P* = .018); and the Sliding Filament Mechanism (p = .002). While the mean average score for the SAQ Pancreas topic was 11.6% greater for the students that participated in the related PodPoint topic versus those that did not (75.8% vs 64.2%), the result was not statistically significant (*P* = .07). Figure 4.8 illustrates the mean team SAQ scores for students covering the related PodPoint topic versus the mean SAQ scores for the students that did not.

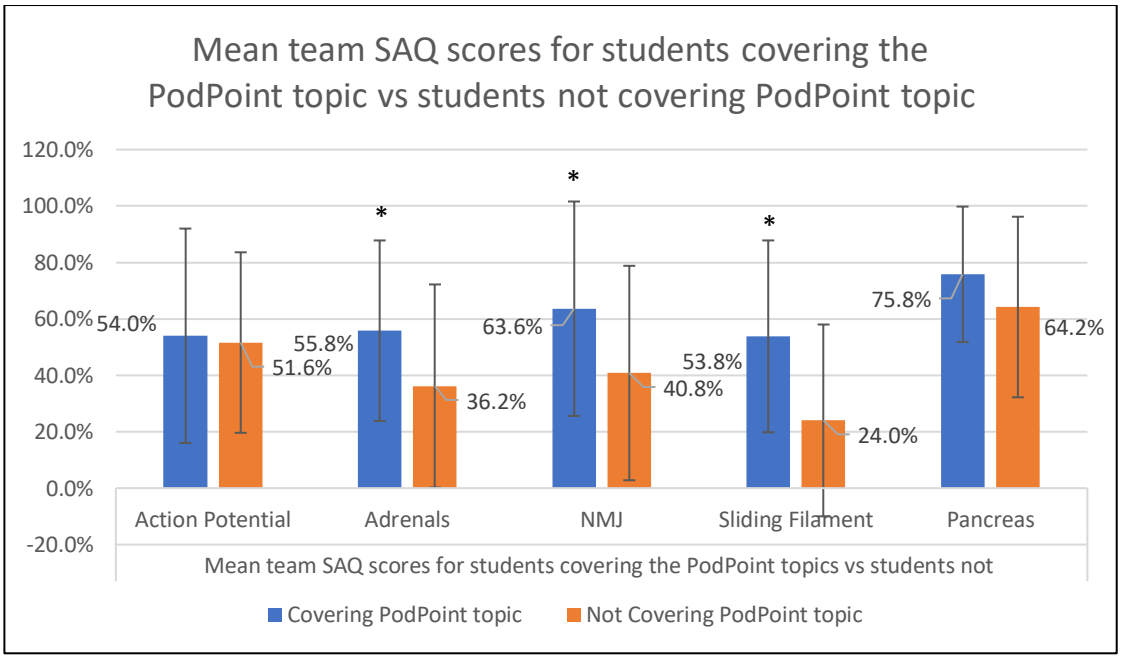


Figure. 4.8. Mean team SAQ scores for PodPoint teams and vs students not covering PodPoint topic.* Significant difference (*P* < 0.05).

Furthermore, the participation in the team PodPoint topics influenced whether students attempted the SAQs. All SAQs were required to be answered but not all students did so and left the answer blank. Of the 140 students, a total of 93 students had participated in Team PodPoints topics that correlated to one of the SAQ topics. The remaining 47-students participated in the three PodPoint topics not directly covered by the SAQ topics (Inflammation, Muscle Structure, and Immunity PodPoints). For all the SAQ topics, more attempts to answer the written questions were made by the students that had participated in the respective PodPoint topic, with a strong positive correlation determined (r = 0.96). This relationship was significant (*P* = .008). Figure 4.9 illustrates these.

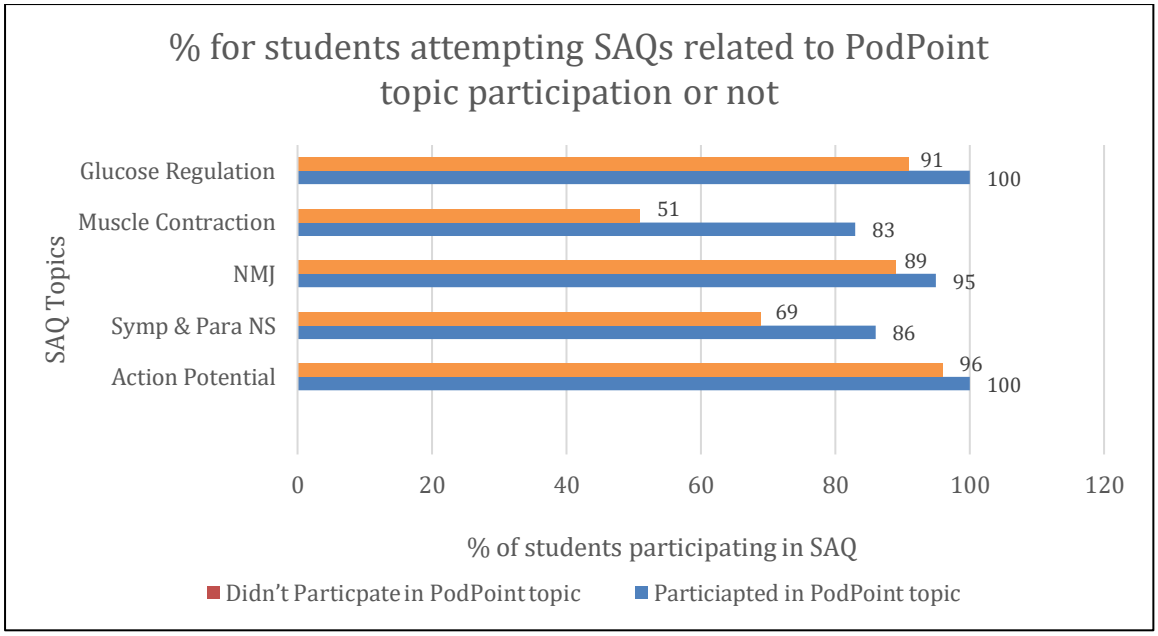


Figure. 4.9. Total percentage of students attempting SAQs based upon participating in PodPoint topics or not.

Except for 5 students (approx. 5%), all other students (88), attempted the SAQs that were related to the topics that they had covered in the team PodPoints. In comparison, for those students that didn't participate in the PodPoint topic that related to the SAQ topic, a total of 128 non-attempts for the questions occurred. This represented approximately 21% of the total questions available for completion. For example, for those students that didn't participate in the Sliding Filament PodPoint topic, only 51% attempted the related SAQ topic on muscle contraction, and for those students who didn't participate in the Adrenal PodPoint topic, nearly one third (31%) did not attempt the related SAQ topic for it. In comparison, the students that participated in both related PodPoint topics, appeared to exhibit a greater level of confidence in attempting to answer the related SAQs topics - 83% of the students attempted the muscle contraction SAQ topic, and 86% attempted answering the Sympathetic & Parasympathetic Nervous System SAQ topic (Adrenal PodPoint topic).

Additionally, for those students that participated in the PodPoint topics related to the Action Potential SAQ topic and the Glucose Regulation (Pancreas) SAQ topic, all students (100%) attempted to answer the respective questions. The Neuromuscular Junction SAQ topic also had a high attempt rate (95%) for those students participating in the related PodPoint topic. Two of these PodPoint topics resulted in the highest mean class SAQ scores for all students - Glucose Regulation SAQ topic was 75.8% and the Neuromuscular Junction was 63.6%. These high participation rates were moderately related to academic performance. There was a moderate positive relationship ($r = 0.56$) for SAQ participation rates and SAQ scores across all SAQ topics, however, this was not statistically significant. For the students that did not participate in the associated PodPoint topic with the SAQ topics, the lowest

participation rate across all SAQs was with the Muscle Contraction topic. Half of the students attempted the question (51%). Again, this was mutually related to academic performance with a mean score result of 24%. In contrast, the students that completed the Sliding Filament PodPoint demonstrated a higher participation rate in attempting to answer the related SAQ topic (83%), and produced a significantly higher mean score for the SAQ (53.8% vs 24%). This further reflects the positive effect of PodPoint completion on related SAQ performance.

4.3.6 Discussion of the quantitative findings

Research question 1 investigated the effect of the intervention on the assessment performance of the students.

No significant difference between the overall test scores for the two cohorts was seen for this present work (65%, 2018 vs 64.4%, 2019). This indicates that the PodPoint intervention did not affect overall academic performance when compared with the results of those students for the previous year in which the PodPoint task was not available. This contrasts with the previous research that has shown that student learning and academic performance for those using podcasts have improved (Rae & McCarty, 2017, Kalludi and colleagues, 2013). For example, Lazzari (2009) reported that students involved in the creation of podcasting lessons outperformed their peers that did not participate in the task. Likewise, Kalludi and colleagues (2015) found that a group of dental students that used video podcast sessions to revise physiology performed significantly better in the MCQ follow-up test, compared to the group of students that only used the textbook for revision.

Our findings, however, are not unusual as others have reported either similar (Vogt et al., 2010, Munns, 2013, Edmond et al., 2016, Prakash et al., 2017, Lien et al., 2018), or otherwise marginal improvements in assessment performance (Abt and Barry, 2007). It is also important to note that the PodPoint intervention did not negatively impact student learning. Moreover, the PodPoint intervention was an AL pedagogy and not instructional or designed to be a supplemental revision tool. The significant difference seen for Block 3 overall test scores for 2018 vs 2019 was not replicated in other Blocks. The reasons for this are not known. Both groups were well matched according to demographics, the degrees the students were enrolled in, and the same teacher had delivered the workshops and the test questions had not changed.

However, students tend to be ‘assessment-driven’ and are likely to have invested considerable time in studying for the last test, that may have had a greater effect on their final mark than the benefit of the PodPoint learning exercise. Interestingly, a difference in academic performance was noted between the HBNT (Human Nutrition) students and the remaining students from the other biomedical-based degrees for both the PodPoint and overall test results. This appeared not to be due to the PodPoint project as comparable findings for the

test results across these groups also occurred with the 2018 cohort. This difference may relate to the diverse academic nature and abilities of the students enrolled across the degrees, particularly in a medical discipline such as physiology. In comparison to the other degrees, enrollment into the HBNT degree required a lower ATAR (university entrance) score and fewer science prerequisites. To shed further light on this, all student postcodes for each of the degrees for the 2019 cohort were graded according to the low "Socio-Economic Status" (SES) postcode measure. This tool bases the students' reported residential address (postcode), with the SES value derived from the Australian Bureau of Statistics' Socio-Economic Indexes for Areas (SEIFA) Index of Education and Occupation for postal areas. The four indexes included in SEIFA are:

1) the Index of Relative Socio-economic Disadvantage (IRSD)
2) the Index of Relative Socio-economic Advantage and Disadvantage (IRSAD)
3) the Index of Economic Resources (IER)
4) the Index of Education and Occupation (IEO)

Postcodes are allocated a "decile" score, where the areas are ordered from the lowest score (1) to the highest (10). A decile ranking score of 1 is deemed to be the most disadvantaged relative to other deciles. The IRSD index and associated postal code decile scores were used to determine whether any differences existed between the 2019-degree groups. The analysis found that the average decile score of 2.7 for the HBNT degree group was considerably less than the average decile scores for the other three degrees. The closest average decile score for the next degree group was 5.6 for the HBBS students that was more than double. The HBBM degree group had an average decile score of 5.8, while the HBES returned the greatest average decile score of 6.2. This indicates that the HBNT students, in comparison to the students from the other three degrees, reside in areas that have a greater likelihood of being socio-economically disadvantaged. This may be one of the factors influencing the differences observed in the academic performance of the HBNT group compared with the others. However, this is a generalisation. It should be noted that just because a HBNT student resides in an area that has a greater likelihood of being socio-economically disadvantaged, it doesn't mean that their original family home is in the same postcode area. The student may have been raised in a "better" neighbourhood but rented in a "poorer" neighbourhood to attend university.

Tangalakis and colleagues (2017) reported that students from low-socioeconomic status (SES) backgrounds are usually under-represented in Australian universities and indicated that the number of SES students, at Victoria University in Melbourne, Australia had increased to 20%. Out of interest, the number of students in the HBNT degree group of students represented 21.1% of the student numbers for the 2019 cohort. Tangalakis and coworkers (2017) further investigated the effect of a peer-assisted study session (PASS) to enhance the learning and inclusion of undergraduate students from low socioeconomic

backgrounds studying physiology. The program involved weekly mentoring of the first-year students by second-year undergraduate students who had done well academically for the related subjects the previous year. The PASS program was found to increase academic performance and reduce the number of students that failed. The students reported improved confidence and that the program had provided them with transferrable skills that could be used in their future studies. Similar findings also occurred earlier work conducted by Hryciw and colleagues (2013) following the use of the PASS program to support the learning of bioscience for mature, first-year undergraduate paramedic students. Considering this, future use of the PodPoint program may be supported by recruiting students that did well in the PodPoint productions and tests to deliver a similar PASS program, or at least offer it.

However, while assessment performance across all degree types (as indicated by overall test scores) found that our intervention did not affect overall academic performance, one important finding of this present work was how the student creation of the PodPoints influenced the SAQs results for them. As part of the final test, five written, short answer questions (SAQs) were included for all Blocks for the 2019 cohort. The SAQs covered five physiology topics that directly related to the knowledge covered in five of the eight PodPoint topics (described in Chapter 3). This work reported these scores across the following three conditions: the total mean SAQ score per topic (score for all students); the mean SAQ scores for all students covering the related PodPoint topics; and the mean class SAQ scores for all students not covering the PodPoint topics. Within cohort analysis found that a mean difference between the scores existed for students that had produced the PodPoints specifically relating to the SAQ topic, and for those students that had not. The average SAQ topic scores for the students covering all the related PodPoint topics were all greater than the mean class SAQ scores for all remaining students not covering the PodPoint topics. Three of the five mean differences seen with these SAQ topic scores were statistically significant. Another mean score (SAQ Pancreas topic), while being 11.6% greater (75.8% vs 64.2%), was not statistically significant. These findings suggest that the PodPoint assessment task supported learning in the related topic areas and enhanced academic performance for them. Besides the introduction of the PodPoint task, the same unit convenor for the 2018 cohort of students facilitated the 2019 cohort with the identical delivery format, content, prescribed textbook, and assessment procedures. Moreover, it was found that the 2019 cohort of students was similar in nature to the previous years concerning age, gender, proficiency level, and educational background. Accordingly, it is plausible to assume that these significant differences found in the SAQ test scores are attributable to the study intervention. It is reasonable to infer that with greater use of the PodPoint task across all the unit topic areas, better overall academic performance by the students may have resulted. Similar findings occurred with Prakash and co-workers (2017), and Pegrum and colleagues (2015). For example, Pegrum and colleagues found that following the student creation of podcasts for two chemistry topics, students who

participated in the podcast topic, “acids & bases”, performed better (statistically significant) at the end of the semester exam on questions relating to this topic, than those students who did not participate in the podcast topic. They inferred that the use of creative podcasting is a potential way to help promote a deep learning approach and called for more research in this area.

Based on the findings of our work it is plausible to argue that the students that participated in the three PodPoint topics that were not covered by the SAQs were placed at a disadvantage. The future use of the PodPoints pedagogy should therefore include an alignment of all SAQs with the PodPoint topics.

Assessment results further demonstrated large differences in the mean marks for the SAQ topics. Across all three reporting conditions, the highest mean SAQ scores occurred for the Glucose Regulation SAQ topic (65.8%, 75.8%, and 64.2% respectively), while the lowest mean SAQ scores were for the Muscle Contraction SAQ topic (27.8%, 53.8%, and 24.0% respectively). This indicates that students found the Glucose Regulation SAQ topic the easiest to answer and had the most difficulty with the Muscle Contraction SAQ topic. While these results were not reflected with the mean marks for the team PodPoint topics, a direct comparison cannot occur, as firstly, the PodPoint task was a teamwork effort, and secondly, the team PodPoint marking matrix comprised several components and not just the topic matter. As mentioned, the students participating in the Pancreas PodPoint topic outperformed those students that did not. While the result was not statistically significant, an 11.6% greater mean score is noteworthy. However, more striking, is the difference between the students’ mean scores for the Muscle Contraction SAQ topic. Students that produced a PodPoint on the Sliding Filament Mechanism topic did much better, with a mean SAQ score of 53.8% versus 24.0% for all other students that did not. While the overall results show that students found the Muscle Contraction SAQ topic the most challenging, this greater than two-fold difference in mean scores, strongly suggests that the PodPoint task for this topic directly supported the learning of this material. These results suggest that the PodPoint task may be of most use for the hardest topics.

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Another notable finding of this work was that the students' attempt to answer the SAQ topic questions was influenced by their participation in the corresponding PodPoint topic.

That is, across all the SAQ topics, there were more students who attempted a given question if they had produced a PodPoint on the topic. This strong positive correlation was found to be statistically significant. Fewer attempts were made by students that did not participate in the PodPoint topic that related to the SAQ topic. These SAQ participation findings support the proposition that the PodPoint task facilitated learning in the related topic areas and bolstered students' levels of confidence to answer the associated SAQs. Out of interest, the Muscle Contraction SAQ topic across all the SAQ topics had the lowest student participation rates. For the students that didn't participate in the associated Sliding Filament Mechanism topic just over half (51%) attempted the question with the remainder leaving it blank. While these participation rates did increase significantly (83%) for the students that did complete the Sliding Filament Mechanism topic, it is interesting to note that this participation rate is still lower that the participation rates seen for the students completing the other PodPoint topics and their associated SAQs. This further indicates the difficulty student had with the Muscle Contraction SAQ topic. These results have been discussed with the unit chair and reflect previous findings that students find the Sliding Filament topic challenging. This has now informed the present teaching staff to give additional support to this topic area. Overall, it would be interesting to compare the outcomes for student performance across all the SAQ topics for this work with other global findings in this area, however, an investigation of this nature was not done.

It could be argued that the reason for the improved student performance seen with the related PodPoint SAQ topic, might simply be the amount of time that the students spent reviewing the physiological information and not the result of creating the PodPoint per se. However, we believe that this is not the case. Firstly, while the PodPoint project provided a unique learning tool for the individual, it also provided a collaborative environment where peer learning took place. This was reported by several of the students. This collaborative learning experience would have less likely taken place with the traditional reviewing of material. Secondly, many students indicated that the alternative learning experience helped to engage them with the topic material. While the following student feedback is perhaps better suited to be discussed in the next section of this thesis, it helps to, from the students' perspective, highlight some reasons why they felt that creating PodPoints benefited them in this area. By combining the creative element of producing their team narrative, which linked the required physiology information with the PodPoint, engagement and learning was supported. Students felt this process had increased their learning of their topics, as well as linked the knowledge to other related areas, directly outside of the topic. On top of this, students found that making the PodPoint itself and linking the required information, both visually and audibly, combined the use of different communication skills.

"Putting it together as a story line made me take notice and I felt I had learned a lot more doing something like this"; "Because I had to apply the knowledge to the super soldier it was engaging for me"; "Yes, making the linkage between the knowledge and story"; "I...had to link content and theory"; "With respect to a tera-toxin (from an octopus) for the neuromuscular junction, it was really interesting connecting the information with the story and putting that in because it helped me learn about what other things do"; and "Yes, because you had to connect the knowledge to the visual component and pictures and diagrams, you had to combine visual and oral communication skills."

Students also indicated that they felt the intervention to be a better learning and assessment experience than traditional methods. One student reported that they can find tests stressful and felt that the PodPoint task was a better alternative. Another stated that the PodPoint task made the "learning process easier", while another student believed that the PodPoint task should be adopted by other subjects, as it makes for an interesting learning experience. One student also exclaimed that they would rather do this task over more traditional assessment tasks.

"Focusing on tests can be stressful as well, so I think the PodPoint is a much better way…"; "Every subject should do it! Presentations are good as well but having this PodPoint would make it interesting across other subjects"; "Made the learning process easier"; and "I'd rather do this, than a 4000-word essay…any day!"

Similar findings have been expressed by others. Almendingen and colleagues (2021) found that *"the students…preferred podcasts as assignment tool over written text or videos"* (p.1). Likewise, Bolden & Nahachewsky (2015) following a qualitative investigation on student podcast creation in an undergraduate music education course reported one student saying:

"I put more time in it than I originally wanted to or allotted. But I just did, like I stayed up really late and worked on it to get it done and I gave myself a- bunch of chunks of time to keep working on it. I found it was way more a learning experience [than other assignments] and I prefer that – like if someone said I could've done something easier and gotten an A but I wouldn't have learned as much, I still would've done the podcast" Grace (Bolden & Nahachewsky, 2015, p.17).

The SAQ results indicated that just viewing a PodPoint rather than creating one did not improve marks. This possibly relates to the following. The viewing of other students' PodPoint work took place after the due date for the assessment task which was at the end week for each Block and very close to the final test. Subsequently, these PodPoints were not made available as a revision tool so the student exposure to them was limited. The intent, however, for this present work was to use the PodPoint project as a novel learning and

assessment tool for students on an allocated topic and not as a revision tool per se. Considering this, some of the better-produced student PodPoints (those scoring 18 or above out of 20 marks) are now being used as a learning and revision tool for students enrolled in the unit. However, with respect to this present work, qualitative data obtained via student feedback indicated that peer learning was supported by the intervention. Students reported enjoying and being engaged by watching other PodPoints, and that learning further knowledge was supported.

> *"Listening to everyone's PodPoints was a good, engaging experience" and "Viewing others we...learned a lot of things as well"* and *"It helped me to understand not only just our own (topic), but others (topics) as well"*.

Munns (2013), following the use of supplemental podcasting on top of the traditional lecture teaching to support the learning of physiology for cohort students enrolled across several health science degrees, found no effect on assessment performance. However, they reported that 64% of students believed that their learning was either moderately or greatly enhanced by the intervention. Accordingly, this work, and ours, demonstrate that student perceptions of learning, engagement with content, and confidence to answer questions are important. Nevertheless, there is a preponderance of test and exam scores being the primary measure of academic performance. Is it time for a change? Can it be inferred that one way in which deep learning takes place is by having the confidence to actively explore the unknown in the search for answers, often where incorrect ones drive the way forward? Learning becomes a summative and powerful experience when the construction of knowledge allows active exploration and engagement with the topic matter, both individually and collaboratively (Lee et al., 2008; Leilani & Kreager, 2017).

Others have also suggested that additional benefits, despite no measurable change in test scores are indeed important. For instance, satisfaction, enjoyment, and increased perception of engagement and learning are often reported by students following podcast use (Vogt et al., 2010 & Munns, 2013). It has been questioned whether positive student satisfaction and engagement with podcasting technology, as opposed to summative assessment performance, is enough to justify its use as an effective teaching tool (Voght 2010). Furthermore, following the use of video podcasting technology for the revision and repeat access to information, students called for them to be used more in their curriculum (Edmond et al., 2016). Comparable feedback is reflected in the findings of this present work. Detailed discussion of the student feedback takes place in the next section.

4.4 Section 3 - Qualitative data analysis and discussion

4.4.1 Surveys, Questionnaires, and Interviews

In total 177 respondents to surveys, questionnaires, and interviews provided both quantitative and qualitative data for the 2019 cohort across Bocks 2 – 4. A full transcript of the students' comments is available from https://phd-research.webs.com/ ("student feedback" page). Table 4.6 details the number of respondents per Block, for each data collecting instrument, and table 4.7 details the number of responder comments, and TA for the number of codes, themes, and sub-themes for each of the data collecting instruments. Figure 4.10 illustrates this.

Table 4.6. Number of student responders for each data collecting instrument.

	Number of Student Responders for each Data Collecting Instrument			
	Surveys	Questionnaires		Interviews
		Individual Student Feedback	Teamwork Feedback	
2019				
Block 2	11	Not used	Not used	14
Block 3	41	4	38	0
Block 4	23	13	12	21
	75	17	50	35
				Total of 177 respondents

Table 4.7. TA for the number of student responders, codes, themes & sub-themes for the surveys, questionnaires, and interviews.

TA for number of Codes, Themes and Sub-themes for each Data Collecting Instrument					
Instrument	# Respondents	Comments	Codes	Themes	Sub-themes
Surveys (Open-ended)	75	76	139	11	28
Individual Questionnaires	17	128	195	52	4
Teamwork Questionnaires	50	385	604	157	136
Interviews	35	190	321	95	60
Total	177	779	1259	315	228

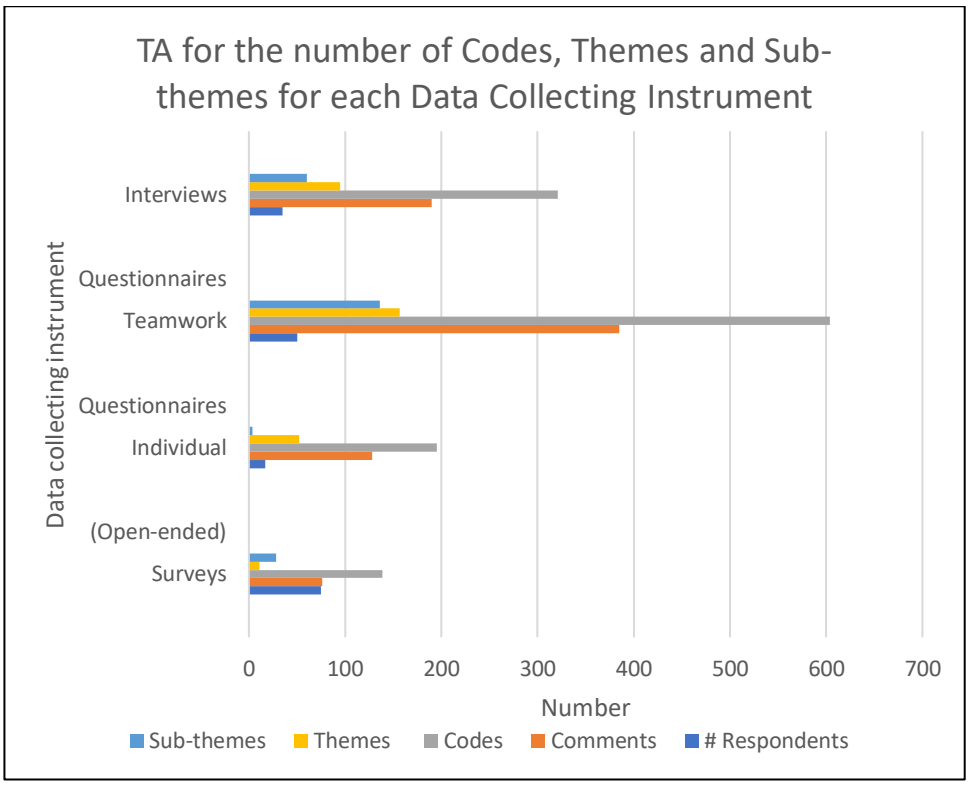


Figure 4.10. Number of Codes, Themes and Sub-themes for each Data Collecting Instrument.

It is interesting to note, that the teamwork questionnaire by far provided the largest amount of qualitative data. Fifty (50) respondents returned 385 comments. Thematic analysis of this generated 601 codes, which were organised into 157 Themes and 136 Sub-themes. This was reflective of the large interest that the students displayed to participate in this.

The following now describes the quantitative results for the statements that were ranked by the students on a Likert scale for the survey statements, the qualitative results for the two open-ended questions for the survey, and then the further thematic analysis of the qualitative data procured from the individual and teamwork questionnaires, and interviews. These include summary reporting for all the questions for each of the data collecting instruments, with tables and thematic maps.

4.4.1.1 Survey

A total of 75 responses to the survey for Blocks 2, 3 and 4, 2019 occurred from 49 females and 26 males, that was reflective of the same gender distribution as the overall cohort. This survey returned the largest number of respondents for all the qualitative data collection instruments. Two respondents were under the age of 18, 62 falling within the 18 to 24-year age grouping, 5 in the 25 to 34-year category, another 5 in the 35 to 44-year category, and one in the 65 to 74-year grouping. The respondents came from the following five of the seven bachelor's degrees: HBBM, HBES, HBBS, HBNT, and HBAS, with the numbers again

reflecting the same degree distribution as the overall cohort. This feedback was procured from the 27 Likert-scale questions and two open-ended questions.

4.4.1.1.1 Likert-scale statements

Survey Likert-scale statements were grouped into respective constructs of interest with some overlap. A strong “positive” response was defined as 70% or above, for the combined “agree” to “strongly agree” categories for each of the Likert-scale opinion-based statements. The findings, in order of rating of the constructs of interest for the combined agree and strongly agree student responses are summarised and illustrated in Figure 4.11. In contrast, approximately 10% of the students strongly disagreed that understanding their VARK preferred communication style helped their learning, as well as the “Uni-Apocalypse” scenario (story) motivating them to learn.

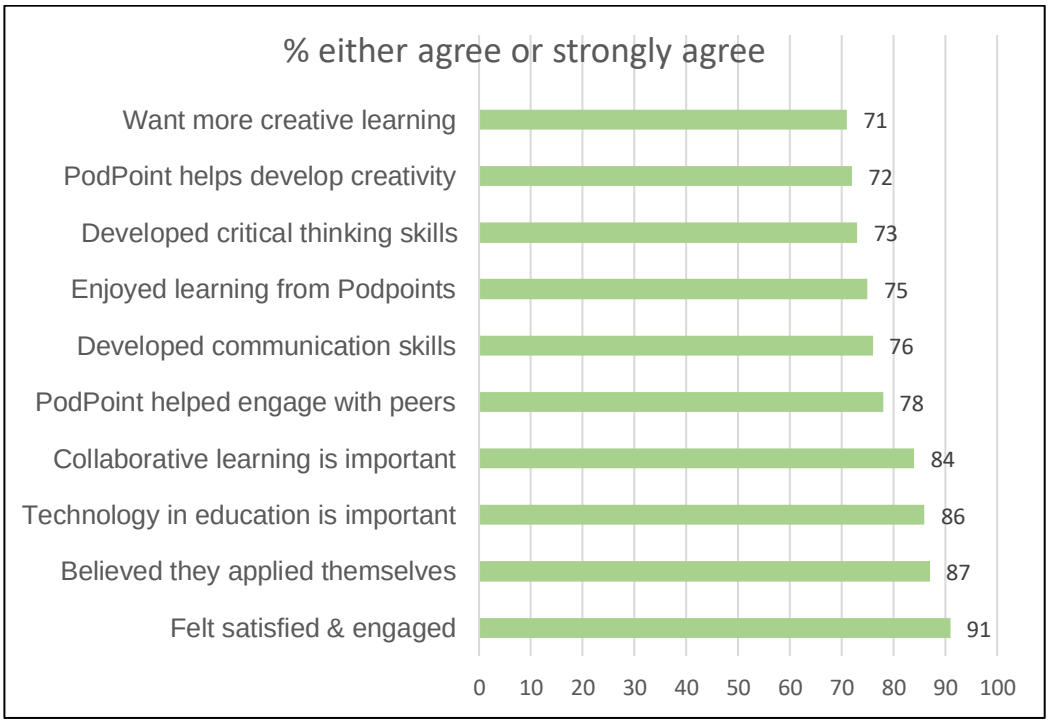
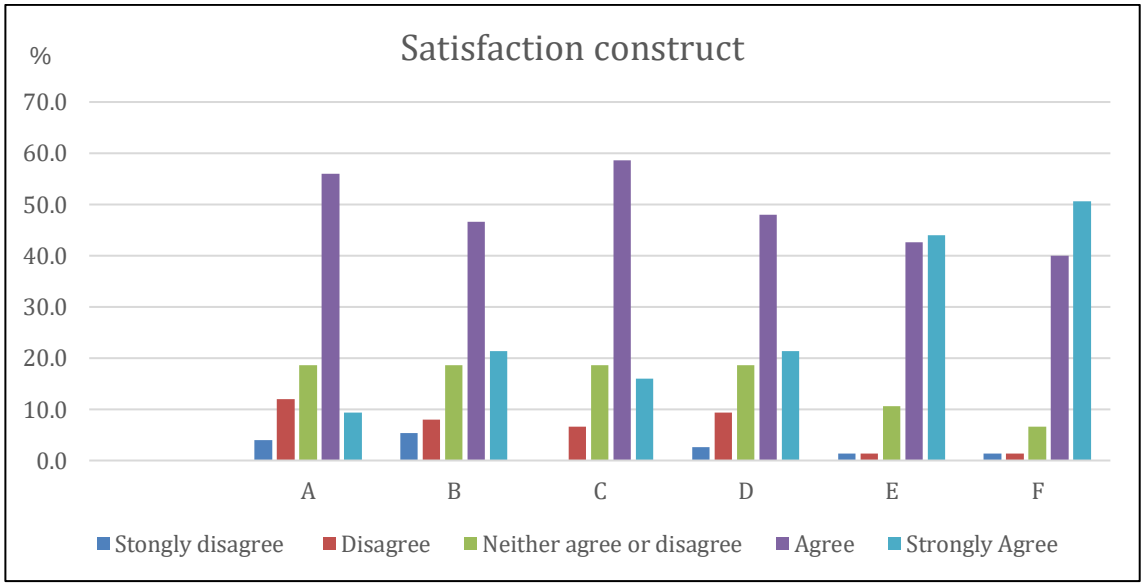


Figure 4.11. Survey constructs in order of rating (% combined agree or strongly agree).

The thesis now specifically reports on and illustrates the survey responses for the Likert-scale statements for each of the constructs of interest (Fig.4.12 - 4.19). As discussed, some of the Likert-scale statements crossover as they are related to one or more of the constructs of interest. The Likert-scale statements and associated constructs were presented in Table 3.4 (Chapter 3).

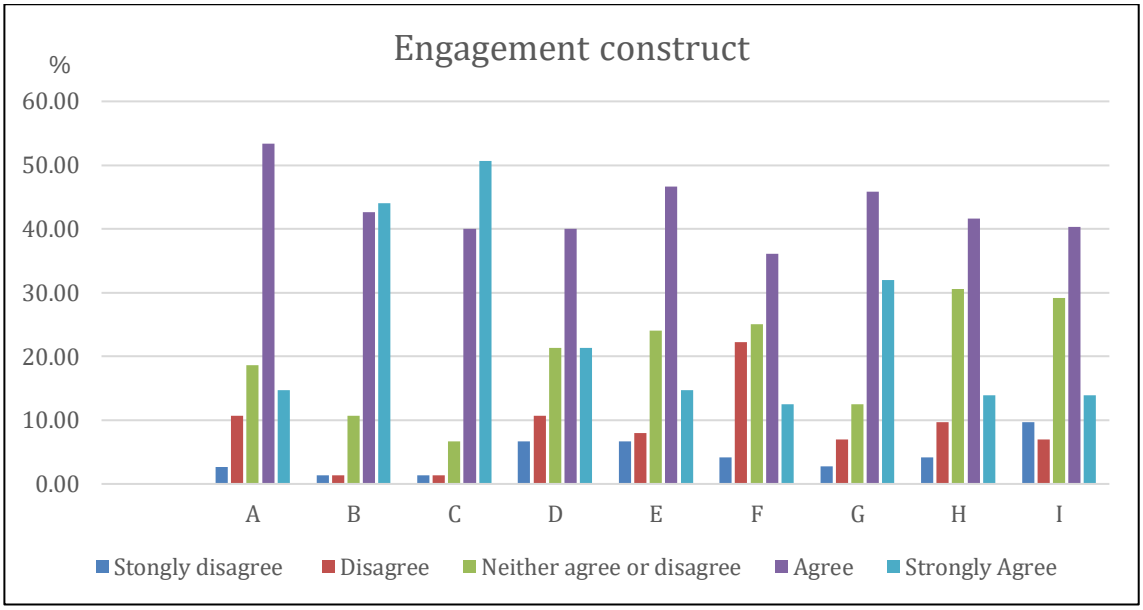
Satisfaction construct: Six statements covered the *satisfaction* construct. The strongest positive response was that approximately 91% of students either agreed or strongly agreed that they had made a valuable contribution to the outcome of the PodPoint task. The largest negative response for student *satisfaction* was that approximately 13% of students either disagreed or strongly disagreed that working in a team was an enjoyable experience. Figure 4.12 illustrates student responses to the Likert-scale statements.

Engagement construct: Nine statements addressed the engagement construct. Again, the strongest positive response was that approximately 91% of students either agreed or strongly agreed, that they had made a valuable contribution to the outcome of the PodPoint task, followed by, "I worked hard on the PodPoint task" at 87%. The largest negative response for student engagement was that approximately 26% of students either disagreed or strongly disagreed that understanding their VARK preferred communication style helped them to engage with others. Figure 4.13 illustrates student responses to the Likert-scale statements.



Legend for Likert-scale statements			
A	Making PodPoints in this unit was a satisfying experience	D	Overall, I am satisfied with the PodPoint teaching & learning innovation
B	I enjoyed working as part of a team	E	I worked hard on the PodPoint task
C	I enjoyed viewing and learning from other teams' PodPoints	F	I felt I made a valuable contribution to the outcome of the PodPoint task

Figure 4.12. Student survey feedback regarding the satisfaction construct.

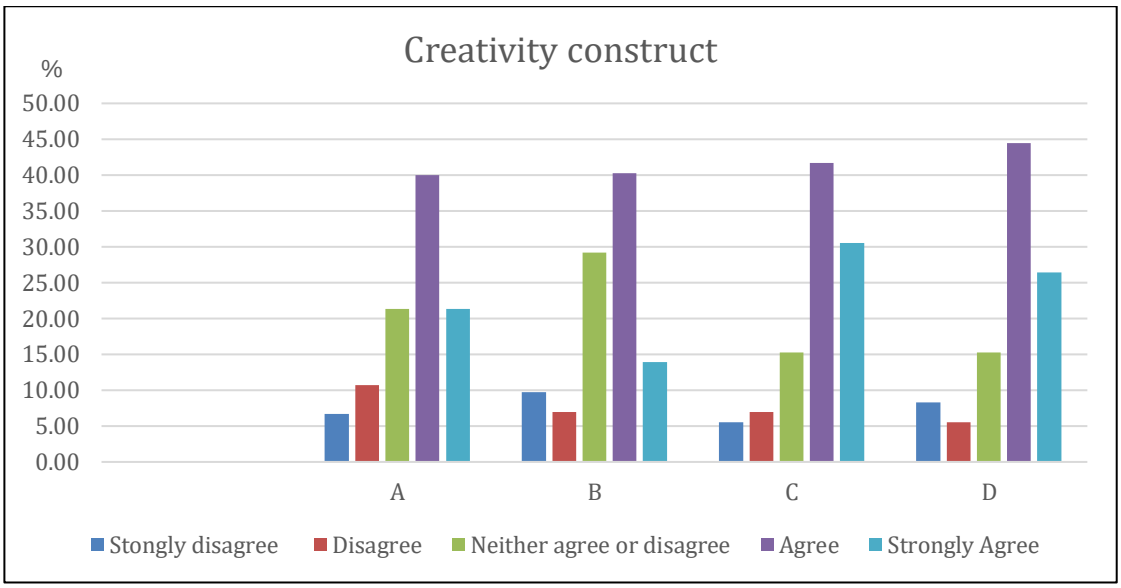


Legend for Likert-scale statements			
A	The use of student-generated PodPoints increased my motivation to be involved	F	Understanding my VARK preferred communication style helped me to engage with others
B	I worked hard on the PodPoint task	G	Making the team PodPoint helped me to interact with my peers
C	I felt I made a valuable contribution to the outcome of the PodPoint task	H	Making the PodPoints helped me better engage with the teachers
D	The "Uni-apocalypse" scenario (story) motivated me to engage with the unit topic matter	I	The "Uni-apocalypse" scenario (story) motivated me to learn
E	The PodPoint technology helped me to engage with the unit topic matter		

Figure 4.13. Student survey feedback regarding the engagement construct.

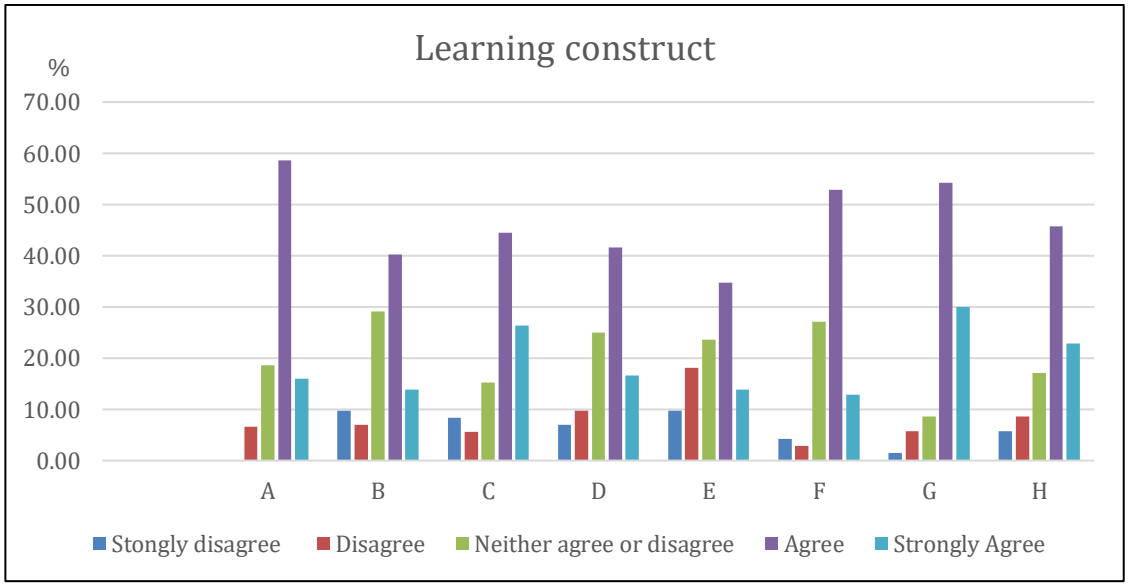
Creativity construct: Four statements addressed the *creativity* construct (Figure 4.14). The strongest positive response was that approximately 72% of students either agreed or strongly agreed, that the PodPoint task helped to develop their creativity. The largest negative response was that approximately 17% of students either disagreed or strongly disagreed that the "Uni-Apocalypse" scenario (story) motivated engagement with the unit topic matter.

Learning construct: Eight statements covered the learning construct. The strongest positive response was that approximately 84% of students either agreed or strongly agreed that collaboration and discussion were an important part of the learning process. This was followed by, "I enjoyed viewing and learning from other teams' PodPoints" at 74%. The largest equal negative responses for the learning construct, was that approximately 28% of students either disagreed or strongly disagreed that understanding their VARK preferred communication styles helped learning. Figure 4.15 illustrates the student responses to the Likert-scale statements.



Legend for Likert-scale statements			
A	The "Uni-Apocalypse" scenario (story) motivated me to engage with the unit topic matter	D	The PodPoint task helped develop my creativity
B	The "Uni-Apocalypse" scenario (story) motivated me to learn	E	I wish more instructors would explore creative learning opportunities, like this

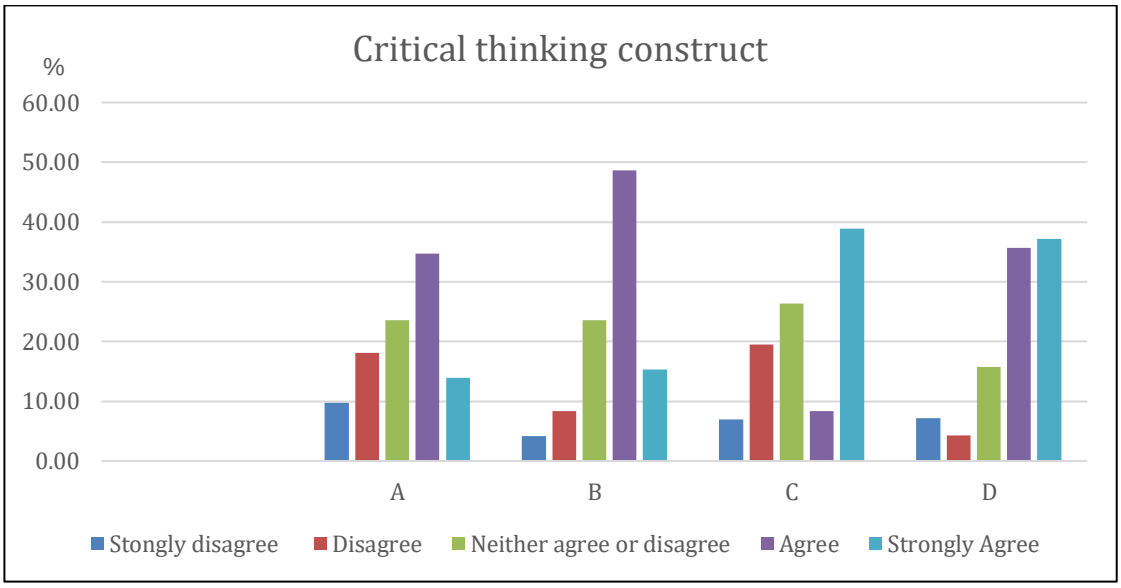
Figure 4.14. Student survey feedback regarding the creativity construct.



Legend for Likert-scale statements			
A	The "Uni-apocalypse" scenario (story) motivated me to learn	E	Understanding my VARK preferred communication style helped my learning
B	I enjoyed viewing and learning from other teams' PodPoints	F	Viewing and assessing other teams' PodPoints helped my learning of the topic material
C	I wish more instructors would explore creative learning opportunities, like this	G	Team collaboration and discussion was an important part of the learning process
D	The PodPoint technology supported my learning of the unit material	H	I feel that the PodPoint task has improved my skills to use technology

Figure 4.15. Student survey feedback regarding the learning construct.

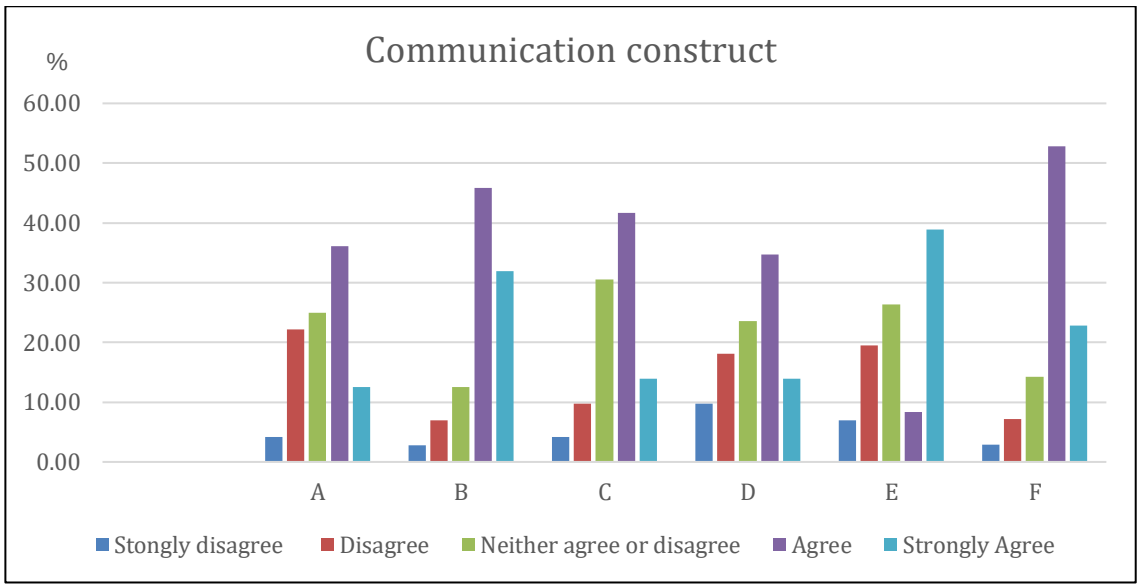
Critical thinking construct: Four statements addressed the critical thinking construct. The strongest positive response related to the assessment of team dynamics - approximately 73% students either agreed or strongly agreed, that overall, the other team members made valuable contributions for the task. Again, the largest negative response for the critical thinking construct was that approximately 28% of students either disagreed or strongly disagreed that understanding their preferred VARK communication styles helped learning. Figure 4.16 illustrates student responses to the Likert-scale statements.



Legend for Likert-scale statements			
A	Understanding my VARK preferred communication style helped my learning	D	This teaching and learning innovation helped me understand myself and others
B	This teaching and learning innovation developed my critical thinking skills	E	Overall, the other members of my team made valuable contributions

Figure 4.16. Student survey feedback regarding the critical thinking construct.

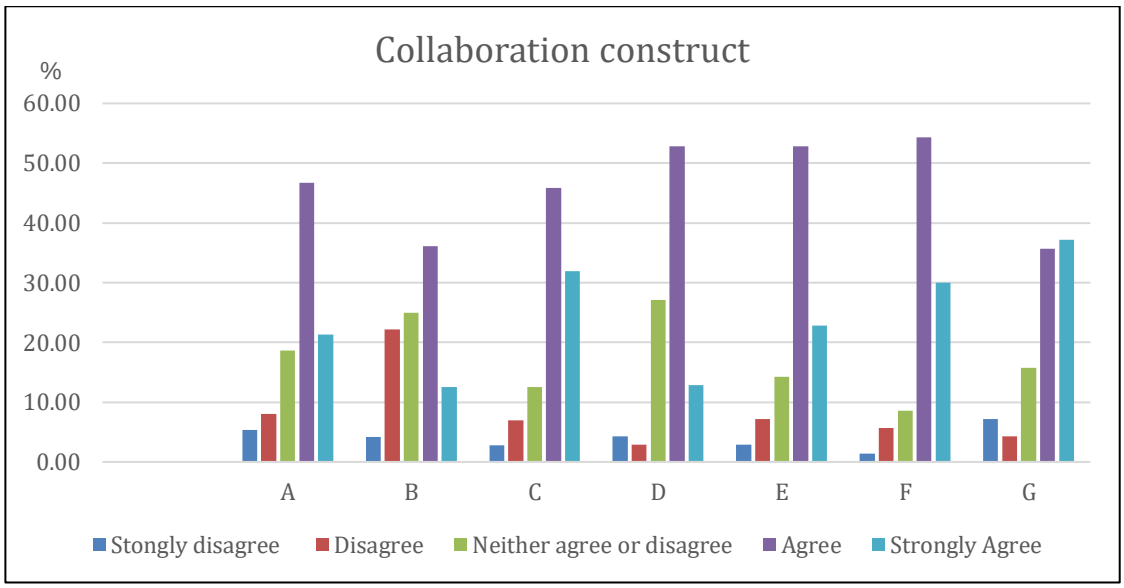
Communication construct: Six statements covered the *communication* construct. The strongest positive response was that approximately 78% of students either agreed or strongly agreed that constructing the team PodPoint supported peer interaction. The Likert statements associated with VARK, again, returned the largest negative responses with approximately 28% of students strongly disagreed that understanding VARK preferred communication styles helped learning, followed by 26% of students either disagreed or strongly disagreed that understanding their VARK communication styles helped them to engage with others. Summary results for the six survey statements are reported in figure 4.17.



Legend for Likert-scale statements			
A	Understanding my VARK preferred communication style helped me to engage with others	D	Understanding my VARK preferred communication style helped my learning
B	Making the team PodPoint helped me to interact with my peers	E	This teaching and learning innovation helped me understand myself and others
C	Making the PodPoints helped me better engage with the teachers	F	Working in a team helped me develop my communication skills

Figure 4.17. Student survey feedback regarding the communication construct.

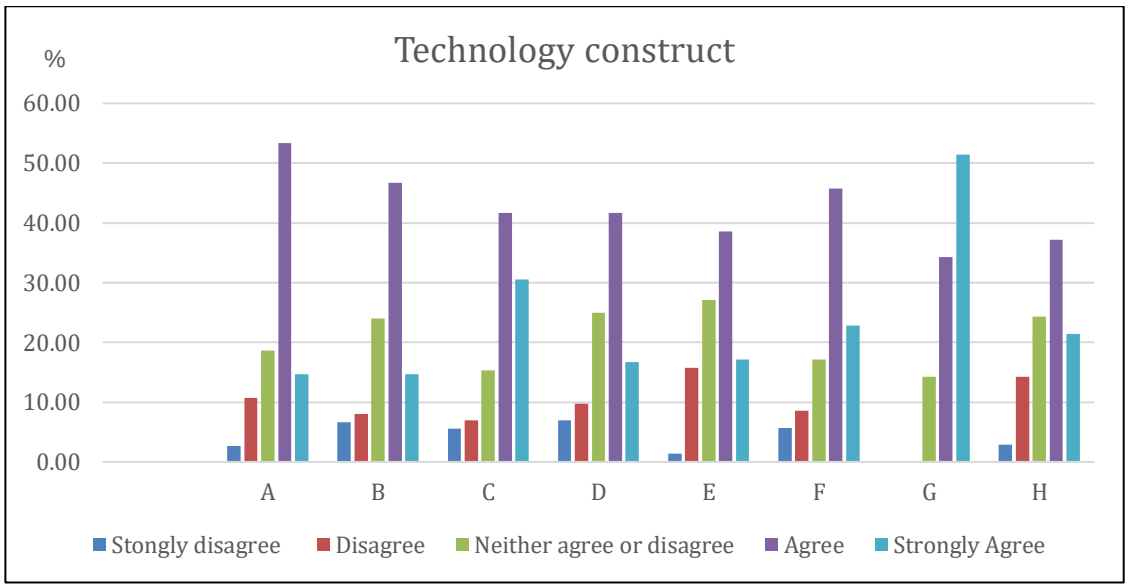
Collaboration construct: Seven statements addressed the *collaboration* construct. The strongest positive response was that approximately 84% of students either agreed or strongly agreed, that team collaboration and discussion are important part of the learning process. This was followed by, “Making the team PodPoint helped me to interact with my peers” at 78%. The largest negative response was that approximately 26% of students either disagreed or strongly disagreed that understanding their VARK preferred communication styles helped them to engage with others. Additionally, approximately 13% of the students indicated that they either disagreed or strongly disagreed that they enjoyed working as part of a team. Figure 4.18 illustrates student responses to the Likert-scale statements.



Legend for Likert-scale statements			
A	I enjoyed working as part of a team	E	Working in a team helped me develop my communication skills
B	Understanding my VARK preferred communication style helped me to engage with others	F	Team collaboration and discussion was an important part of the learning process
C	Making the team PodPoint helped me to interact with my peers	G	Overall, the other members of my team made valuable contributions
D	Viewing and assessing other teams' PodPoints helped my learning of the topic material		

Figure 4.18. Student survey feedback regarding the collaboration construct.

Technology construct: Eight statements covered the *technology* construct. The strongest positive response was that approximately 86% of students either agreed or strongly agreed that use of technology in education is important for the modern student. Approximately 69% of the students also either agreed or strongly agreed that the PodPoint task had improved their skills to use technology. The equal negative responses for the communication construct were that approximately 17% strongly disagreed with the option for more instructors to use PodPoint technology in their courses, that the PodPoint technology was easy to use, and that PodPoint technology had supported their learning of the unit material. Figure 4.19 illustrates student responses to the Likert-scale statements addressing the *technology* construct.



Legend for Likert-scale statements			
A	The use of student-generated PodPoints increased my motivation to be involved	E	I found the PodPoint technology easy to use
B	The PodPoint technology helped me to engage with the unit topic matter	F	I feel that the PodPoint task has improved my skills to use technology
C	The PodPoint task helped develop my creativity	G	I think the use of technology in education is important for the student of today
D	The PodPoint technology supported my learning of the unit material	H	I wish more instructors would utilize PodPoint technology in their courses

Figure 4.19. Student survey feedback regarding the collaboration construct.

4.4.1.1.2 Open-ended questions

From the 75 survey respondents, a total of 76 comments were recorded for the two open-ended questions. Thematic analysis generated a total of 139 codes that were sorted into 11 descriptive themes and 28 sub-themes. For the most part, the combined feedback for these two questions was positive, with 79% (110 codes) related to positive experiences, and 29 codes associated with negative experiences. The following presents the TA for these two open-ended questions.

Q.31. What was the best aspect of your experience with this teaching innovation?

Forty-nine (49) comments were returned, with responses ranging from a couple of words to a few lines. Thematic analysis generated 91 codes comprising a couple of words to small sentences, that were collated into 9 descriptive themes and 10 sub-themes. These included some crossover of overlapping codes for several themes. Predominantly, students reported positive experiences with the project task. Table 1a (Appendix) lists the codes, themes, and sub-themes for this question. Figure 4.20 illustrates the breakdown in percentages for the identified themes. Figure 4.21 illustrates the overall thematic map for the

relationships between the themes and sub-themes (in italics), with the number of codes in brackets (same format for all ensuing thematic maps).

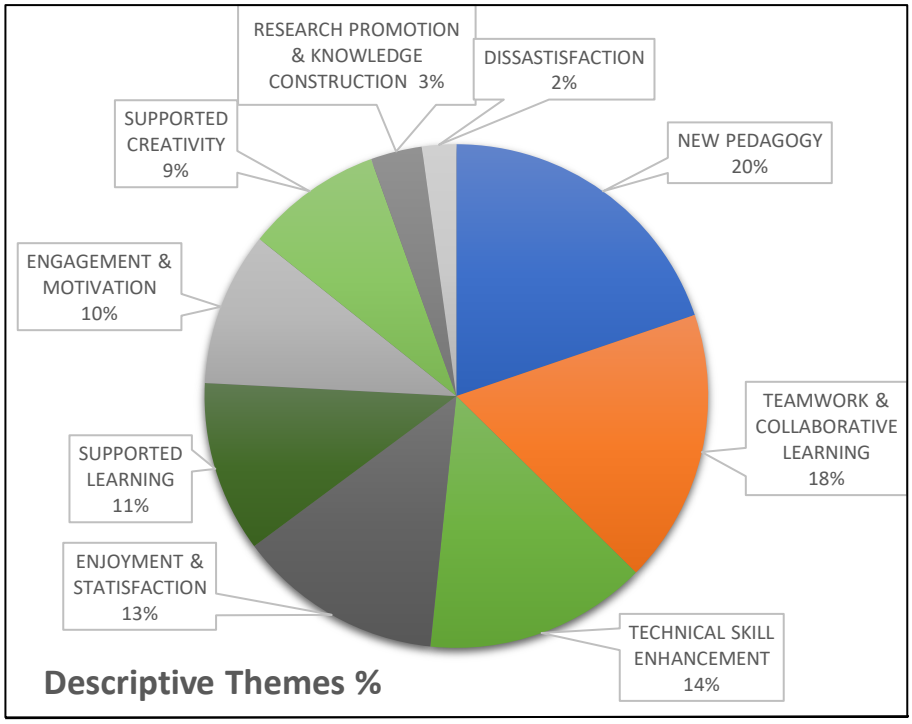


Figure 4.20. Survey. Descriptive themes percentages for survey Q31.

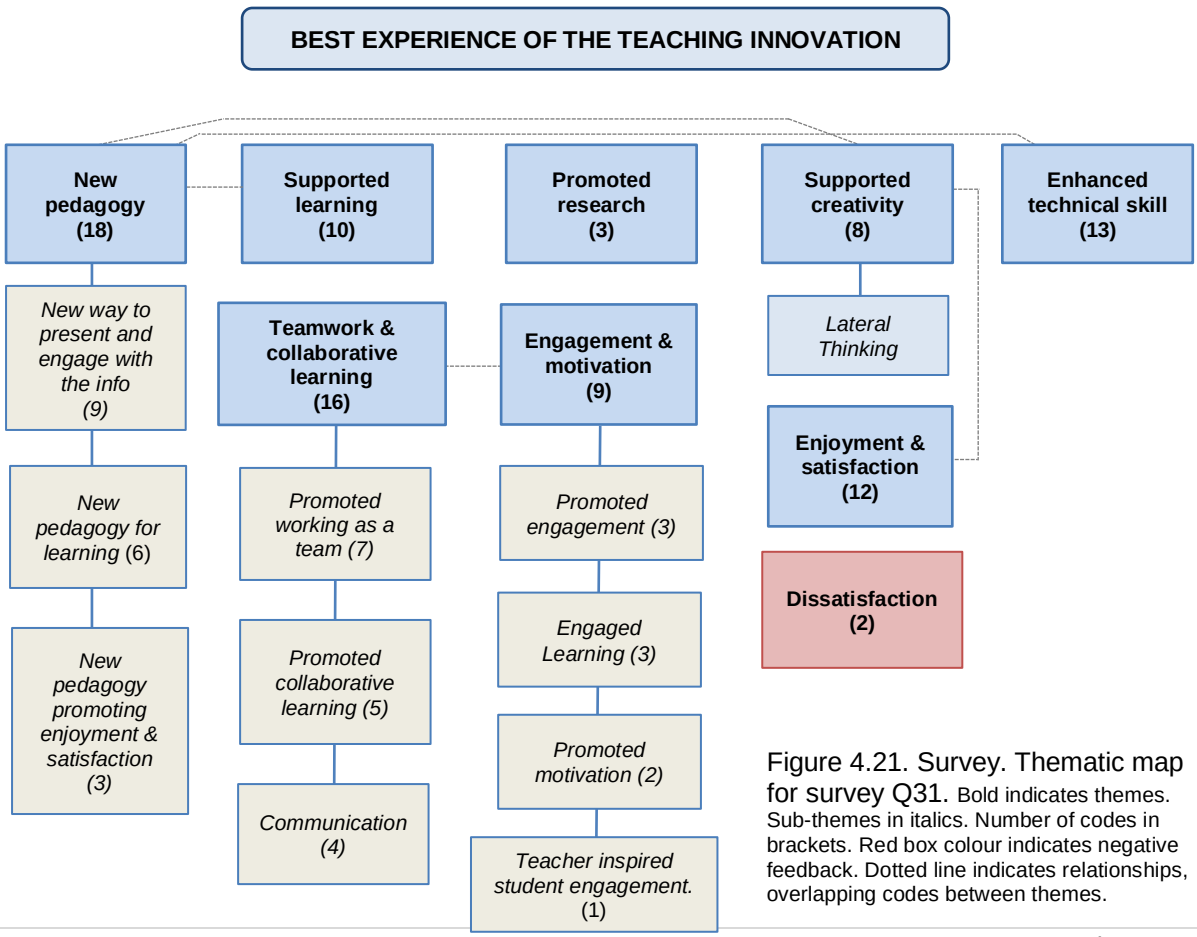


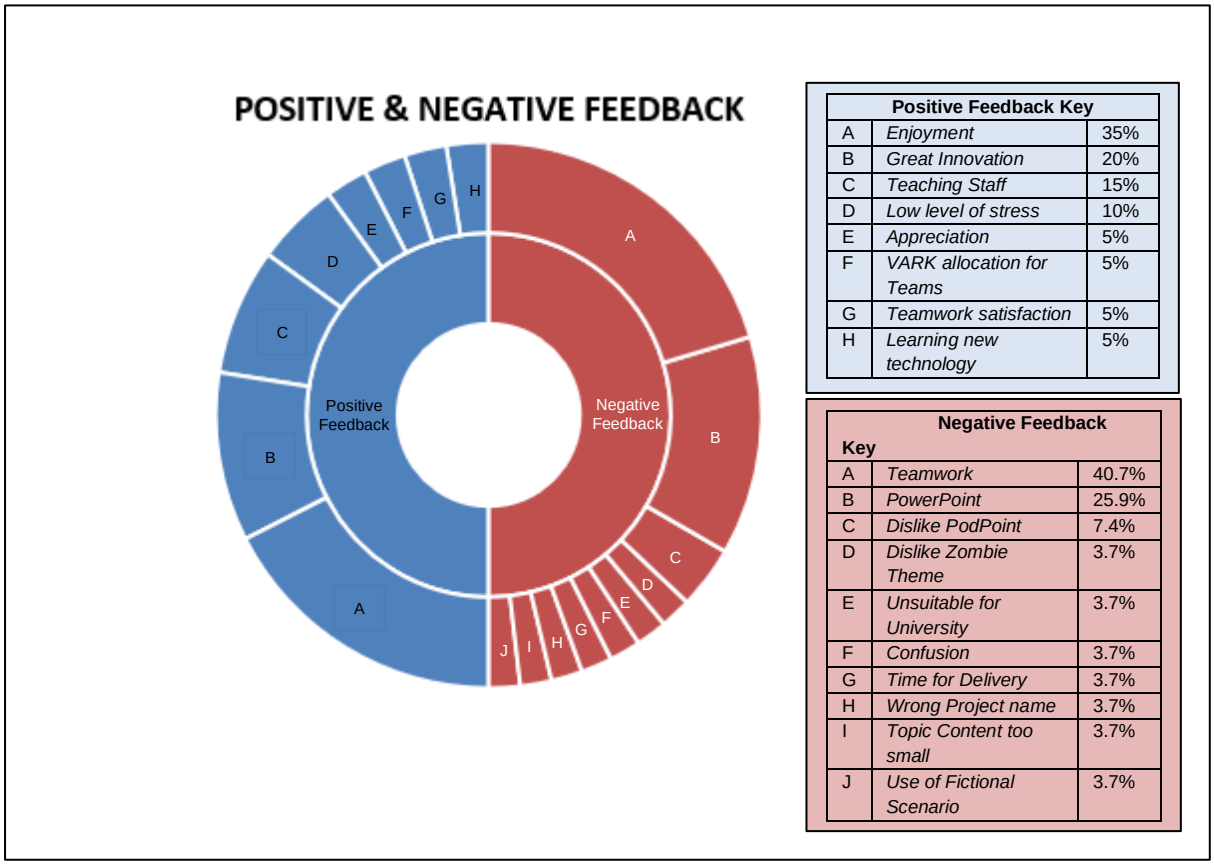
Figure 4.21. Survey. Thematic map for survey Q31. Bold indicates themes. Sub-themes in italics. Number of codes in brackets. Red box colour indicates negative feedback. Dotted line indicates relationships, overlapping codes between themes.

Q .32. Do you have any additional comments or feedback?

Twenty-seven (27) comments were made for the question: "Do you have any additional comments or feedback?" Thematic analysis generated 48 codes which elicited two overarching themes, comprising positive and negative aspects of the PodPoint teaching intervention. These were labelled "Positive Feedback" and "Negative feedback" and included 18 sub-themes (Table 2a - Appendix). Figure 4.22 illustrates the positive and negative themes and associated sub-themes, and magnitudes (percentages). Figure 4.23 illustrates the thematic map for the relationships between the two overarching themes and their related sub-themes.

For the theme, Positive Feedback, 21 codes were identified comprising of single word to small sentence responses that were organised into 8 sub-themes. Some codes overlapped. Student feedback strongly indicated enjoyment (35%) and acknowledged the innovations unique way to support learning (20%).

For the theme, Negative Feedback, 27 codes consisting of a few words to small sentences, were collated into 10 descriptive sub-themes with some codes overlapping. A large degree of the negative feedback related to *Teamwork* (40.7%, 11) and *PowerPoint (*25.9%, 7).



Positive Feedback Key		
A	*Enjoyment*	35%
B	*Great Innovation*	20%
C	*Teaching Staff*	15%
D	*Low level of stress*	10%
E	*Appreciation*	5%
F	*VARK allocation for Teams*	5%
G	*Teamwork satisfaction*	5%
H	*Learning new technology*	5%

Negative Feedback Key		
A	*Teamwork*	40.7%
B	*PowerPoint*	25.9%
C	*Dislike PodPoint*	7.4%
D	*Dislike Zombie Theme*	3.7%
E	*Unsuitable for University*	3.7%
F	*Confusion*	3.7%
G	*Time for Delivery*	3.7%
H	*Wrong Project name*	3.7%
I	*Topic Content too small*	3.7%
J	*Use of Fictional Scenario*	3.7%

Figure 4.22. Survey. Positive & negative themes, associated sub-themes, and magnitudes (%) for the open-ended question: Do you have any additional comments or feedback?

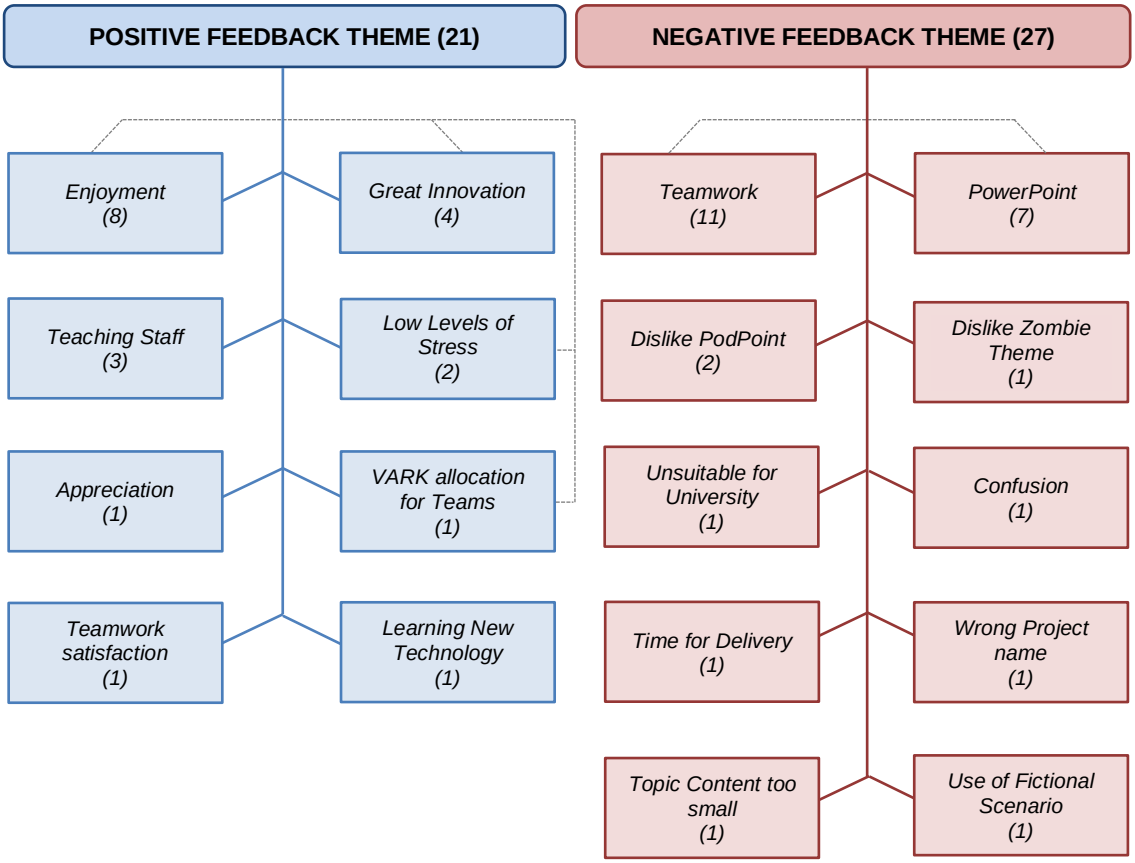


Figure 4.23. Survey. Thematic map for the open-ended question: “Do you have any additional comments or feedback?”

4.4.1.2 Questionnaires

4.4.1.2.1 Individual questionnaire

A total of 17 respondants (for Blocks 3 & 4, 2019) provided 128-comments, of which, 117 (91%) comments were positive, and 11 comments were negative. Seven of the eleven negative responses were made by the same respondent, all of which were short, one to two-word responses providing little feedback. The other 4 negative comments came from another three students. Thematic analysis of the responses for questions 1 to 6, generated 153 codes that were organized into 39 themes and 1 sub-theme. These codes ranged from a single word to short sentences. Figure 4.24 details the thematic map illustrating the relationships between the themes, sub-themes, and relationships for these. Additionally, 39 codes generated thirteen (13) themes and 3 sub-themes for the feedback on instructor engagement and further comments (Q7 & 8) - discussed shortly.

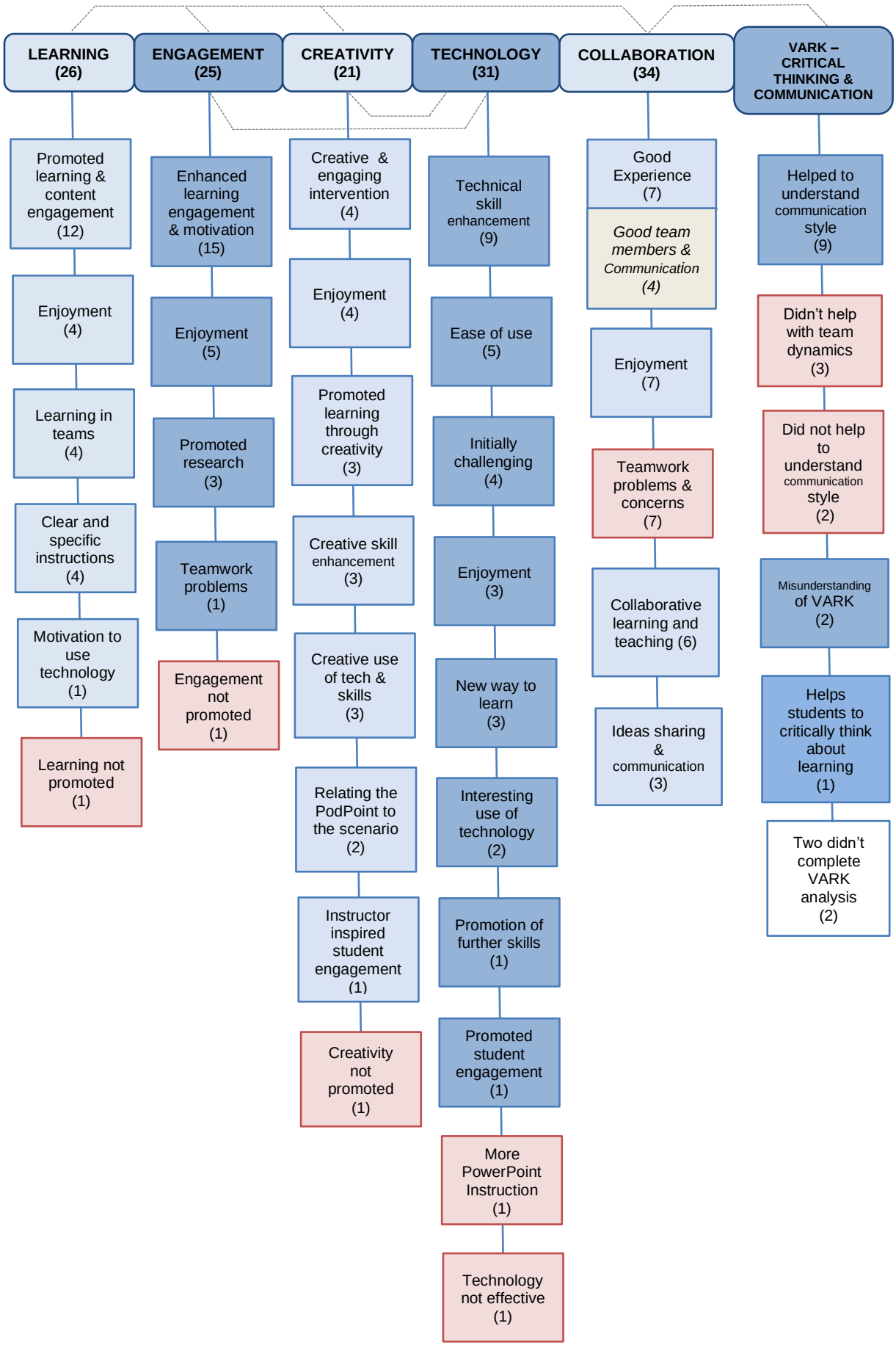


Figure 4.24. Individual questionnaire. Thematic map for the individual questionnaire. Themes and associated sub-themes (*italics*). Number of codes in brackets. Dotted line indicates relationships, overlapping codes. Red boxes highlighting negative feedback.

In order, the following highlights the major findings of the TA outcomes for each of the questions and related constructs, as well as the additional questions for instructor engagement, and open feedback.

Q.1. - Did the teaching innovation promote your learning? If so, how? - Learning construct

Students felt that the teaching innovation had promoted their learning and supported content engagement. Of the 26 codes generated, just under half (46%) were associated with theme "Promoted learning & content engagement (12)". One student felt that their learning was not promoted. Table 3A (Appendix) lists the themes and associated codes.

Q.2. - Did it help to motivate and engage you with the topic material? If so, how? - Engagement construct

Sixty percent (60%) of the student feedback indicated that they believed that the innovation enhanced learning engagement and motivation. Additionally, 20% of the feedback indicated that the students had enjoyed the teaching innovation. However, one student felt that their engagement was not promoted. Table 4A (Appendix) lists the themes and associated codes.

Q.3. - Did you think the teaching innovation promoted your creativity in the learning process? If so, how? – Creativity construct

Seventy-one percent (71%) of the student feedback indicated that the students believed that the innovation promoted their creativity with the learning process across several fronts – two of the students using the word "definitely". One student felt that their creativity was not promoted. Table 5A (Appendix) lists the themes and associated codes.

Q.4. - How did you find the use of the podcasting/PowerPoint technology? - Technology construct

For the question covering technology the greatest feedback was that the students felt that the use of the technology had enhanced their technical skills (29%) and that it was easy to use (19%). One student felt that the technology was not effective. Table 6A (Appendix) lists the themes and associated codes.

Q.5. - How did you find working in teams? - Collaboration construct

For the question covering *collaboration* (and *communication*), 53% of the student feedback indicated that students had a good, enjoyable experience with teamwork and communication,

while 21% indicated problems and concerns with teamwork. Table 7A (Appendix) lists the themes and associated codes.

Q.6. - What do you think about doing your own VARK analysis? Was if helpful in understanding your communication style? - Critical thinking & Communication constructs

This question conjointly addressed individual perspectives on the constructs of *critical thinking* and *communication* with respect to VARK. Students were asked to critically appraise how they felt about their individual VARK modality profiles. Two students replied that they had not completed the VARK questionnaire and made no further comments (2 codes). Principal feedback from all other responses indicated that students believed that the VARK helped them to understand individual communication style (47%), while another 26% of the combined feedback indicated that it didn't help with team dynamics, nor with understanding communication style. Table 8A (Appendix) lists the themes and associated codes.

Q.7. - Was the instructor helpful? - Instructor engagement

All 17 students returned comments regarding instructor engagement. Analysis generated 28 codes, including two garnered from the open feedback question. Figure 4.25 illustrates the thematic map for the codes, themes, and sub-themes for student feedback on instructor engagement. Table 9A (Appendix) lists the themes and associated codes.

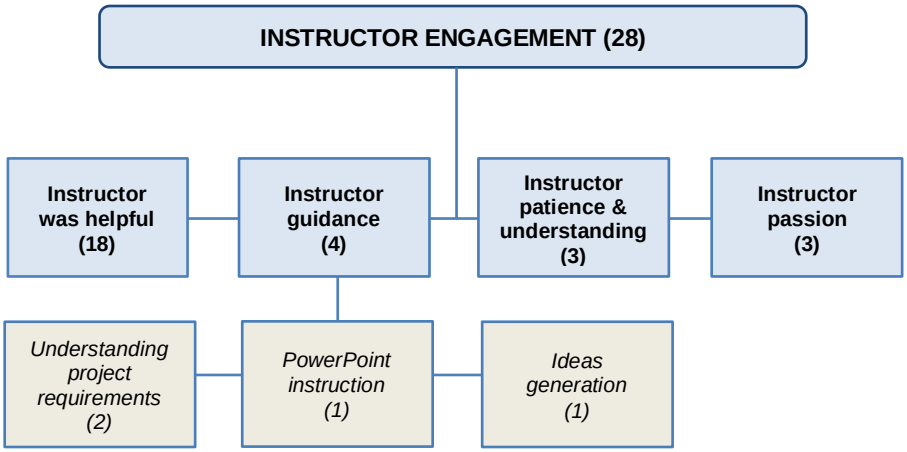


Figure 4.25. Individual questionnaire. Thematic map for student feedback on instructor engagement – "Was the instructor helpful?" Bold indicates themes. Sub-themes in italics.

Q.8. - Do you have any further comments or feedback? - Open-ended feedback

Twelve (12) students responded to the question inviting further feedback, however six replies related to "no further comment". The remaining 6 comments generated 12 codes that were

organized into 9 themes (Figure 4.26). Table 10A (Appendix) lists the themes and associated codes.

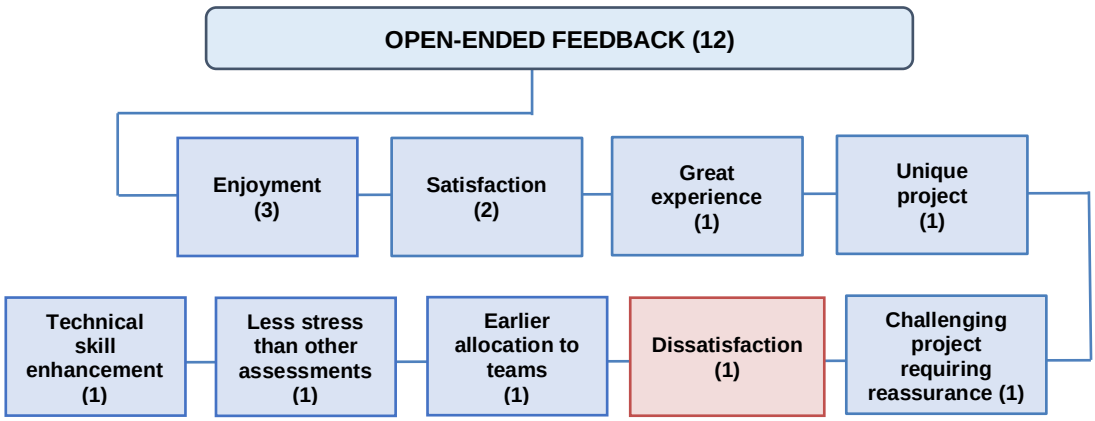


Figure 4.26. Individual questionnaire. Thematic map for student comments for open feedback – "Do you have any further comments or feedback?" Bold indicates themes. Number of codes in brackets. Red boxes highlighting negative feedback.

4.4.1.2.2 Teamwork questionnaire

The teamwork questionnaire contained 11 questions. The first two questions were administrative (class group number & topic). Questions 3 to 10 invited feedback on six of the constructs of interest, including *satisfaction*, *engagement*, *collaboration, communication*, *critical thinking*, and *learning*. One further open-ended question was included -- "Do you have any further feedback? (Q11). As discussed, the teamwork questionnaire was introduced in Blocks 3 and 4, following Block 2 student feedback about potential concerns with teamwork dynamics. It was used as an investigative tool to shed further light on teamwork dynamics for these two blocks. Following the survey, it returned the second largest number of respondents (50) for all the qualitative data collection instruments alongside a large body of qualitative data. Three hundred and eighty-five (385) comments were made, providing a large body of feedback. Again, comments ranged from a single word replies to large paragraphs of text. Thematic analysis generated a total of 604 codes ranging from single words to short sentences, that were sorted into 157 themes and 136 sub-themes. Notably, this was the largest amount of qualitative data generated from all the data collection instruments.

The following presents the thematic analysis findings and comments for each of the questions that invited feedback.

Q.3. - Overall, please describe your experience in working as a team - Overall team experience

Fifty (50) responses generated 110 codes that were collated into 4 themes and 17 sub-themes (Figure 4.27) (Table 11.1A & 11.2A – Appendix).

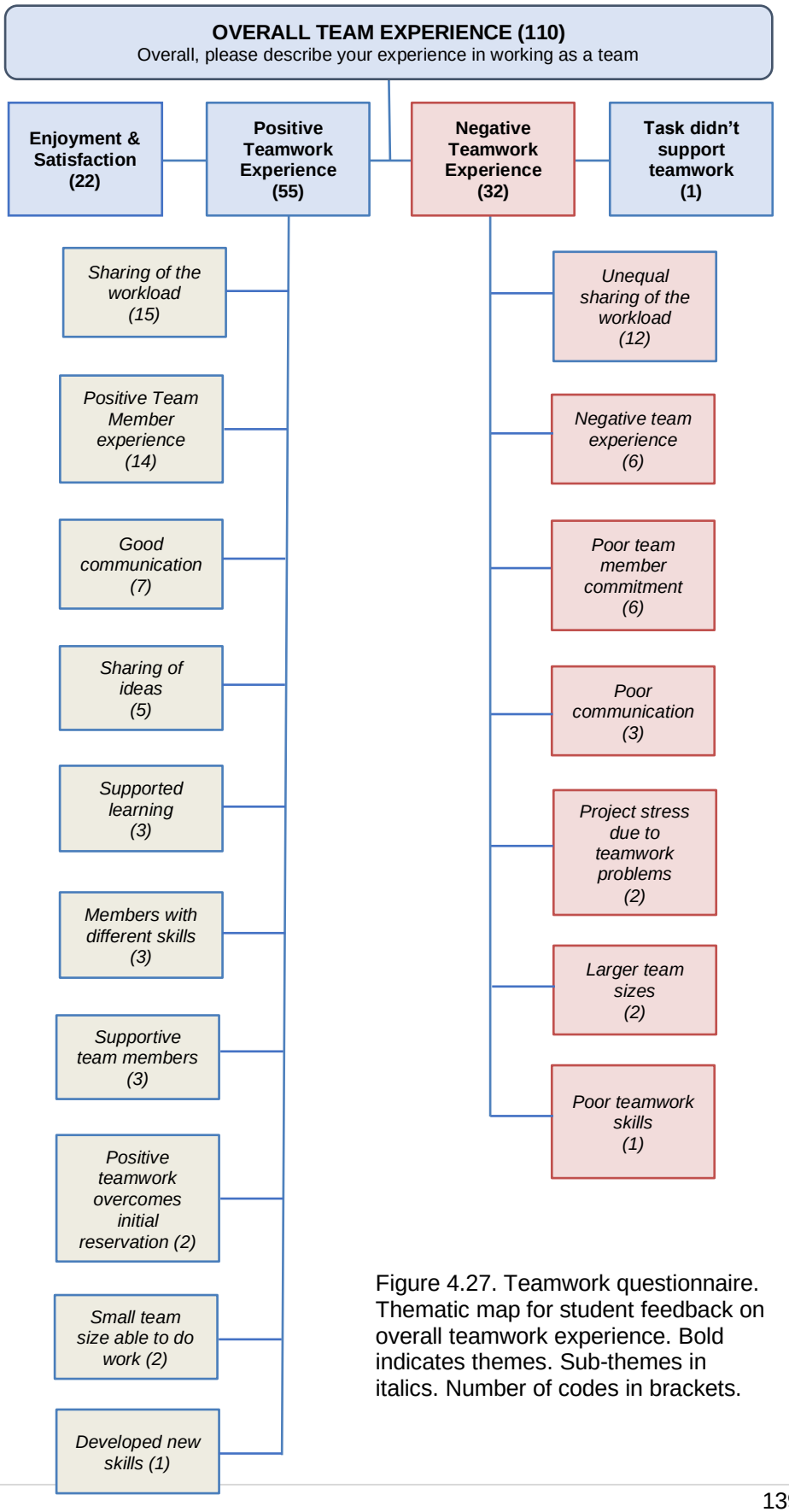


Figure 4.27. Teamwork questionnaire. Thematic map for student feedback on overall teamwork experience. Bold indicates themes. Sub-themes in italics. Number of codes in brackets.

Seventy percent (70%) of the students' feedback either indicated enjoyment and satisfaction or demonstrated a positive teamwork experience across several fronts. In contrast, the remaining 30% of the feedback indicated negative teamwork experiences, again across several fronts, with one student believing that the task didn't support teamwork.

Q.4. - Do you feel that you made a valuable contribution to the outcome of the PodPoint task? If so, how? - Individual contribution

The question inviting feedback on students' individual contribution garnered information pertaining to the *satisfaction*, *engagement*, and *critical thinking* constructs. Forty-eight (48) responses generated 91 codes that were collated into 14 themes and two sub-themes with slight cross-over (Figure 4.28) (Table 12.A). Just over half (53%) of the feedback indicated that students believed they had made valuable contributions with the research of content and gathering of information, as well as the PodPoint production using PowerPoint, and with the generation of ideas for the PodPoint and story and script production. Some negative feedback related to the unequal sharing of the workload. Additionally, one student felt that their contribution was not appreciated by the other team members.

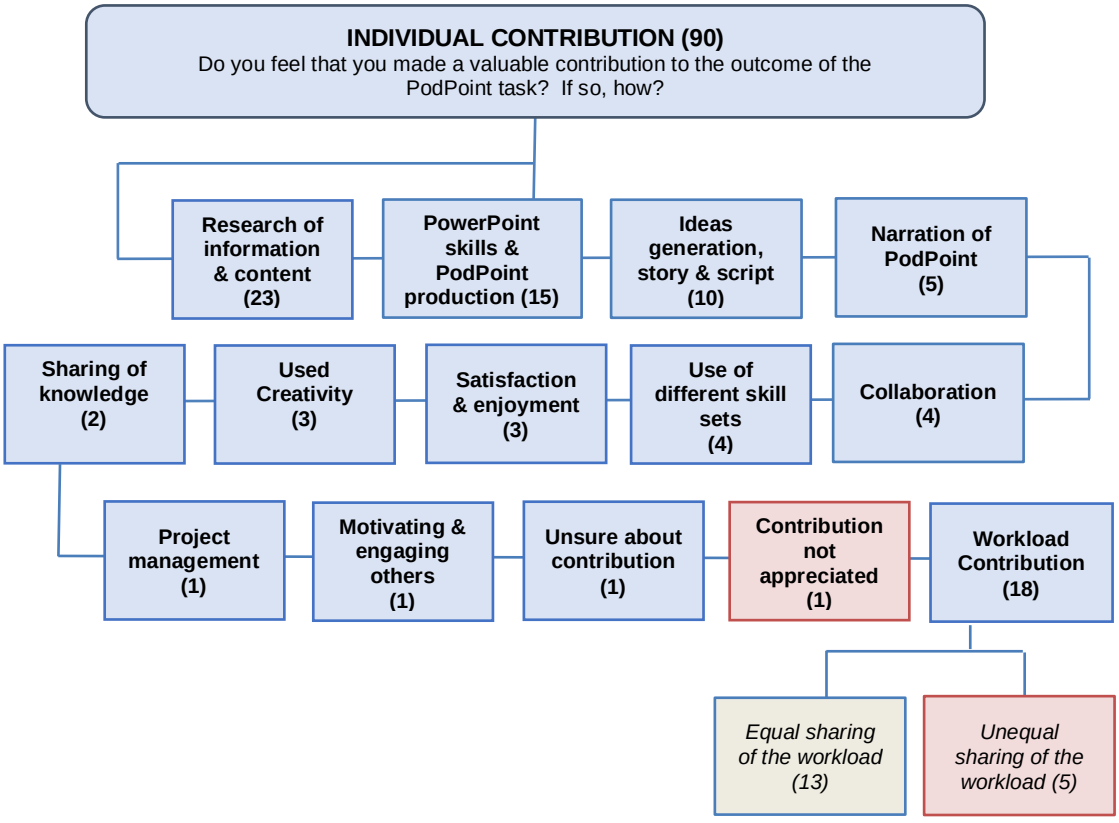


Figure 4.28. Teamwork questionnaire. Thematic map for individual contribution. Bold indicates themes. Sub-themes in italics. Number of codes in brackets. Red box colour indicates negative code.

Q.5. - Do you feel that working as a part of the team helped you to engage with the topic material? If so, how? - Teamwork and topic engagement

The question inviting feedback on students' perceptions about the effect of teamwork on topic engagement, gathered information pertaining to the *engagement, collaboration,* and *learning* constructs. Forty-six (46) responses generated 61 codes that were collated into the two overarching themes and 14 sub-themes with slight cross-over (Figure 4.29) (Table 13A – Appendix). Eighty percent (80%) of the feedback indicated that students experienced positive teamwork and engagement with the topic matter across several fronts, with the remaining 20% of the feedback associated with negative experiences with teamwork and topic engagement.

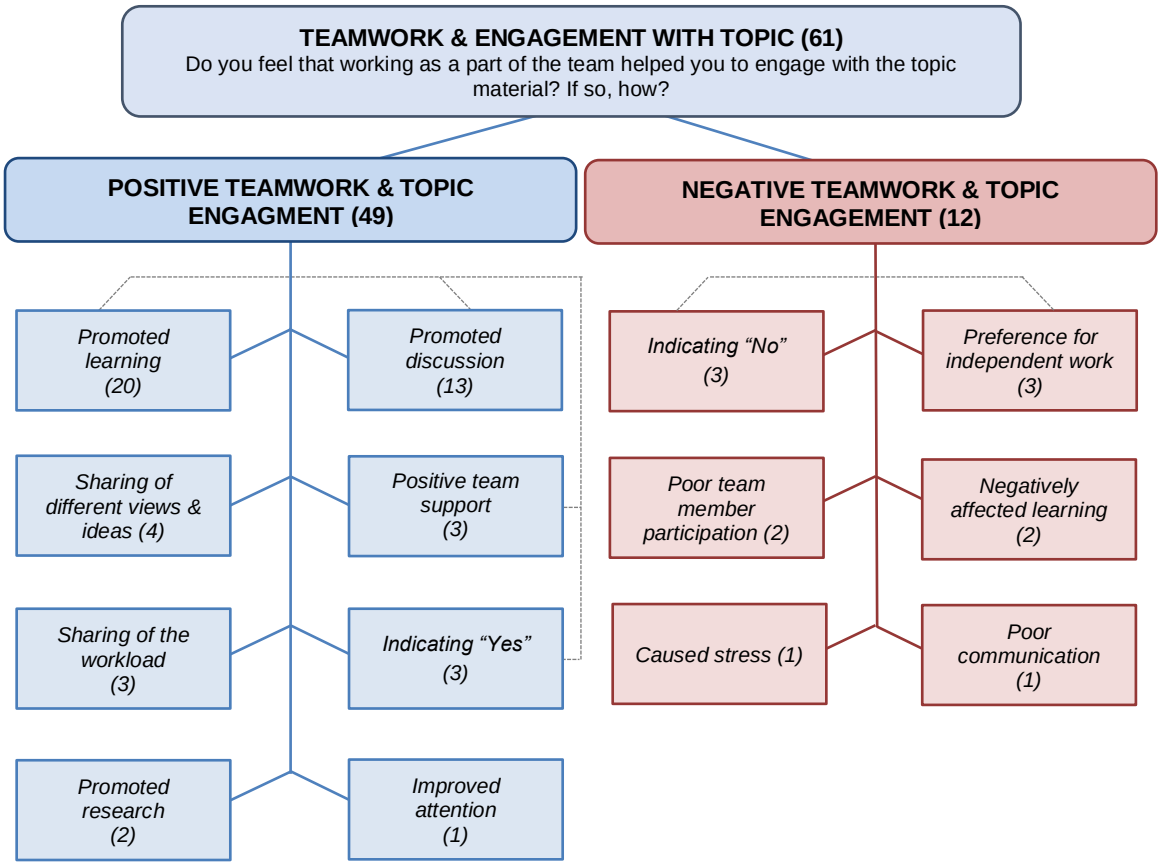


Figure 4.29. Teamwork questionnaire. Thematic map for teamwork & engagement with topic. Bold indicates themes. Sub-themes in italics. Number of codes in brackets. Red box colour indicates negative code. Dotted line indicates relationships, overlapping codes between themes.

Q.6. - Please describe whether you felt if team collaboration and discussion was an important part of the learning process - Team collaboration, discussion & learning

The question inviting feedback on students' perceptions about the effect of teamwork, collaboration, and discussion on learning, provided further information pertaining to the *engagement*, *collaboration*, *communication*, and *learning* constructs. Forty-seven (47)

responses generated 57 codes that were collated into four themes and 15 sub-themes (Figure 4.30) (Table 14A – Appendix). Eighty-one (81%) of the feedback related to the students reporting good teamwork dynamics across several fronts, while 16% of the feedback related to poor teamwork dynamics. Additionally, one student expressed a preference for independent project work.

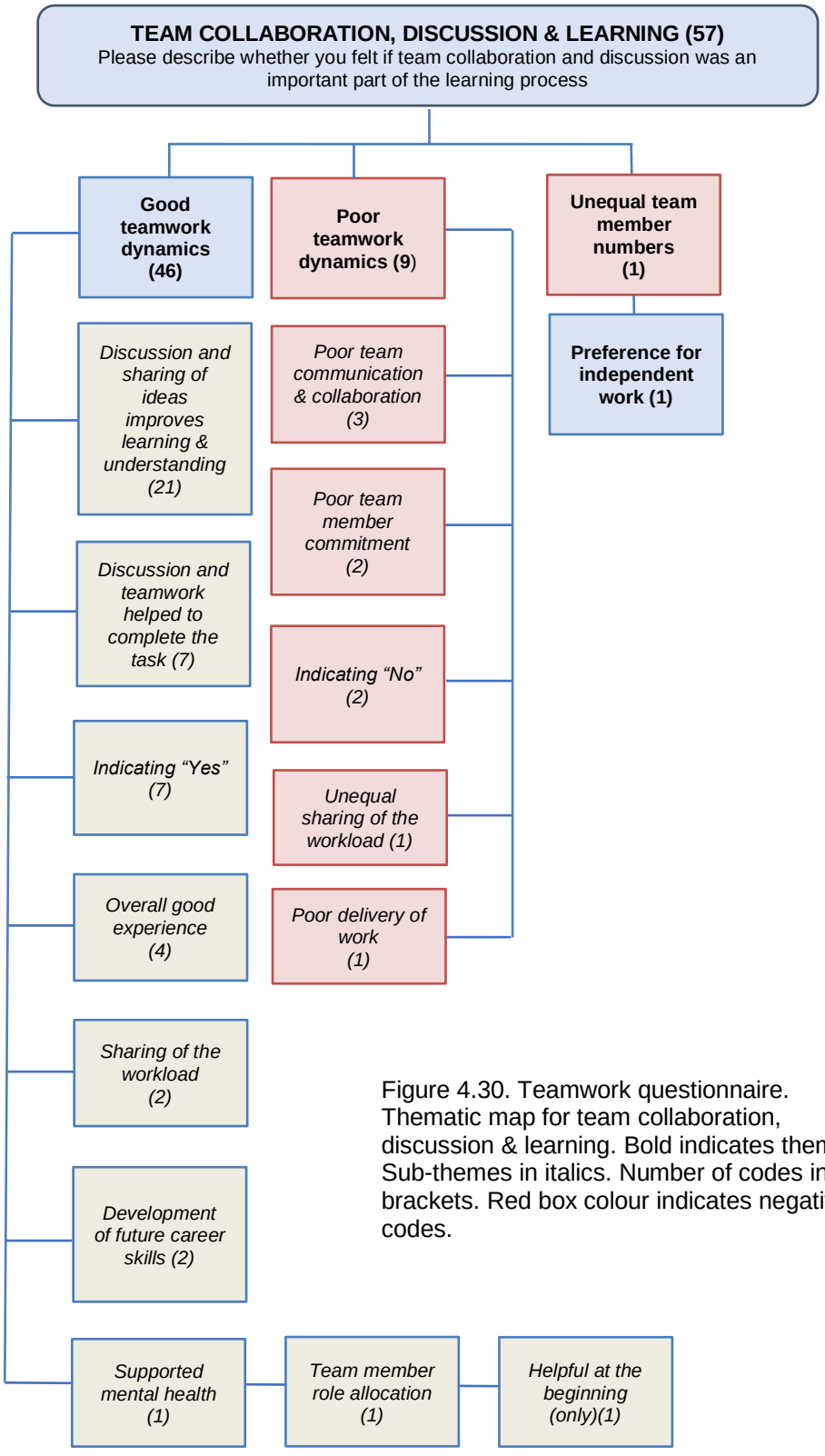


Figure 4.30. Teamwork questionnaire. Thematic map for team collaboration, discussion & learning. Bold indicates themes. Sub-themes in italics. Number of codes in brackets. Red box colour indicates negative codes.

Q.7. - Do you think that working in the team has helped you develop skills that will allow you to communicate and work with others in the future? If so, how? - Skill development and future communication with others

The question provided further information pertaining to the *collaboration* and *communication* constructs. Forty-eight (48) comments were made, that generated 58 codes that were organized into 12 themes and 8 sub-themes (Figure 4.31) (Table 15A – Appendix). Approximately 29% of the feedback indicated that students believed they had developed communication skills and recognized the importance of it in teamwork. A further 16% of feedback indicated that students felt that working in a team supported collaborative skills development. In contrast, 14% of the feedback indicated that students felt that no skill improvement had occurred, although half of this feedback was associated with the sub-theme "Already had pre-existing skills". One comment didn't address the question, but related to Q8, so was included in the responses for that question.

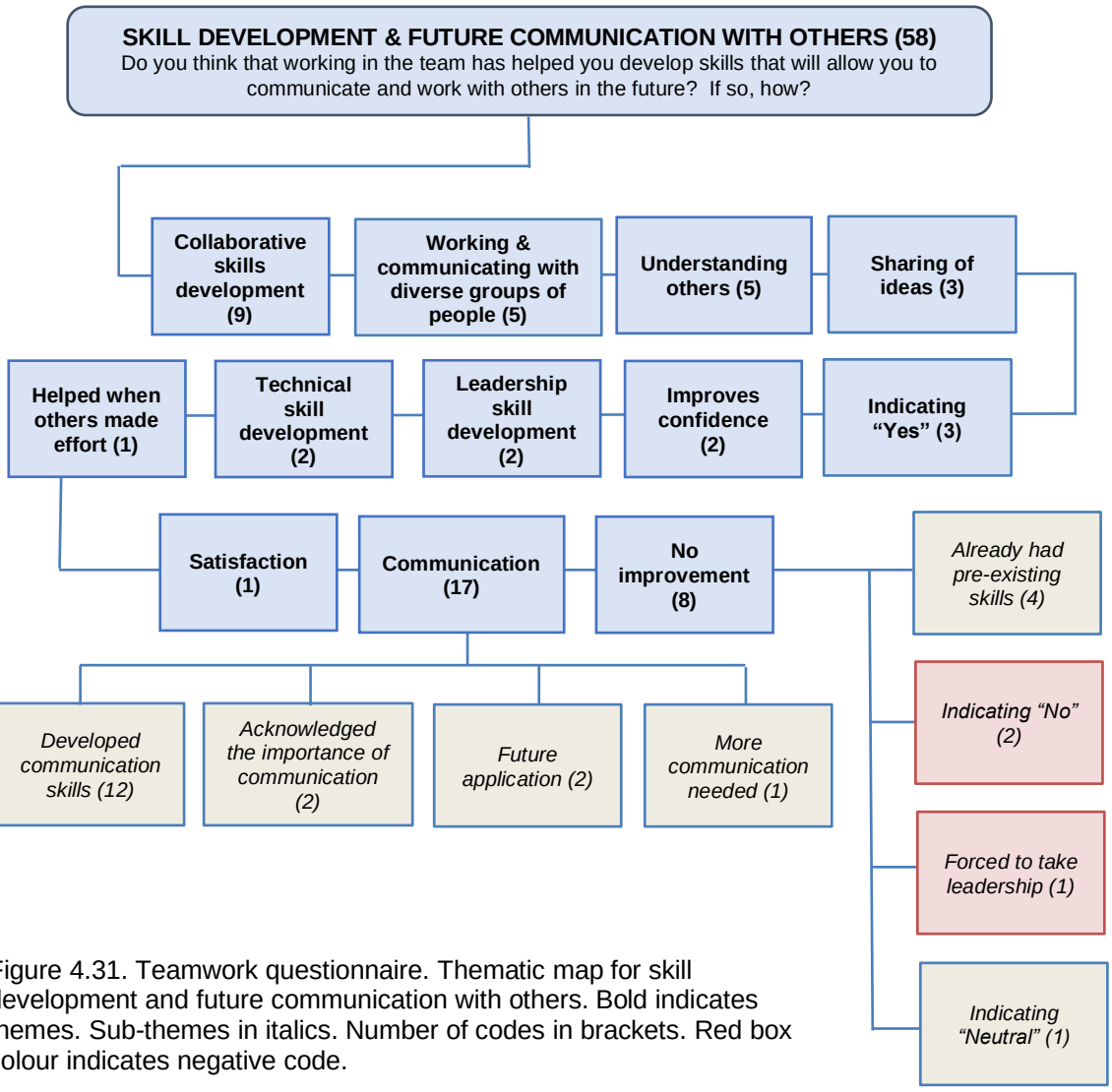


Figure 4.31. Teamwork questionnaire. Thematic map for skill development and future communication with others. Bold indicates themes. Sub-themes in italics. Number of codes in brackets. Red box colour indicates negative code.

Q.8. - Do you feel that the other members of your team made valuable contributions? - Other team member contribution

The question inviting feedback on students' perceptions about other team member contribution, provided further information pertaining to the *collaboration*, and *critical thinking* constructs. Fifty (50) comments were made, generating 75 codes that were organized into two overarching themes, 'Positive team member contribution' (65%), and 'Negative team member contribution' (35%) and combined 14 sub-themes (Figure 4.32) (Table 16A – Appendix). This included the 1 crossover response relocated from Q7 as it directly related to this question. The principal positive feedback (28%) related to students simply indicating "yes", followed by students reporting that other team members made equal, valuable contributions (13%). On the other hand, the greatest negative feedback related to students reporting that there was an unequal contribution (12%) made by team members.

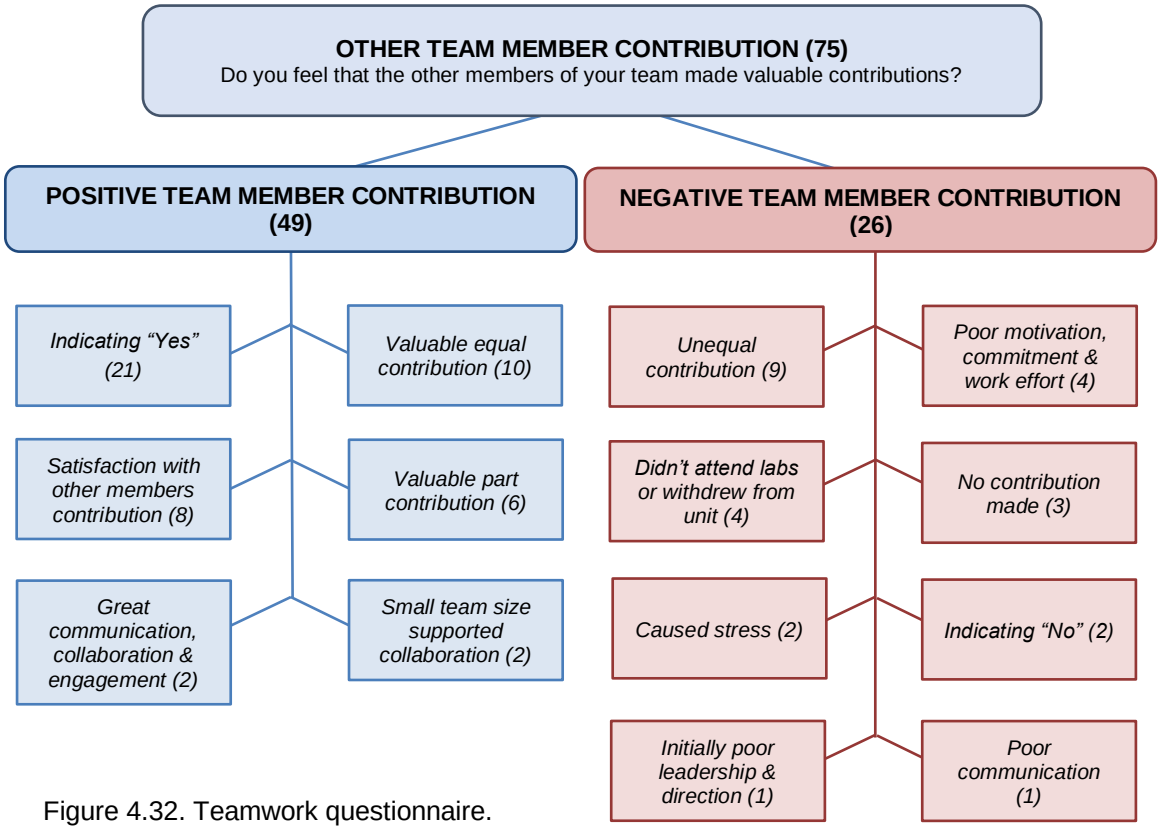


Figure 4.32. Teamwork questionnaire. Thematic map for other team member contribution.

Q.9. - What were the positives and negatives of working in a team? – Positives & negatives of teamwork

The question returned 48 comments, producing 106 codes that were sorted into the two overarching themes, labeled 'Positives' and 'Negatives', both comprising 30 sub-themes in total. One additional code produced another theme and was labeled 'Neutral view' (Figure

4.33) (Table 17.1A and 17.2A – Appendix). Approximately 64% of the feedback related to positive student beliefs about teamwork, with just under a third of this related to a positive collaborative experience and sharing of the workload among team members. In comparison, 35% of the feedback related to the negatives of teamwork, with 38% of this related to either poor team member participation and commitment, or poor collaboration and team member communication.

Q.10. - Do you suggest any changes that could enhance future working as a team?

The question returned 23 comments, generating 23 codes that were sorted into 11 themes and 10 sub-themes (Figure 4.34) (Table 18A – Appendix). Four (4) responses didn't address the question but were specifically related to Q10 (further feedback), so were included in the data for that question. Predominantly the comments were constructive with 83% of the feedback suggesting ways to enhance the team and project structure and more. The remainder of the feedback (17%) called for the removal of teamwork or not working with the same team members again.

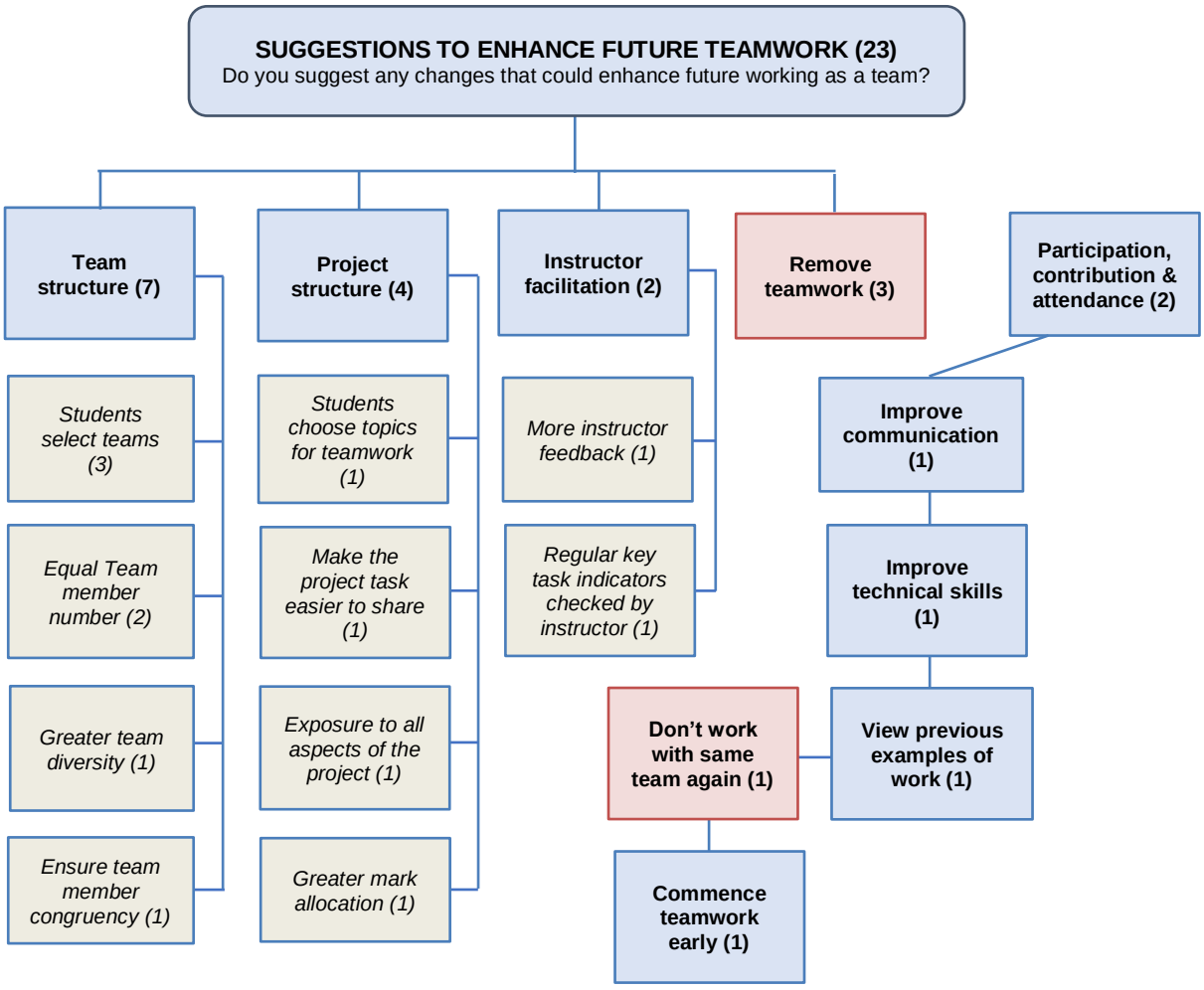


Figure 4.34. Teamwork questionnaire. Thematic map for suggestions to enhance future teamwork. Bold indicates themes. Sub-themes in italics. Number of codes in brackets.

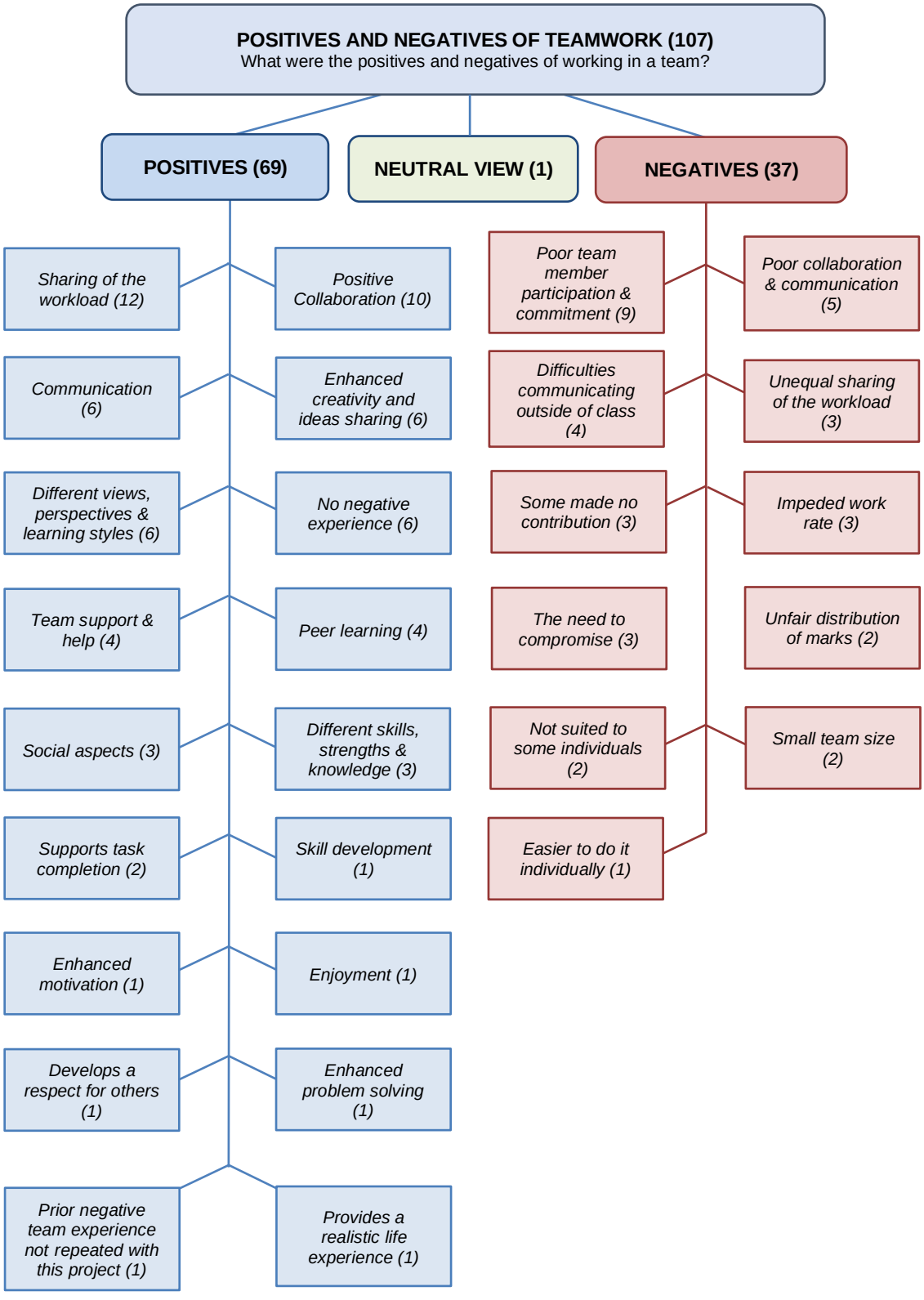


Figure 4.33. Teamwork questionnaire. Thematic map for the positives and negatives of teamwork. Bold indicates themes. Sub-themes in italics. Number of codes in brackets. Red box colour indicates negative code.

Q .11. - The open-ended question – "Do you have any further feedback?"

The open-ended question returned 18 comments, including the 4 responses relocated from Q9. From these, 23 codes were identified and sorted into the two primary, overarching themes, labelled 'Positive' and 'Negative' and a combined 14 sub-themes (Figure 4.35) (Table 19A – Appendix).

Fifty-seven percent (57%) related to positive comments and 43% elated to negative comments. Principal positive feedback was associated with project enjoyment, satisfaction, and support for learning (62% of the total positive feedback), while 40% of the negative feedback related to a dislike of the project, and the belief that not enough learning of the content was supported.

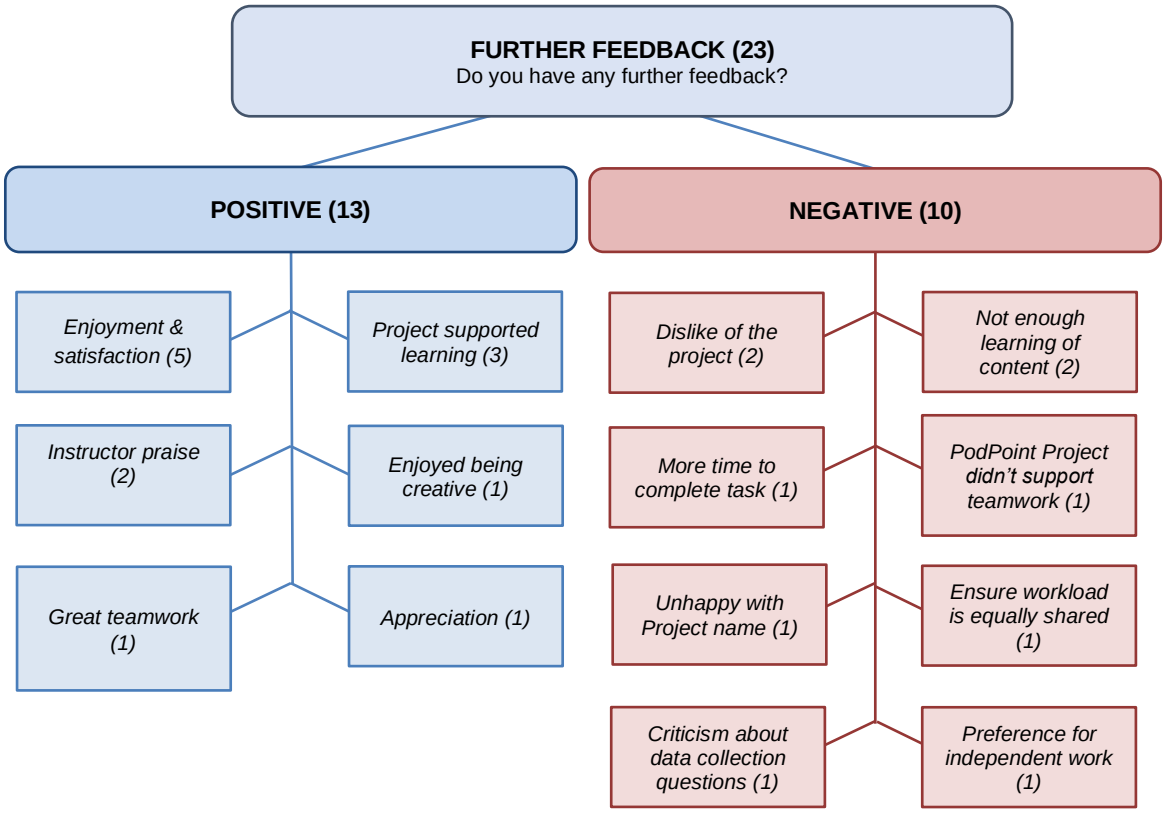


Figure 4.35. Teamwork questionnaire. Thematic map for further feedback. Bold indicates themes. Sub-themes in italics. Number of codes in brackets. Red box colour indicates negative code.

4.4.1.3 Interviews

Thirty-five participants attended 10 interviews over Blocks 2 and 4, 2019. No interviews were conducted for Block 3, 2019. Depending on student availability these were conducted either individually, or in small groups (2-9 students). As discussed, seven leading interview questions invited discussion around all the constructs of interest. The last question was entirely open, inviting students to freely give any further comments or feedback. The total interview time was 233 minutes. With permission, 190 verbal comments were recorded and later transcribed into text. These ranged from single word responses to short statements (paragraphs). The same person conducted all interviews and transcription of the recorded voice to text. Predominantly, the comments related to positive feedback (87.4%) with 24 negative comments being made. A total of 321 data codes were extracted from the comments which generated 95 themes and 60 sub-themes. For each Block period these were as follows:

For Block 2 (2019), 28 students agreed to participate and were booked in. Fourteen of the 28 attended over a three-day period, with seven interviews being conducted for 154 minutes in total. They were a combination of short to medium-length (15-31-minute) interviews, either individually or in small groups (2-3) due to student availability. One hundred and seventeen verbal comments were recorded. Most of the feedback was positive (89%) with 13 negative comments.

For Block 4 (2019), 23 students agreed to participate and were booked in. Twenty-one attended. Due to student availability, three, 23-30-minute interviews were conducted over one day as small FOCUS groups (Group 1, n = 8, Group 2, n = 4, Group 3, n = 9). The total interview duration was 79 minutes. The 21 participants provided 73 verbal comments.

The following presents the TA results of the combined interview data for Blocks 2 and 4, for each of the questions, including thematic maps. To reduce the volume of data presented the tables recording the exact student comments are not included. Moreover, this interview data was very similar, including repeated feedback, with the comments obtained from the individual questionnaire. Essentially, the same questions were used for both data-collecting instruments.

Q.1 - Did the teaching innovation promote your learning? If so, how? – Was learning promoted?

The question provided further information pertaining to the *learning* construct. Thirty-four responses generated 60 codes that were collated into 15 themes (Figure 4.36). Student feedback strongly indicated that learning was promoted with 95% of the code data reflecting positive experiences. Students reported that the teaching innovation had provided an alternative way to learn (25%), had provided an opportunity to learn through peer teaching (13%), and had promoted learning through the research of information (13%). A small amount

of feedback (5%) came from students that believed that the project didn't support learning and that too much time was spent on the production of the PodPoint rather than learning.

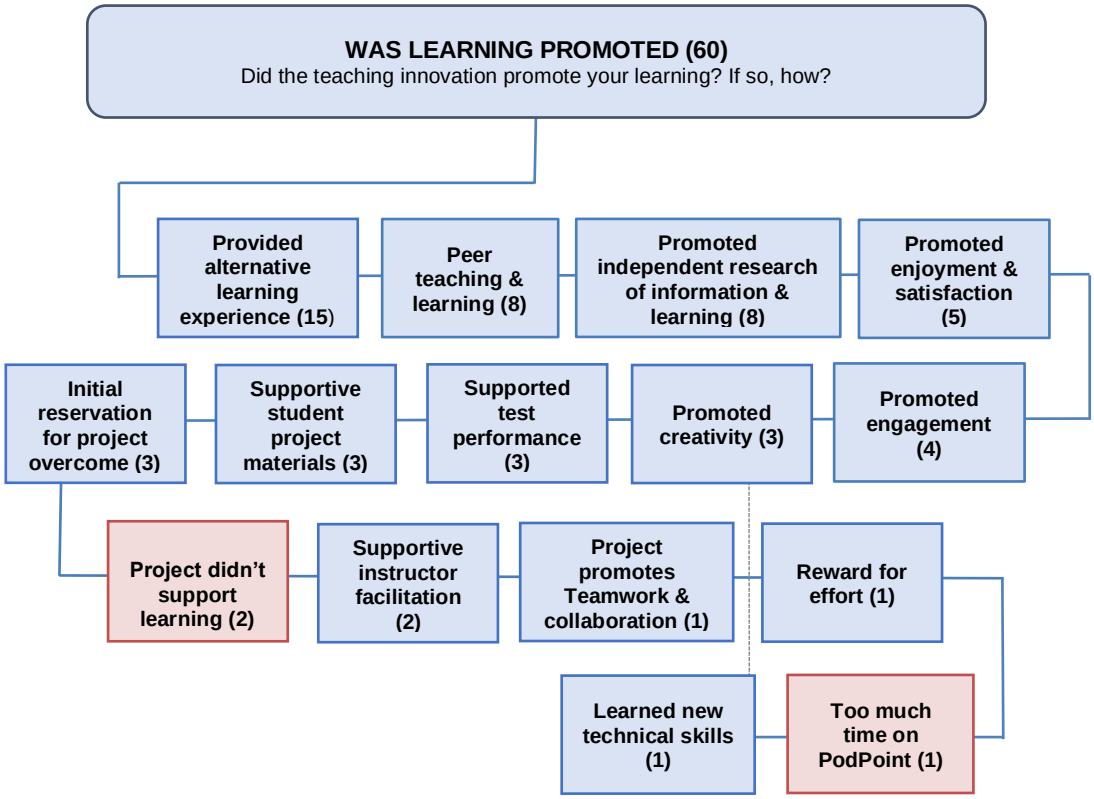


Figure 4.36. Interview. Thematic map for was learning promoted? Bold indicates themes. Sub-themes in italics. Number of codes in brackets. Red box colour indicates

Q2 - Did it help to motivate and engage you with the topic material? If so, how?

The question inviting feedback on students' perceptions about whether the innovation helped to motivate and engage them with the topic material provided further information pertaining to the *engagement* construct. Twenty-two comments generated 33 codes that were collated into 14 themes, and two sub-themes (Figure 4.37).

Just over half (54%) of the feedback indicated that students felt that the teaching innovation helped to engage and motivate them by providing an alternative, and better learning and assessment platform, by promoting enjoyment, and that good teacher engagement had supported learning.

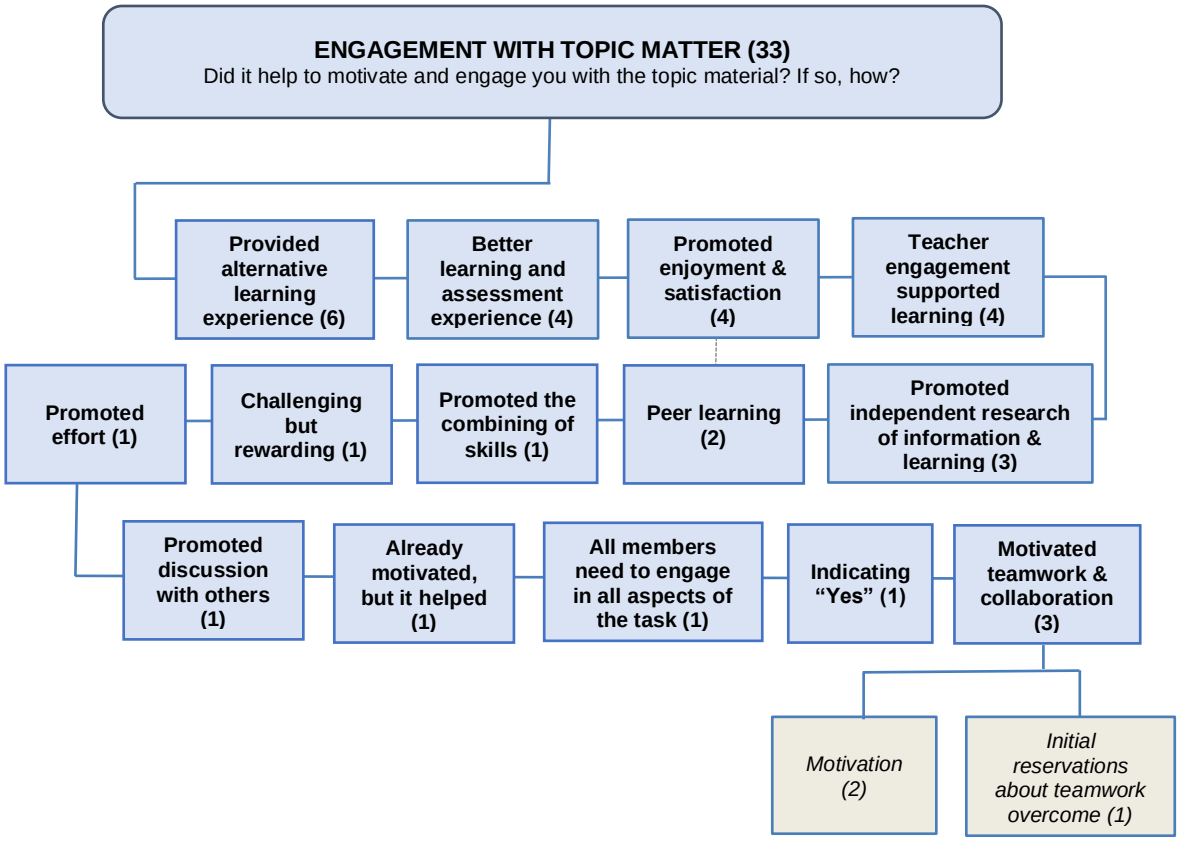


Figure 4.37. Interview. Thematic map for engagement with topic matter. Bold indicates themes. Sub-themes in italics. Number of codes in brackets.

Q3 - Do you think the teaching innovation promoted your creativity in the learning process? If so, how?

The question inviting feedback on students' perceptions about whether the innovation promoted creativity in the learning process provided further information pertaining to the *creativity* construct. Twenty-three comments were made, generating 29 codes that were collated into 14 themes, and 9 sub-themes (Figure 4.38).

Student feedback indicated that the teaching innovation promoted student creativity and the expression of it. Just over a third of the feedback (34%) related to student expression of creativity, such as with the PodPoint storyline, script and images used. Students enjoyed being creative with one student declaring that this was the first time that they had been so. Several other aspects related to creativity, collaboration, technology and others were also noted in the feedback. One student called for the need for more creativity to be used at university.

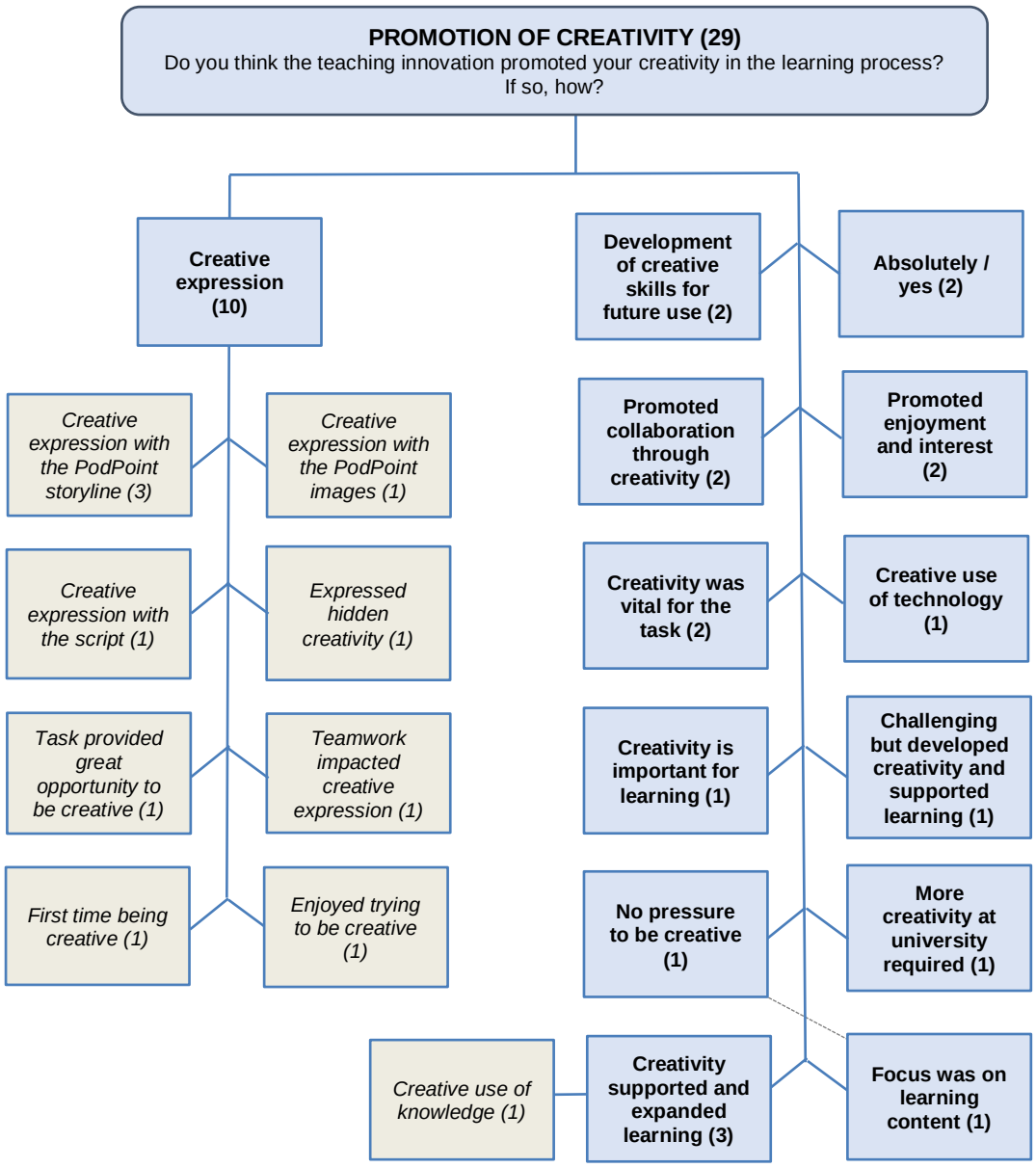


Figure 4.38. Interview. Thematic map for promotion of creativity. Bold indicates themes. Sub-themes in italics. Number of codes in brackets. Broken lines denote linkages.

Q4 - How did you find the use of the podcasting/PowerPoint technology?

The question provided feedback pertaining to the *technology* construct. Twenty-nine comments were made, generating 43 codes that were collated into four descriptive themes, and 19 sub-themes (Figure 4.39). For the most part, student feedback indicated that a positive experience occurred with the use of the technology and that it was easy to use (65%). However, just over a quarter (26%) of the feedback reported negative experiences and an additional 9% of the feedback related to students claiming that time constraints had impacted on their ability to do the work.

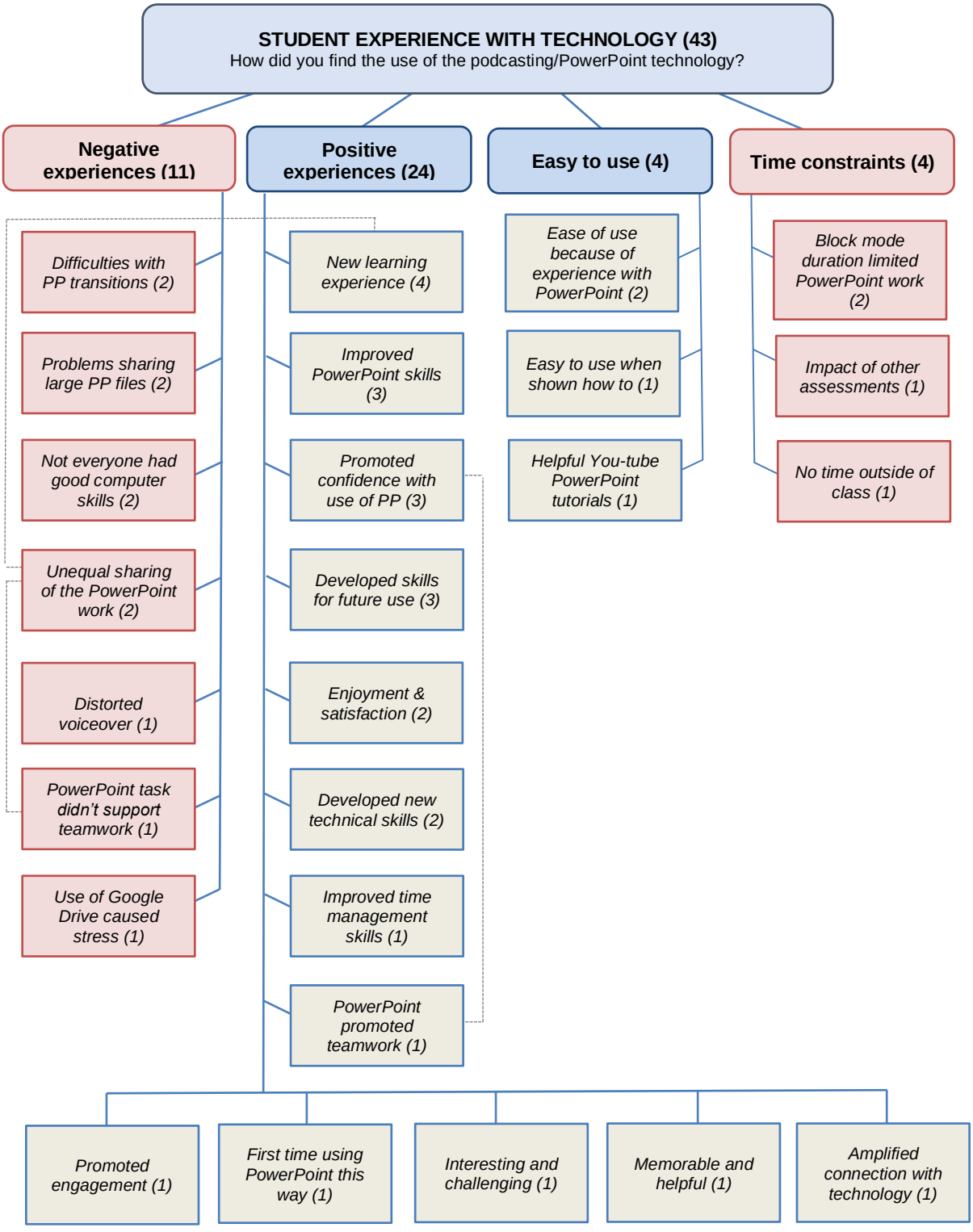


Figure 4.39. Interview. Thematic map for student experience with technology. Bold indicates themes. Sub-themes in italics. Number of codes in brackets. Red box colour indicates negative code. Dotted line indicates relationships, overlapping codes between themes. PP = PowerPoint.

Q5 - How did you find working in teams?

Forty comments provided feedback about the student experience of working in teams. Seventy-seven codes were identified, generating the two overarching categories, "Positive experience" and "Negative experience", with many themes and some sub-themes falling under each. There were slightly more codes extracted from the feedback for the positive experiences (41), compared to the negative experience category (31). A smaller number of codes fell outside of these two categories, creating the additional theme, "Further suggestions" (5) (Figure 4.40). The greatest combined positive feedback related to students having an enjoyable and satisfying team experience, and appreciation of the peer teaching and learning that took place (44% of the total positive feedback). The greatest negative feedback related to students reporting an unequal sharing of the workload (23% of the total negative feedback).

Q6 - What do you think about doing your own VARK analysis? Was if helpful is understanding your communication style?

As previously mentioned, this question gathered student perceptions on the constructs of critical thinking and communication with respect to the individual VARK questionnaire. Fourteen comments were made, eliciting 23 codes that were organized into 10 themes (Figure 4.41). The greatest combined feedback (48%) related to students believing the VARK to be useful for team member allocation and that it was helpful to understand their own VARK modalities.

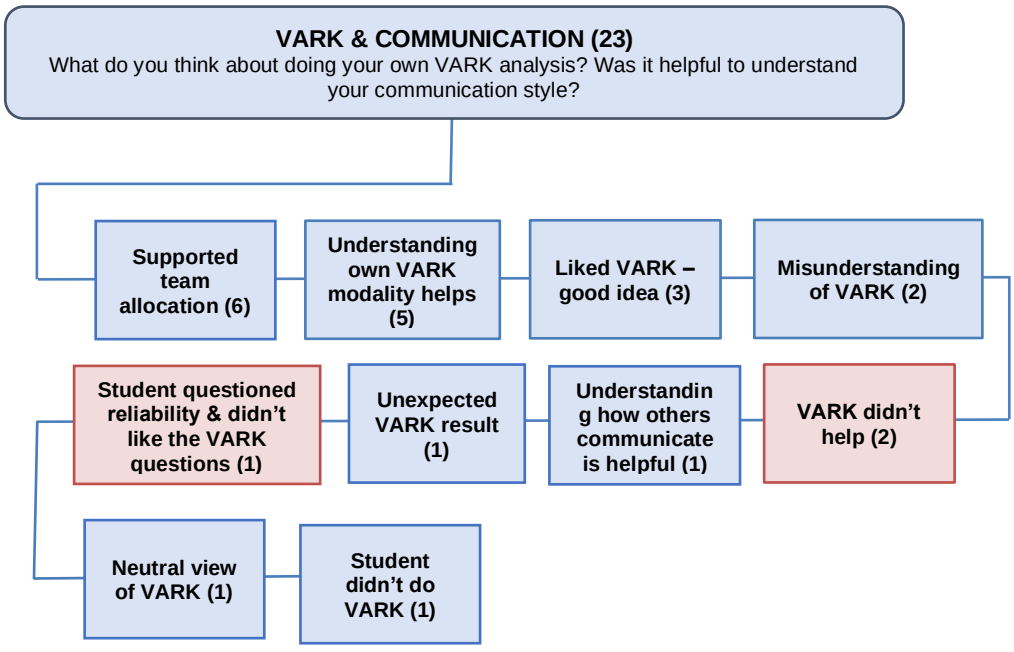


Figure 4.41. Interview. Thematic map for student experience with VARK and communication. Bold denote themes. Number of codes in brackets.

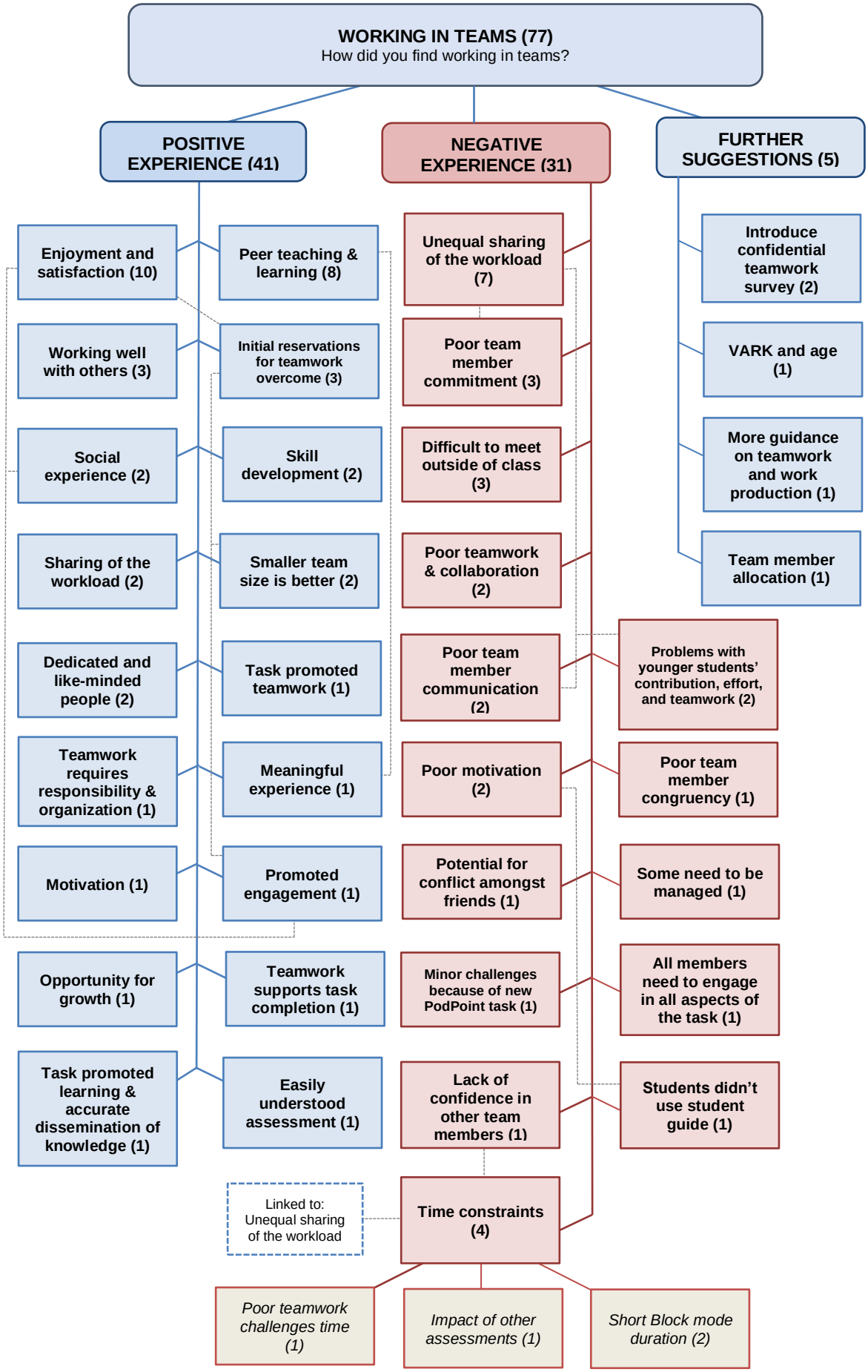


Figure 4.40. Interview. Thematic map for student experience with working in teams.

Q7 - Do you have any further comments or feedback?

The open-ended question inviting further feedback returned 26 comments. From these, 56 codes were identified and sorted into four themes, each with their own sub-themes (Figure 4.42). Just over half of the comments related to positive experiences (55%) and an additional 21% relating to suggestions for future use. Sixteen percent (16%) highlighted negative experiences reported by the students with some of those negative concerns being discussed by another student (7%).

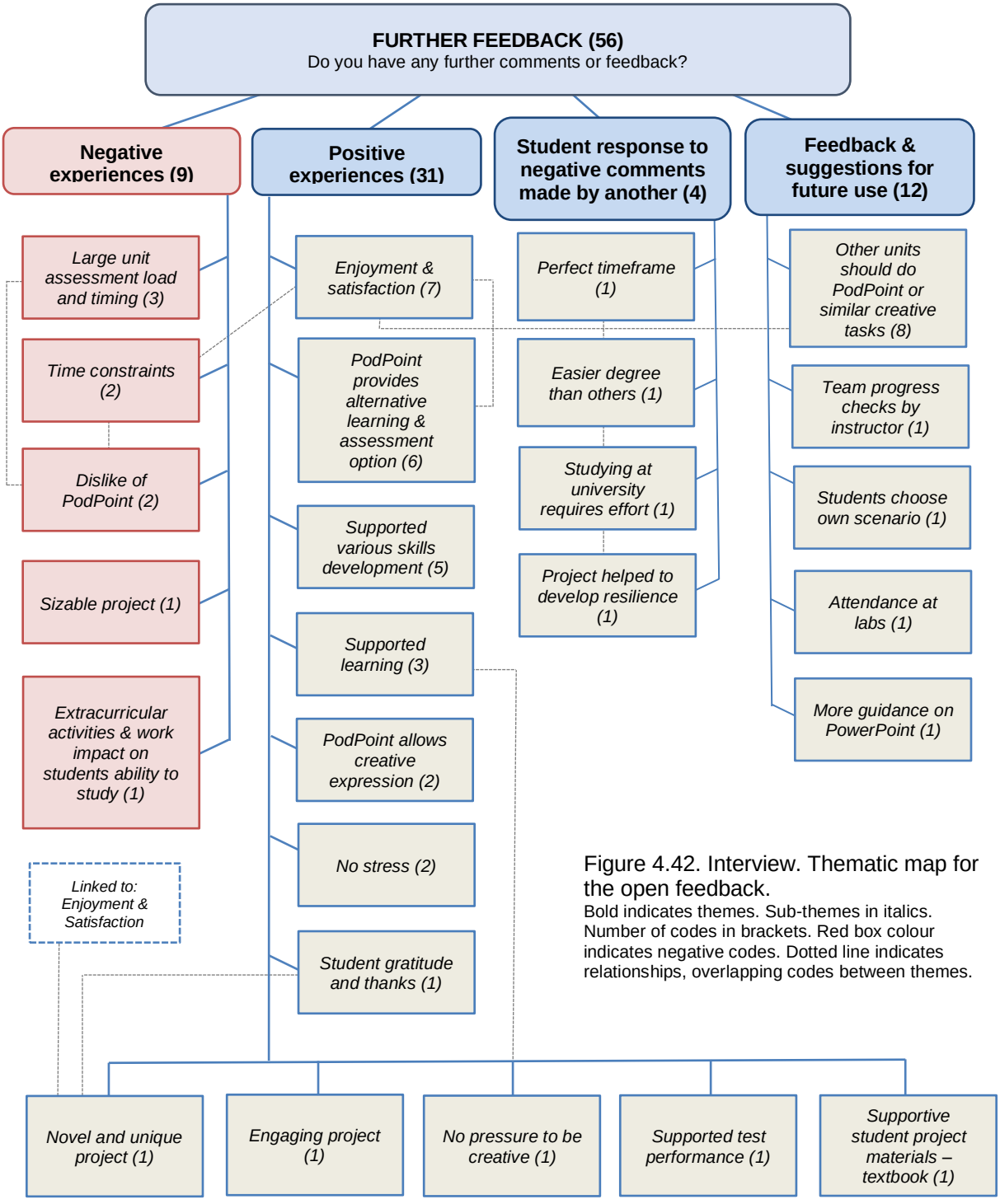


Figure 4.42. Interview. Thematic map for the open feedback.
Bold indicates themes. Sub-themes in italics. Number of codes in brackets. Red box colour indicates negative codes. Dotted line indicates relationships, overlapping codes between themes.

4.4.2 Summary of predominant construct themes & main end-themes

The following presents a TA analysis and presentation of the predominant themes and sub-themes identified from all qualitative data procured via the survey, questionnaires, and interviews. Complete TA involved, firstly, the generation of codes and themes, and sub-themes from the composite student feedback across the four qualitative data collections instruments (survey, individual questionnaire, teamwork questionnaire, interviews). A total of 779 comments generated 1259 codes that were organized into 315 themes and 228 sub-themes.

In the first instance, the responses for this data have been grouped and presented according to the eight constructs of interest thereby facilitating an understanding of the student engagement with, and perception of each. Then, recurring, and similar themes and sub-themes across the constructs have been grouped together under a predominant theme label. Again, it should be noted that this overall summary of the constructs includes further crossover data, with some codes relating to two or more of the constructs of interest. Further, there is the potential for repeated data -- comparable feedback from the same respondent, because of the same or similar questions being used across some of the data collecting instruments.

Across all four qualitative data collecting instruments, a total of 24 questions invited student feedback related to the eight constructs of interest, including open-ended feedback, and additional suggestions for future use. From these, a total of 539 themes, comprising 1845 codes were collated for all the construct themes (Table 4.8). These were then grouped into 109 predominant construct themes (Table 4.9). The final TA of these, including further cross-over and repeated data, resulted in the 16 main end-themes (1950 codes) that represented the summary findings of the students' experiences and perceptions of the novel teaching and assessment intervention.

Table 4.8. Total construct themes & subthemes for all qualitative questions.

Overall construct themes & sub-themes for all qualitative questions		
Construct of interest	**Themes**	**Codes**
Satisfaction	79	270
Engagement	70	258
Creativity	40	89
Learning	54	222
Critical thinking	47	229
Communication	31	164
Collaboration	172	509
Technology	46	104
	539	1845

Table 4.9. Summary for predominant constructs - code magnitudes and percentages.

Summary for predominant construct themes and magnitudes			
Construct of interest	**Predominant Themes**	**Codes**	**%**
Collaboration construct	31	509	27.6
Satisfaction construct	13	270	14.6
Engagement construct	13	258	14.0
Critical thinking construct	20	229	12.4
Learning construct	7	222	12.0
Communication construct	7	164	8.9
Technology construct	10	104	5.6
Creativity construct	8	89	4.8
	109	1845	100.0

The predominant theme findings for each of the constructs of interest (predominant construct themes) are now presented with the related magnitudes tabulated and graphed (%).

4.4.2.1 Constructs of interest – predominant construct themes

4.4.2.1.1 Satisfaction construct

The 79 themes and sub-themes comprising 270 codes produced the following 13 predominant construct themes seen in Table 4.10.

Table 4.10. Predominant themes - Satisfaction construct.

Predominant Satisfaction Construct Themes	**(%)**	**Codes**
Enjoyment & satisfaction	28.1	76
Positive teamwork experience	21.5	58
Negative teamwork experience	11.9	32
Instructor was helpful	8.5	23
Dissatisfaction	6.3	17
PowerPoint Skills and PodPoint production	5.6	15
Ideas generation, story, & script	3.7	10
Skills development and resilience	3.7	10
Low level of perceived stress	3.0	8
Large unit assessment load & timing	3.0	8
Future suggestions & feedback	2.6	7
Supportive student project materials & textbook	1.9	5
Extracurricular activities & work impact on students' ability to study	0.4	1
	100.0	270.0

Approximately 76% of the grouped code data reflected the finding that students were extremely satisfied with the project task. Predominant themes gave a very good indication that students were satisfied with the teamwork experience and the overall project/task experience. Fifty percent (50%) of the data related to this.

Students were further satisfied with the instruction, support, and guidance of the instructor, and with the efforts they had made towards the completion of the task and the creation of the PowerPoint. Students were also satisfied with the work they had put towards the generation of ideas, including scenarios for PodPoint stories and scripts. Further distinctive themes included satisfaction with new skills development, the building of resilience, and a low level of perceived stress for the task. Finally, five codes supported the theme that students were satisfied with the guidance and instruction provided by the student project materials (PodPoint Project Student Guide and textbook).

In comparison, approximately one-fifth (21%) of the grouped code data reflected student dissatisfaction. Over half (55%) of this related to negative teamwork experiences, and the remaining students' dissatisfaction with a general dislike of the entire project and the creation of the PodPoint itself. Additionally, one theme ("Large unit assessment load & timing") indicated dissatisfaction by highlighting student concerns with the number of unit assessments (including the PodPoint task) that were required to be undertaken over the short time frame of 4-weeks. Dissatisfaction was also related to the timing of these tasks, as some were due on the same date. Some students felt that the PodPoint task itself was sizeable and that more time was needed to complete it. Furthermore, one theme, while not a predominant one (according to code magnitude or similar themes), was included because it distinctively had a potential impact on a students' level of satisfaction with the project task and entire unit. This theme comprised of one code and was extracted from one student comment (interview) and labeled "Extracurricular activities & work impact on students' ability to study". As previously mentioned, this student (and team member) failed to produce a PodPoint for the peer-review assessment of them and received an extension from the unit chair to produce the work. Unfortunately, based on the work PodPoint received and the results of other unit assessment tasks the student didn't pass the unit. While this student returned strong negative feedback about the PodPoint project task, they also indicated that they had difficulty committing to the workload of the unit because of extracurricular activities and outside work commitments. The unit chair also noted that this student had commitment issues.

A final theme reflected the potential for future student satisfaction based on present student feedback about the project and its future delivery of it. Seven (7) codes were included in the theme "Future suggestions & feedback" and included the following suggestions and feedback - that the choice of topic for the task be made by students; students choose the scenario of the project (outside of the Zombie narrative), the project task should be made easier to share as a team; that all students should participate in all project tasks together, and

not divide them up; that the project task has a greater allocation of the overall unit mark; that the instructor conducts regular team progress checks and greater policing; and that previous student PodPoint work should be made available for viewing for students before them undertaking the task.

4.4.2.1.2 Engagement construct

The 70 themes and sub-themes comprising 258 codes were grouped under the following 13 predominant themes listed in Table 4.11.

Table 4.11. Predominant themes - Engagement construct.

Predominant Engagement Construct Themes	(%)	Codes
Promoted independent research of information & learning	21.3	55
Positive teamwork promoted learning	20.2	52
Positive teamwork promoted communication, discussion, & ideas sharing	9.3	24
Engagement & motivation	8.1	21
Negative teamwork & topic engagement	9.7	25
PowerPoint Skills and PodPoint production	5.8	15
Engagement via creative expression	5.8	15
Positive instructor experience	5.8	15
Positive teamwork supported task completion	4.7	12
Future suggestions & feedback	0.8	2
	100.0	258

Analysis of these demonstrated that the PodPoint Project intervention strongly supported student engagement across several areas. A total of 231 codes (89.5%) were associated with positive feedback for this. Students felt engaged and motivated by the project task, with approximately 21% of feedback indicating that the task had promoted independent student research of the information and that it had engaged them with the learning process. Another 29% of the positive feedback related to students feeling engaged through positive teamwork. Students reported that positive teamwork promoted learning and engagement via constructive communication, discussion, and ideas sharing among team members. Students also acknowledged that the skills developed by the present teamwork project will be important for future career skills. Importantly, reflecting upon another team's outcome, one student indicated that the experience of sharing with others supported mental health.

Additionally, several students believed that positive teamwork ensured the successful completion of the PodPoint task. It was further reported that certain tasks associated with the PodPoint Project itself helped students to engage. For example, students reported satisfaction with their efforts and handiwork with the PowerPoint slides and overall resultant PodPoint work. Teacher interaction was also addressed in the feedback, giving rise to an additional common theme labeled "Positive instructor experience". It comprised several codes reflecting

the importance of the teacher's role in fostering student interest, satisfaction, and engagement. Students felt that the instructor supported learning, via instructor guidance, passion, and patience. Notably, one student reported that the instructor inspired them to engage with the task. Lastly, a small amount of student feedback simply indicated that the PodPoint Project task was "Overall, a good experience."

The remaining feedback was grouped under the following two themes, "Negative teamwork & topic engagement" and "Future suggestions & feedback". Approximately 9.5% of the entire feedback grouped under the satisfaction construct indicated student dissatisfaction with the PodPoint Project experience, and a small amount about further suggestions. Regarding the level of engagement, students felt that teamwork didn't help them to engage, with teamwork problems causing stress. Poor team collaboration and communication, poor team member participation and commitment, poor teamwork skills, unequal sharing of the project workload, and poor delivery of the work were some of the teamwork problems encountered. A small number of students felt that poor teamwork negatively affected learning, with some indicating a preference for independent work and assessment tasks. Additionally, one student felt that too much time was given during the project to the construction of the PodPoint itself and not enough time for the learning aspect.

Concerning the theme "Future suggestions & feedback", students suggested that the future delivery of the PodPoint Project could include greater involvement by the instructor with the teams, via more feedback about their progression and overall team effort being done. Another student also suggested that regular key team task indicators should be used by the instructor to police team dynamics and progression of the project work.

4.4.2.1.3 Creativity construct

The 40 themes and sub-themes comprising 89 codes related to the *creativity* construct were grouped together forming the following 8 predominant themes listed in Table 4.12.

Table 4.12. Predominant themes - Creativity construct.

Predominant Creativity Construct Themes	**(%)**	**Codes**
Supported & promoted creativity	48.3	43
Enjoyment, satisfaction, & engagement	13.5	12
Promoted Learning through creativity	9.0	8
Novel creative pedagogy	9.0	8
Promoted collaboration through creativity	7.9	7
Creative skills development	7.9	7
Creativity not supported	2.2	2
Further suggestions & feedback	2.2	2
	100.0	89

Six of the eight predominant themes for the creativity construct strongly indicated that students believed that the intervention supported and fostered creativity for them as well as the learning process. Eight-five codes (95.5%) related to supportive feedback about various creative aspects of the intervention, with just under fifty percent (48.3%) of the feedback indicating that the intervention supported and promoted creativity. Students believed that creativity was vital for the task and reported that the project had supported and promoted creativity in ideas generation, story, and script creation. Students acknowledged that the novel PodPoint task allowed for creative expression with the PodPoint construction. They enjoyed aligning the team scenario with the PodPoint images, as well as producing the individual PodPoint team storylines.

Overall, students felt that the task was enjoyable and provided a great opportunity to be creative, with one student happily reporting that the task had allowed them to discover and express hidden creativity. Another student reported that this was the first time they had been creative with a project. Other students identified that the project while being challenging, had developed their creativity, and appreciated the fact that there was “no pressure to be creative”. Students also recognized the uniqueness of the intervention, describing it as a “great innovation”, “unique” and “novel”. One student recognized that the project task afforded a creative use of technology (PowerPoint). Several themes, including “Creative use of skills”, “Creative skill enhancement”, and the “Development of creative skills for future use” further indicated the positive influence of the task on student creativity. These were grouped under the dominant theme of “Creative skills development”.

Another theme (Promoted collaboration through creativity) demonstrated that students believed that the task promoted teamwork and collaboration through being creative. Students appreciated discussing and sharing ideas among team members. In comparison, a very small amount of the feedback indicated that the task itself didn’t promote creativity or the expression of it. One student felt that their creative expression was limited by the other members of their team. Another small theme is related to further suggestions and feedback. Students felt that more creativity is required at university and that other units should either incorporate the PodPoint project task into their curriculum or undertake similar creative tasks.

4.4.2.1.4 Learning construct

The 54 themes and sub-themes comprising 222 codes related to the *learning* construct were grouped into the following 7 predominant themes and associated codes listed in Table 4.13.

Table 4.13. Predominant themes - Learning construct.

Predominant Learning Construct Themes	(%)	Codes
Positive teamwork, discussion, & collaborative Learning	33.8	75
Promoted learning & content engagement	27.9	62
New Creative Learning & Assessment Pedagogy	19.4	43
Negative teamwork affected learning & topic engagement	7.7	17
Promoted Enjoyment & satisfaction	5.0	11
Project didn't support learning	3.6	8
Additional learning outcomes	2.7	6
	100.0	222

The thematic analysis found that five of the seven predominant themes supported the finding that the project task positively fostered learning for the students. Approximately eighty-nine percent (88.7%) of the code data was related to this. Three principal themes encompassed the positive effects associated with collaborative learning, the positive effects of the intervention on student learning and content engagement, and the positive reception expressed by the students to the new learning and assessment pedagogy. Concerning collaborative learning, positive outcomes appeared to be related to good teamwork dynamics and communication. Students found that the task supported teamwork and promoted discussion and the sharing of ideas. Peer teaching and learning were identified as helpful outcomes, as well as positive team member support, and sharing of the workload. Moreover, one student reported that the positive collaborative learning experience supported mental health. Regarding the project task and its effect on learning, substantial feedback indicated that students believed that the task had promoted and supported learning through independent research and greater content engagement. Additionally, students appreciated the novel task and were receptive to the new learning and assessment pedagogy. Feedback indicated that students valued the alternative learning and assessment experience, as it motivated them and provided an enjoyable and fresh way to present and engage with the information. Some considered it to be a better learning and assessment experience than the more traditional methods. Others appreciated the clear and specific instructions imparted by the teacher-prepared project materials (e.g.: - PodPoint Project Student Guide), and one student indicated that the task motivated them to learn and to use the technology.

Approximately eleven percent (11.26%) was associated with negative feedback. The thematic analysis also found that some students believed that the project task didn’t support learning, with some feedback either stating that it didn’t promote learning or simply indicating “No” with no further comments. Several students indicated that poor teamwork had affected learning and engagement with the topic matter. One student felt that there was not enough emphasis on the learning aspect of the task.

A small amount of feedback was associated with further learning outcomes. Students reported that the learning of the allocated team PodPoint topic had supported test performance (answering test questions), and further believed that the experiential learning helped develop important career skills for the future.

4.4.2.1.5 Critical thinking construct

The project task incorporated several aspects that supported higher-order thinking. The processes of experiential, collaborative, and AL culminated in the construction of a piece of work (PodPoint) that reflects a high degree of creativity and critical thinking skills. According to The Australian Council for Educational Research (ACER), critical thinking encompasses several elements involving knowledge construction, evaluating reasoning, and decision-making skills (Heard et al., 2020).

The fundamental work of the present project is founded on critical and innovative thinking, and knowledge construction. To determine student perceptions on this and others, the qualitative data collecting questions focused on gathering critical feedback concerning several constructs of interest. Subsequently, much data has been procured through the student evaluation of them and is presented across the summaries for each of the constructs of interest. However, to converge focus for the critical thinking construct, four of these questions required students to critically appraise their performance and view of self, as well as the performance of others. The analysis of the feedback associated with these four key questions is presented below. Furthermore, the peer-reviewed student assessment of other teams' PodPoints provided a further practical experience allowing students to reflect on other students' work and to critically assess them using a marking rubric.

Thematic analysis of these questions generated a total of 47 themes consisting of 229 codes, that were grouped into 20 predominant themes. These questions and the principal findings of the student reflections for each are now presented.

Q1. What do you think about doing your own VARK analysis? Was if helpful to understand your communication style? (VARK Analysis).

Fourteen themes comprising 41 codes were generated from the student feedback for this question. Grouping for predominant themes and sub-themes, produced the four themes listed in Table 4.14.

Table 4.14. Predominant Critical Thinking themes - VARK.

Predominant Critical Thinking Construct Themes - VARK Analysis	(%)	Codes
Positive reflection of VARK	63.4	26
Negative reflection of VARK	24.4	10
Misunderstanding of VARK	9.8	4
Neutral view of VARK	2.4	1
	100.0	41

Students were able to critically appraise their VARK results and use them. While a small number of students had incorrectly associated it with “learning styles” rather than communication styles, the majority either returned a positive reflection or negative reflection of their VARK and application. Students felt the use of the VARK analysis was a good idea and that it supported team member allocation. The VARK analysis also helped students to understand their preferred communication styles – that is, how they prefer to receive information as well as communicate it. One student felt that VARK was important, as it helps students to critically think about learning. Another looked beyond their VARK result and reflected on how knowing other peoples’ results can help with communication. In contrast, negative reflections of VARK included feedback that either simply indicated that it didn’t help, that it didn’t help in understanding communication style, or that it did not help with how the team interacted. One student reported that they didn’t like the VARK questions used and questioned the reliability of it, as well as other questionnaires. Interestingly, they further admitted that they had not completed the VARK questionnaire honestly, and just selected random responses for the answers to the questions. Another student, upon reflection, had no concrete view about their VARK result, indicating a neutral position on it.

Q2. Do you feel that you made a valuable contribution to the outcome of the PodPoint task? If so, how? (Individual Performance Appraisal).

A total of 14 themes comprising 86 codes were generated for this question. Grouping for common themes and sub-themes gave rise to the 5 predominant themes listed in Table 4.15.

Table 4.15. Predominant Critical Thinking themes – Individual Performance.

Predominant Critical Thinking Construct Themes - Individual Performance Appraisal	(%)	Codes
Collaboration and teamwork contribution	31.4	27
Research of information and content	26.7	23
Creative input	20.9	18
PowerPoint Skills and PodPoint production	17.4	15
Satisfaction & enjoyment	3.5	3
	100.0	86

This question invited students to reflect on the individual work they had done towards the completion of the PodPoint task and to evaluate whether their efforts made a valuable contribution to the end work.

Upon reflection, students indicated that they enjoyed contributing and were overall satisfied with their contribution to the PodPoint task. The predominant theme, “Collaboration and teamwork contribution”, comprised several sub-themes indicating that the students believed that they had made valuable contributions towards team collaboration, equal sharing of the work, and the sharing of knowledge. Students reflected that this involved the use of different skill sets, with one student believing that their efforts in project management had a substantial effect on the outcome of the project task. Another student felt that they had made a valuable contribution by helping to motivate and to engage their team members with the task. Two students felt otherwise. One was not sure about the impact of their contribution, while the other felt that their team members did not appreciate or recognize the efforts and work done by them. Another predominant theme identified that many students felt contented and pleased with the work they had put into researching the information and content that was put into the PodPoints. This information was independently researched and then used as part of the PodPoint content and helped them to engage with the task. Additionally, many students believed that their creative input concerning ideas, storyline, script, and script narration added value to the final PodPoint result. Some of this creative input further combined technical skills, as several students expressed satisfaction with their PowerPoint work done to create the PodPoint.

Q3. Do you feel that the other members of your team made valuable contributions? (Team Member Appraisal).

Thematic analysis found 15 themes and sub-themes comprising 74 codes relating to this question. These were grouped into the following seven predominant themes listed in Table 4.16.

Table 4.16. Predominant Critical Thinking themes – Team Member Appraisal.

Predominant Critical Thinking Construct Themes - Team Member Appraisal	**(%)**	**Codes**
Positive team member contribution	60.8	45
Negative team member contribution	18.9	14
Poor team member effort	10.8	8
Great communication, collaboration & engagement	2.7	2
Small team size supported teamwork and performance	2.7	2
Team members caused stress	2.7	2
Poor team member communication	1.4	1
	100.0	74

To gain a critical appraisal of the performance of the team, students were offered to provide feedback about the other team members. Specifically, students were invited to give feedback on how they felt about the contributions of their team members and if those contributions added value to the completion of the project task. This required students to critically think about the project task requirements, and then, whether they believed the other team members met those requirements. It further allowed students to critically appraise the team dynamics and how the team collaborated and, if assigned, whether the team members successfully undertook their individual task roles.

Following student reflection, approximately two-thirds (66%) of the feedback indicated that students felt that their team members made valuable contributions to the project task. A large number (43%) for this simply indicated "yes" with no further critical appraisal on why they thought so. However other students provided further critical review, reporting that they were satisfied with the efforts of their team members, with some believing that the team members either made a valuable equal or valuable part contribution towards the work. Additionally, some felt that the positive team member contribution was supported by great communication, collaboration, and engagement. It was further noted that the small team size (two members) supported this collaborative process.

In contrast, approximately one-third (34%) of the student feedback comprised critical feedback representing a negative stance towards team member contribution. Several students felt that their team members didn't contribute equally and that some had poor motivation, poor communication, poor commitment, and poor work ethics. Students reported that some team members made no contribution toward the outcome of the project task and indicated their disappointment about some team members not attending the PodPoint labs. Some of this caused stress.

Q4. Was the instructor helpful? (Instructor Appraisal).

This question further allowed students to critically think about the performance of another individual, in this case, the teaching staff, and to analytically express a judgment on it.

A total of 28 codes of data was obtained from the feedback that generated 4 themes and 3 sub-themes. As this question solely related to the individual questionnaire and was not used across any of the other data collecting instruments, no further themes or sub-themes could be collated and compared. Accordingly, these themes and sub-themes are considered the predominant ones for this feedback. Table 4.17 lists these.

Table 4.17. Predominant Critical Thinking Construct themes – Instructor Appraisal.

Predominant Critical Construct Themes - Instructor Appraisal	(%)	Codes
Instructor was helpful	64.3	18
Instructor guidance	14.3	4
Instructor patience & understanding	10.7	3
Instructor passion	10.7	3
	100.0	28

A critical analysis by the students about the instructor's performance found that students were pleased and satisfied with it. No negative criticisms were made. Just under two-thirds (64%) of the feedback indicated that the instructor was helpful to very helpful, eliciting codes such as "absolutely" and "definitely". A deeper critical review by the students showed that the students appreciated the instructor's guidance on several project task elements, appreciated the patience and understanding given by the instructor, and appreciated the passion and enthusiasm shown by the instructor with one student being inspired by this.

4.4.2.1.6 Communication construct

Thematic analysis uncovered a total of thirty-one themes and sub-themes comprising 164-codes that were related to the *communication* construct. These were grouped under the following seven predominant themes listed in Table 4.18.

Table 4.18. Predominant Communication Construct themes.

Predominant Communication Construct Themes	(%)	Codes
Communication, sharing, & learning	32.9	54
Project promoted communication & skills	25.6	42
VARK & Communication	22.6	37
Poor team communication & dynamics	7.3	12
Communication supported project task completion	5.5	9
No improvement	4.9	8
Other positive aspects	1.2	2
	100.0	164

Students believed that team collaboration and discussion was an important part of the learning process. Eighty-three percent (83%) of the code data reflected either strong support for this position or highlighted further aspects of positive communication and collaboration on

learning. Good communication among team members with the sharing of knowledge and ideas were reported as important aspects facilitating learning in the team environment. Students reflected on how the task had supported and fostered communication and discussion. It was acknowledged that working and communicating with diverse groups of people helped to develop communication skills, and the ability to gain a greater understanding of others. Some students further identified that this has helped to develop confidence for them, as well as recognising the importance of this experience for future skills use. Others indicated that they believe that effective communication was pivotal for the successful completion of the project task. Additionally, one student recognised the effect that positive team communication had on mental health and wellbeing.

Concerning the VARK questionnaire, most of the student opinions reflected a positive experience with it. Students reported that it helped them understand their preferred communication style, as well as being helpful to understand how others like to communicate. On reflection, some students felt that it was a useful tool to allocate team members and thought that it was a "good idea". On the other hand, some students believed that it didn't help to understand their communication style, however, it was also noted that some students had a misunderstanding of VARK, believing it to be a questionnaire to determine learning styles, rather than communication styles. One student reported receiving a VARK profile result that surprised them, expecting to have a different outcome. Another student disparagingly questioned the validity of the questionnaire and disliked some of the VARK questions. This student, however, admitted to not taking the questionnaire seriously and had randomly selected answers.

Not all student feedback echoed satisfaction. Critical feedback from the students revealed that some teams had negative experiences with team communication and this impacted on learning. Poor team communication and collaboration, poor team member commitment, unequal sharing of the workload, and the poor delivery of allocated student work were reported as some of the problems that the students believed to have negatively impacted the experience. Furthermore, some students believed that no improvements occurred with their ability to communicate, as they felt that they already had sound pre-existing communication skills. Another student felt that communication, collaboration, and team direction were severely lacking, so they decided to take on the role of the team leader but felt "forced" to do it.

4.4.2.1.7 Collaboration construct

Thematic analysis uncovered a large amount of data pertaining to the *collaboration* construct. A total of 172 themes and sub-themes, comprising 508 codes, was collected from the four qualitative data collecting instruments. This feedback was initially grouped under the following three overarching categories including "Good teamwork dynamics (Positive)", "Poor teamwork

dynamics (Negative)", and "Suggestions for future use". The "Good teamwork dynamics (Positive)" overarching category (349 codes) included the following 11 predominant and notable themes listed in Table 4.19.

Table 4.19. Predominant Collaboration Construct themes – Good team dynamics.

Predominant Collaboration Construct Themes - Good team dynamics	(%)	Codes
Positive teamwork & collaborative experience	24.6	86
Task supported collaborative learning	21.2	74
Contribution and sharing of the workload	14.6	51
Positive communication and discussion	9.7	34
Sharing of ideas, views, and perspectives	6.9	24
Skills development & use	6.6	23
Task promoted collaboration & teamwork	4.3	15
Other notable positive aspects	4.0	14
Motivation & engagement	3.2	11
Collaboration supported task completion	3.2	11
Team size and collaboration	1.7	6
	100.0	349

Sixty-nine percent (69%) of the student feedback related to good teamwork dynamics and collaboration. This included the finding that students enjoyed and were satisfied with the teamwork experience, with helpful and supportive team member collaboration being reported as a primary reason. Other reasons included team congruency being supported by others that were like-minded and equally dedicated as well as the bringing together of different strengths. Moreover, some students reported that no negative teamwork experience had occurred and that the initial reservations about working as a team were overcome by the positive collaboration that took part in the present task. Notably, the collaborative interaction that took place was reported by one student to be a "meaningful experience", and another reported that their prior negative team experiences were not repeated with this project. Student feedback also indicated that they felt that the PodPoint task itself promoted and supported collaborative learning. This occurred through peer teaching and learning, with discussion and sharing of knowledge comprising a large part of this. Additionally, students reported that collaborating with others with different learning styles was beneficial. Equal contribution and sharing of the workload were also found to be a common theme, with positive collaboration supporting this outcome. Further common themes were associated with positive communication and discussion; the facilitation and sharing of ideas, different views, and perspectives; and the collaborative use of different skills sets including the development of new skills, such as collaborative skills, future career skills, leadership skills, project management skills, and problem-solving skills. One student recognized that the collaborative experience had provided an opportunity for personalized "growth". Some students also acknowledged that the task itself

had placed them in a position to work collaboratively, while others identified that the effective collaboration that took place among them was pivotal for the successful completion of the task. Further feedback indicated that several students felt that the collaborative task helped to motivate them and facilitated their engagement with others, as well as with the topic, and the project task itself. Small team size was also reported to have a positive effect on collaboration and work production. Other notable aspects of the positive collaboration experience included the enhancement of creativity, the reward of good social interaction, developing respect for others, and the support for mental health.

The "Poor teamwork dynamics (Negative)" overarching category (137 codes) included the 6 distinctive predominant themes listed in Table 4.20.

Table 4.20. Predominant Collaboration Construct themes – Poor team dynamics.

Predominant Collaboration Construct Themes - Poor teamwork dynamics	**(%)**	**Codes**
Poor team member participation, collaboration & commitment	35.8	49
Unequal work contribution and poor delivery of work	26.3	36
Other notable negative aspects	19.0	26
Poor team communication	10.9	15
Negatively affected learning and other work outcomes	5.8	8
Task didn't support teamwork & collaboration	2.2	3
	100.0	137

Twenty-seven percent (27%) of the feedback indicated poor teamwork dynamics. Students reported that some team members were not enthused to help and didn't participate or participated poorly in the collaborative task. Poor motivation, lack of work effort, lack of attendance in the labs, or commitment to meet outside of them, was cited as some of the issues of concern. A large body of data across several sub-themes for this construct further demonstrated that students believed that some students didn't contribute to the production of the work, or when they did, there was an unequal sharing of the workload across the team members. It was also reported by some of the students that the work done by their team members was of a poor standard and that no valuable contribution was made. Poor team member communication, within the labs and outside of them was further reported to be an issue. A small number of students felt that the VARK profiling questionnaire about communication didn't help with the team dynamics or with the collaboration that took place. For some, these issues negatively affected learning and other outcomes such as impeding the rate and timely delivery of the work, as well as team engagement with topic material. One student felt that the PodPoint task itself did not support teamwork and collaboration. This is solely related to the fact that one team member took charge and did all the PowerPoint work for the task. Some other minor, yet notable negative aspects were reported to be a preference

by some students for independent work, as they felt that it would have been easier to do the task individually. Some noted that their team members had a lack of teamwork and collaborative skills, including problems with younger students' contribution, effort, and teamwork commitment. One student reported that the other team members had not read the PodPoint Project Student Guide which they felt showed a lack of commitment. Additionally, concerns were raised in the feedback about the unfair distribution of marks for the team project, dissatisfaction with small team sizes, that some students had little confidence in the abilities of their team members, and that some members needed to be “managed”. Much of this caused stress for students with one student declaring that bad teamwork had marred what should have been an enjoyable project experience.

The final overarching theme, “Suggestions for future use”, grouped together the remaining 4% (23 codes) of the feedback. This data was collected from the open-ended questions inviting further feedback, as well as the question inviting student suggestions that could potentially enhance future working as a team. Table 4.21 lists the predominant themes and magnitudes (%).

Table 4.21. Predominant Collaboration Construct themes – Suggestions for future use.

Predominant Collaboration Construct Themes - Suggestions for future use	**(%)**	**Codes**
Student selection of teams	17.4	4
Participation, contribution, and greater attendance needed	13.0	3
Remove teamwork	13.0	3
Introduce confidential teamwork survey	8.7	2
Equal team member number	8.7	2
Commence teamwork early	4.3	1
Earlier allocation to teams	4.3	1
VARK and age	4.3	1
Greater team diversity	4.3	1
Ensure team member congruency	4.3	1
Team Progress checks by instructor	4.3	1
More guidance on teamwork and work production	4.3	1
Ensure workload is equally shared	4.3	1
Don’t work with same team again	4.3	1
	100.0	23

The principal findings demonstrated that students would prefer greater control in the selection of the teams, with students’ choosing team members and equal numbers, that greater attendance, participation, and work contribution occur equally for all student team members, and that the introduction of a confidential teamwork survey is used to gauge this team member performance. Other suggestions included the earlier allocation to teams

allowing earlier commencement of work, with greater team guidance and policing by the instructor occurring with the inclusion of team progress checks. One suggestion was put forward that the VARK questions should be better tailored to different age groups, and another called for greater team member diversity. Conversely, another student suggested that team congruency should be considered when allocating them. Negative suggestions included the call for the removal of teamwork, plus one student stipulating to never work with the same team members again.

4.4.2.1.8 Technology construct

Thematic analysis generated 46 themes and sub-themes comprising 104 codes for the *technology* construct. Grouping of the feedback data produced the following 10 predominant themes listed in Table 4.22.

Table 4.22. Predominant Technology Construct themes.

Predominant Technology Construct Themes	**(%)**	**Codes**
Technical skills enhancement	30.8	32
Enjoyment & satisfaction	19.2	20
New way to learn & use technology	16.3	17
More PowerPoint Instruction	7.7	8
Problems using the technology	6.7	7
Promoted engagement with technology	5.8	6
Teamwork, technology & stress	4.8	5
Time constraints affected PowerPoint work	3.8	4
Promotion of other skills	2.9	3
Technology promoted engagement with others	1.9	2
	100.0	104

Seventy-seven percent (77%) of the grouped data reflected positive feedback and student experience with the PowerPoint App technology used for the PodPoint project task. Students reported either enhancing existing technical and PowerPoint skills or completely learning new skills. It was also recognized that the project task had developed important technical skills for future use. Much of the feedback indicated students enjoyed using the PowerPoint App technology and were satisfied with the work done. Some students found the technology easy to use, while others initially found it challenging. However, following instructor support and education, as well as team support, the challenges were soon overcome and resulted in a rewarding and memorable experience. Additionally, several students acknowledged the task to be a new way to learn and use technology. Feedback described the

project as a new and interesting method that creatively used technology to foster learning. One student reported that this was the first time they had used PowerPoint in this way, while another reported that the task had amplified their connection with technology. Likewise, other students reported that the task boosted their engagement and motivation to use the technology, with some reporting that the project experience had helped them to gain confidence in using technology. Less prevalent but noteworthy feedback included students reporting that the creation of the team PodPoint helped them to engage with others and that the creation of the PodPoint had cultivated their creativity skills. Moreover, while not specifically related to the technology construct, two students indicated that they felt the task had improved their time management skills.

The remaining twenty-three percent (23%) of the grouped data encompassed negative student feedback and experience with the technology. Predominately students felt that more instructor guidance and education about PowerPoint and its functions were required to assist them with its use. Students further reported that other team members were lacking in computer skills, that some difficulties with PowerPoint transitions had occurred, and that problems were encountered when they tried to share large PowerPoint files among themselves. Furthermore, some students reported collaborative team problems associated with the unequal sharing of the PodPoint work, and another student felt that the PowerPoint App itself, didn't support collaboration as it was too difficult to share and divide the work. Another student didn't believe that the technology was effective as a tool to engage students and support learning. Additionally, while not directly related to the use of the PowerPoint App, one student reported that the team had decided to use Google Drive to share files between themselves and had not notified them about this. Unfortunately, this student had no experience with this technology and was confused as to how to use it. Both instances caused stress for the person. The issue of time constraints was raised by some students indicating that the short 4-week Block mode duration for the unit had limited the amount of work they felt that they could do. The impact and timing of other unit assessments were also reported to be a problem - students believed this reduced the time they could allocate to the PodPoint task. Interestingly, one student attested that they had no time outside of class hours to devote to the project task.

4.4.2.2 Summation of the main end-themes

This section now presents a summation of the final TA themes for all the qualitative data analysed. It represents the summary findings of the students' experiences and perceptions of the novel teaching and assessment intervention. The final TA of these, including grouping of cross-over and repeated data, resulted in 16 MAIN END-THEMES (1950 codes). These main end-themes have been generated from the preceding predominant construct themes just discussed, including open-ended feedback and suggestions for future use. Comparable

predominant construct themes have been combined under either the original, similar, or new labels. Three overarching categories have been used to group the related end-themes for these and include:

1. The “POSITIVE EXPERIENCES AND OUTCOMES” overarching category comprising approximately 82% (1593 codes) of the summary data.

2. The “NEGATIVE EXPERIENCES AND OUTCOMES” overarching category comprising approximately 17% (323) of the summary data.

3. The “FUTURE SUGGESTIONS AND FURTHER FEEDBACK” overarching category comprised 1.7% (34) of the summary data.

Table 4.23 lists the main end themes grouped under each overarching category respectively. Figure 4.57 the final thematic map. Tables 20A to 35A (Appendix) list the predominant construct themes comprising each of the main end-themes.

Table 4.23. Final TA summary of overarching categories and main end-themes.

Final TA summary of overarching categories and main end-themes		
Positive experiences and outcomes overarching category	**Codes**	**%**
Promoted learning	349	21.9
Positive teamwork & collaborative experience (main end theme)	340	21.3
Promoted communication, sharing & discussion	330	20.7
Enjoyment & satisfaction	139	8.7
Skills development & other	134	8.4
Promoted creativity and other	107	6.7
Promoted engagement with technology & other	70	4.4
Positive instructor experience	66	4.1
Promoted student engagement	50	3.1
Other notable aspects	8	0.5
	1593	*100.0*
Negative experiences and outcomes overarching category		
Negative teamwork & collaborative experience	260	80.5
Dissatisfaction and other concerns	63	19.5
	323	*100.0*
Future suggestions and further feedback overarching category		
Suggestions to improve teamwork and collaboration	24	70.6
More Instructor feedback required	5	14.7
PodPoint Project changes	3	8.8
More creativity is required at university	2	5.9
	34	*100.0*
	1950	100.0

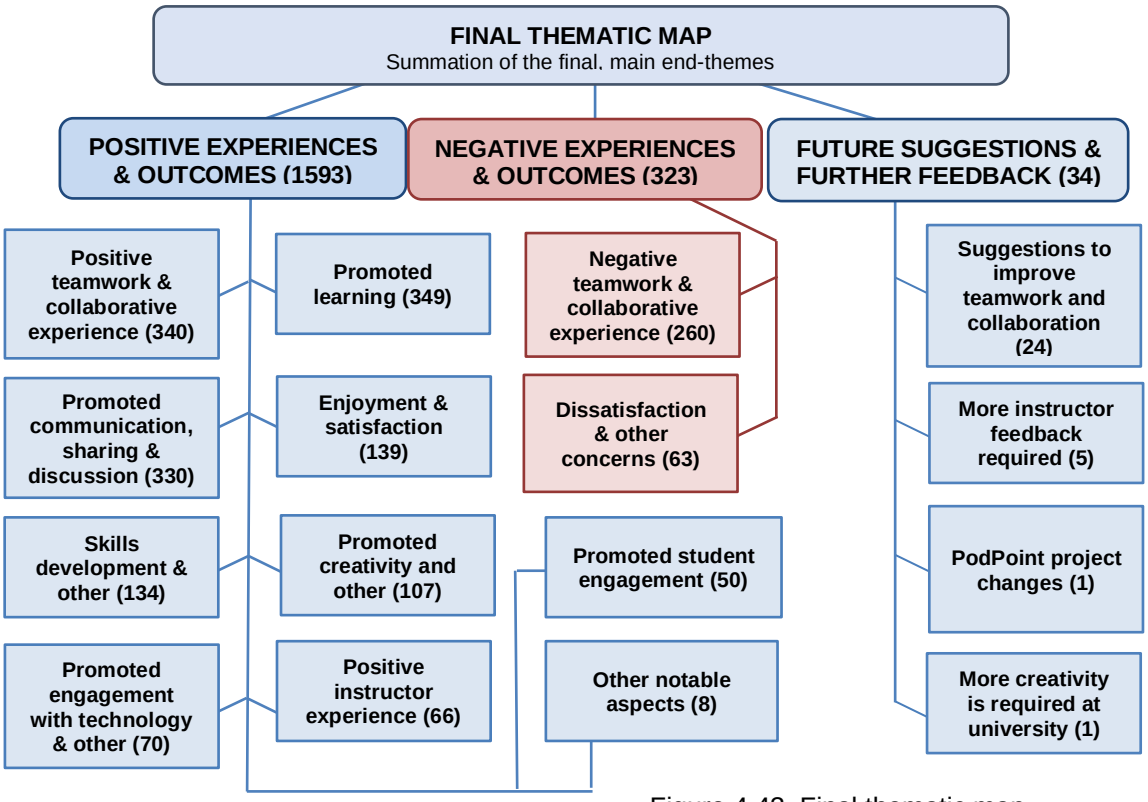


Figure 4.43. Final thematic map.

4.4.3 Discussion of the qualitative data findings

Research question two investigated what the user perceptions of the novel teaching intervention were concerning the eight constructs of interest.

Overall high levels of student satisfaction, motivation, and engagement occurred with the novel pedagogy. Students found it to be an overall enjoyable experience and demonstrated excellent support for the intervention. As shown, qualitative findings were extrapolated from a large body of student feedback that underwent TA (779 comments, producing 1259 codes, 315 themes, and 228 sub-themes) (Table 4.24). From this, the overall student feedback indicated a positive experience, with 1008 of the 1259 TA data codes (80%) relating to positive comments. This included a very small number associated with positive suggestions for future use. As student participation in voluntary feedback based upon invitation can sometimes result in a low number of respondents, the four options (survey, two questionnaires, and interview) provided students greater freedom of choice to participate. Fortunately, in this case, the student response was high. Although, it should be noted that the feedback includes crossover data with some codes relating to two or more of the constructs of interest. Additionally, it is worth being cognisant of the potential for repeated comments from the same respondent being included within the entire data set. This relates to the use of similar or exact questions being used across some of the qualitative data-collecting

instruments. Such repeat feedback could reflect how strongly the students feel about the comment made and have consequently been treated as part of the bona fide data set. Because of anonymity, it is not possible to determine the number of times this may have occurred.

To facilitate the understanding of this, and to reduce a large amount of crossover and repeated data, the following discussion centers on the 16 main end themes. Having been generated from the predominant construct themes, these 16 main end themes represent the final TA summary of the students' experiences and perceptions of the novel teaching and assessment intervention. Moreover, they include open-ended student feedback and suggestions for future use. For interest, the remaining student feedback (comments) obtained from the survey open-ended questions, the two questionnaires, and the interview questions have been collated and reported in the PDF document titled "Student feedback for the survey, questionnaires, and interviews" found in the Ph.D. research website (https://phd-research.webs.com/ located on the "Student feedback" Tab).

4.4.3.1 Positive experiences and outcomes overarching category

The thematic analysis found that approximately eighty-two percent (81.7%) of the data codes indicated that students had positive experiences and perceptions of the intervention. The predominant construct themes associated with the "Promoted Learning" end-theme are tabulated in the appendix (Table 20A).

Notably, "Promoted learning", with 349 codes comprising 17.9% of the total feedback was found to be the top TA end-theme. This indicates that above all the constructs of interest investigated, students felt the top outcome of the PodPoint intervention was that it had supported their learning. This, alongside the finding that the student creation of the PodPoints influenced the associated SAQs results bolsters the position that the PodPoint project was successful as a novel means to support learning. Furthermore, some students did report that the learning of the allocated team PodPoint topic had supported test performance (answering test questions).

> "*The second test we had, some of the questions related to the PodPoint topic we had, so I did very well with them…I had to understand the topic before I could create the PodPoint"*; and *"I could tell by, just doing the test that...all of the questions related to my topic I could do straight away."*

These findings support the contention that learner-generated podcasts are catalysts for knowledge creation (Lee et al., 2008). In line with the student-generated AL approach adopted by our work, Pegram and colleagues (2015) also reported that student-led creative podcasting resulted in enhanced learning outcomes. Likewise, Bolden and Nahachewsky (2015)

undertook a qualitative investigation on podcast creation as transformative music engagement for undergraduate students studying a music education course. While not in physiology, like our PodPoint project, the students were allowed to create and share unique representations of their learning creatively and expressively. Following positive student feedback, Pegrum and colleagues (2015), like our findings, reported that podcasting technology promoted meaningful knowledge construction. Additionally, Kraal and colleagues (2021) employed the use of 'Student Produced Audio Narrative' (SPAN) assignments on students' perceptions and attitudes toward science in introductory geoscience courses. The innovative approach gave students a large degree of creative freedom as they could choose the topic and the narrative style. The goal was for the SPAN assignments to increase students' connection to the geoscience topic matter. Our goal too was to engage and promote student learning through innovation by providing an opportunity for students to have freedom with their creative expression. Following the use of the SPAN assignments, students returned positive feedback and it was reported that the intervention positively changed students' perceptions of their learning environment and attitudes toward science. Based on the student feedback, collated under the "Promoted learning" end-theme, we believe that our work has also done so.

The next top two end-themes included "Positive teamwork and collaborative experience" (17.4%), and "Promoted communication, sharing, and discussion" (16.9%). This is not surprising, considering the teamwork questionnaire interestingly returned the largest amount of qualitative data generated from all the data collection instruments - 385 comments generating a total of 604 codes that were sorted into 157 themes and 136 sub-themes. It was used as an investigative tool to shed light on teamwork dynamics associated with the production of the team PodPoints for two of the three study blocks. This is not inclusive of the teamwork and collaborative feedback associated with the other data-collecting instruments. Lee and colleagues (2008) also reported podcasting to be a powerful tool to stimulate both individual and collective learning. They further suggested that the collaborative development of the podcasts supported the social processes of perspective-taking and negotiation of meaning that underpin knowledge creation. Moreover, Leilani and Kreager (2017) proposed that deep learning and the construction of knowledge are promoted when individuals can actively engage with the subject matter as well as with other individuals. Our results indicate that the intervention has successfully provided a positive collaborative AL experience reflecting the findings of others. Students felt that it promoted and encouraged enjoyable teamwork, and collaborative learning, where they had the opportunity to teach and learn from others, as well as foster positive communication. Overall, students appreciated the ability to collaborate, share the workload, and the sharing of ideas with other team members. They further felt that the teamwork creation and viewing of other PodPoints, allowed for the teaching, and learning of information in a new and interesting way. Some students recognized that good teamwork is important for collaborative teaching and learning to take place. Some

students mentored other students that lacked PowerPoint skills. These experiences indicate that the ZPD for those individuals that benefited from peer teaching were raised. Shabani and colleagues (2010) reported that in such cases it allows the individual the ability to then undertake the same task again independently without support.

Importantly, other work has reported that AL strategies founded on team interactions and peer-to-peer presentations can enhance student engagement and importantly motivate student enthusiasm for the subject material (Allen et al., 2013; Atayee et al., 2012; Steinhardt et al., 2017). Bolden & Nahachewsky (2015) acknowledged the deep engagement that occurred following the use of creative, student-generated podcasting stating that "students took pride in their work and felt a strong sense of personal ownership over it" (Bolden & Nahachewsky, 2015, p.29). The following student feedback was cited in Chapter 2 of this thesis but has been placed here again being a prime example of this.

> *"I put more time in it than I originally wanted to or allotted. But I just did, like I – stayed up really late and worked on it to get it done…I found it was way more a learning experience [than other assignments] and I prefer that – like if someone said I could've done something easier and gotten an A but I wouldn't have learned as much, I still would've done the podcast"* Grace (Bolden & Nahachewsky, 2015, p.17).

Such commitment was also demonstrated by several of the students with our work. One student claimed to have, on two occasions, to have worked during the early morning hours to "make sure it was perfect", while another reported spending more time on their work than other previous tasks - "I definitely felt that I spent more time on the creative side compared to another assignment". Perhaps one of the most striking feedback items we received for the "Positive teamwork and collaborative experience" end-theme, was that a student that had withdrawn from the unit (during the Block period) continued to help their team - "everyone contributed (Even our team-mate who has dropped out!)".

Additionally, students acknowledged the importance of good team member communication as well as the importance of such for future interactions. Students reported that collaborative skills had improved through becoming more social, learning from each other, becoming constructive, and planning the work together. Two students recognized that the team experience fostered learning that will help them in the future. It was also noted that working and communicating with diverse groups of people afforded learning opportunities for communication skill enhancement and that several students indicated that they gained a greater understanding of others. Moreover, two students felt that participation in the team project had improved their confidence in their ability to communicate with others.

Other positive end-themes highlighted that the task promoted student enjoyment and satisfaction (7.1%), that it supported skills development (6.9%), and that it promoted creativity (5.5%). Whilst “Enjoyment” wasn’t incorporated as a construct of interest, student feedback crossing several of the constructs indicated clear levels of it and satisfaction.

Others have questioned whether an increase in learning, as justified by improved exam scores is required, or whether positive student engagement and satisfaction with the podcast experience is enough to warrant this technology as an effective teaching method (Vogt et al., 2010). Whilst improvement in student academic performance concerning the SAQ questions occurred for this present work, no significant difference between the overall test scores for the two cohorts was seen. The PodPoint intervention, however, didn’t negatively affect academic performance. Pegrum and colleagues (2015) had a similar finding, reporting that their results show that there were no negative effects on exam performance, because of students creating podcasts. Moreover, a large amount of student feedback for the present work indicated enjoyment, satisfaction, and engagement warranting the use of the PodPoint technology. Similarly, Kalludi and colleagues (2013) reported a favorable attitude by students following the use of podcasts as supplementary teaching and learning aid. Clark and colleagues (2007) also found that students felt that the podcasts provided positive learning benefits and recommended that the lecturer keep using them. Likewise, for this present work, students called for the continued use of the PodPoint intervention as part of the curriculum for the physiology unit, as well as for its inclusion in other units.

Further positive end-themes included “Skills development and other” (6.9%) and “Promoted creativity and other” (5.5%). Students felt that the PodPoint intervention had supported skills development in the following areas: PowerPoint Skills and PodPoint production; Technical skills enhancement; Skills development and resilience; Promotion of collaborative skills & use; Creative skills development; and promotion of other skills, such as resilience. Students also acknowledged that the skills developed by the PodPoint teamwork project would be important for future career skills.

As creativity was cemented in the foundations underpinning the design and delivery of the intervention, as well as with the student works produced, it is encouraging that it was identified as one of the end-themes. Students felt that the intervention promoted creativity across several fronts by supporting and promoting creativity; allowing creative input; through ideas, story, and script generation; providing a novel creative pedagogy; creatively promoting learning; promoting collaboration through creativity; and allowing the developing of creative skills. One student reported that this project was the first time that they had been creative (for an assessment task), while another student expressed that they were happily surprised, as the task had allowed them to discover and express hidden creativity. The fostering of student creativity for other student-centered podcasting tasks has motivated students, including those otherwise disengaged. For example, Pegrum and colleagues (2015) found that students, that

had previously demonstrated disinterest in the unit content, creatively used an analogy founded on characters in the Twilight film saga to successfully produce a podcast on a chemistry topic. The authors concluded that creative, student-centered podcasting can motivate students and can promote a new, deeper understanding of some of the topic material and called for others to adopt creative approaches.

The remainder of the feedback under the "Positive experiences and outcomes" overarching category related to improved student connection and engagement with technology (3.6%), a positive instructor experience for the students (3.4%), and enriched student motivation and engagement (2.6%). Having engagement included across the end-themes demonstrates that the PodPoint Project intervention strongly supported student engagement across several areas. While it has been noted that student engagement is difficult to measure (Price, 2018), several data-collecting instruments provided positive student feedback for it. Furthermore, Hanus & Fox (2015) define engagement as the degree of attention and absorption that a student gives to a task and question the likelihood of student engagement when tasks are "imposed by the teacher". The reported levels of high student engagement across several of the constructs of interest support this definition of engagement - the students were independently and collaboratively involved in the AL process to construct the PodPoints. Much of this student engagement included independent student research, positive teamwork promoting learning, and engagement via constructive communication, discussion, and ideas sharing among team members. In addition, a further significant finding of our work was that the students' levels of test engagement, defined by their attempt to answer the SAQ topic questions, were influenced by their participation in the corresponding PodPoint topic.

With respect to technology, it was positive that the students felt connected and engaged with the PodPoints. The task was shown to enhance student technical skills through increased understanding of, and different use of the PowerPoint technology, installing new levels of confidence in students. Some students noted the difference between this intervention compared to regular assignments and reported that the use of PowerPoint was initially confusing and challenging. However, it was further noted that these challenges were quickly overcome, and subsequently fostered their technical and creative skills. On the other hand, others felt that technology was easy to use while others believed that the intervention strongly promoted technical skills development that can be used in the future. Students indicated enjoyment and appreciated a different approach to learning using technology.

> *"It is very different to what our standard assignments are…"*; *"a different way to learn"; "It was very interesting to learn how to use PowerPoint during this PodPoint assessment"*; *"overall it was quite easy to make sense of"*; *"We were enabled to learn the new technology right from the start of the unit"*; *"Many skills*

were learned during the process of making the PodPoint"; *"At first it was confusing and overwhelming"*; *"It is very different to what our standard assignments are…However, it did come to place and it really opened up my creativity skills"*; *"It taught me some new PowerPoint presentation skills which I will use again."*

Finally, a small (0.4%), yet noteworthy feedback, revealed that students believed that the collaborative project was a good social experience. It further provided a realistic collaborative task that helped to develop a respect for others. One student acknowledged that the positive collaborative experience supported their mental health, by allowing them to have a "sanity check" with their team members. It would be interesting to see if others have reported mental health benefits associated with teamwork or other collaborative tasks such as these.

We are pleased to highlight that all of these end-themes grouped under the "Positive experiences and outcomes" overarching category support the Victoria University graduate capabilities (GC1 & GC2), where 1) students develop the capabilities to become *"adaptable and capable 21st century citizens who can communicate effectively, work collaboratively, think critically and solve complex problems"*, and 2) students develop the capabilities to become *"confident, creative lifelong learners who can use their understanding of themselves and others to achieve their goals in work and learning"*. These attributes enhance the transferable skills and employability of the students. Students identified that the opportunity provided by the team project, allowed for the development of collaborative skills, with one recognizing the importance of these for their future working environment:

"We learned more about team work and group work skills -- It sets an example of future career environment."

4.4.3.2 Negative experiences and outcomes overarching category

It has been reported that despite good intentions, collaborative learning activities do not always foster student collaboration (Le et al., 2018). This was the case with our work. Approximately seventeen percent (16.5%) of the student feedback indicated some having a negative experience or outcome with the project as was reported under the "Negative experiences and outcomes "overarching category.

Predominantly, eighty percent (80%) of this feedback related to the end-theme "Negative teamwork & collaborative experience". The majority of this related to the following five (5) predominant construct themes: "Poor team member participation, collaboration, and commitment" (21.9%); "Unequal work contribution and poor delivery of work" (19.2%), "Negative teamwork affected learning, topic engagement, and other work outcomes" (19.2%);

“Negative teamwork experience” (12.3%); and “Poor team communication and dynamics” (11.5%). The remaining negative feedback (12.3%) for this end-theme related to several concerns such as the teamwork had caused stress, students exclaiming that they preferred individual projects, that the task itself didn’t foster teamwork, that the small team size (2 members only) affected work outcomes, the potential for conflict among friends, lack of confidence in other members, that some need to be managed and that poor team member congruency resulted in poor teamwork. One mature-aged student indicated that problems arose with the younger-aged team members’ effort, contribution, and overall teamwork. Another felt that their contribution to the team was not appreciated.

While the project involved teamwork, the aim wasn’t to manage it, nor to introduce a strategy to mitigate negative teamwork dynamics. That goes beyond the scope of this present work. However, several steps were taken to facilitate the collaborative process. These included the use of individual VARK questionnaires to support fair team member allocation, teacher instruction, and teamwork support materials. However, with the team member allocation, at times due to student numbers, a full even spread of each VARK communication modality could not occur with all teams. To lessen the chances of being disadvantaged, these small groups received at least one multimodal VARK profile to balance them. Some students found the use of the VARK questionnaire both helpful individually and collectively as a team, while others did not find it useful in any way. Part of that may lie in the misunderstanding of the purpose of the VARK questionnaire. Some students believed that their VARK results indicated learning styles as opposed to their preferred communication styles. Sometimes, students are given the option of choosing their teams, that allows friendship groups to work together but decreases the need to interact with strangers as well as collaborative skills development. In contrast to this, one student with our work exclaimed that teamwork tasks have the potential for conflict amongst friends. They didn’t give any further explanation of this. Others have reported problems with team matching. For example, when those methods used for student allocation to teams are matched upon either a heterogenous for ability or homogenous for age, these group interactions do not always foster effective collaboration (Baker & Clark, 2010; Blatchford et al., 2003).

Concerning our work, a significant amount of the negative feedback is further related to poor team member participation, collaboration, and commitment, as well as unequal work contribution and poor delivery of work by team members. These were partly demonstrated through an unequal contribution to the workload, with some students claiming that others didn’t contribute at all. In this situation, students felt that there was an unfair distribution of the marks associated with the task. Other student perspectives on teamwork hold the opinion that unequal individual contribution and participation in group tasks can occur (Freeman & Greenacre, 2010).

Poor team communication and dynamics were also reported by students with our work, which didn't help student collaboration. One student believed that the poor team communication spoiled for them what should have been an enjoyable project. Some of the mature-aged students felt that poor communication, effort, and teamwork were associated with the younger students. The older students felt that they brought a "different attitude" to the task at hand and that the young need to understand that teamwork requires effort, especially with the sharing of knowledge, team focus, or if the opportunity arises, team leadership. Li and Campbell (2008) and Pauli and colleagues (2008) reported similar findings, including the lack of communication skills for some students, as well as teamwork skills. In light of this, one student in our present work believed that many students, having come straight from high school to university, have yet to develop effective teamwork skills.

As an attempt to encourage and guide the teamwork process with our work, instructor support was given to the entire class with a discussion on the importance of teamwork, how to effectively work as a team, and how to manage and schedule the project tasks. These details were additionally supplied in the student PodPoint Project materials. Student teams were also instructed to write their team "PodPoint project charter" – rules of working as a team, what they expected from each other, and how they can respect and support each other. Despite these steps, the above problems associated with poor teamwork dynamics did mar some of the positive experiences associated with the project as they constituted the main challenges faced (by both the students and instructor alike). Teamwork, despite topic matter, is often inherently challenged by a variety of elements including age, personality type, social-economic status, ethnicity, academic ability, language constraints, and others.

Many of the generic teamwork problems encountered with this present work have been reported by instructors that faced challenges with collaborative tasks. For example, Gillies & Boyle (2010) found that problems with activity design, scheduling group activities within class time, and allocation of group members can arise while utilizing collaborative activities. Le and colleagues (2018) also reported that others (Hämäläinen & Vähäsantanen, 2011; Van Leeuwen et al., 2013) had identified problems with the supervision of productive collaboration, as well as effective means to enhance it. In their investigation into the perceived obstacles that students and teachers have about collaborative learning, Le and co-workers (2018) found that the following four common obstacles to collaboration comprised of: students' lack of collaborative skills, free riding (unequal sharing of the work), competence status (perceived intellectual ability and capabilities), and friendship (detrimental effect of friendship in groups).

The students' previous experience with teamwork in other units in first year was not investigated. It would be interesting to know how much experience they had and if this could have shed further light on the teamwork problems that were encountered. Therefore, while teamwork, when it works can turn out to be a great collaborative experience, as experienced by most of the students with our work, going forward, it would be useful though to conduct

research in this area to explore what strategies have proven to be useful for teamwork and what new work could be done. Additionally, in hindsight, perhaps there are better tools other than the VARK questionnaire that we used with our work to facilitate the team participant selection process. For example, The Comprehensive Assessment of Team Member Effectiveness (CATME) SMARTER Teamwork tool (https://info.catme.org/), or other project management tools designed to support the collaborative experience for group members (see article “6 Best Project Management Tools for Educational Institutes & Students”) can be of assistance.

The remaining 20% of the feedback related to the end-theme “Dissatisfaction and other concerns”. The use of technology caused some stress for the students unfamiliar with it. Some reported that more PowerPoint instruction was required and that some problems with using the technology occurred. While the teacher did provide some instruction on the use of PowerPoints, it was envisaged that the students would find it easy to use considering the age of the application and its widespread use throughout the education sector. Moreover, students were directed to use the Microsoft links and YouTube links found in the PodPoint Project Student Guide for PowerPoint tutorials. At times, other more proficient team members also helped with the use of PowerPoint for some of the other less technically proficient students. This added to the collaborative peer learning and teaching experience. With respect to podcasting, Bolliger and Des Armier Jr (2013) did highlight the need for the application of the podcast teaching tool to be done so with caution, particularly with students with limited technology skills. They identified that those who are not IT savvy may experience cognitive overload with this learning medium, that could cause major challenges for instructors. This, alongside the negative experiences with the PowerPoint technology for this present work, suggests that more instruction would be beneficial.

Some students also believed that there was an unfair distribution of the marks when the work was not equally shared and that some individuals are not suited for teamwork. Interestingly, one student believes that collaboration is not an important part of the learning process. Some students also believed that the task itself didn’t support learning and that the experience didn’t improve communication.

Some dissatisfaction with the project intervention was expressed by the students. One felt that the intervention was “useless” and not representative of “real” learning. One student disliked the zombie narrative. Others indicated that the PodPoint assessment task conflicted with the load of the other unit assessments and the timing of these. Several students indicated that time constraints reduced the amount of work done on the PodPoint. Two students identified that the 4-week Block model didn’t afford enough time to fully educate themselves about the use of PowerPoint, or to collaborate and peer-educate others who lacked PowerPoint skills. Additionally, one further student indicated that their team didn’t have the time outside of the allocated class time to meet and work on the project. They didn’t elaborate

on what the reasons were but reported that they shared documents and information by email to address it. Furthermore, one student exclaimed that extracurricular activities and work commitments impacted their ability to study and did not put in the work required for the PodPoint project.

4.4.4.3 Future suggestions and further feedback" overarching category

A smaller, yet beneficial amount of student feedback, was related to the "Future suggestions and further feedback" overarching category (1.8%). This feedback consolidated the open-ended responses and the questions inviting further comments and suggestions and included four end-themes.

Approximately seventy-one percent (70.6%) of the suggestions and feedback related to the end-theme, "Suggestions to improve future teamwork and collaboration" for the project task. Within this, five predominant construct themes, making up sixty percent (60% of this feedback), included suggestions for: the ability of students to select teams (16.7%); the need for equal participation, contribution, and better attendance at labs for team members (12.5%); the removal of teamwork tasks from the unit (12.5%); the introduction of a confidential teamwork survey (8.3%); and the need for all teams to have equal student numbers (8.3%). The remaining feedback for this end-theme, included suggestions for students to choose the topics for the teamwork task, for students to choose their scenario (as opposed to the Uni-Apocalypse, Zombie scenario), to make the project task easier to share (facilitate teamwork), to ensure that all members of the team are exposed and involved in all aspects of the project, to ensure that the team workload is equally shared across members, to commence teamwork early in the unit, to have an earlier allocation to teams, to have greater team diversity, to ensure better team member congruency, and do not work with the same team again (all equal feedback at 4.2%).

The second end-theme, "More Instructor feedback required" comprised 14.7% of the suggestions in this category. Again, predominantly this related to teamwork, including suggestions for the instructor to conduct more regular key tasks and team progress checks, and more teamwork guidance for collaboration as well as the team dynamics for the PodPoint production.

The third end-theme grouped suggestions for "PodPoint project changes" (8.8%). This included the ability for students to view previous examples of PodPoint work, and greater mark allocation to the project (because of the amount of work required for the task). Additionally, one student felt that the VARK questionnaire should consider age. The viewing of previous student-generated PodPoint work would have been beneficial, however was not possible as this work was a pilot project. The instructor though did create short example PodPoints based on other physiology topics that the students had access to.

The final end-theme, “More creativity is required at University” (5.9%) included student feedback recommending that other units should do the PodPoint project or other similar tasks, as well as the general need for more creativity to be incorporated into the university curriculum. Edmond and co-workers (2015) reported that a similar request was made by students following the use of video podcasting technology for the revision and repeat access to information. Additionally, this feedback echoes the call put forward by Pegrum and colleagues (2015) (previously discussed), which was for the greater adoption of creative approaches because of the positive impact they have on student creativity, contextualization, and deep learning. Likewise, Middleton (2016) said that *“Imagining is an under-used idea in higher education”* and strongly attests there is a significant relationship between imagination and the creative dimension of learning. Middleton further contents that the playful mind, as a significant element of learning, needs to be fostered within the teaching process, including university.

4.5 Section 4 - Triangulation of data and discussion

As reported, a large body of data, both quantitative and qualitative has been collected and analysed using a variety of data sources. Triangulation of data was used to further solidify and validate the relationships between the effect of the intervention on student performance and related perceptions. The focus was given to identifying matching crossover and repeating data that corroborated the primary results of these relationships. To do this, the triangulation of data included:

1) the comparison of the quantitative primary findings of student feedback for each of the constructs of interest procured from the survey Likert scale statements, and the TA findings for the predominant construct themes that were generated from the four qualitative data collecting instruments (survey open-ended questions, the two qualitative questionnaires, and the student interview responses), and

2) the quantitative outcomes for student assessment performance (test question results & engagement, PodPoints) and the predominant qualitative findings for two of the principal constructs of interest directly related to assessment performance – the learning construct and the engagement construct.

4.5.1 Construct Likert-scale statements vs TA predominant construct themes

To shine a light on crossover data, firstly, the results for the associated Likert-scale statements for each of the constructs of interest were compared with the TA predominant themes of the

associated constructs covered by the four qualitative data collecting instruments. The top three responses for the Likert-Scale statements were then compared with the top three predominant TA themes for the associated constructs of interests.

4.5.1.1 Satisfaction construct

To determine the degree of crossover and repeat of data for the *satisfaction* construct, the quantitative outcomes for the associated six (6) Likert-scale statements were compared with the qualitative predominant construct themes. The six Likert statements covered students' levels of satisfaction ("agree to strongly agree" response) with respect to: individual PodPoint work contribution; levels of enjoyment; collaborative experience; and overall satisfaction with the PodPoint project task. The positive outcomes for all the Likert-scale statements were reflected in the following TA predominant themes for the satisfaction construct: "PowerPoint skills & PodPoint production"; "Enjoyment & Satisfaction"; and Positive teamwork experience". To further elucidate matching, the top three Likert-scale statement responses were compared to the top three predominant themes. Table 4.24 lists the top three Likert-scale statement responses and the top three predominant themes.

Table 4.24. Top three Likert-scale statement responses and the top three predominant themes for the *satisfaction* construct.

Satisfaction construct	
Likert-scale statements	1."I felt I made a valuable contribution to the outcome of the PodPoint task"
	2."I worked hard on the PodPoint task"
	3."I enjoyed viewing and learning from other teams' PodPoints"
Predominant themes	1. Positive teamwork experience
	2.Enjoyment & satisfaction
	3.Negative teamwork experience

The comparative magnitudes (percentages) for each partially matched. While all three Likert-scale statements were reflected in the "Enjoyment & satisfaction" predominant theme, the other two predominant themes did not overlap. However, the "Positive teamwork experience" predominant theme did match with one of the other Likert-scale statements - "I enjoyed working as part of a team".

4.5.1.2 Engagement construct

Nine Likert-scale statements were compared with the qualitative predominant construct themes for the *engagement* construct. The Likert-scale statements covered students' levels of satisfaction with respect to: levels of contribution and effort; motivation; interaction with

others; engagement with learning; and VARK & engagement with others. The positive outcomes for eight of the nine the Likert-scale statements were reflected in the following TA predominant themes for the engagement construct: “Engagement & motivation”; “Positive teamwork promoted communication, discussion, & ideas sharing”; and “Positive teamwork promoted learning”. The Likert-scale statement “Understanding my VARK preferred communication style helped me to engage with others” was not included as a predominant theme.

To further elucidate matching, the top three Likert-scale statement responses were compared to the top three predominant themes. Table 4.25 lists the top three Likert-scale statement responses and top three predominant themes.

Table 4.25. Top three Likert-scale statement responses and the top three predominant themes for the *engagement* construct.

Engagement construct	
Likert-scale statements	1.“Making the team PodPoint helped me to interact with my peers”
	2.“The use of student-generated PodPoints increased my motivation to be involved”
	3.“The “Uni-Apocalypse” scenario motivated me to engage with the topic matter”
Predominant themes	1.Promoted independent research of information & learning
	2.Positive teamwork promoted learning
	3.Positive teamwork promoted communication, discussion, & ideas sharing

The top three Likert-scale statement responses and predominant themes essentially matched. The Likert-scale statement (#1), “Making the team PodPoint helped me to interact with my peers” matched with the predominant theme (#3), “Positive teamwork promoted communication, discussion, & ideas sharing”. “The use of student-generated PodPoints increased my motivation to be involved” Likert-scale statement (#2), while not matching with one of the top three did match another predominant theme - “Engagement & motivation”. The final Likert-scale statement (#3), “The “Uni-Apocalypse” scenario motivated me to engage with the topic matter” also matched with the “Engagement & motivation” predominant theme, as well with (# 1) predominant theme - “Promoted independent research of information & learning. It also matched with the “Engagement via creative expression” predominant theme.

4.5.1.3 Creativity construct

To determine the degree of crossover of data for the *creativity* construct, the quantitative outcomes for the associated Likert statements were compared to the TA predominant construct themes. Four statements addressed this construct and covered creativity, the need for more creativity at university, creative engagement with the topic material, and creative learning. All of these were reflected in the following predominant themes for the creativity

construct: “Supported & promoted creativity”; “Enjoyment, satisfaction, & engagement”; “Promoted Learning through creativity”; and “Further suggestions & feedback” (More creativity required at university, and other units should do PodPoint or similar creative tasks).

To further elucidate matching, the top three Likert-scale statement responses were compared to the top three predominant themes. Table 4.26 lists the top three Likert-scale statement responses and top three predominant themes.

Table 4.26. Top three Likert-scale statement responses and the top three predominant themes for the *creativity* construct.

Creativity construct	
Likert-scale statements	1.“The PodPoint task helped develop my creativity”
	2.“I wish more instructors would explore creative learning opportunities, like this, in their course”
	3. “The ‘Uni-Apocalypse’ scenario motivated me to engage with the topic matter”
Predominant themes	1.Supported & promoted creativity
	2.Enjoyment, satisfaction, & engagement
	3.Promoted learning through creativity

Matching of data was found as all the top three Likert-scale statements matched with the top three predominant themes. The Likert-scale statements covering creativity (#1) matched with the number 1 predominant themes (“Supported & promoted creativity”). Likert-scale statement, number 2, addressed creative learning, and the desire for more. This was matched with the “Promoted learning through creativity” (#3) predominant theme. It further matched with the student feedback collated under the smaller predominant theme, “Further suggestions & feedback” (More creativity required at university, and other units should do PodPoint or similar creative tasks). The third Likert-scale statement, “The ‘Uni-Apocalypse’ scenario motivated me to engage with the topic matter”, matched with the “Enjoyment, satisfaction, & engagement” (#2), and “Promoted learning through creativity” (#3) predominant themes.

4.5.1.4 Learning construct

Eight Likert-scale statements were related to the *learning* construct and covered students’ levels of satisfaction with respect to: teamwork, collaborative learning; enjoyment & satisfaction; the need for more creative learning at university; learning of technology skills; learning through technology; creative learning; motivation to learn; and VARK & learning. The positive outcomes for six of these statements were reflected by the following TA predominant themes for the *learning* construct: “Positive teamwork, discussion, & collaborative Learning”; “Promoted Enjoyment & satisfaction”; “Promoted learning & content engagement”; and New

Creative Learning & Assessment Pedagogy. The Likert statements addressing VARK & learning were not covered by the predominant themes, and the statement addressing the learning of technology skills ("I feel that the PodPoint task has improved my skills to use technology") was partially covered by the predominant theme "Additional learning outcomes" (the development of future career skills).

To further interpret matching, the top three Likert-scale statement responses were compared to the top three predominant themes. Table 4.27 lists the top three Likert-scale statement responses and top three predominant themes.

Table 4.27. Top three Likert-scale statement responses and the top three predominant themes for the *learning* construct.

Learning construct	
Likert-scale statements	1. "Team collaboration and discussion was an important part of the learning process"
	2."I enjoyed viewing and learning from other teams' PodPoints"
	3. "I wish more instructors would explore creative learning opportunities, like this, in their courses"
Predominant themes	1. Positive teamwork, discussion, & collaborative Learning
	2. Promoted learning & content engagement
	3. New Creative Learning & Assessment Pedagogy

Matching crossover data found that the top three responses for both Likert-scale statements and the predominant themes strongly reflected each other. The Likert scale statement, "Team collaboration and discussion was an important part of the learning process" (#1), matched with the predominant theme #1, "Positive teamwork, discussion, & collaborative Learning". Statement #2, "I enjoyed viewing and learning from other teams' PodPoints", matched with two of the top predominant themes (#'s 1 & 2), as well as with one of the other predominant themes - "Promoted Enjoyment & satisfaction". Statement #3, "I wish more instructors would explore creative learning opportunities, like this, in their courses", matched with the predominate theme #3.

4.5.1.5 Critical thinking construct

Four Likert-scale statements were related to the critical thinking construct and covered students' critical reflections on: the performance of other team members; the development of critical thinking skills, VARK and understanding individual communication style; and the ability of the intervention to foster a greater understanding of oneself and others. The overall thematic analysis of the critical thinking construct involved the generation of predominant construct themes using four key questions asking students to critically appraise their own performance

and view of self, as well as the performance of others. Of the four, three of these questions better matched the associated Likert-scale statements and have subsequently been used as the predominant themes for the comparative data.

The positive outcomes for three of the four Likert-scale statements were reflected by the following TA predominant themes for the critical thinking construct: “Positive team member contribution”; “Research of information and content”; “Creative input”; and “Positive reflection of VARK”. The Likert-scale statement inviting the students’ reflection on the ability of the intervention to foster a greater understanding of oneself and others (“This teaching and learning innovation helped me understand myself and others”) was not matched with any of the predominant themes.

To further interpret matching, the top three Likert-scale statement responses were compared to the top three predominant themes of the three associated TA question results. Table 4.28 lists these top three Likert-scale statement responses and top three predominant themes.

Table 4.28. Top three Likert-scale statement responses and the top three predominant themes for the *critical thinking* construct.

Critical thinking construct	
Likert-scale statements	1. “Overall, the other members of my team made valuable contributions”
	2. “This teaching and learning innovation developed my critical thinking skills”
	3. “Understanding my VARK preferred communication style helped my learning”
Predominant themes Question 1	1. Positive reflection of VARK
	2. Negative reflection of VARK
	3. Misunderstanding of VARK
Predominant themes Question 2	1. Collaboration and teamwork contribution
	2. Research of information and content
	3. Creative input
Predominant themes Question 3	1. Positive team member contribution
	2. Negative team member contribution
	3. Poor team member effort

Matching crossover data found that the top three responses for Likert-scale statements and the top three predominant themes strongly reflected each. The Likert scale statement, “Overall, the other members of my team made valuable contributions” (#1), matched with the Q3, predominant theme #1, “Positive team member contribution”. Statement #2, “This teaching and learning innovation developed my critical thinking skills”, matched with Q1, predominant themes #’s 2 and 3, “Research of information and content” and “Creative input”. Statement # 3, “Understanding my VARK preferred communication style helped my learning”, matched with Q1, predominant theme #1, “Positive reflection of VARK”.

4.5.1.6 Communication construct

Six Likert-scale statements were related to the communication construct and covered students' critical reflections on: the interaction and collaboration with team members; the development of communication skills; communicating and engaging with others: VARK, communication, and learning; and the ability of the intervention to foster a greater understanding of oneself and others. The positive outcomes for five of these statements were reflected by the following TA predominant themes for the communication construct: "Communication, sharing, & learning"; "Project promoted communication & skills"; and VARK & Communication". The Likert-scale statement inviting the students' reflection on the ability of the intervention to foster a greater understanding of oneself and others ("This teaching and learning innovation helped me understand myself and others") was not matched with any of the predominant themes.

To further interpret matching, the top three Likert-scale statement responses were compared to the top three predominant themes. Table 4.29 lists these.

Table 4.29. Top three Likert-scale statement responses and the top three predominant themes for the *communication* construct.

Communication construct	
Likert-scale statements	1. "Making the team PodPoint helped me to interact with my peers"
	2. "Working in a team helped me develop my communication skills"
	3. "Making the PodPoints helped me better engage with the teachers"
Predominant themes	1. Communication, sharing, & learning
	2. Project promoted communication & skills
	3. VARK & Communication

Matching crossover data found that the top three responses for Likert-scale statements and the top three predominant themes strongly reflected each. The Likert scale statement, "Making the team PodPoint helped me to interact with my peers" (#1), matched with the predominant themes #'s 1 and 2. The statement, "Working in a team helped me develop my communication skills" (#2), matched with both predominant themes #1 and #2. The statement, "Making the PodPoints helped me better engage with the teachers" (#3), also matched with the predominant themes #1 and #2. The predominant theme, "VARK & communication" (#3), didn't match with any of the top three predominant themes, but did match with fully with the Likert-scale statement, "Understanding my VARK preferred communication style helped me to engage with others", and partially with the statement, "Understanding my VARK preferred communication style helped my learning".

4.5.1.7 Collaboration construct

Seven Likert-scale statements were related to the collaboration construct and covered students' critical reflections on: collaboration, engagement, and communication; team member contributions; satisfaction & enjoyment; collaborative learning; and VARK & communication.

A large body of data (508 codes) was collected and underwent TA to produce three overarching categories including "Good teamwork dynamics (Positive)" and "Poor teamwork dynamics (Negative)", and "Suggestions for future use". In total, these comprised 31-predominant themes. Of the three, the "Good teamwork dynamics" overarching category better matched the associated Likert-scale statements and have subsequently been used as the predominant themes for the comparative data. The positive effects of six of the seven Likert-scale statements were reflected across seven of the eleven predominant themes including: "Positive teamwork & collaborative experience"; "Task supported collaborative learning"; "Contribution and sharing of the workload"; "Positive communication and discussion"; "Sharing of ideas, views, and perspectives"; "Task promoted collaboration & teamwork"; and "Collaboration supported task completion". The Likert-scale statement inviting the students' reflection on the ability of VARK to foster a greater understanding of oneself and others ("Understanding my VARK preferred communication style helped me to engage with others") partially matched with the predominant theme, "Motivation & engagement".

To further interpret matching, the top three Likert-scale statement responses were compared to the top three predominant themes for the overarching category, "Good teamwork dynamics (Positive)". Table 4.30 lists these.

Table 4.30. Top three Likert-scale statement responses and the top three predominant themes for the *collaboration* construct.

Collaboration construct	
Likert-scale statements	1. "Team collaboration and discussion was an important part of the learning process"
	2. "Making the team PodPoints helped me to interact with my peers"
	3. "Working in a team helped me develop my communication skills"
Predominant themes	1. Positive teamwork & collaborative experience
	2. Task supported collaborative learning
	3. Contribution and sharing of the workload

Matching for crossover data was demonstrated with two of the three top responses for Likert-scale statements corresponding to two of the three top predominant themes. The third statement matched one of the other predominant themes. The Likert scale statement, "Team collaboration and discussion was an important part of the learning process" (#1), matched with

the predominant themes #1 and #2, and with another predominant theme ("Positive communication and discussion"), and then partially with the predominant theme, "Collaboration supported task completion". The Likert scale statement, "Making the team PodPoints helped me to interact with my peers" (#2), matched with matched with both predominant themes #1 and #2, and the additional predominant theme, "Task promoted collaboration & teamwork". The Likert-scale statement, "Working in a team helped me develop my communication skills" (#3), matched with another predominant theme (fourth in ranking) – "Positive communication and discussion".

4.5.1.8 Technology construct

Eight Likert-scale statements were related to the technology construct and covered students' critical reflections on: technology & education; technology and creativity; technical skills; technology and engagement; the need for more creative learning at university; technology and learning; and satisfaction. Seven of the eight statements were reflected either fully, or partially in the following predominant themes: "Technical skills enhancement"; "Enjoyment & satisfaction"; "New way to learn & use technology"; "Promoted engagement with technology" and "Technology promoted engagement with others". The Likert-scale statement, "I wish more instructors would utilize PodPoint technology in their courses", did not correspond to any of the predominant themes.

To further interpret matching, the top three Likert-scale statement responses were compared to the top three predominant themes. Table 4.31 lists these.

Table 4.31. Top three Likert-scale statement responses and the top three predominant themes for the *technology* construct.

Technology construct	
Likert-scale statements	1. "I think the use of technology in education is important for the student of today"
	2. "The PodPoint task helped develop my creativity"
	3. "I feel that the PodPoint task has improved my skills to use technology"
Predominant themes	1. Technical skills enhancement
	2. Enjoyment & satisfaction
	3. New way to learn & use technology

Matching crossover data found that the three top responses for Likert-scale statements partially corresponded to the three top predominant themes, with some comprising a combination of them. The Likert scale statement, "I think the use of technology in education is important for the student of today" (#1), partially matched with predominant themes #1 and #3, as well as the predominant theme, "Promoted engagement with technology" (#6). The Likert-scale statement, ""The PodPoint task helped develop my creativity" (#2), matched with the predominant theme, "Enjoyment & satisfaction" (#2) (satisfaction with creativity outcomes),

and partially with the predominant theme, “New way to learn & use technology” (#3). The Likert-scale statement, “I feel that the PodPoint task has improved my skills to use technology” (#3), matched with the predominant theme, “Technical skills enhancement” (#1).

4.5.2 Student assessment performance vs TA predominant themes (learning & engagement)

To further clarify the relationships between the effect of the intervention on student performance and related perceptions, this section identifies the crossover data between the quantitative outcomes for student assessment performance and engagement (test question results), and the predominant qualitative TA findings for two constructs of interest. These two constructs of interest include the *learning* construct and the *engagement* construct and have been selected for comparison because of their clear relationships with assessment performance.

4.5.2.1 Student assessment performance & learning

Student assessment performance was determined by overall test results and overall unit grades. Quantitative analysis found no difference in these outcomes between the 2018 and 2019 cohorts. However, a significant difference existed in test scores for students grading well with the PodPoint task. This may be related to the learning that took place with the production of the PodPoint, or to the fact that these students, because of academic merit, performed equally well across all the unit assessments tasks. However, of greater interest are the student results for the five written, short answer questions (SAQs) included in the final test for the 2019 cohort. These SAQs covered five physiology topics that directly related to the knowledge covered in five of the eight PodPoint topics. The analysis found that the average SAQ topic scores for the students covering the related PodPoint topics were all greater than the mean class SAQ scores for all remaining students not covering the PodPoint topics, with three of these statistically significant. This suggests that the PodPoint assessment task supported learning in the specific topic areas. The predominant findings for the learning construct indicated that the intervention supported and promoted learning. The three top predominant construct themes are: “Positive teamwork, discussion, & collaborative Learning”; “Promoted learning & content engagement”; and “New Creative Learning & Assessment Pedagogy”. These predominant themes indicate the influence of the PodPoint intervention on the students’ perceptions of learning. As the PodPoint assessment task had supported learning in the specific topic areas with the associated SAQ, as demonstrated by the scores, there appears to be a sound linkage between the students’ perceptions of learning and academic performance. Moreover, further strong matching with the SAQ topic scores occurred with

another predominant theme for the learning construct – “Additional learning outcomes”. Codes collated under this predominant theme included student statements indicating that learning the allocated team PodPoint topic had supported test performance (answering some of the SAQ questions).

4.5.2.2 Student assessment performance & engagement

Participation in the team PodPoint topics positively influenced whether students attempted the associated SAQ. Across all the SAQ topics, more attempts were made to answer the written questions by students who had completed the respective PodPoint topic. This suggests that participation in the PodPoint topic supported learning in these areas and bolstered the confidence of students to engage with the question(s). Furthermore, these participation rates were mutually related to academic performance. Statistical analysis found a moderate positive relationship ($r = 0.56$) existed for SAQ participation rates and SAQ scores across all SAQ topics but was not statistically significant. However, this further reflects the positive effects of the PodPoint task on engagement and performance. A crossover of the data is demonstrated with the top predominant theme for the engagement construct, “Promoted independent research of information & learning”, matching the findings. The second and third top predominant construct themes, “Positive teamwork promoted learning”, and “Positive teamwork promoted communication, discussion, & ideas sharing” also match.

4.5.3 Triangulation of data summary

Overall, sound matching was demonstrated between the data procured for the Likert-scale statements and the associated TA predominant themes for each of the constructs of interest. Likewise, a comparison of the quantitative outcomes for student assessment performance (test question results & engagement), with the predominant TA findings for the *learning* construct and the *engagement* construct, produced similar findings. This triangulation and matching of data have strongly corroborated the primary findings that the novel learning and assessment intervention has positively affected learning and student engagement across several fronts.

CHAPTER FIVE:

5.0 CONCLUSION

5.1 Research implications, relevance, and positioning of this work

In conclusion, the PodPoint intervention significantly improved academic performance, with participation in the team PodPoint topics positively influencing whether students attempted the SAQs of the final test and the results of them. The average SAQ topic scores that related to the students covering the PodPoint topics, were all greater than the mean class SAQ scores for all students not covering the PodPoint topics, with three of these being statistically significant ($P < .05$). While no significant difference between the test scores for the two cohorts occurred, a significant difference was seen in test scores for students doing well with PodPoints within their cohort. Thematic analysis of the qualitative data collected by surveys, questionnaires, and interviews returned positive student feedback across several constructs, including satisfaction, learning, collaboration, creativity, engagement, and technology. Triangulation of data corroborated the primary findings that the novel learning and assessment intervention had positively affected learning, student engagement, and creativity.

The positive uptake and use by the students demonstrate how the PodPoint intervention successfully provided an alternative means for the use of educational podcasting. The traditional flow of information between the teacher and student, as well as between the students themselves has been replaced by a strategy promoting active participation in the creative construction of student-generated media based on the learning taking place. This was achieved through the marrying of several themes of an evolving educational landscape as considerable thought and effort went into designing this teaching and AL intervention. Freeman and colleagues (2014) compared STEM courses using traditional lecturing versus AL by conducting a comprehensive analysis of 225 studies in this area. Analysis of the reported academic outcomes for these found that those strategies based upon the traditional (lecture) method resulted in a failure rate of 150% greater than those students undertaking some form of AL strategy. Based on the findings they proposed that teachers start to question the use of traditional daily lecturing practice. The positive findings of our work, concerning enhanced academic performance for the SAQ component further support this proposition and reinforces the impetus to incorporate more AL strategies into the curriculum, especially those utilising technology. We believe that student production of the PodPoint has supported both individual and collaborative learning. The students' academic performance and engagement with the short answer questions indicates this and is further acknowledged in the feedback garnered from the students.

As noted, the modern student, having been raised with technology, prefer different ways to learn, above and beyond the traditional didactic method (Munns, 2013). Therefore, it is encouraging to see that the success of this AL strategy has been demonstrated across several fronts including student-centered learning, technology, creativity, and collaboration. Wanner (2015) highlighted the fact that students crave interaction and student-centred approaches that use technology. However, the costs associated with the use of technology, especially those that gamify learning are often too prohibitive. What's more, Pegrum and colleagues (2015) encouraged more teachers to adopt creative approaches, such as podcasting technology, to positively impact student learning. They put forward two primary implications for future practice: 1) to encourage students to adopt a deep learning approach, it is worth employing appropriately structured creative podcasting tasks, and 2) large undergraduate science units, that may have budget constraints and limited staff, should consider using creative podcasting as it can improve outcomes for students by promoting creativity and contextualization. Considering this, it is encouraging to see that the top TA end-theme is "Promoted learning". Consequently, we feel that the success of this present work demonstrates how the innovative and creative use of PowerPoint technology provided a readily accessible and extremely cost-effective podcasting alternative to promote learning, student interaction, and engagement. The use of PowerPoint has not specifically been applied in this manner before for physiology education, nor have they been co-combined with a fictional narrative, such as the "Uni-Apocalypse" that fostered creative learning within an interactive game-like platform. This is an important finding of this work. As previously discussed, many students find anatomy & physiology subjects content-heavy and challenging to learn (Munns, 2013), and various strategies are being explored to help promote learning of this foundational subject matter. The findings of our work indicate this intervention can be one such strategy. Moreover, it is a cost-effective, versatile, and highly engaging resource to add the instructor's toolkit across any subject matter with potentially global reach.

Moreover, as mentioned, personal motivation for the research team for this work stemmed from the observation and experience that 1) students crave interaction and active participation; 2) there is a lack of creativity and imagination in the learning process, and lastly 3) that students can be disengaged and unmotivated learners. Therefore, on top of the positive project findings, the confirmation that at the grassroots level of learning, individual teaching observations and active strategies can have purposeful meaning for the curricula is heartening. The upstream, personal reward that comes from this helps to solidify one core reason why we as educators, as well as many others, entered the profession of teaching in the first place -- which is to help others to learn. Successful strategies born from teachers who actively engage in the teaching process helps to keep alive the spark and passion for teaching in an era where many teachers themselves become disheartened, disengaged, and burnt out.

To the best of our knowledge, this work stands alone against other AL strategies. Its unique pedagogical approach comprises a blend of several elements that acknowledge the top three AL strategies reported by Abuso (2017), such as applying technology, cooperative learning, and a project-based approach. In comparison to the didactic learning model, it better aligns with the preferences of the modern learner.

Importantly it encompasses a high degree of creativity with its design and has allowed students the freedom to showcase theirs. It is the first piece of research exploring the effect of a novel teaching method promoting the student production of creative, game-based human physiology PodPoints, on first-year students' perceptions, engagement, and assessment performance. Thus, the work presented here is unique, has addressed the call for further exploration in this area, and looks to add to the growing knowledge in this field. Practically, it has provided a constructively new approach to actively support learning, especially in physiology.

It is, however, heartening to see others conducting similar strategies to foster learning. Just recently, following our work, Scott (2022) used a novel approach to engage student learning during the COVID-19 pandemic. Fictional characters from the popular television series, Games of Thrones, were used to help 80 students understand physiological and pharmacological concepts. Using a novel and engaging scenario, the author used the poisoning plots seen in the programme for the students to research aspects of physiology and the pharmacology underpinning them. This was delivered online using a flipped tutorial environment. While no effect on assessment performance was reported, feedback from the online tutors indicated the students readily engaged with the task and generated more communication, including emails between the tutors and the students. Additionally, a greater than the normal number of comments (average of 203 comments) in the online chat occurred using this method. The tutors believed that the students' ability to master the discipline-specific material was better demonstrated with this fictional context, compared to the traditional 'dry' questions relating to topic matter (Scott, 2022). Additionally, the task, and the flipped, online tutorials afforded the opportunity for the students to not only demonstrate a mastery of their discipline-specific knowledge, but also imagination, problem-solving, lateral thinking, and originality (Scott, 2022). While our work was conducted face-to-face, there are similarities. For example, our work used fictional characters (The Professor, The Super-soldier, and the zombies) with the Uni-Apocalypse narrative to engage the students. Moreover, students put forward sound physiological suggestions based on toxins to interfere with the functioning of the zombies.

> *"Use octopuses' toxin (Tetrodotoxin) to manufacture bullets and darts to interfere with the nerve transmission in Zombies at the neuromuscular junction."*

5.2 Study limitations, concerns, and future directions

Several limitations are associated with this present work. Considering the amount of student feedback associated with the teamwork component, the delivery and success of this intervention balanced on how well the students collaborated. While student academic performance and learning were supported by an AL strategy expressing creativity, collaboration was a construct of interest. As reported, the intervention did support learning and return positive collaborative experiences for the students, however, the greatest concern and challenges faced by the students was with teamwork - 80% of the total feedback for the "Negative experiences and outcomes" overarching category related to students having negative teamwork and/or collaborative experience. This in part, may have limited the positive effects of this intervention on student learning, enjoyment, and engagement. Several students expressed disappointment about the lack of commitment by other students, with one believing this situation to be the "worst experience" that can occur with teamwork. Another student reported that bad teamwork had marred what should have been an enjoyable project experience. Teamwork is often inherently imbued with multifocal challenges, some of which have been highlighted with our work and reported by others, such as unequal individual contribution and participation in group tasks can occur (Freeman & Greenacre, 2010), or a general lack of communication skills for some students, as well as teamwork skills (Campbell, 2008; Pauli et al., 2008). The teamwork problems encountered for this present work may have been mitigated through additional work addressing teamwork dynamics. However, as already inferred, the scope of this present work didn't overly include the management of the teamwork dynamics. While the steps used (previously described) in our work to mitigate issues worked for some of the students, they didn't work for others. As such, further investigation and implementation of new strategies and methods to promote positive teamwork would potentially increase the success of the PodPoint task. To make equally diverse teams, a person's age, personality type, social-economic status, ethnicity, academic ability, language, and other skill sets could be used. Additionally, acknowledging and actioning the suggestions put forward by other researchers addressing this area would be useful. For example, Le and colleagues (2018) reported on problems with the supervision of productive collaboration, as well as effective means to enhance it. They reported that the following four common obstacles to collaboration comprised: students' lack of collaborative skills, free riding (unequal sharing of the work), competence status (perceived intellectual ability and capabilities), and friendship (detrimental effect of friendship in groups).

While the students' perceptions about their own creativity were explored, our work didn't directly test student levels of creativity before and after the intervention. Future work would benefit us to do so. Creativity outcomes for students have been measured via several pre-post divergent thinking tests with the data showing significant increases in measures of

fluency, flexibility, elaboration, and originality -- all linked to creativity (Stolaki and Economides, 2018). This is an important limitation to note with our present work as other work has shown that creativity enhancement can take place with targeted interventions (Kienitz et al., 2014).

All the student support materials in the teaching package aligned and contained all the details and instructions necessary for the students to deliver the work independently by themselves. As such, the students could have completed the work without attending the classes. That said, beyond teamwork issues, the second greatest challenge was associated with the use of PowerPoint technology. Various teacher support was provided on the use of PowerPoint via face-to-face instruction and the student PodPoint Project support materials, but the degree of this, as indicated by several students, was not sufficient. This is therefore identified as a limitation of this present work and would need to be addressed for any student-generated PodPoint projects going forward.

As I was the teacher facilitating the PodPoint Labs and had a vested interest in the success of this project, it could be argued that I should have not conducted the interviews. Budget did not allow for the use of a research assistant and the requested student interview times did not suit the schedules of the remainder of the research team. So, I conducted them. This is noted as something that could be addressed in the future. Teachers as researchers can face a myriad of ethical dilemmas (Al hinai, 2015). I did, however, take into consideration the ethical dilemma associated with me as the teacher, being the interviewer. I understood that by acting as both, a power imbalance could influence whether a student decided to participate or not, and the type of feedback given. To mitigate this, I used four qualitative data-collecting instruments -- survey, two questionnaires, and interviews. The questions used for the individual questionnaire were the same as the interview questions bar one. The question “Was the instructor helpful?” was omitted from the interviews. The several data-collecting instruments gave students the opportunity to participate (or not), in one or all according to how comfortable they felt. Participation was entirely voluntary, and all, except the interviews, were anonymous. Additionally, as the teacher, I made myself open and available for all students during the PodPoint classes and both welcomed and encouraged feedback. Subsequently, this may have helped those students attending the interviews to feel comfortable to freely expressing themselves. The interviews returned both positive and negative comments (166 vs 24). This was somewhat reflective of the other data-collecting instruments, however, interestingly, more negative comments were made during the interviews compared to those returned by the anonymous individual questionnaire (13% vs 9% respectively). Therefore, it appears that my presence didn’t prevent the students from honestly expressing themselves during the interviews.

Concerning the PodPoints themselves, academic performance, as noted by SAQ results, improved when students produced the related PodPoint topic. For example, while the overall results show that students found the Muscle Contraction SAQ topic the most

challenging, a greater than two-fold difference in mean scores existed between those students undertaking the related PodPoint topic and those that didn't. This strongly suggests that the PodPoint task for this topic directly supported the learning of this material. This is a major outcome as the largest effect appeared to be in the most difficult topics, which is far more beneficial than helping students learn and understand topics that are already inherently easier. Because of the varying levels of performance across the different SAQ topics, it would be beneficial for future work to compare these outcomes with other findings in these areas. Moreover, student engagement with the related SAQs was high. However, these findings were limited only to the SAQ questions where there was an overlap of the PodPoint topics. The SAQs covered five physiology topics that related to the knowledge covered in five of the eight PodPoint topics. As such, assessments need to be cognizant of providing the opportunity for all students to answer a PodPoint-related topic so that none are disadvantaged. Thus, alignment of new learning tools such as the PodPoint with overall assessment is important. It is plausible to infer that with greater use of the PodPoint task across all the unit topic areas, better overall academic performance by the students may have resulted. Therefore, future work could include the use of the student-generated PodPoints across all topics to enhance academic performance. It would also be interesting to investigate how other AL strategies, like ours, affect the levels of student test question engagement.

As this work was done to support the learning of fundamental physiology topics for first-year undergraduate students, the effect of this type of intervention on more advanced physiology topics is unknown, however, based on our findings it is reasonable to infer that similar positive outcomes would result. It would be interesting to investigate whether creativity and engagement would increase if students already had the base knowledge required to begin applying to a game-based scenario, particularly if they already had experience with the format in their formative university years. We believe that this novel learning and teaching tool can be readily used to support student learning in other disciplines and subject matter. It would be of benefit to see if this was the case.

Additionally, while others have reported that students benefit from the repeated use of podcasts as a revision tool (Kalludi et al., 2013), this was not possible with our present work, and so future use of the PodPoint intervention should look to do so. This could be achieved by having the PodPoint task completed early on during the delivery of the unit, allowing not only repeat access to the work done for those that produced it, but also access to the work for all students. However, the short 4-week nature of the VU block model makes this difficult. This would have to occur in a unit that is delivered through the traditional 12-week semester format. On this, it would be beneficial to determine the effects of this intervention across this longer time. Students reported time constraints as a challenge for this present work. Considering learning, and consolidation of memory can be an iterative process, a longer time frame for this type of AL intervention may be of more benefit. Kalludi and colleagues (2013) reported that

the effect of podcasts on long-term retention and recall of information could not be assessed in their work. The same also occurred with ours.

It was noted that while the flipped classroom model is promoted with the teaching unit, most of the students had not conducted the pre-learning and reading activities. As such, first-time exposure to the learning content took place in the classes or the PodPoint labs. Future PodPoint work could be delivered in two parts – firstly as a "PodPoint Learning Series" whereby teacher-generated PodPoints, would in part deliver the learning content, and secondly, as an AL assessment task, like that used with this present work. Additionally, other fictional scenarios, outside of the "Uni-Apocalypse" narrative could also be explored, perhaps with the students selecting them allowing greater expression for their creativity.

Whilst "Enjoyment" wasn't incorporated as a construct of interest, student feedback crossing several of the constructs indicated sound levels of it. On top of learning outcomes, future research should look to directly gauge students' levels of enjoyment as an important means to validate the use of AL strategies such as ours.

Another researcher could have done the TA to provide another set of eyes. Especially considering the large amount of qualitative data that was analyzed. This was done manually by me using the Excel application and was an iterative process that was very time-consuming. This was the first time that I had collected feedback from study participants and the need for qualitative analysis. Following research, and advice from other academics, TA was chosen as the appropriate method to undertake the analysis. While the manual TA process provided me with a sound grounding for this method, in hindsight, the use of a qualitative data analysis tool designed to manage 'coding' procedures, such as "NVivo", could have significantly reduced the complexity of the task and simplified the process (Hilal & Alabri, 2013). Moreover, while the four qualitative data collecting instruments used in our present work gave the students a greater opportunity for participation, a large degree of comments were returned (779) with additional challenges of repeated data – comparable feedback from the same respondent, because of the same or similar questions being used across some of the data collecting instruments. Additionally, some of the Likert-scale statements crossover as they are related to one or more of the constructs of in resulting in some repeated data. It can be argued that more specific Likert-scale statements associated with each of the constructs of interest could have been used. All of these would be something to take into consideration with future work.

Finally, we believe that this AL strategy has successfully acknowledged and met the needs of the modern learner, and as such offers a highly transferable tool for other teachers to use across other curriculums and subject matter. It has met the call for further research in this area. Hopefully, it will inspire others to do so.

5.3 Concluding statement

In summary, this work aimed to provide a novel and engaging strategy to support the AL of physiology, with one research question addressing student test performance, and another, the student perceptions of it. Its pedagogical approach is unique, using a blended, collaborative AL and assessment approach based on readily available and cost-effective technology. It is the first to explore the use of student-generated PodPoints in promoting the AL of physiology and the student experience. Moreover, it is the first investigation using a novel, game-based narrative based upon a Zombie Apocalypse theme, called "Uni-Apocalypse" to foster creativity and student engagement. It comprised several AL elements including technology-enhanced approaches, cooperative learning approaches, and project-based approaches, all of which have previously been identified as the top three preferred AL strategies for students (Abuso, 2017). Leilani and Kreager (2017) attest that deep learning and the construction of knowledge are facilitated when individuals can actively engage with the subject matter as well as with others. Our results corroborate this. The effort undertaken to create this novel teaching and AL pedagogy has been rewarded -- students reported having a "meaningful experience". We believe that the project aims and objectives have been achieved, substantiated by the improved academic performance noted with the SAQs results, alongside the positive feedback provided by the students across all the constructs of interest.

Despite the considerable use of technology in the education system Middleton (2016) suggested that audio-rich media formats, such as podcasts, can be extended beyond their existing use and should inspire innovators to confidently identify new opportunities for student-centered AL. We believe that we have answered the call to do so.

Our work demonstrates that with a little imagination and creativity, teachers can readily engage and support the modern learner by allowing them to showcase theirs. As such, this innovative teaching program effectively supports an evolving educational landscape - one whereby the methods and practices of teaching acknowledge the needs of the modern learner, position them at the fore of knowledge construction, and put some fun back into learning. The potential exists for this novel strategy to be used to support student learning across other disciplines. It is a cost-effect, readily available, and relatively simple tool to use. Conversations regarding this have taken place with other academics at the conferences where this work was showcased. The global reach of our work has occurred with a presentation at the "Reimagine Education Conference (virtual) in 2020) where it was shortlisted for an award in the E-Learning category. The Uni-Apocalypse narrative and PodPoint format itself could be used by other disciplines by changing the content and learning to match the discipline topic. Additionally, another narrative could replace the zombie theme, such as a science fiction/fantasy one, war, or emergency services. Many options are possible -- all it takes is a little imagination.

Considering innovation underpins many of the changes we see in today's world, it is critical the education system foster creativity and imagination. As a passionate educator, I believe that the students of today are the innovative change-makers of tomorrow.

THE END.

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APPENDIX:

FIGURES

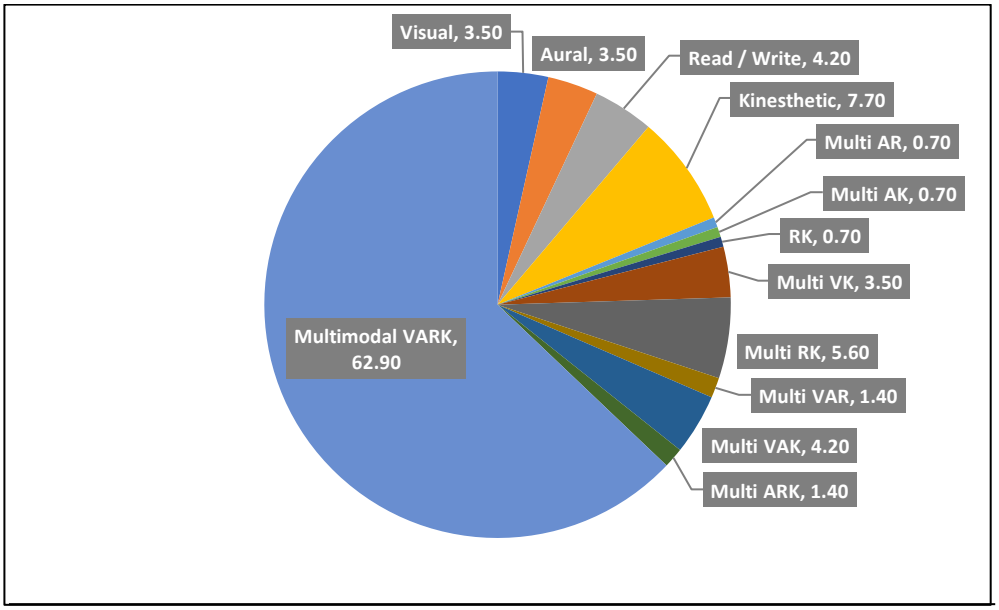

Figure 1A. VARK Profiles.

TABLES

Table 1A. Survey. Codes, themes, and sub-themes for “What was the best aspect of your experience with this teaching innovation?”

THEME	Code
NEW PEDAGOGY 18	
New way to present and engage	new method of presenting information
with the information 9	We got to find out information about this unit in a productive...way
	a new form of presenting information
	It was something different and it changed things up from the the usual theory
	This task was a bit more different then a usual creative task that might be normally done
	it was something different…
	...something new
	a new way
	unique way to engage
New pedagogy for learning 6	getting the chance to learn and study in a very different way than usual
	a new way of learning new things and gaining knowledge
	to learn my materials better and in a more interesting way
	Trying a new type of...learning
	unique way to engage in the unit content
	a new way of learning
New pedagogy promoting enjoyment	fun to learn...something new
& satisfaction 3	a more interesting way
	was nice to have a new kind of assessment
SUPPORTED LEARNING 10	It was interesting learning, able to link back to the super soldier, helped gain perspective -
	(cont) how the subject works in relation to the whole body
	learning to make an interactive, game based presentation
	Learning new things.
	encourage them to learn their topic more
	Learning the information and doing work
	help us to understand the concept
	it was...a good way to learn.
	it made learning the content easier and more understandable
	it was interesting to participate and learn
	Learning about my topic
RESEARCH PROMOTION &	i had to research about my topic beforehand
KNOWLEDGE CONSTRUCTION 3	researching unit content
	reserach to build the podpoint
SUPPORTED CREATIVITY 8	i was able to dive in and expand my imagination
	utilising creativity

Table 1A. continued.

	it takes the generic presentation format and adds a little more creativity
	the uni-apocolypse setting helping to engage a students more creative side
	The creativity side of things
	We got to find out information about this unit in a ...creative way!
	Making our own stories to star on
Lateral Thinking	The creative thinking aspect. Creatively incorporate the content to the story helped lateral thinking
TECHNICAL SKILL ENHANCEMENT 13	increase my understanding of technology
	Discovering new feature of PowerPoint
	play around with technology more in a different light
	The use of PowerPoint
	I learned about podcasting... it was my first time of making a Podpoint
	learn new skill regarding powerpoint in the process of the creation of the podpoint
	using the technology
	i didn't know what i could do with power point before
	using new technology
	learned how to use animation in the powerpoint
	Learning how to create a podpoint
	interaction with technology like powerpoint
	Being able to learn new PowerPoint skills
TEAMWORK & COLLABORATIVE LEARNING 16	
Promoted working as a team 7	i was able to work with different people
	Working in a team
	work as a team
	it did encourage me t involve more in team working
	as a group
	Group work
	Enjoyed making the podpoint with the team
Promoted collaborative learning 5	collaborating this learning
	Helping others learn the content
	Teaching and learning in parallel
	Trying a new type of group project and learning
	learning with people that are different to me
Communication 4	Interacting and talking with my partner
	communications and contributions
	being able to interact with my peers and sharing information
	communicating with my team members to produce the podpoint

Table 1A. continued.

ENGAGEMENT & MOTIVATION 9	
Promoted engagement 3	engage myself with the topic
	it did encourage me
	I was able to engage in the activity even more than usual
Promoted motivation 2	I felt more more motivated
	doing work but feeling excited to do so
Engaged learning 3	to learn...in a more interesting way
	it was interesting to participate and learn
	unique way to engage and learn
Inspired student engagement by teacher 1	I liked that the teacher was passionate about the podpoint, it made me -
	(cont) more interested in participating in the activity
ENJOYMENT & SATISFACTION 12	i really enjoyed recording our voice and using different utilities/ play around with -
	(cont) the visual component of PowerPoint
	fun to learn
	We got to find out information about this unit in a...fun...way
	it's fun and it doesn't feel like work
	a funny and good way
	it was fun...
	I thought it was a fun
	was fun
	it was nice to have a new kind of assessment
	it doesn't feel like work
	i didn't know what i could do with power point before
	I am proud of how much work I put in
DISSASTISFACTION 2	sometimes felt like it was useless
	nothing
91	

Table 2A. Survey. Positive and negative feedback sub-themes and codes – “Do you have any additional comments or feedback?”

Positive feedback	**Do you have any additional comments or feedback?**
THEME	**Code**
Enjoyment	Overall I think it was a great experience
(linked to Great innovation)	i really love the concept...
(Linked to stress & VARK)	it was perfect!
	definitely an enjoyable experience
	I enjoyed it
	Ive really enjoyed this block - it has been the best this semester
	This PodPoint was alright
8	i really love the concept and how and the ideas
Great Innovation	thought it was a great way to learn
	Innovation of learning
	first of its kind
4	I think it's a fantastic idea
Teaching Staff	FAV TEACHER!!!! very nice and easy communication
	Instructors have done a great job
3	Instructor is awesome
Low levels of stress	never felt like it was stressful
2	less stressful than a presenation
Appreciation 1	Thanks
VARK allocation to Teams 1	working in groups based on our VARK scores was also a great idea.
Teamwork enjoyment 1	it was good to work in a team
Learning new technology 1	We were enabled to learn the new technology right from the start
21	
Negative feedback	
Teamwork	but the group work was not as useful and helpful
	more than two are better... too much for just two people to do
	make the groups bigger so when someone leaves its doesn't make it harder
	only few team members were engaged
Perception not experienced	project would be difficult if...other students weren't pulling their weight
Perception not experienced	it could feel alienating for a student to be the only one engaged in the work
Perception not experienced	in that situation (which thankfully I wasn't) I would feel stressed and anxious about this assignment
	Making labs compulsory so that people from your group actually come and help with the work

Table 2A. continued.

	have teams sorted out early in the unit to allow students to begin planning sooner
	give examples of what role assignment should take place in order to avoid an imbalance in group participation
11	without suggestions on how to spread the workload... lead to 1 person taking on the resposibility of the powerpoint
PowerPoint	I wish we were taught more on how to use interactive functions on powerpoint
	A couple of hours should be dedicated to educating...on the fundamental features of PowerPoint
	Perhaps ask students who are proficient in PowerPoint and team them up with rose who are not
(linked to teamwork)	1 person taking on the resposibility of the powerpoint...VERY VERY VERY time consuming
	i did 80% of the work...beacuse when 1 person says "yeah I will do all the transitions"
	"yeah i'm good with powerpoint" then they get stuck doing it
	artistic value of the piece stays in tack then 1 person need to take charge of the powerpoint
7	It is IMPOSSIBLE to share the workload of a powerpoint
Dislike PodPoint	Do a project that does not involve PodPoint. It is not useful or effective and has no relevance to its intention
2	PodPoint is uselss
Dislike Zombie Theme	i felt like i dislike the apocalypse zombies concept
Unsuitable for University	I don't like the project as it's presented...just questionable execution at a University level
Confusion	i'm just a bit confused about how this was related to it
Time for delivery	It was a bit rushed
Inappropriate Project name	Calling this a podcast was innacurate
Topic Content too small	The topics we had were quite small...with no "creative (zombie)" part to it then it would only take 2-6 minutes
Use of Fictional Scenario 7	it would have been more effective if the scenario was REAL LIFE...Not made up
27	

Table 3A. Individual questionnaire. Themes and codes for the individual questionnaire item – learning construct – "Did the teaching innovation promote your learning? If so, How?"

Learning Construct	Did the teaching innovation promote your learning? If so, How?
Theme	Codes
Clear and specific instructions 4	very instructional and specific on what I needed to learn so there was less stress
	made my understanding clearer
	it seemed easier to keep up with things
	easy to understand
Learning in teams 4	team work was interesting and fun to learn and participate
(linked with Collaboration below)	it gave us the opportunity to teach our fellow cohort in a new and different way
	It was very interesting to see the outcomes of the other PodPoints
	listening to the PodPoints of other groups was ideally a good way to learn new information
Promotion of learning & content engagement 12	having to write a script and then to speak it. I think that made me really engage with the content
	it helped with retaining information and understanding the depths of the learning content.
	helps to make assignments fun and information more retainable
	I had to look more in depth into the topic
	searching content related to my topic helped me to understand it easily.
	the teaching innovation promoted our learning
	consolidate the information that was learned in our workshops
	it allowed me to better understand the topic
	I was able to apply knowledge in a scenario, which further promoted my learning
(linked to creativity construct)	learning something that is put into a creative aspect really helped me retain information easier,
	as well as keeping me more focused.
(from Engag & Mot Construct)	The topic of material my team was given was very interesting, as someone who likes learning ,
	immunology, inflammation was a great topic to create on
	I was able to combine the information we learnt during the week and put it in a presentation
Enjoyment 4	face to face lecture fun
	I thought it was a great idea and very creative
	helps to make assignments fun and information more retainable
	it made learning this content fun
Motivated to use the technology 1	I was motivated to use the new technology.
Learning not promoted 1	No
26	

Table 4A. Individual questionnaire. Themes and codes for the individual questionnaire item – engagement construct – "Did it help to motivate and engage you with the topic material? If so, how?"

Engagement & Motivation	Did it help to motivate and engage you with the topic material? If so, how?
Theme	Codes
Enhanced learning engagement & motivation 15	it did motivate me to an extent
	It helped me engage with the topic
	it wasn't boring to tackle
	it kept things more interactive
	definitely- it was motivating...
	wanting to see another students' work
	it was a never done before type of assignment, so it was interesting and engaging
(from creativity)	I wanted to get all possible content
	having to write a script and then to speak it. I think it made me really engage with the content
(from learning)	I was able to combine the information we learnt during the week and put it in a presentation
	The topic of material my team was given was very interesting, as someone who likes learning
	immunology, inflammation was a great topic to create on
	it was a different method of "teaching"
	Yes it did.
	I already had a high skill in PowerPoint and this made me use my ability (from technology)
Enjoyment 5	the intentions of this PodPoint assessment seemed very good and fun
	likes learning immunology
	the PowerPoint it made it more enjoyable.
	learning this content was fun, as it was a different method of "teaching"
	...make it funny and creative
Promoted research 3	I researched the topic
	it made me do a research on each topic
	It encouraged me to research
Teamwork problems 1	not as engaging as I thought it would be due to the problems in my group working as a team
Engagement not promoted 1	NO (same person that replied no to above)
25	

Table 5A. Individual questionnaire. Themes and codes for the individual questionnaire item – creativity construct – "Did you think the teaching innovation promoted your creativity in the learning process? If so, how?"

Creativity	Did you think the teaching innovation promoted your creativity in the learning process? If so, how?
Theme	Codes
Creative, innovative, and engaging intervention 5	The scenario(zombie) was interesting
	out of the box thinking
	it was a never done before type of assignment, so it was interesting and engaging
	I thought it was a great idea and very creative
	very creative
Relating PodPoint to the scenario 2	making powerpoint relate to it, helped me to develop my creativity
	It was really fun creating clips and scenes within the PodPoint.
Enjoyment 4	very creative which helps to make assignments fun
	It was really fun
	The use of humor and outrageous storyline helped with this
	I thought it was a great idea and very creative which helps to make assignments fun...(from learning)
Promoted creativity 4	it really opened up my creativity skills (from Technology question)
	the task in general was creative it was easier to get more creative in the way we did things
	it made us think about the situation and be creative with the ideas
	helped me to develop my creativity
Promoted learning through creativity 3	it helped me and the others to better learn the topic when we had a creative spin on the presentation
	a creative aspect really helped me retain information easier (from learning question)
	very creative which helps to make...information more retainable (from learning question)
Creative use of technology & skills 3	learn more of technology
	It taught me some new PowerPoint presentation skills which I will use again.
	The lecturer assisted in applying computer knowledge
Instructor inspired student engagement 1	The instructor was really involved and excited in the work, which was inspiring
Creativity not promoted 1	No
23	

Table 6A. Individual questionnaire. Themes and codes for the individual questionnaire item – technology construct.

Technology	**How did you find the use of the podcasting/PowerPoint technology?**
Theme	**Codes**
New way to learn 3	It is very different to what our standard assignments are…
	a different way to learn
	A new experience.
Interesting use of technology 2	Its very good and interesting
	It was very interesting to learn how to use PowerPoint during this PodPoint assessment.
Ease of use 6	Easy (x 2 comments)
	overall it was quite easy to make sense of
	It was not too difficult to use
	once I started it was much easier than I thought
	Surprisingly easy
Enjoyment 3	Fun
	I found it a fun experience
	Fun and enjoyable
Technical skill enhancement 9	Many skills were learned during the process of making the PodPoint
	The lecturer assisted in applying computer knowledge (from creativity)
	It taught me some new PowerPoint presentation skills which I will use again (from creativity)
	learning new ways to use the program
	It taught me some new PowerPoint presentation skills which I will use again
	with time and practice we learned how to use it
	Yes, learn more of technology
	The lecturer assisted in applying computer knowledge
	We were enabled to learn the new technology right from the start of the unit (Instructor engagement)
Challenging 4	…in the beginning, it was quite confusing navigating slides and adding pictures and audio
	When we first started it was hard to create the PodPoint
	I thought it would have been good to get a bit more instruction on how to use it.
	At first it was confusing and overwhelming…
Promotion of creativity skills 1	Howerever, it did come to place and it really opened up my creativity skills
Promoted student engagement 1	I already had a high skill in PowerPoint and this made me use my ability.
More PowerPoint Instruction 1	I thought it would have been good to get a bit more instruction on how to use it
Technology not effective 1	Not effective. (Same student)
31	

Table 7A. Individual questionnaire. Themes and codes for the individual questionnaire item – collaboration construct – "How did you find working in teams?"

Collaboration	**How did you find working in teams?**
Theme	**Codes**
Good experience (satisfaction) **11**	It was engaging
	It was good
	Very effective
	It was great
	I found it to be a good experience
	I always prefer working alone, but it was good and challenging for me.
7	Good
Sub-theme	
Communication & Good team member(s)	I never like group projects, but my team member was really good
	My partner was very helpful
	I am usually someone who prefers working individually, however, I had a very communicative team
4	communicating was easy (from VARK - critical thinking)
Enjoyment (satisfaction) **7**	It was...enjoyable.
	team work was interesting and fun to learn and participate (from Learning)
	I was lucky and had a great team
	we were able to split the workload into what we would enjoy doing more
	Very...fun
	Fun.
	I had such a great job (from VARK - critical thinking)
Ideas sharing and communication **3**	Can share ideas
	it was really good sharing each of our ideas and thoughts.
	all the team members worked as a group to achieve this task
Collaborative teaching and learning **6**	learn new things
	it gave us the opportunity to teach our fellow cohort in a new and different way (from Learning)
	It was very interesting to see the outcomes of the other PodPoints (from Learning)
	listening to the PodPoints of other groups was ideally a good way to learn new information (Learning)
	In teams you are able to teach others, which helps understanding
	if you are unsure on a subject someone else in your group may be able to teach you
Teamwork problems and concerns **7**	not as engaging as I thought it would be due to the problems in my group working as a team
	(from Engagement & Motivation)
	although one team member was not an active participant and did not attend the class. Also left the group at the last PodPoint session

Table 7A. continued.

	Teams were okay, communication was lacking a little bit
	Working in a team, unfortunately, took a toll on the outcome of the PodPoint. (Same student)
	Not finishing the PodPoint to the level of expectations of many brought the performance of the team down (same student)
	members had to put in much more work than other team members clearly showed the flaws in teamwork due to the lack of commitment and responsibility shown by fellow peers (same student)

Table 8A. Individual questionnaire Themes and codes for the individual questionnaire item – Critical thinking & Communication construct.

VARK	**What do you think about doing your own VARK analysis?**
Critical Thinking & Communication	**Was if helpful is understanding your communication style?**
Theme	**Codes**
Helped to understand individual communication style	It was alright
9	Yes
	In a way
	Yes.
	It was helpful.
	Yes.
	Yes, it was.
	Yes, and it was correct
	It is a true assessment of my main strength - my reading ability
Didn't help to understand communication style 2	Not really.
	Not effective (same student that has provided negative feedback for all questions)
Didn't help with team dynamics	But I don't think I used it to benefit my group
3	It was nice to see the results, but they didn't really help in terms of the task.
	VARK wasn't very helpful, to be honest as it clearly didn't make a great team that I worked with
Helped students think critically about learning 1	a good idea though and I think made students think critically about learning
Didn't complete VARK Analysis	I did not do the analysis
2	I don't think I completed that because I was unable to come into uni that day :(
Misunderstanding of VARK	I think it's hard to accurately judge learning style through this medium as our own ideas about how we want to be seen might affect choices in the questionnaire
2	It was interesting to see what learning style I fitted in to. However, I don't think it helped understand my communication style.
19	

Table 9A. Individual questionnaire. Instructor Engagement – “Was the instructor helpful?” Codes, themes, and sub-themes.

Instructor engagement	**Was the instructor helpful?**
Theme	**Codes**
Instructor was helpful 18	Yes, the instructor was very helpful.
	Yes
	Yes
	Yes
	very helpful
	Yes.
	Yes, he was very helpful and understanding
	Yes, absolutely.
	was helpful
	Yes, very helpful.
	Yes.
	Very Helpful.
	Definitely
	Very Helpful.
	Very
	Yes
	Instructor is awesome (from open feedabck).
	Instructors have done a great job (from open feedabck)
Instructor guidance 4	
Understanding Project requirements 2	Constantly checking up on our group every PC Lab session enabled us to understand the project
	a lot of project guidance
PowerPoint instruction 1	the instructor assisted us with using powerpoint
Ideas generation 1	many ideas were explored with the instructor.
Instructor patience & understanding	the instructor showed a lot of patience
3	which has been amazing and make students comfortable to ask questions/ get help
	Yes, he was very…understanding
Instructor passion	The instructor was really involved and excited in the work, which was inspiring
3	showed a lot of passion and cared
	was enthusiastic
28	

Table 10A. Individual questionnaire. Themes and codes for the individual questionnaire item – Open feedback – "Do you have any further comments or feedback?"

Open feedback	**Do you have any further comments or feedback?**
Theme	**Codes**
Great experience 1	Overall, I think it was a great experience
Unique project 1	first of its kind for me and I think a lot of students
Challenging 1	means more reassurance for those who are intimidated by the new format
Enjoyment 3	I enjoyed it though
	Only that I've really enjoyed this block
	it has been the best this semester
Satisfaction 2	Instructors have done a great job
	instructor is awesome
Technical skill enhancement 1	We were enabled to learn the new technology right from the start of the unit
Less stress than other assessments 1	less stressful than a presentation.
Earlier allocation to teams 1	It might be better having teams sorted out early in the unit to allow students to begin planning sooner
Dissatisfaction 1	PodPoint is uselss (same student)
12	

Table 11.1A. Themes and codes for the teamwork questionnaire item – Overall team experience.

Overall team experience	**Q3 - Overall, please describe your experience in working as a team**
Theme	**Codes**
Enjoyment & Satisfaction	I enjoyed working in a team environment
22	was a very good experience
	Interesting, Fun
	The overall experience in working as a team was really good
	It was good
	it was okay I guess
	the experience was okay, it wasnt bad
	It was ok
	The experience I had was great
	i loved working in a team
	we all work as a team really well
	It was really good
	It was a good experience
	ENJOYABLE EXPERIENCE
	really good
	It was great working as a team
	I enjoyed working in my team.

Table 11.1A. continued.

	It was a good experience
	fun
	It was great
	Working in a team was helpful
	Really good
Positive Teamwork Experience 52	
Positive Team Member experience	it was not a problem working with my partner
	I got along well with other members
	some people were really helpful and hardworking
	I really had good teammates
	It was great working in a team
	Our teamwork is very well and organised
	Working in a team is always good
	Initially I was a bit sceptical about working as a team especially with people I didn't know
	but it turned out to be an useful and a fun experience.
	Had its positive
	I had a great team and we worked well together
	my team and I worked very well together
	the other member was very helpful
	I felt that my team worked very well together
14	We collaborated well in doing our research
Members with different skills	I am pleased with the way that we were put in different groups with people with different skills
	Each member of the team was good at something and this really helped to be able to work as a team
3	it was good to manage roles and outcomes
Sharing the workload	It helped us delegate tasks more easily, which led to earlier completion dates
	Everyone contributed to the presentation
	we were prepared to create the work
	as a team we could share the notes between us
	everyone worked together
	everyone pulled his own weight
	each member contributed a fair amount of work
	putting a powerpoint together
	The team worked well at delegating roles and spitting up the work evenly
	Everyone was able to complete their tasks in the given timeframe
	The group worked well after organising tasks at the start
	everyone contributed to the work
	both were relaible in completing work
	meeting up out of class hours to work on the assignment together
15	all of us worked as a group to achieve this task
Sharing of ideas	We were able to write a script…record it and put it together relatively easily
	work as a team and share different ideas and make a wonderful result

Table 11.1A. continued.

	we all had great ideas
	collaborating our information together
5	bounced ideas off each other making the work much easier.
Supported learning	we both learned a lot for each other
	helping each other out to learn about new information
3	we could read over and learn from each others work
Supportive team members	no one was leaving anyone behind
	group member help me to edit the podpoint
3	my team partner was super helpful and we both were on the same level
Good communication	perfect communication
	Communication was effective
	we had great understanding and communication
	CLOSE WITH THE GROUP MEMBERS. OVERALL WENT SMOOTHLY.
	communication between members was good
	Overall, communication between the group was good
7	I learnt to cooperate with my team mates.
Small team size able to do work	although we were only 2 in the group, we were able to finish the PodPoint right in time
2	It was great we had only two people in our group and we worked very well together
Developed new skills 1	it helped me to develop my experience working as a group
Positive teamwork overcomes initial reservation 2	Initially I was a bit sceptical about working as a team especially with people I didn't know… but it turned out to be an useful and a fun experience.
	I always struggle a little, with working with some personalities but I feel happy with how… the group work resulted and am happy with the collaborative work

Table 11.2A. Themes & codes for the teamwork questionnaire item – Overall team experience.

Overall team experience	**Q3 - Overall, please describe your experience in working as a team**
Negative Teamwork Experience 32	
Negative team experience	Disappointing
	Not as productive as expected
	unfortunately not great
	group work is difficult at the best of times
	Overall, it was a mediocre experience
6	Had its...negative aspects
Poor team member commitment	some group members were absent during the time we had to work on this project
	the motivation of my team mates were not as desired
	hasn't been the greatest experience due to the lack of commitment
	there were 3 people in one group, one person ditched the group at the last moment
	team members have not been putting the same effort as others

Table 11.2A. continued.

6	there was a serious lack of contribution from two group members... had to beg the other two members…to do any work in order for them to accomplish anything...
Project stress	...adding to the stress load of an already difficult course and ruining an assignment that should have been enjoyable
2	This podpoint project has been very stressful...causing a great sense of disturbance and stress as it was very uncertain whether the podcast was going to be finished
Poor communication	lack of communication between fellow peers
	i do wish there was more communication in order to maximize efficiency
3	communication and commitment was a bit of an issue
Unequal sharing of workload	Team member did not end up contributing to the PodPoint at all
	the work wasn't equalised and i felt that alot of the work was put on me
	It was difficult as most of the project was the animation...
	that's very difficult to do with multiple people, it ends up being one person doing 80% of the work
	A bit difficult, not everyone was involved
	1 person is left with the majority of the work when they are given the
	creative power to do as they choose
	Without suggestions on how to spread the workload appropriately
	1 member is an expert in powerpoint and the other has NEVER USED IT BEFORE
	myself and another group member were continuously lumped with
	majority of the work
	we did have a group member who didn't do anything
	At times, it felt as though the majority of the work was placed on one person
12	team members have not been putting the same effort as others
Underdeveloped Teamwork skills	MOST 1st YEAR STUDENTS ARE FRESH OUT OF HIGH SCHOOL WHERE VCE
1	IS VERY MUCH A 1 person game
Larger Team sizes	i just wished there was a consideration made that more people...
	would be in each other groups
2	i do feel like a team of two isnt really great especially for a project like this
Task didn't support teamwork 1	the task made it difficult to work cooperatively
107	

Table 12.A. Themes and codes for the teamwork questionnaire item – Individual contribution.

Individual contribution	**Do you feel that you made a valuable contribution to the outcome of the PodPoint task? If so, how?**
Ideas generation, story & script	my ideas helped make the final outcome
	I did...the story line
	I helped create the script for the podpoint
	I did the design
	I was able to create a story line and relate all the relevant information back to the podoint story line

Table 12.A. continued.

	relating the concept to the super soldier
(collaboration)	I collaborated on the delivery of the content and storyline
(collaboration)	I collaborated on the delivery of the content and storyline
(collaboration)	worked well with my partner and listened to her ideas, as well as providing my own
(creativity)	I was able to be creative in the use of my writing ability
10	I CONTRIBUTED TO THE SCRIPT
Creativity	I was able to be creative in the use of my writing ability
	my team were very creative
3	I added creative ideas
PowerPoint skills & PodPoint	i made use of my skills in powerpoint to help
production	I did my part of Powerpoint organise
(workload contribution)	I did most of the work in relation to the actual Podpoint
	I also helped with the making of the Podpoint on powerpoint.
	I tried all my best to make any improvements to the podpoint.
	I did all of the slides to make it presentable
	developing the podpoint presentation
	make a podpoint out of all the information that we found
	putting together the slide show
	I assembled the power point
	putting together the podpoint.
	I contirbuted…to the powerpoint
	my involvement with the powerpoint presentation
	i made the slides and did the animation and special effects
	I find technology and powerpoint presentations relatively easy, my partner didn't find it as easy,
15	so i took final editing and audio on as my task, which I was happy to do
Narration of PodPoint	I did the audio
	I was the narrator
	I read the book
	I did…the voiceover
5	I'm providing narration
Research of information & content	I tried to get all the relevant information to our topic
	I did the research that I needed to do
	I helped with gathering information
	i did most of the research
	finding of the lost knowledge
	add relative information needed for the task
	I...took some notes for the podpoint
	did the research and info write-up
	I have taken care of the content part with the help of Sherwood
	i helped my team mate find all the information, put all the information together
	research
	contribute the information that was required of us finding information

Table 12.A. continued.

	preparing the expected information
	have worked on the information provided
	I provided the group with all the pictures and information
	I CONTRIBUTED TO...MY OWN RESEARCH PART
	I was able to research the vital information
	I did research for the topic
	a good understanding of the subject matter
	I spent a considerable amount of time working on compiling information
	I was able to gather information and apply it
23	I added a lot of information
Collaboration	I collaborated on the delivery of the content and storyline
	worked well with my partner and listened to her ideas, as well as providing my own
	I find technology and powerpoint presentations relatively easy, my partner didn't find it as easy,
	so i took final editing and audio on as my task, which I was happy to do
4	put it together along with my other team member
Individual contribution	Do you feel that you made a valuable contribution to the outcome of the PodPoint task? If so, how?
Workload contribution 18	
Equal sharing of the work	we both did our part very well and joined together
	we all have a valuable contribution to the podpoint
	we organised who's doing what so everyone has a fair amount of work
	our group worked well together so we were all able to contribute equally
	we halved all the work because we didn't have a large group
	as a group we divided the tasks equally
	the work load was split evenly and putting together the podpoint was done by everyone
	we all made a valuable contribution
	I believe our team divided the work evenly
	another group member volunteered to complete it instead (PowerPoint) and has done a fantastic job
	the tasks were split evenly so it was fair
	we divided each part of the topic among the members

Table 12.A. continued.

13	I did my part slide editing and my partner did their part
Unequal sharing of the work	i put the most effort into the podpoint
	I did most of the powerpoint presentation
	I spent more time on it than all of the hours my members spent on it
	their knowledge of how to use powerpoint was TERRIBLE... i had to do it ALL MYSELF
5	I did most of the work in relation to the actual Podpoint
Use of different skill sets	we all have different skills sets
(creativity)	as my team were very creative and I'm very logical and analytical so there was a great balance
	I feel that I brought good language skills to the team
4	I was able to be creative in the use of my writing ability and use of images
Sharing of Knowledge	we did share our knowledge
2	I shared some podpoint pictures with my group member
Satisfaction & enjoyment	I was proud of what we produced by the end of it
	the topic fun to create
3	I am so proud of it - it's so good.
Project management 1	I...arranged the separation of work, ensured we were all ok with the completion and submitted and checked in throughout the process
Motivating & engaging others 1	trying to convince other group members to cooperate and engage in doing any form of work
Unsure about contribution 1	I'm not too sure if I did but I think we all worked well together
Contribution not appreciated 1	i felt like my contribution wasnt really appreciated seeing as the slides i did were not used…stayed up a couple of times till 3 in the morning to make sure it was perfect
90	

Table 13A. Themes & codes for the teamwork questionnaire item – Teamwork & topic engagement.

Teamwork & engagement with topic	**Do you feel that working as a part of the team helped you to engage with the topic material? If so, how?**
Positive experience 49	
Promoted learning	we had to learn the topic even i it wasnt still taught in the workshop
(Peer learning)	every one was teaching each other
(Peer learning)	helped me engage with the material as everyone helped each other learn
(Peer learning)	the other member was able to teach me as we went along
(prompted discussion) (peer learning)	I also learnt whilst researching my own topics and conveying it back to my partner
(Peer learning)	we explained things to each other
	I feel like it made it easier to understand
	it helped everyone to have a better understanding
	I got to learn about new information
	it made me better understand it.
	it helped me learn how the immune system work
	helped each other to fill in the gaps with the knowledge
(Promoted discussion)	there was a lot of information to sort through and cross check that the facts and information was correct
	the whole topic that gave me a good understanding on the topic
	helped understand our content
(Peer learning)	they could teach me thing I could not understand and I could teach them things they didn't understand
	more interesting than individual learning
	It was important that we both understood the subject matter
	working in a group really helped with learning aspect of this task
	this allowed all of us to understand the content in a enjoyable manner
20	It made me remember a lot of the parts of the topic
Promoted research 2	had to work of our topic to find all required information ad get more familiar with the topic
(Promoted discussion)	gathering information
Promoted discussion (communication)	we discussed about the topic and the required contribution from each of us
	during gathering information, we were talking and discussing
	we had to discuss how to present the info and if the information was relevant
	we were speaking about it in detail
	we could discuss the topic and what we did and didn't understand
	it allowed group discussion
	We discussed a couple of points I was questioning
	we were able to discuss the unknown things as a group
	there was a lot of information to sort through and cross check that the facts and information was correct
	it raised conversation and questions about certain topics within our project

Table 13A. continued.

	we needed to bounce things off each
	we could rehearse sections and ensure that spoken parts were appropriately relevant to the topic
13	researching my own topics and conveying it back to my partner
Sharing of different views and ideas	everyone in the group understood the concept differently
	everyone had some great ideas to put into the podpoint
	it helps me discover new ways of thinking through interacting with other team members
4	i had to consider other ideas i may have not acquired on my own
Positive team support	working as a team is important because we helped each other out
	Working as a team was helpful
3	we encouraged each other to keep on top of the work
Sharing of the workload	THE WORK IS DISTRIBUTED AND THE LOAD IS DISPERSED...MADE IT MORE ENJOYABLE
	AS I DIDN'T HAVE TO DO EVERYTHING ALONE
3	my partner and I both pulled our weight. We did no procrastinate
Increased attention 1	definitely because in a team you have to pay more attention because your not alone
Indicating "Yes" x 3	No further comments made
Negative experience 12	
Poor team member participation	not everyone wants to participate
2	there were some areas where some people didnt put effort into
Poor communication 1	the team was not as engaging as we were supposed to be due to the lack of communication
Caused stress 1	i felt more pressured and concerned with others work contribution
Preference for independent work	it just made me bored, would rather have done it myself
	the project would have been done better independently
3	I prefer working on my own so i get all the work done
Negatively affected learning	i feel as though it was a deterrent and impeded on my learning due to the bad team experience
2	not everyone learnt the information in as much details as others
Indicating "No" x 3	No further comments made
61	

Table 14A. Themes and codes for the teamwork questionnaire item – Team collaboration, discussion, and learning.

Team collaboration, discussion & learning	**Please describe whether you felt if team collaboration and discussion was an important part of the learning process**
Good teamwork dynamics 46	
Discussion and sharing of ideas	discussing your ideas to each other is a perfect team outcome
improves learning & understanding	It was necessary because everyone had good ideas
	Team discussions helped everyone learn about the task at hand...an important part of the learning process.

Table 14A. continued.

	It was an important part because if we had no communication, nothing would have been completed
	discuss was an important part
	everyone can learn from the other one and four brain works better than one brain
	team collaboration and discussion played a crucial part in learning the material
	it started conversation, got everyone to voice what they didn't understand
	it was an important part of the learning process as it helps you better understand
	it was really important because our topic was a really heavy one
	TEAM COLLABORATION ALLOWED FOR ANY ERRORS TO BE CORRECTED
	IT ALLOWED FOR PEER REVIEW AND ENCOURAGED ME TO LEARN MORE TO EDUCATE MY PEERS.
	we had to discuss a lot of things and because everyone was willing to discuss everything
	it was easier to work as a group and learn information
	It is through discussion i learned a lot.
	it helped clarifying things…
	very important in the learning process
	talking with your group about the content really reinforces content and learning
	learn more from the topic
	if you didn't understand something and your partner did then you could go and ask them for assistance
21	definetly, talking about things is an effective way for me to learn
Discussion and teamwork helped to	without team collaborating it would be very difficult to complete the task
complete task	if we had not discussed the content effectively we would not be able to create the podpoint effectively
	without team discussion, the project would not flow and make sense
	very important to...ensure we were on track and the tasks were being completed by the timeframe
	It was important as it kept everyone on the same page making it easier to get work done
	without a team work this could not have been achieved
7	Communicating with each other well was essential to this project
Supported mental health 1	it helped...have a sanity check
Sharing of the workload 2	it was great to have not as much work as you would if you did it by yourself
(Skill development)	We needed to work on our parts and then ensure they flowed with each other
Team member role allocation 1	it is important because you need to discuss the roles of each team member
Overall, good experience 4	it was overall a good experience however, could be better
	Team collaboration was sucessful

Table 14A. continued.

	indeed team collaboration and discussion was important and very effective
	VERY important. Usually I have been in teams where I've done most of the work or we've never met up etc and having meet up times and class times was very helpful
Development of future career skills	it was indeed. It sets an example of future career environment
(teamwork) *2*	we learned more about team work and group work skills
Indicating "Yes" *x 7*	No further comments made
Helpfulful at the beginning (only) 1	it was helpful at the start…
Poor teamwork dynamics 9	
Poor team communication & collaboration	we rarely discussed anything... i think we were just also both confused with the whole assignment and worried
	that the other qouldnt like our ideas therefore we rarely spoke about it
	collaborations and discussions were at a minimal
3	it certainly would have been, although in this instance it was certainly lacking
Unequal sharing of the workload	in any team situation there are people who listen and people who delegate…unfortunately there is always one
1	person who ends up doing most of the work
Poor delivery of work *1*	by the time actually supplying the information came around, things became a bit jumbled and disjointed
Poor team member commitment	my team didn't take everything on board
2	lack of responsibility shown by fellow team members
Indicating "No" *x 2*	No further comments made
Unequal team numbers **1**	the teams were not all even as half our team never arrived
Prefer independent work **1**	I prefer working by myself
57	

Table 15A. Themes and codes for the teamwork questionnaire item – Skill development and future communication.

Skill development & future communication with others	**Do you think that working in the team has helped you develop skills that will allow you to communicate and work with others in the future? If so, how?**
Collaborative skill development 9	I did learn new things from this presentation and of course it will help me in future
	we all...planned the work to everyones standards
	it has helped me to be constructive.
	It has helped me work with others who are struggling with the topic
	caused me to open up and become more social
	we learnt from each other and improved
	It helped with my...sociable skills
	...has improved my current skillset...

Table 15A. continued.

	team work
Communication 17	
Developed communication skills 12	i believe that this has helped me develop better communication skills
	we all communicated…
	i learned to communicate my ideas to my partner
	this has helped me develop better communication skills
	it has helped me to be more communicative and direct with other team members
	to prevent any further miscommunication
	the more I work as a team my communication skills becomes better
	group work has taught me communication skills…
	it helped me learn how to communicate…
	...BEING IN A GROUP ENABLES US TO DEVELOP OUR COMMUNICATION SKILLS…
	It helped with my communication skills…
	it has really improved my communication skills with a group
(Understanding others)	Listening to others…
Acknowledgement the importance of communication	its important to communicate and you learn when continuing to do it
2	...BEING ABLE TO ADVOCATE FOR YOURSELF AND SAY WHAT'S ON YOUR MIND IS CRITICAL
Future application	when I work in a team again I would try and improve the communication between team members
2	...BEING IN A GROUP ENABLES US TO DEVELOP OUR COMMUNICATION SKILLS FOR FUTURE INTERACTIONS.
More communication needed 1	More communication would have helped me prepare a little bit more
Leadership skill development	group work has taught...being able to delegate tasks equally.
2	helped me to make sure everyone contributed and tried their best
Technical skill development	It developed my computing skills…in the power point
2	I developed skills using powerpoint presentation that i never knew before
Sharing of ideas	...communicate my ideas
	...to communicate with others and express my ideas
3	i got the platform to share my thought with my group mates
Working & communicating with diverse groups of people	you need to be able to communicate with many different types of people
	you have learn to communicate with people you might not usually interact with
	...communicate with new people with different experiences in life
	you learn to interact with different types of individuals... and their learning styles
5	Yes, especially working with female students and people younger then me
Understanding others	The team environment helps you to get to know classmates better

Table 15A. continued.

	good lines of communication and understanding
	you learn to interact with different…learning styles
	you gain an understanding of how different people think and you can use that and apply it to the task
5	Listening to others…
Improves confidence	i feel like i have, more confidence
2	I wasn't very comfortable in the beginning but I…developed confidence to communicate with others
Satisfaction 1	it was a great idea
Helped when others made effort 1	it helped when people wanted to put effort into the podpoint
Indicating "Yes" x 3	No further comments made
No Improvement 8	
Already had pre-existing skills 4	I already had skills for working in a team but I don't think it improved other people's skills
	Not really...I can already communicate with other people pretty well
	I was already very outspoken and used to working with others
	I have these skills from working with people
Forced to take leadership 1	no. i was forced to become a drill sergeant in order for any progress to be made
Indicating "No" x 2	No further comments made
Indicating "Neutral" 1	Neither here or there
58	

Table 16A. Themes & codes for the teamwork questionnaire item – Other team member contribution.

Other team member contribution	**Do you feel that the other members of your team made valuable contributions?**
Positive team member contribution 49	
Satisfaction with other members contribution	my team member was amazing
8	without them our podpoint would not be as good as it is
	she was marvelous.
	They all did their best to be a part of the team…
	definitely...
	absolutely. I was very lucky in my group
	my team member did the best they could to increase the quality of our work
	my fellow team member was excellent...
Valuable equal contribution	everyone has a valuable contribution
	we both helped each other
	...we brought our skills together to complete the project
	I think everyone contributed equally
	the other member has contributed well…
	EVERYONE PLAYED AN EQUAL ROLE IN THE OVERALL PROJECT

Table 16A. continued.

	everyone contributed (Even our team-mate who has dropped out!)
	everyone did the parts that they were assigned to really well
	there was a reasonable amount of contribution…
10	...excellent in sharing the work load equally
Valuable part contribution	One member made a huge contribution in my opinion
	Another team member made valuable contributions
	one other member made valuable contributions
	Yes, one did…
	...one other member of the group made valuable contributions
6	...the rest contributed effectively
Great communication,	they did their best to engage with the team
engagement & collaboration 2	...team member was excellent in her...communication and group working style.
Small team size supported collaboration	BEING A SMALLER GROUP ALLOWED THE WORK TO BE COMPLETED MORE EFFICIENTLY.
2	there were only two of us, so the collaboration was easy
Indicating "Yes" x 21	No further comments made
Negative team member contribution 26	
Unequal contribution	I feel like I made the most contribution...
	Another team member was less helpful towards the end
	some did some didn't
	not all the members contributed as much as others
	Only on of them did
	...other fellow group members weren't...contributed as much...
	...there was usually one key person in the group who ended up doing the majority
	Only one other member of the group…
9	...I HAD SPENT 12 HOURS in 1 day just working on it (from Q7)
No contribution made	one member was not an active participant and did not provide any valuable contributions to the team
	...the other two did not *(make contribution)*.
3	...except for one *(not contributing*)
Poor motivation, commitment, work	...many of my team mates did not feel the desire to get it done as much as I did
effort	...showing a lack of commitment
	The others made little to no effort…
	...even with adequate timeframes, i was still waiting for them to do ANYTHING productive...
4	...even them telling or asking me to do things for them instead of taking any initiative…(from Q7)
Initially poor leadership & direction 1	No one was able to take the lead in the beginning, so i did almost immediately…(from Q7)
Didn't attend labs or withdrew from unit	They did not attend classes…
	the others that were meant to be here obviously did not *(not attending lab)*
	…did not show up in any of the sessions. I've never met them

Table 16A. continued.

4	...are not part of the group anymore at the very last session…
Poor communication 1	...other fellow group members weren't as communicative…
Caused stress	...was disappointing and stressful
2	...which made it difficult because we had to do her part
Indicating "No" x 2	No further comments made
75	

Table 17.1A. Themes and codes for the teamwork questionnaire item – Positives & negatives of teamwork.

Positives & Negatives of Teamwork	What were the positives and negatives of working in a team?
Positives 69	
Communication	It gave me the opportunity to communicate
	we communicated well
	so you need to listen to other people
	I think that working in a team improves communication skills
	...interacting discussion
6	we communicated if we didnt know how to do something…
Enhanced creativity and	two or more people are always better for…increasing creativity
Sharing ideas	It's good to collaborate with other people's ideas and creativity
	more ideas
	having more creative ideas
	different ideas
6	each team member had different ideas…
Sharing of the workload	two or more people are always better for…finishing off difficult tasks
	your not the only one responsible
	can split work load and can learn new things
	we could make the assignment quickly , we divided into 2 parts each person got one to do
	Share responsibility
	dividing the information
	everyone was willing to work together…
	LESSER LOAD OF WORK REQUIRED FROM EVERY INDIVIDUAL
	distribution of workload.
	everyone shares an equal amount of Tasks
	Workload shared
12	having lots of content with less work, was good
Different views,	different learning styles
Perspectives & learning styles	learn new way of thinking…
	being able to see things from a different perspective
	interesting and effective and got the chance to interact with different types of people
	You get to hear other people's opinion
6	...learn that you are not always right

Table 17.1A. continued.

Positive Collaboration	people learn to work with each other.
	to engage with people…
	getting to talk to new people and gaining team work abilities
	Everyone worked well
	Everyone worked as a team
	It was all positive we engaged well
	...but we worked as a group to resolve that problem
	we collaborated well and got along
	We both had to pull our weight and cooperate with each other
10	Collaborative work, putting together two groups of info
Different skills, strenghts & knowledge	able to utilize each other's strengths to produce a good project
	...unique skills all being brought to the group
3	breadth of knowledge
Skill development 1	learn new skills
Enjoyment 1	Fun
Enhanced motivation 1	increases motivation and improves grades
Social aspects	meeting new people
	Making friends…
3	I made some nice new friends
Enhanced problem solving 1	two or more people are always better than one for solving problems
Develops a respect for others 1	so you need to...respect their opinions and work with them
	people learn to respect each other's different opinions
Provides a realastic life experience 1	It is realistic to what you will deal with in the real world
Supports task completion 2	When working as a team you can achieve your goals faster and more efficiently
	easier and quicker to complete the task as a group rather than doing it alone
Peer learning	Everyone helped each other in regards to understanding the topic
	the opportunity to...learn the topic better.
	having other peoples knowledge
4	help with content - learn together
Team support & help	Great to get extra help
	Able to ask each other for help
	everyone helped
4	...to ask for help
No negative experience	No negatives.
	NA
	It was all positive
	Cons - nothing with this group
	I didn't experience any real negatives durig this particular assignment.

Table 17.1A. continued.

6	none
Prior negative team experience not repeated with this project 1	In past group assignments however, I have found it difficult to complete work to a high standard without entirely taking over due to group members being slack and not contributing...this was not the case with this assignment

Table 17.2A. Themes and codes for the teamwork questionnaire item – Positives & negatives of teamwork.

Positives & Negatives of Teamwork	What were the positives and negatives of working in a team?
Negatives 37	
Small team size	we were only two and other groups were 4
2	only two of us
Poor team member participation &	lack of commitment displayed by fellow team members
commitment	not all people pulled their weight
	it's not so good when other people don't participate
	...doesn't mean that people will pull their weight
	Team members should take their workload rather seriously if nit the whole team is in trouble
	sometimes they werent concentrated on the assessment
	can't always rely on the other group embers to ensure that they get their assigned tasks completed
	have team members not show up
9	some would not be readily available when questions were raised
Some made no contribution	...someone didn't do anything
	...some group members did not contribute anything towards the project
3	some members didn't contribute
Unequal sharing of the workload	being let down and having to do most of the work
	one person has to do all the recording so he had lot of work than me.
3	unequal share of work
Unfair distribution of marks	Overall grade of the task is based off the work contributed by another person/s
2	the others get the same result for doing under minimum
Poor collaboration & communication	If the other team member is not a good approachable person, then it will affect the total work
	difficulty communicating
	miscommunication…
	group work offers a decreased work load and collaboration.
5	Communication was difficult
Not suited to some individuals	I don't like working in teams or with other people
2	i'm used to being independent- so it was uncomfortable working in a team

Table 17.2A. continued.

Eaiser to do it individually 1	sometimes its easier to do it all yourself
Impeded work rate	not being able to work ahead
	YOU HAVE TO WAIT FOR EVERYONE TO COMPLETE THEIR PARTS
	THERE IS A LOT OF WAITING AND RETRIEVING OF INFORMATION FROM EVERYONE.
3	we've got little time to work on the project.
Difficulties communicating outside of	finding it hard for time to work outside class
lab/class time	sometimes to meet and discuss with group members is not possible due to distance and outside
	commitments trying to fit each others time schedules
4	Sometimes it was hard to communicate outside class time
The need to compromise	compromising on opinions
	it took some time to agree on one script…
3	...it was sometimes hard to put those ideas together/ compromise
Neutral view 1	There were none
107	

Table 18A. Themes and codes for the teamwork questionnaire item – Suggestions to enhance future teamwork

Suggestions to enhance future teamwork	**Do you suggest any changes that could enhance future working as a team?**
Team structure 7	
Equal team member number	make even the number of groups
2	when theres only 2 members left they should be put in other groups
Greater team diversity 1	try to get a more divers type of droup
Students select Teams	to maybe be able to pick your group
	choosing our own groups would of been better because usually your friends have the
	same academic mindset and the work process would be a lot more engaging
	Allowing people to choose their teams might lead to a better work outcome as they
3	may quickly get comfortable and start working earlier
Ensure team member congruency	Make sure to put people of similar skill set/mindsets etc. together
1	because this was the first time I was put with someone like me and it ran so smoothly
Project structure 4	
Students choose topics for teamwork 1	...people...discuss a certain topic and then they all go off and create their own podpoint…
Make the project task easier to share	make the information required easier to section between groups so that everyone
1	gets equal amount of work
Exposure to all aspects of the project	We separated the powerpoint aspect, and delegated to one person, which made it easier…
1	but I would have liked to have fiddled a bit with it too, to get some experience

Table 18A. continued.

Greater mark allocation (large project) *1*	the more intensive project will definitely be very enriching for a great portfolio, therefore, more marks will force students to put more effort
Instructor facilitation 2	
More instructor feedback *1*	Maybe a little more constructive criticism
Regular key task indicators *1*	Contrubition milestones that are assessed by a demonstrator. E.g. evidence of work of each indivdiual
checked by instructor *1*	E.g. evidence of work of each indivdiual - milestones at end of each week.
Participation, contribution & attendance	Maybe increase the consequences for the lack of contribution from team members in a group.
2	Ensuring every group member attends classes and group meetings
Improve communication 1	Better communication.
Improve technical skills 1	Become more familiar with new technology.
View previosus examples of work 1	Possible look at past examples so we can get an idea on how to present the information
Don't work with same team again 1	Not with this group
Remove teamwork	let me work by myself
	No teamwork at all.
3	NO MORE GROUP WORK
Commence teamwork early 1	start early
23	

Table 19A. Themes and codes for the teamwork questionnaire item – Further feedback.

Further feedback	**Q11 - Do you have any further feedback?**
Positive 13	
Enjoyment & satisfaction	I liked it…
	it was good project
	Cool idea for a task :)
	This was a fun and innovative project
5	everything was good
Enjoyed being creative ***1***	it was good to be creative
Great teamwork ***1***	I had a great group and we all contributed and were there for each other
Instructor praise	was fantastic, engaging, happy to help and respectful, deserves commendation for his hard work and teaching style
2	We were thrown ion the deep end at the start of the unit but the assistance from the tutor was superlative
Appreciation ***1***	Thanks...for coming up with the idea.

Table 19A. continued.

Project supported learning	I definitely took more note the sliding mechanism topic and understand it in what I think is great depth
	I learned a lot during it
3	this is the good set up for learning in the future
Negative 10	
More time to complete task 1	Need more time for PodPoint
PP Project didn't support teamwork	I found this particular project was difficult to do as a team from the slides as it needs to be cohesive
1	and not everyone has the PowerPoint skills
Dislike of the project	GET RID OF THE PODPOINT ASSESSMENT
2	Choose a different assignment to assess students on
Unhappy with Project name 1	IF YOU SAY IT's A PODCAST THEN MAKE IT ONLY AN AUDIO FILE…
Not enough learning of content	I found we spent 80% of time on story and presentation and less than 20% on content.
2	I would have preferred to do a project that helped me learn more in depth about my subject rather than animation
Ensure workload is shared equally 1	...you need to tweak it to ensure 1 person isn't stuck doing ALL THE WORK
Criticism about data collection questions	don't ask leading questions that give you the data you want...Open ended questions actually give people the
1	chance to be real and not just tell you what you want to hear
Preference for independent work 1	let me work by myself please
23	

Table 20A. Predominant construct themes for the Promoted learning end-theme.

Predominant construct themes for the Promoted Learning end-theme	Codes	%
Promoted independent research of information & learning (78)	78	22.3
Task supported collaborative learning (75)	75	21.5
Promoted learning & content engagement (62)	62	17.8
Positive teamwork promoted learning (52)	52	14.9
New Learning & Assessment Pedagogy (43)	43	12.3
New way to learn & use technology (17)	17	4.9
Novel creative pedagogy(8)	8	2.3
Promoted Learning through creativity (8)	8	2.3
Additional learning outcomes (6)	6	1.7
	349	100.0

Table 21A. Predominant construct themes for the Positive teamwork & collaborative experience end-theme.

Predominant construct themes for the Positive teamwork & collaborative experience end-theme	Codes	%
Positive teamwork, contribution & collaborative experience	173	50.9
Positive teamwork, discussion, & collaborative Learning	75	22.1
Positive team member contribution	45	13.2
Task promoted collaboration & teamwork	15	4.4
Positive teamwork and collaboration supported task completion	13	3.8
Small team size supported teamwork,collaboration and performance	8	2.4
Promoted collaboration through creativity	7	2.1
Other positive teamwork outcomes	4	1.2
	340	100.0

Table 22A. Predominant construct themes for Promoted communication, sharing, & discussion end-theme.

Predominant construct themes for Promoted communication, sharing, & discussion end-theme	Codes	%
Communication, sharing, & learning (54)	54	16.4
Contribution and sharing of the workload (51)	51	15.5
Positive communication and discussion (48)	48	14.5
Sharing of ideas, views, and perspectives (46)	46	13.9
Project promoted communication & skills (42)	42	12.7
VARK & Communication (37)	37	11.2
Positive reflection of VARK (26)	26	7.9
Negative reflection of VARK (10)	10	3.0
Communication supported project task completion (9)	9	2.7
Misunderstanding of VARK (4)	4	1.2
Neutral view of VARK (1)	1	0.3
Other positive aspects (2), including...		
[Supported mental health (1)	1	0.3
Team member role allocation (1)	1	0.3
	330	100.0

Table 23A. Predominant construct themes for the Enjoyment & satisfaction end-theme.

Predominant construct themes for the Enjoyment & Satisfaction end-theme	Codes	%
Enjoyment and statisfaction	110	79.1
Enjoyable engagement	10	7.2
Low level of percieved stress	10	7.2
Supportive student project materials & textbook	5	3.6
Overall good experience	4	2.9
	139	100.0

Table 24A. Predominant construct themes for the Skills development & other end-theme.

Predominant construct themes for the Skills development & other end-theme	Codes	%
PowerPoint Skills and PodPoint production	45	33.6
Technical skills enhancement	32	23.9
Skills development and resiliance	24	17.9
Promotion of collaborative skills & use	23	17.2
Creative skills development	7	5.2
Promotion of other skills	3	2.2
	134	100.0

Table 25A. Predominant construct themes for Promoted creativity & other end-theme.

Predominant construct themes for Promoted creativity & other end-theme	Codes	%
Supported & promoted creativity	43	42.6
Creative input and effort	18	17.8
Ideas generation, story, & script	10	9.9
Novel creative pedagogy	8	7.9
Promoted Learning through creativity	8	7.9
Promoted collaboration through creativity	7	6.9
Creative skills development	7	6.9
	101	100.0

Table 26A. Predominant construct themes for Promoted engagement with technology & other end-theme.

Predominant construct themes for Promoted engagement with technology & other end-theme	Codes	%
PowerPoint Skills and PodPoint production	45	64.3
New way to learn & use technology	17	24.3
Promoted engagement with technology	6	8.6
Technology promoted engagement with others	2	2.9
	70	100.0

Table 27A. Predominant construct themes for Positive instructor experience end-theme.

Predominant construct themes for Positive instructor experience end-theme	Codes	%
Instructor was helpful	41	62.1
Positive instructor experience	15	22.7
Instructor guidance	4	6.1
Instructor patience & understanding	3	4.5
Instructor passion	3	4.5
	66	100.0

Table 28A. Predominant construct themes for Promoted student engagement end-theme.

Predominant construct themes for Promoted student engagement end-theme	Codes	%
Engagement & motivation	35	70.0
Engagement via creative expression	15	30.0
	50	100.0

Table 29A. Predominant construct themes for the Other notable aspects end-theme.

Predominant construct themes for Other notable aspects end-theme	Codes	%
Good social experience	5	62.5
Develops a respect for others	1	12.5
Supported mental health	1	12.5
Provides a realistic life experience	1	12.5
	8	100.0

Table 30A. Predominant construct themes for the Negative teamwork & collaborative experience end-theme.

Predominant construct themes for the Negative teamwork & collaborative experience end-theme	Codes	%
Poor team member participation, collaboration & commitment	57	21.9
Unequal work contribution and poor delivery of work	50	19.2
Negative teamwork affected learning, topic engagement & other work outcomes	50	19.2
Negative teamwork experience	32	12.3
Poor team communication & dynamics	30	11.5
Preference for independent work (easier to do it individually)	5	1.9
Task didn't support teamwork & collaboration	3	1.2
Small team size caused problems	2	0.8
Problem with younger students' contribution, effort, and teamwork	2	0.8
Poor team member congruency	1	0.4
Potential for conflict amongst friends	1	0.4
Some need to be managed	1	0.4
Lack of confidence in other team members	1	0.4
Contribution not appreciated	1	0.4
Unequal team member numbers	1	0.4
Lack of teamwork and collaborative skills	1	0.4
Other notable negative aspects (9), including...		
Teamwork caused stress	13	5.0
Unfair distribution of marks	2	0.8
Not suited to some individuals	2	0.8
Technology & stress	2	0.8
Collaboration is not an important part of the learning process	2	0.8
Students' didn't use student guide	1	0.4
	260	100.0

Table 31A. Predominant construct themes for the Dissatisfaction & other concerns end-theme.

Predominant construct themes for the Dissatisfaction & other concerns end-theme	Codes	%
Dissatisfaction	17	27.0
Large unit assessment load & timing	8	12.7
Project didn't support learning	8	12.7
No improvement (with communication)	8	12.7
More PowerPoint Instruction	8	12.7
Problems using the technology	7	11.1
Time constraints affected PowerPoint work	4	6.3
Creativity not supported	2	3.2
Extracurricular activities & work impact on student's ability to study	1	1.6
	63	100.0

Table 32A. Predominant construct themes for the Suggestions to improve teamwork & collaboration end-theme.

Predominant construct themes for the Suggestions to improve teamwork and collaboration end-theme	Codes	%
Student selection of teams	4	16.7
Participation, contribution, and greater attendance needed	3	12.5
Remove teamwork	3	12.5
Introduce confidential teamwork survey	2	8.3
Equal team member number	2	8.3
Students choose topics for teamwork	1	4.2
Students choose own scenario	1	4.2
Make the project task easier to share	1	4.2
Exposure to all aspects of the project	1	4.2
Ensure workload is equally shared	1	4.2
Commence teamwork early	1	4.2
Earlier allocation to teams	1	4.2
Greater team diversity	1	4.2
Ensure team member congruency	1	4.2
Don't work with same team again	1	4.2
	24	100.0

Table 33A. Predominant construct themes for the More instructor feedback required end-theme.

Predominant construct themes for the More instructor feedback required end-theme	Codes	%
Team Progress checks by instructor	2	40
More instructor feedback	1	20
Regular key team task indicators checked by instructor	1	20
More guidance on teamwork and work production	1	20
	5	100.0

Table 34A. Predominant construct themes for the PodPoint project changes end-theme.

Predominant construct themes for the PodPoint project changes end-theme	Codes	%
View previous examples of work	1	33.3
Greater mark allocation	1	33.3
VARK and age	1	33.3
	3	100.0

Table 35A. Predominant construct themes for the More creativity required at university end-theme.

Predominant construct themes for the More creativity required at university end-theme	Codes	%
More creativity required at university (1)	1	50.0
Other units should do PodPoint or similar creative tasks (1)	1	50.0
	2	100.0

PODPOINT PROJECT STEP-BY-STEP PROCESS

WORKING AS A TEAM!

Your team is required to produce ONE PodPoint using PowerPoint.

Step 1. Download the PodPoint project student guide. It tells you how to do the project.

Step 2. Once you have your team, record each other's names and contact details.

Step 3. Write your teams PodPoint project charter – rules of working as a team, working effectively, respect and supporting each other.

Step 4. As a team watch the specific body system PodPoint to learn about your topic and the required information your team needs to include in the PodPoint. Make notes.

Step 5. As a group LEARN all of the required knowledge. Teach each other by reading and discussing the associated parts of the text. Do not "split" up the knowledge and allocate different questions to each – learn it all together. You will all need to know it for the tests anyway. Now LINK THE REQUIRED KNOWLEDGE WITH THE SUPER-SOLIDER and ZOMBIES. How will the required knowledge help us make the super solider? Do you have any suggestions that could enhance the super-soldiers' powers and to also help us to battle the Zombies (weapon)? Your facilitator will visit you to see how you are going and to discuss all of this. For further details refer to your PodPoint project student guide and refer to the Scenario suggestion sheets.

Step 6. As a team discuss story options on how you will incorporate this knowledge with the creative scenario – The "Uni-Apocalypse" and into the PodPoint.

Step 7. If your team is not familiar with PowerPoint teach each other how to use it, especially how to insert images, audio, links, and slide transition etc. There are suggested URL sites that will help in the PodPoint project student guide. The instructor will also demonstrate how to use PowerPoint in the lab.

Step 8. As a team make your PodPoint. Use Appendices A, B and C in the PodPoint project student guide to direct your team in doing this. Make sure your PodPoint file plays correctly and that the voice is loud and clear and not distorted by background noise. If the file is over 60Mb, compress and optimise the file. Ask for help if needed.

Step 9. Once your team is happy with the final podpoint upload it using the assessment dropbox link on VU collaborate. Make sure to name and save it as per instruction in the PodPoint student guide. Only one PodPoint per team is required.

visual * aural * read/write * kinesthetic

VARK®

a guide to learning preferences (https://vark-learn.com)

The VARK Questionnaire

VARK Questionnaire version 8.01

Choose the answer which best explains your preference and click the box next to it. Please click more than one if a single answer does not match your perception. Leave blank any question that does not apply.

I prefer a presenter or a teacher who uses:

- ☐ handouts, books, or readings.
- ☐ demonstrations, models or practical sessions.
- ☐ diagrams, charts, maps or graphs.
- ☐ question and answer, talk, group discussion, or guest speakers.

When choosing a career or area of study, these are important for me:

- ☐ Working with designs, maps or charts.
- ☐ Communicating with others through discussion.
- ☐ Applying my knowledge in real situations.
- ☐ Using words well in written communications.

I have a problem with my heart. I would prefer that the doctor:

- ☐ used a plastic model to show me what was wrong.
- ☐ gave me something to read to explain what was wrong.
- ☐ described what was wrong.
- ☐ showed me a diagram of what was wrong.

I want to learn how to take better photos. I would:

- ☐ use examples of good and poor photos showing how to improve them.
- ☐ ask questions and talk about the camera and its features.
- ☐ use diagrams showing the camera and what each part does.
- ☐ use the written instructions about what to do.

I want to learn how to play a new board game or card game. I would:

- ☐ read the instructions.
- ☐ watch others play the game before joining in.
- ☐ use the diagrams that explain the various stages, moves and strategies in the game.
- ☐ listen to somebody explaining it and ask questions.

VARK Questionnaire

I want to find out about a house or an apartment. Before visiting it I would want:

- ☐ a printed description of the rooms and features.
- ☐ to view a video of the property.
- ☐ a plan showing the rooms and a map of the area.
- ☐ a discussion with the owner.

I want to assemble a wooden table that came in parts (kitset). I would learn best from:

- ☐ watching a video of a person assembling a similar table.
- ☐ written instructions that came with the parts for the table.
- ☐ diagrams showing each stage of the assembly.
- ☐ advice from someone who has done it before.

I want to learn about a new project. I would ask for:

- ☐ a written report describing the main features of the project.
- ☐ an opportunity to discuss the project.
- ☐ examples where the project has been used successfully.
- ☐ diagrams to show the project stages with charts of benefits and costs.

I want to learn to do something new on a computer. I would:

- ☐ talk with people who know about the program.
- ☐ follow the diagrams in a book.
- ☐ start using it and learn by trial and error.
- ☐ read the written instructions that came with the program.

A website has a video showing how to make a special graph or chart. There is a person speaking, some lists and words describing what to do and some diagrams. I would learn most from:

- ☐ listening.
- ☐ watching the actions.
- ☐ reading the words.
- ☐ seeing the diagrams.

I need to find the way to a shop that a friend has recommended. I would:

- ☐ write down the street directions I need to remember.
- ☐ find out where the shop is in relation to somewhere I know.
- ☐ use a map.
- ☐ ask my friend to tell me the directions.

When I am learning I:

- ☐ see patterns in things.
- ☐ read books, articles and handouts.
- ☐ use examples and applications.
- ☐ like to talk things through.

I want to save more money and to decide between a range of options. I would:

- ☐ read a print brochure that describes the options in detail.
- ☐ consider examples of each option using my financial information.
- ☐ use graphs showing different options for different time periods.

VARK Questionnaire cont.

- [ ] talk with an expert about the options.

When learning from the Internet I like:

- [ ] videos showing how to do or make things.
- [ ] interesting written descriptions, lists and explanations.
- [ ] audio channels where I can listen to podcasts or interviews.
- [ ] interesting design and visual features.

I want to find out more about a tour that I am going on. I would:

- [ ] read about the tour on the itinerary.
- [ ] look at details about the highlights and activities on the tour.
- [ ] use a map and see where the places are.
- [ ] talk with the person who planned the tour or others who are going on the tour.

I have finished a competition or test and I would like some feedback. I would like to have feedback:

- [ ] using a written description of my results.
- [ ] from somebody who talks it through with me.
- [ ] using graphs showing what I achieved.
- [ ] using examples from what I have done.

OK

VARK Questionnaire cont.

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