# An Innovative Learning Management Approach for improving learning practices in Australian University Context

by

**Harpreet Singh**

Thesis submitted in fulfilment of the requirements for the Degree of

**Doctor of Philosophy**

Institute for Sustainable Industries and Liveable Cities,

Victoria University Melbourne, Australia

March 2021

# ABSTRACT

With rapid expansion in knowledge streams over the last few years, the role of relevant education models and mechanisms have become increasingly important. Smarter Learning Management Systems (LMS) devised to enable student learnings at the university level have proven to be effective, yet the previous research points to the lack of employers' perspective in the design of such systems. To bridge the existing gaps in the learning management systems, this study applied Design Science Research Methodology to design and develop an LMS artefact. This informed by the analysis of qualitative data collected from a random sample of students in graduate and post-graduate programs and teachers from universities in Melbourne, Australia. This artefact is a mobile-based application named Student Career Assistance System (SCAS). SCAS was designed, developed and evaluated in accordance with the DSR methodologies towards creating a solution which caters to the information and learning needs of the students, teachers and employers in an integrated manner.

This thesis by publication consists of four papers. Article 1 developed a theoretical analysis based on the Smart Education concept under which a systematic literature review is conducted. The purpose of this work is to provide a theoretical foundation for an initial innovative approach called Students Career Assistance System (SCAS) by describing the present state of Smart Education research. Article 2 initialises the concept of developing a cloud based collective platform with industry involvement in the Learning systems. Article 3 builds and assesses a novel idea of mobile-based learning technology for strengthening current LMS techniques using and assessing Design Science Research Methodology. For this a pilot study has been conducted and interviewed stakeholders. Article 4 details the design research and process towards development of an integrated learning management system and its evaluation using qualitative findings.

Qualitative research conducted with user groups both revealed and confirmed the lack of integration of employability functions in existing learning management systems. In case of select systems with employment functions, lack of awareness regarding the same was reported by both students and teachers. Additionally, it was found that separate employment platforms deployed in the institutions were also not

being used by the students because of lack of awareness, thereby making a stronger case for inclusion of the employment functionality within the primary LMS. This can allow students to seamlessly greater clarity regarding career pathways after graduation. In fact, students reported lack of clarity about career pathways after graduation because of lack of exposure to the industry employers. Certain functionalities of SCAS like ‘Jobs’ and ‘Portfolios’ also have the potential of saving time and money resources for different user-groups. This study also outlines key areas for the investigation which primarily include security concerns such as data integrity, information confidentiality and entity authentication for data availability. This study concludes through an evaluation of the SCAS artefact, deriving insights and recommendations for further development of the artefact. The key recommendations include integration of existing online products and services to address the privacy and security concerns of the user groups in a manner that enables the platform in facilitating dynamic conversations between the students, teachers and employers.

## DECLARATION

"I, Harpreet Singh, declare that the PhD (Integrated) thesis entitled "An Innovative Learning Management Approach for improving learning practices in Australian University Context" is no more than 80,000 words in length including quotes and exclusive of tables, figures, appendices, bibliography, references and footnotes. This 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".

Signature Date 26/03/2021

## ACKNOWLEDGMENT

First and foremost, all the praise to the Almighty who gave me this wonderful opportunity for doing research. I extend my heart-felt gratitude to my Principal Supervisor Professor Yuan Miao of Victoria University, Melbourne, who guided and supervised me in my research. His utmost dedication and inspiration brought a new vigour in my efforts to conduct this incredible research. I am also thankful to my Associate supervisors Dr. Khandakar Ahmed and Dr. Shah Miah for their support and suggestions throughout my research.

I would also like to thank my wife for her patience, constant care and support in my research. I would like to thank my family, friends and colleagues for their prayers and motivations.

# LIST OF PUBLICATIONS

## Journal Articles

1) **Singh, H.,** Miah, S.J. Design of a mobile-based learning management system for incorporating employment demands: Case context of an Australian University. *Educ Inf Technol* 24, 995–1014 (2019). https://doi.org/10.1007/s10639-018-9816-1
2) **Singh, H.,** Miah, S.J. Smart education literature: A theoretical analysis. *Educ Inf Technol* 25, 3299–3328 (2020). https://doi.org/10.1007/s10639-020-10116-4
3) **Singh, H.**, Miao, Y., Miah, SJ., Ahmed, K., (2021) An Innovative Smart-education Solution: Employing a Design Perspective for Addressing Employability Issues in an Australian University. *British Journal of Educational Technology* (currently under review)

## Conference Papers

1) **H. Singh** and S. J. Miah, "A Cloud-Based Collective Platform: Combined Requirement Perspectives of Learners, Educators, and Employers," 2017 4th Asia-Pacific World Congress on Computer Science and Engineering (APWC on CSE), Mana Island, Fiji, 2017, pp. 154-158, doi: 10.1109/APWConCSE.2017.00034.

# DETAILS OF INCLUDED PAPERS: THESIS BY PUBLICATION

| Chapter Number | Publication Title | Publication Status (e.g. published, accepted for publication, to be revised and resubmitted, currently under review, unsubmitted but proposed to be submitted) | Publication Details (e.g. date published, verification of Scopus quartile ranking of the publication, indicator of quality etc.) |
|---|---|---|---|
| 2 | Smart education literature: A theoretical analysis | Published | 29/01/2020 Education and Information Systems, SCImago Journal Rank: **Q1** |
| 3 | A Cloud-Based Collective Platform: Combined Requirement Perspectives of Learners, Educators, and Employers | Published | 12/12/2017 IEEE Conference |
| 3 | Design of a mobile-based learning management system for incorporating employment demands: Case context of an Australian University | Published | 24/09/2018 Education and Information Systems, SCImago Journal Rank: **Q1** |
| 4 | An Innovative Smart-education Solution: Employing a Design Perspective for Addressing Employability Issues in an Australian University | Currently under review | British Journal of Educational Technology, SCImago Journal Rank: **Q1** |

Declaration by: Harpreet Singh Signature: [redacted] Date: 26/03/2021

# TABLE OF CONTENTS

# LIST OF FIGURES

# LIST OF TABLES

# LIST OF ABBREVIATIONS

| | | |
|---|---|---|
| **AmI** | - | Ambient Intelligence |
| **API** | - | Application Programming Interface |
| **BJET** | - | British Journal of Educational Technology |
| **CAQDAS** | - | Computer-Assisted Qualitative Data Analysis Software |
| **CBA** | - | Competition Based Approach |
| **CPL** | - | Cross Platform |
| **DBR** | - | Design-Based Research |
| **DSR** | - | Design Science Research |
| **EDM** | - | Educational Data Mining |
| **GPRS** | - | General Packet Radio Service |
| **GSM** | - | Global System for Mobile Communications |
| **GUI** | - | Graphical User Interfaces |
| **ICT** | - | Information and Communications Technology |
| **IoT** | - | Internet of Things |
| **IS** | - | Information System |
| **IT** | - | Information Technology |
| **LA** | - | Learning Analytics |
| **LMS** | - | Learning Management System |
| **PAMA** | - | Pharmacy Assistant Mobile Application |
| **PLEBOX** | - | Personal Learning Environment Box |
| **QILT** | - | Quality Indicators for Learning and Teaching |
| **RFID** | - | Radio-Frequency Identification |
| **SCAS** | - | Students Career Assistance System |
| **TAR** | - | Technical Action Research |

| | | |
|---|---|---|
| **TEL** | - | Technology Enhanced Learning |
| **TPB** | - | Theory of Planned Behaviour |
| **UML** | - | Unified Modeling Language |
| **UX** | - | User Experience |
| **VU** | - | Victoria University |
| **WAP** | - | Wireless Application Protocol |
| **WI-FI** | - | Wireless Fidelity |
| **WIL** | - | Work Integrated Learning |

# CHAPTER 1

# INTRODUCTION

There has been rapid progress in the development of smarter learning management systems and integrating them in the curricula of various graduate and post-graduate programs across universities in Australia. However, these systems have not yet been able to address the recruiters' information needs, thereby restricting the scope of such systems to in-situ learning management at the universities. This study focuses on developing an integrated, collaborative learning management system hosted on cloud servers that actively caters to the needs of the students, teachers and recruiters from the industry.

Some of the previously available tools focussed on the learning, teaching and employment need separately; for example, while e-portfolio (Yu, 2011) only captures information about the students' academic development, a lot of research that is being carried out focuses predominantly on the skills required by the employers. (Biggs, Hovey, Tyson, & MacDonald, 2010) Additionally, the online systems that have moved towards integration have done so by integrating the in-situ learning processes, which only link the students and teachers. In contrast, the employer remains outside the linking system.

Towards the completion of this study, an artefact, based on Design Science Research (DSR) principles was designed and developed. Key stakeholders were identified and probed on their critical information needs, which informed the artefact's design; big data analytics were used to involve the stakeholders in the evaluation of the prototype.

## 1.1 Research background and problem statement

Smart education are no longer merely a fad; they have evolved into a way of education and a social environment. Smart systems tend to support providing specific information needs of a user across different forms and formats. The usage of various educational tools and access to IoT technology in education are all part of the development of smart education. For the development and implementation of such systems in education contexts, both students (Yu, 2011) and employers (Bostock, 2019) have been studied and involved. Involving students in the formulation and evaluation of job-search

criteria has its own limitations (Ko & Jun, 2015); most of the students, however, report job-search in their study discipline to be the hardest (Wang, Xu, Zhang, & Fang, 2017).

Similarly, employers struggle to find suitable candidates who meet the employment criteria and consequently spend a lot of time and money resources towards the same. On the other hand, non-technical skills are also a vital aspect nowadays. One of the key things employers tend to look for in their potential employees is interpersonal skills(Biggs et al., 2010). A study found that building competency and employability abilities need special attention (Abas et al., 2016).

At present, none of the systems allow for the integrated and collaborative management of the learning process by the students, teachers and employers. The proposed collaborative framework seeks to plug the existing gaps towards making the learning management system more effective.

For the current study, the focus is based on the following key questions and sub-questions mentioned below:

- How can a new systematic learning approach be developed to facilitate active industry participation in higher education?
- Which functionalities are value-additional for an effective LMS?
- How do undergraduate students plan careers in their areas of study?
- What are the benefits accrued to the students through industry participation in the LMS?

### 1.2 Solution overview

The proposed study focuses on the development and evaluation of a new problem-solving technique as an online learning tool that allows employers to participate in current LMSs. By generating new and innovative artefacts, the design-science paradigm aims to push the boundaries of human and organisational capabilities. The study's broad approach is constructive with identifying, verifying, and fulfilling user-groups needs as its focus. The design research follows qualitative methodologies and interview data gathered from the stakeholder interviews, including the user interviews, is analysed to inform the design process.

The design process also incorporated Hevner's seven guidelines (Hevner, March, Park, & Ram, 2004) across different phases. The problem determination & required artefact

design phase broadly covers two of Hevner's guidelines: artefact designing and problem relevance. Artefact designing pertains to the design processing strategy and operations involved in developing the artefact. In problem relevance, artefact development procedure demands an evaluation of the problems occurring in the current learning procedures and its relevance to the proposed artefact.

Development and Evaluation of artefact phase maps onto three key guidelines: design evaluation, research rigor and the design of the search process. Design evaluation guides allow for a well-executed evaluation process in terms of its utility, quality and efficacy of a design artefact. Whereas, in both the development and assessment of the design artefact, design-science analysis relies on the implementation of robust methods. The search for an efficient artefact involves the practice of usable means to accomplish desirable ends while dealing with regulations in problematic situations.
In the Distribution and Knowledge generation phase, research contribution and research communication are the key components. In design artefacts, design foundations, or design methodologies, successful design-science analysis must have consistent and verifiable contributions. Moreover, design-science analysis must be delivered to both technology-oriented and management-oriented audiences appropriately.

### 1.3 Key components of the solution artefacts

The key components working in the proposed system facilitate the involvement of education providers. This framework allows for students' participation through the learning modules, including exercises, tests and case-studies. Simultaneously, the teachers are expected to provide course inputs tailored to the employer requirements and test the students on the same. The student score data thus generated, would make for a searchable database of high quality that allow employers to filter prospective candidates.

This relates to both employers and the recruitment scenarios, further distinguishing that the learners extract the benefits while developing their skills, more so in terms of technical and interpersonal skills. Most employers seek interpersonal skills in their potential employees. These skills predominantly include motivation, communication, team building, leadership, conflict resolution and so forth. This further provides insight

into personality traits and cultivated skills that most employers focus on while recruiting (Powell & Jankovich, 1998).

Furthermore, the generation of data through learners and employers acts as a stimulant in the whole system's operation. The research is being conducted at The Victoria University with the Information System (IS) students and academicians. Thus, the direct interview method contributes to a significant portion of the data, an ongoing process. This research also intends to interview the potential employers who are keen to recruit IS students.

An architectural design mainly presents the description of various layers working together to form a framework. The framework initially provides robust and smart learning systems. This system also facilitates employers with an array of options to further assist them in the recruitment processes. The design consists of five different components, database, analytical layer and analytical framework. In the database layer, the data is generated through various sources, including students, teachers and employers. This further needs several inputs as data is generated with the help of multiple interfaces and browsers. Data is inclusive of text, photo, audio and video files. This provides access to information mediated by framework, therefore only to the users with registration rights and logins. Analytical Layer consists of various queries and commands helpful in developing sequential and logical data. Most of the generated analysis consists of structured and unstructured format. This analytical layer further categorises the collected information into data sheets by using various techniques, hence ensuring easy access to the users. In Analytical Framework the structured data must get some logical idea related to its performance. Here this layer also aims at the rigorous performance of analytics that would be done based on programming through various programs. Analytics in itself is just a measurement and mathematical calculations and Big Data in itself is just a bunch of gigantic unstructured data (Sanders, 2016). In this layer, the Big Data analytics would be performed to provide a significant output as logical information. The information collected and formulated intends to benefit all the stakeholders through its robust and incredible performance input. Figure 1.1 depicts the strategy involved in Big Data analytics.


Figure 1.1: Data Analytics Strategy

The given figure explains the strategic working model of Data Analysis. In which there are four major steps included, data collection, reporting, analysis and action. The goal of data collection is to create potential data (structured and unstructured) from a variety of inputs. This process also aims at producing data regularly. This data contains information that makes it cost-effective and innovative and can further prove helpful in strengthening the perception and add to decision making (Chen, Preston, & Swink, 2015). Data collection then aims through various questionnaires and interviews of ongoing graduates of Australian Universities. This also strives to collect data by interviewing different employers considering their keenness towards the project. Their consents occupy a significant role too. The collected data is Big Data, characterised through its Volume, Velocity, Variety, Variability and Volatility (Miah, Vu, Gammack, & McGrath, 2016). Reporting consists of the statistical submission of data in data reporting aims to present precise and accurate information. Data reporting in the form of a predictive approach to the research helps in developing advanced research modeling. This assumes that complete and consistent data reporting is usually taken as a good research practice (McNamara, Hanigan, & White, 2016). In analysis, the proposed system is rational, secure, and logic-based, but there could be a possibility of having data redundant to the stakeholders. This is the step where data in the form of text, audio, video, and images will be analysed and modified according to the need. Mostly relevant data collected would be sorted out according to outlines drawn by the system. The next step involves various tasks, including record matching, data cleaning, deduplication, and column segmentation and to perform these steps various tools such as correlation, confidence interval and regression (Handy, 2017) would be used. Action is based on the usability, efficiency and validity that belongs to the working model in the real world. The model would be found on the data analysed through various inputs as the framework is proposed to generate a collaborative system for effective learning and recruitment criteria. The action would be performed online through multiple sites. Anyone can access the framework by registering themselves into the system, and only

concerned users could get logical access to the system. The framework has been secured from outside interventions.

### 1.3.1 User Interface and Application Programming Interface (API)'s

In this layer, API develops the user interface. The incredible feature is its user-friendliness while performing the tasks. This interface gives easy access to its users providing security and protection, which provides portal access to the concerned and authorised people. Further aims at formulating the logical interface between the software and its designated user, which ensures the development of a proper working interface.

### 1.3.2 Cloud and Internet Access

Cloud and Internet Access is concerned with the practical use of the system, which includes providing access to all the current browsers and applications related to operating systems in use. This further aims to offer downloadable capacity at common place systems such as iOS and Android systems and the web browsers like Google Chrome, Mozilla Firefox, Internet Explorer, Safari, and so forth. By developing different logins for different individuals with a variety of different functions to choose from, the system allows students to access exercises, case studies and other learning products that are blended in the system. At the same time, the system also furnishes employers with all the candidates' details and facilitates them to upload and manage job descriptions in the system.

Moreover, the presence of these components helps in the evolution of the system and ensures effective implementation. The addition of these key criteria and the other aspects linked to the system thereby benefits all the stakeholders respectively. Major possible interventions in the education-employment sector are as stated below:

**Students:** The aim is to have students submit their technical and interpersonal skills via the collaborative system. The platform will then have big data analytics that captures student's activity logs, types of activities, exercises, and case studies to showcase their qualification and prior knowledge and experience by capturing various data formations, including texts, videos, and pictures in enhancing their professional outlook while promoting themselves. This framework also allows them to visualize their professional development and critically evaluate them following the new

requirements in actual terms. This funtionality helps students in enhancing their self-understanding towards their potential fields.

**Employers:** Employers are a significant component of the proposed framework and this places the demand to deploy quick and innovative recruitment procedures superseding the conventional hiring criteria. The current working employment system consumes a lot of time and money and comprises many stages of engagement from advertisement to final recruitment. The proposed method offers the knowledge and the skill details that are automatically generated through big data analytics for providing constructive information related to the potential candidates. This system equips employers with a login to access the console to view and extract relevant information.

**Stakeholders:** This system also offers secure access to selective stakeholders, including education providers, community leaders, social workers, educational consultants. This is a powerful, secure system and authorities reserve the right to limit access to the people who are in any way associated with the information provider. It is an online system that can be accessed worldwide. It benefits the education providers and faculty through its evaluation surveys, by reading the documents related to professional development and by offering assessment access for accreditation to the institutions.

### 1.4 Structure of the thesis

This thesis is divided into seven chapters, the first of which is the introduction. The thesis framework is depicted in Figure 1.1. This section gives a brief overview of each chapter. According to the figure chapter 4 contains major part of conceptual knowledge about artefact development and evaluation, and it’s a centralised chapter referencing the material in the respective chapter accordingly.


Figure 1.2: Thesis chapters

Chapter 2: **Literature Review**

Through an extensive review of the literature within the Smart Education domains, evaluation of the value of employers perspective in the current educational systems is identified in this chapter, alongwith the various issues involved in the current systems. The theoretical concepts are defined and constructed to position the employability perspective in learning using requirement analysis.

Chapter 3: **Methodology**

This chapter details the research philosophy which relies on a broader than a narrow understanding of knowledge and learning. Following which, we discuss the research methodology along with an overview of the study plan and the various stages of the research design. This chapter also discusses the research methodology, which includes the application of the DSR methodology to the LMS, development, and evaluation. In addition, the chapter discusses data gathering and analysis methods, as well as the ethical implications of the research.

This chapter elaborates the theoretical basis of the Design Science Research solution framework. We will explore the research paradigm used in the study to put into perspective the findings. The research methodology used in this study follows the seven guidelines mentioned by Hevner et.al. (2004). The definitions and benefits of DSR have been enumerated in this chapter to meet the criteria of artefact and to facilitate the development of concepts to fulfill the current learning requirements.

Chapter 4: **Artefact Design**

This chapter explains how to design and implement an artefact for LMS, that caters to the requirements of smart education, including a brief on how to create the first artefact prototype (instantiation). It covers the design and development principles for DSR solutions, as well as the numerous components such as, students, teachers and employers dashboard, that are critical to the proposed LMS artefact requirements. The functional model of the DSR artefact is then described, along with several user interfaces (UIs) for user-system interaction.

Chapter 5: **Evaluation and findings**

This chapter explains the rigorous procedures used to evaluate the DSR prototype. The goals of the system evaluation were to satisfy user needs and the user experience with the system, as well as to detect any persistent issues with the system. The artefact was evaluated for usability, efficacy, performance, and overall user experience while using the prototype. The evaluations finding supports the creation of a user-friendly solution artefact for students, learners and employers.

This chapter also explains the findings gathered from the qualitative research and data collections. It charts out the empirical results from the multiple interviews and discussions that were conducted with possible end-users in the educational sectors as well as employers. In this, various stages are discussed to produce a detailed understanding about the interview outcomes. The objective of the study was to identify the issues, strategic needs, and requirements for a new LMS. This section also reflects on the theoretical and practical contribution of the study.

Chapter **6**: **Conclusion**

This chapter presents a summary of the research, reiterating the study's objectives and significant conclusions. It also discusses the theoretical, methodological, and practical implications of the research as well as its strengths and limitations. This chapter

concludes with a discussion of future research directions. The following chapter examines LMS strategic decision-making in the context of DSR methodological framework and evaluates the existing literature.

### 1.4 Chapter Summary

The cloud-based collective gateway is founded on the data collection process, which involves students, employers and teaching staff. Past research has focussed on the tasks performed on an individual basis. To enhance the already existing LMS's, the proposed study caters to the employer and student requirements simultaneously in an integrated manner on a single portal. This proposed research primarily relies on design science research methods and its key components include distinct layers performing actions using data analysis and user interface. This model seeks to analyse, evaluate and process the data by developing a working artefact, towards assisting in education, career development systems and processes. Finally, after analysis and evaluation, the proposed research aims to generate an operating system to enable the students and employers in easier and effective job search and recruitment.

# CHAPTER 2

# LITERATURE REVIEW

Technologically driven information systems have been rapidly growing to transform the educational system to engage and empower students, educators and employers in an efficacious way. New technologies have been adopted by educationists and recruiters, alike, for enhancing the system of education. It is often found that these approaches are critically evaluated for a dearth of suitable theoretical and technological basis. A systematic literature review is conducted as a part of problem relevance and research contribution for acquiring required intuition to set up the inceptive solution artefact design comprehension. Content investigation method was implemented to treat comprehensive particularization as an elucidated outcome. The interpretation proposes that smart education is a swiftly emerging fact-finding discipline that accolades applications of various new technologies. A contemporary substructure of smart education is constituted through the collected data to put in place a digital artefact. The artefact then gets exhibited as a mobile-based application that equips students to control their education and employment strategy, towards a better future. A theoretical analysis on smart education literature has been done as a part of this research and added in this chapter. Please refer Article-1 for detailed analysis of the topic.

The swiftly emerging statistics dissipation and social media technologies constituted an enormous hope for contemporary analysts. In today's world of scientific advancements, growing diversified data generation as well it's productive utilization and conservation are turning out as remarkable challenges and obstacles for IS researchers and educational design practitioners. These obstacles though, when identified and overcome, lead to the evolution of a better technological apparatus which further led to new technological innovations in the field. Fortes et al. (2019) showed that academic organizations and universities could extensively impact society via the applications of fresh technological expansions within the situation of smart cities. In this regard, as Zhu et al. (2016) explained, advantageous technological development for educational or similar facilitation, such as smart teaching, which is an interpretation to narrate the new learning procedure in the modern age of information, could play an essential role in considering the evolution of smart city developments.

Furthermore, Internet contrivance and other similar technologies are progressively used by educational associates or scholars (Chang et al. 2017). Mobile applications utilized to locate real-time tram location or find the route or times of public transport. Online dialogue, chat, communicating with counterparts through social media, mobile applications, businesses, online banking, fee payment, and RFID tags to access the facilities or electronic ID cards have been a publicized method and gadget for smart living.

All these gadgets generate a diversified data called Big Data. As per Miah et al. (2019a), big data is distinguished by its volume, velocity, variety, variability, and volatility. Furthermore, Big Data created at social media and through different IoT's have established plentiful anticipations for deducing even more mastery to the users and different decision-makers (Miah et al. 2017a). The present and effective examination of big data could yield a result that may mold our lives easier and smarter. Big data analytics in building our conventional living in cities as smart living is known as "smart city" (Ang et al. 2019). It opens a new avenue for manufacturing compelling research in the academic sector. While using the big data utilization perspective, it is important to redraw the contours of the educational domain to include education operations and unprecedented productive substructure is of utmost job for analysts.

Social media and internet-based technological progressions have pierced the heart of our society. Citizens are connected and actively engaged by digital means for accomplishing their daily tasks (Gabriela et al. 2018). The supposition and pragmatic requirements, a technologically modern educational composition, and similar proceedings for effective education delivery may bring forth recourse to a more acceptable future generation. It is crucial to contemplate educational, technological advancement to look after the spread of smart education. An up-to-date plan of action may consider the vital requirement of enhancing a learning management system (LMS), that can work productively in terms of improving scholars' understanding of industry enabled and demand-dependent study material supplied by the educational organisations. Smart education systems and approaches mainly used and created data by pursuing students, employers, and teachers online. The testing sector is fast advancing however, not enough studies have been conducted to demonstrate how the existing literature can edify the new artefact design. A structured literature analysis is conducted to deduce a basis for designing a new and ingenious smart education

application. The application as a design structure can be considered as a conceptual architecture that would assist students in studying and professional growth for a fruitful future. Running literature on IS comprises proposals made by Rowe (2014) who suggested six categories - theory development; research essay; ethnography and narrative; empirical research; issues & opinion; and literature review, as the axis on which IS research can be conducted such that diversities inside a particular area are reconciled to generate new knowledge. The existing literature review on IS research contains 1) annotated synopsis of existing works; 2) an appraisal of existing contributions 3) assessment of all-inclusive outcomes as well as 4) profile substitute insights and techniques of prior research (Schwarz et al. 2006). The literature review can provide astonishing perspectives from a suitable set of literature, acutely uniting existing relevant studies on a specific topic (Schwarz et al. 2006). To perform a literature review under Smart Education's dominion, we have used the recommendation noted by (Rowe 2014). As per Rowe (2014), the literature review's typical conformation is to recognize the key technological impact and knowledge gaps as "issues and opinion" in the previous literature on the associated areas of interest. In this study, a systematic search of articles based on keywords has been taken as mentioned by Rowe (2014), the matter compilation entails searching and selecting relevant articles.

### 2.1 Modernised learning approach (Smart Education)

Smart education authorizes the application of the newest or smart technologies in conjunction with advanced professorial practices, tools, and techniques (Gabriela et al. 2018) for the constructive delivery of education services. These smart technologies are competent to transfigure the teaching and learning process in institutions. As a result, an inquiry might be essential to uplift the learning and teaching techniques to attract students who are digitally aligned in their livings (Chang et al. 2017). Tools like student cloud-based learning goes far beyond the concept of distance education likeability. Like this, smart education mainly opens channels and opportunities to uplift the learning tools and enhance teaching delivery methods (Salah et al. 2014). Students' Mobile Devices or smartphones connect to the internet in-class and/or work by providing non-class access to all sources of information. However, this is not enough, as the modern age of intelligent education has become ground-breaking with enhanced

networking in wireless networks between heterogeneous devices (Santana Mancilla et al. (2013).

The aim of research is to classify and analyse published literature in the fields of intelligent education science, to develop new insights which will contribute to the successful understanding of architecture. Rowe (2014) presented a guide for successful literature evaluation studies to achieve the study's outcomes. As mentioned in the background section, the field of smart education is changing rapidly. The study, therefore, focuses on research papers that have appraised the dynamic movement of the fast-changing sector. The study also focuses on research notes, short papers, editorial notes, and white papers of the industry or professional and non-academic papers. This research on smart education is mainly based on sampling the research papers. A successful search based on a five-step technique was performed to collect samples (Miah et al. 2017a). A systematic investigation has been included for a list of most publications from the appropriate and authentic databases. Documents were selected from the year 2010 to 2018. Springer, ScienceDirect, Wiley, Scopus, NCBI, IEEE and ACM are the chosen databases to gather data. In the first stage, multidisciplinary journals are extracted from the search engine to compile the publications using the keywords ‘smart city’ and ‘smart education.’ This search pattern produces a wide variety of articles, which must be filtered into more detailed extraction. The following search, which gathered 161 papers, was based on the keyword 'intelligent learning.' After reviewing the abstract, keywords, title, and body of the paper, a new list was created and brought 96 papers to our collection. In the following stage, the list includes examples of material relating to the conceptualisation case scenario, covering a detailed understanding of the subject and 63 posts. 40 papers compiled in the final stage pursue the principles on learning and pedagogical topics relevant to smart education. The last step involves content analysis based on the 40 highly relevant articles collected. The most significant aspect of these papers was the display of current and modern education standards. The content analysis methodology is then used to analyse the samples gathered. The content analysis was known as a tool for a qualitative and quantitative study. For example, Arnott and Pervan (2012) discussed previously published design research papers on decision support systems (DSS). Al-Debei and Avison (2010) study content analysis using current literature to analyse the business model. We have designed the following phases from Elo and

Kyngäs, in line with the previous analysis (2008). We used qualitative techniques in this analysis to explore and analyse sample papers or their contents explicitly to gain valuable insights (Miah et al. 2017a). Such a technique strengthens researchers' capacity to use documents as a valuable source of evidence to identify and document a novel phenomenon.

The study is driven by Elo and Kyngäs's three stages of planning, organisation and reporting (2008). The preparation process is designed to categorize a set of codes or headings based on similar and common characteristics. This involves the task of clarifying the categories describing the analysed phenomena (Elo and Kyngäs 2008). The first consideration is to find what to analyse? In this instance, 40 papers have been selected by research-related terminology from the databases. We employed tools from NVIVO to define the problems, core topics and how the concept was implemented during the organizing process. NVIVO can quickly process, extend, reuse, and share information in a single large file containing all the information. It also provides the possibility of collaborating with other analysis tech platforms like EndNote. For referring and categorizing purposes, all publications are stored in the Endnote. EndNote's XML extracted from NVIVO to keep all the details. The information gathered following systematic literature review covers in the following article published in Education and Information Technology journal attached below.

This chapter includes the following paper:

1) **Singh, H.,** Miah, S.J. Smart education literature: A theoretical analysis. *Educ Inf Technol* 25, 3299–3328 (2020). https://doi.org/10.1007/s10639-020-10116-4

Singh, H., Miah, S.J. Smart education literature: A theoretical analysis. Educ Inf Technol 25, 3299–3328 (2020). https://doi.org/10.1007/s10639-020-10116-4

## 2.2 Learning Management Systems

Academics and students use web-based or e-learning and online teaching materials for collaborative, self-driven information collecting and problem-solving activities using LMS (OECD 2005; Dalsgaard et al. 2009). In general, the word "learning" is seen as too broad to be encapsulated in simple meanings (Schunk, 2012). Today, learning is generally related to an authoritative connotation of comprehension, efficient or constructive usage in educational technology, as opposed to simple preservation of information or surface learning (Januszewski & Molenda, 2013). This study, however, focuses on learning, broadly interpreted as encompassing more than mere comprehension and efficiency as a yardstick. A learning management system (LMS) is a robust software system that can be used to develop learning (Brusilovsky, 2003), especially in higher education (Maslov & Nikou, 2020). LMS is an Internet-based platform used to deliver and administer e-learning courses (Coates, et al. 2005), a critical element of the digital learning experience (Koh & Kan, 2020). It offers an automated mechanism for providing course material and tracking learning progress (Dalsgaard, 2006). There are two types of LMS: open and closed source. Generally, open-source LMSs are free of charge. They are customizable at a low cost depending on user needs (Machado, 2007). Another type is Software as a Service (SaaS) or Cloud-based LMS, for example, Canvas, Edmodo, Google Classroom and other personalised software based on organisational needs (Wicaksono et al., 2020).

Teaching criteria is very experimental right from the start. Two dominant perspectives on teaching methods have classified teaching into theoretical and practical approaches (Sedova, 2017). According to Sedova (2017), dialogical teaching is directly related to the theoretical explanation of the knowledge teachers usually find difficult to practice. At the same time, physical and online learning is becoming a debatable issue in the educational scenario (Lijuan, Sau-ching Ha, & Xu, 2014).

After learning and teaching, the next step is employment; the phase covers a significant part of attention for both students and employers. Students spend a lot of time selecting and applying for the right job according to their expectations. The competition-based approach (CBA) is becoming more prominent in most graduate and postgraduate studies in various fields (Rezgui, Mhiri, & Ghédira, 2017). Employers spend time and money finding a suitable candidate for their expected job position (Just, 2014).

As technological involvement and the internet could provide a comprehensive understanding and possibility towards the most modern system (Baisutti, 2015). It is assumed that the current scenario's expectations include collaboration between learning, teaching, and employment at an advanced level of data analysis process in order to provide the most effective outcome from a technology-based system.

### 2.2.1 Issues related to Current LMS

Undoubtedly, LMS and e-portfolios are excellent ways of keeping and managing professional milestones, but there are still some hindrances related to the system. These issues are still a hurdle towards the fulfillment of the professional requirements.

#### 2.2.1.1 Transformation of Learning

The LMS was built to plug the gap between offline learning and online methods. Previous learning styles (offline methods) are constitutively different from the current systems. Clumsy paper-based learning demands physical documentation. Moreover, securing and keeping the records becomes a challenging task. Due to technological advancements, we can see massive changes in overcoming the issues related to this challenge. Of late, the internet and now cloud-based learning is beneficial in revolutionising the whole education system (Lipton, 2017). It aims at interacting in real-time while performing various activities such as playing and composing music (Biasutti, 2015), playing video games, online chatting, video conferencing, etc. According to Biasutti (2015), people take a keen interest in having online learning activities rather than pursuing the traditional way of learning. In this contemporary era, this framework adopting is the most modern way for learning and recruiting procedures, though this is more inclined towards recruitment. Politis and Politis (2016) mentions that “online learning is becoming more attractive to prospective students because it offers them greater accessibility, convenience and flexibility to study at a reduced cost” (p. 204)

The Victoria University (VU) policies' key concerns are to strike a balance between online, face-to-face teaching and the overall learning environment (Wong & Tatnall, 2010). Due to this concern, universities often introduce systems or platforms to facilitate the student learning program. In 2006, the university introduced the Blackboard Learning System, which provided basic online teaching resources to help

first-year accounting students (Wong & Tatnall, 2010). Later, various e-learning resources like an online discussion board, live chat and email system came into existence. In 2009, teachers recorded lectures and made them available online, which added more value to the online learning platform.

#### 2.2.1.2 Pedagogical Concern

There is a significant distinction between physical and online education (Lijuan et al., 2014). According to Lijuan et al. (2014), there is a very general dominant teaching perspective pattern. Students feel a lack of personal attention leading to incompatibility with the focus towards their career. It is important to receive personalized attention and to concentrate on specific job objectives. When students finish their studies and enter the working world, they find themselves in a perplexing situation. With the help of an online learning environment, teachers can develop a well-structured online material that may enhance the quality of students learning as well as the online learning experience (Yamagata-Lynch, 2014)

Primarily, there are two teaching basics: teaching a method and teaching concept (Mahmud, Alwi, & Sulaiman, 2014). Mahmud et al. (2014) mention that teachers' role in teaching occupies a vital significance in delivering knowledge from them to the students. In parallel to this, teaching methods explain the teachers' knowledge, experience, and creativity, which helps in the students' professional growth. Moreover, teachers will also have the ability to categorize their time spent on student career growth (Xerri & Campbell, 2016a). In this case, they can also boost their professional development. E-portfolio pedagogy is a dynamic approach towards education that focuses on active learning, on demonstrating the robust outcomes out of the assignments while reflecting such outcomes on learning.

#### 2.2.1.3 Learners Concern

Among students in higher education institutions, e-learning or Distance Education is increasingly becoming the preferred mode of education. According to Allen and Seaman (2008), a report suggested that in the fall of 2005, 3.2 million students in the USA (mainly undergraduates) took at least one online course. They found that online registrations have risen substantially than general higher education registrations (Allen and Seaman, 2008). The report states that,

- During the fall 2006 semester, nearly 3.5 million students took at least one online course, an improvement of almost 10 percent over the number recorded in the previous year.
- The growth rate of 9.7 percent for online enrolments well exceeds the growth rate of 1.5 percent of the total population of higher education students.
- In the fall of 2006, close to twenty percent of all U.S. higher education students took at least one online course.

Among these, thousands of university students cannot get their desired jobs as per their selected field (Hil, 2015).

#### 2.2.1.4 Employers Concern

Employers are dedicatedly concerned about their selection of employees. The 2017 Employer Satisfaction Survey (ESS) conducted by Quality Indicators for Learning and Teaching (QILT) shows the vast majority of employers believe graduates are well-prepared for work (Qilt, 2017). One of the university's primary concerns is to prepare the students according to the job requirement (Oraison, 2019). This is suggested to the universities that they need to do more to meet graduates and employers' needs (Minister of Finance, 2018). In the 21$^{st}$ Century, this is a topic of debate about whether or not university courses adequately provide relevant information about the workplace's skills (Kivunja, 2014). The existing employment climate has its pros and cons.

On the one hand, it reduces students' academic performance, on the other hand, it has lasting positive effects on their employment experience. In addition to monetary gain, students' access to work opportunities during their studies is one of the primary interventions.

#### 2.2.1.5 Technological transformation

Technology helps speed up information distribution, incorporate networking between companies, allow stronger relations between companies and consumers, minimise regional borders, and improve contact efficiency (Spiezia, 2011). Every infrastructure, software or communications technology introduced by an organization to support the business process and to promote strategic decisions is contained in Information and

Communication Technologies (ICT) (Beynon-Davies, 2013). To support data collection and processing for business decision-making, ICT can also be used (Beynon-Davies, 2013). Many owners/managers of companies are often poor planners, particularly when using far more user-friendly informational systems. For business practices, the use of ICT remains a concern (Magee, 2007). Developing a repository containing this digitalized collection of various artefacts requires some computer and media skills to further use ICT-based mobile applications. As for the students, it is assumed that all the educational institutions provide online learning systems to allow themselves to use most of the media-related techniques while studying. However, critical media literacy involves searching, retrieving and processing a gigantic database or huge amount of information and communicating online through various ways (Hadjiconstantinou, 2017). Then the case is a bit different in terms of interpreting digitised knowledge. Critical thinking is a crucial skill to develop when it comes to professional and academic existence and performance. According to Mu-Yen Chen, Francis Mou-Te Chang, Chia-Chen Chen, Mu-Jung Huang, and Jing-Wen Chen (2012), teachers and educators need to make some extra effort to facilitate students computer self-efficacy in every way, be it online or offline support (Mu-Yen Chen et al., 2012). However, teacher's digital literacy also matters. Xerri and Campbell (2016b) teacher's digital literacy as a major concern in their study, which means the usage of digital devices. According to the study, most of the teachers are interested in paper-based files (Xerri & Campbell, 2016b).

#### 2.2.1.6 Problem of Ownership

Currently, institutional e-portfolios are hosted at university servers. However, in such a situation it is difficult to discern and decide who the owner of the content of the hosted servers would be. Students have the right and access to change and update their e-portfolio any time. Then the question arises, whether anybody other than a student can make changes to the student's e-portfolio? Here, it is assumed that if the student manages data as a gigantic file cabinet to collect digital evidence, its owner must also be none other than a student (Jenson & Treuer, 2014).

#### 2.2.1.7 Lack of Employers involvement

The platform where the students can reflect their entire professional development till date, where they define “learning by doing” which further enables them to acquire practicalities related to the study (Yastibas & Yastibas, 2015). In an e-portfolio, the only way to interact with the practical or professional world is through the students' access to the employers. Employers cannot see or search for the information they require from the system. Work Integrated Learning (WIL) refers to university initiatives such as internships, clinical and fieldwork. Work-integrated learning isn’t new to university education but is on the rise as universities adopt strategic targets for student workplace participation as an element of their studies (Ahmed, 2019). Preparation of students in terms of their employability skills and employers' active participation is always a need for research (Halper et al., 2020). Collet et al. (2015) explain that the current Higher Education structure finds it challenging to implement new changes, leaving the employers ambiguous and indeterminate. There is a paucity of communication between the employer and the educational institutions regarding the skills requirements. (Jackson, 2014). Due to a generic skills development provision in the universities, researchers found a distance between employers and deserving student candidates (Bostock, 2019).

#### 2.2.1.8 Authenticity Issues

An E-portfolio acts as a bridge between higher education and the professional world (Nudelman, 2017). Whatever is visually provided is assumed to be a valid document related to the candidate. However, there are no specific criteria to validate either the documents' authenticity or the information provided.

### 2.2.2 Technologies to support learning and teaching

There are a variety of technologies that are involved in learning and teaching practices. Out of which, various universities use various software, which differs according to the university's needs. Such as Moodle, blackboard and VU collaborate in VU. These are some of the open and closed sourced platforms available at the educational ground. Moodle is used mostly as it is a free e-learning platform (Kobayashi, Arai, Sato, Tanimoto, & Kanai, 2017).

The current system is based on the full involvement of students in their ongoing professional development. According to the study based on the Personal Development Planning (McKenna, Baxter, & Hainey, 2017) mentions about e-portfolio. According to McKenna et al. (2017), an e-portfolio is significant in supporting and improving students' aptitude towards advancing their careers.

An electronic way of organising digital artefacts related to the users. Users who have dedicatedly represented "Students" in the Educational Institutions. An E-portfolio is believed to be a repository of files and primarily, it is also known as a digital resume with multimedia attachments (Jenson & Treuer, 2014). In this 21st Century, students directly access mass communication and information and to a very fast-growing technology (Carl & Strydom, 2017). In this era of rapid technological developments, e-portfolio enables reflective learning and continuous professional development while acquiring the students' attributes and skills. Moreover, it is a contemplation towards their professional development. Carl and Strydom (2017) state that reflection is keeping records and an opportunity to perceive professional growth.

E-portfolio provides an articulated arrangement of professional documents on an online platform, where an individual can access his/her account from across the world. This is a tool for managing the documents of one's learning for the whole life, which can endorse deep and continuous learning (Jenson & Treuer, 2014). It is not defined as a tool unless one owns it and knows how to operate it (Jenson & Treuer, 2014). Arranging electronic documents in the form of degrees, certificates of achievements, recorded audios and videos provide an opportunity to categorise each and everything according to the need.

While explaining about their qualification, it is a widespread practice that students tend to provide their university name instead of telling what they have achieved and can achieve. Therefore, they do not reflect in their learning about their acquired knowledge (Ugolini Francesco & Orazi, 2015). The e-portfolio provides an opportunity to categorise one's achievements, qualifications and work experiences altogether.

### 2.3 Key Summary

The critical results demonstrate society's progress distinctly by the applications of numerous contemporary technologies that affect the universities (Anttila and Jussila 2018). The students' retention is the concern of the educators and institutions to create

effective, efficient and fascinating learning (Gomede et al. 2018). This is the main reason that led to the emergence of smart education. The subsequent work will enhance the development of the technology in a smarter way that will make vision the reality (Salah et al. 2014).

In this majorly cloud-based environment (Bajaj and Sharma 2018), it reinforces the transformation of traditional classrooms to smart classrooms. Personalised learning contents can be presented, operated, and assessed anywhere and anytime. Cloud-based applications (Stoica et al. 2018; Shee et al. 2018) help and ease the demand of mobility of the LMS. A student can get access to the study material, group discussions, and exercises. E-learning (El Janati et al. 2018). Through mobile applications (Kim et al. 2018) this study material can be assessed and managed effectively. This could also be managed through mobile applications through Web-based applications (Gunasekera et al. 2018).

In recent ICT studies, big data plays a vital role in providing better learning services (Anshari et al. 2016). Moreover, a need arises for developing practical analytical tools to manage the data generated through various LMSs for example, The majority of the organisations base their decisions to provide new knowledge upon extensive data (Dubey et al. 2018) that would bring improvements in the methodologies for learning (Cantabella et al. 2019). 5 Vs (i.e. volume, variety, velocity, veracity and value) characterise the big data (Miah et al. 2017b, 2018, 2019a) that has been redefined in numerous studies for various purposes and is complicated to store, analyse and process (Dubey et al. 2018). According to Cantabella et al. (2019), student behavior was analysed for capturing their behavioral patterns in the past four years. This new research has shown how big data can be used for adding value for decision-making in education.

Big data analytical tools must be developed appropriately to analyse and evaluate data collected from student activity, including for analysing student backgrounds, behavior and developments (Wilson et al. 2017; Katrina and Loganathan 2015), such as SQL (Sykes 2014) and predictive analysis (Gomede et al. 2018) which are used in developing learning profiles. The majority of multimedia (Abdel-Basset et al. 2018) today covers data generation and visualisation for most digital parts. A smart classroom (Kim et al. 2018) contains a variety of different devices that give students specialized realistic interactions focused on adapting multimedia in education and privacy (Yang

et al. 2018) & security (Maqbool et al. 2017). Smart education is an important way for an advanced society to evolve. However, above mentioned are a few of the concerns which are connected directly with smart education.

On the other side, mobile technologies like cell phones are expected to detract from students' attention (Anshari et al. 2017). Mobile phones can, however, be made into efficient and inexpensive instruments. If not correctly used, this could be a severe intrusion (Amichai-Hamburger and Etgar 2016). Exposure to unnecessary broad knowledge and dependence on mobile networking continuously is a significant obstacle to e-learning (Anshari et al. 2017). This addiction comes from quick access on their mobile devices to the high-speed Internet (Qudah et al. 2019). This is also known as behavioral dependence. For example, expanded access to cell phones in rural India has negatively affected technology addiction among school students (Jamir et al. 2019). All the classified articles and papers provided the reference to IoT involvement in educational institutions (Abdel-Basset et al. 2018). The advanced technological system of a smart city is its people's vision (Anttila and Jussila 2018).

The results demonstrate a dire need for industry involvement in traditional LMS, which could also enhance the awareness of demands in the industry of learning processes with technology like cloud-based mobile applications. The technology involved in the advancement of learning processes is related broadly to the scope of smart education. Smart means intelligent, engaging and scalable, and the people's inspiration to learn the expertise and skills of the 21st century is the goal of smart education (Zhu et al. 2016). TEL has been utilised to facilitate advanced technological education (Zhu et al. 2016). IoT and software application involvement enhanced score skill development and graduate employability (Tomy and Pardede 2019). It also advances student satisfaction with the course. The literature's discoveries initiate a notion to implement advanced technological practices such as cloud-based mobile applications to the learning techniques based upon industry-enabled course materials. TEL's necessity has led to the emergence of a new system capable of providing learners an innovative platform to perform effectively and succeed in the real world.

### 2.3.1 Existing learning applications

Applications of the Internet of Things (IoT) have been well-recognised. The IoT is no more new technology, it is much greater than the machine to machine communication,

wireless sensor networks, 2G/3G/4G, Global System for Mobile Communications (GSM), General Packet Radio Service (GPRS), RFID, Wireless Fidelity (WI-FI), Global Positioning System (GPS), microprocessor and microcontroller (Abdel-Basset et al. 2018). Sanatana-Mancilla et al. (2013) used Ambient Intelligence for the digital environment to provide intelligence to otherwise ordinary classrooms. The various higher education institutes utilised multiple systems to gather and manage important information regarding LMS. The majority of the study institutions implement customised or have developed their own LMS to deliver, manage and capture learning information and requirements., Blackboard, Blackboard Collaborate, ePortfolio, Moodle and learning collaboration systems are some of these technologies. However, these technologies have provided mobile options to all users. Table 2.2 elaborated some examples of the technologies involved which are Moodbile, Wireless Application Protocol (WAP), Personal Learning Environment Box (PLEBOX), Cross-Platform (CPL), iQualify, Pharmacy Assistant Mobile Application (PAMA). These examples used various mobile-based applications for providing various additional services, such as English lessons for students' benefits. The technologies have their web-based application to address the requirements of students in the form of education needs. Not a single technology has an option such as linking employment or industry-related opportunities. The LMS may not be considered industry-enabled to meet the demands of industry-oriented problems. Many research studies show that LMS is essential to collect and process data specific to employers' needs. It is an anticipation that smart education applications can fulfill the higher sector requirements to enhance industry uptake. Adding the employment prospect to LMS attracts further employment possibilities and provides an opportunity to the researchers to undertake advanced research in smart education for more innovative technological advancement.

### 2.3.2 Conceptual Interpretation

In recent decades, there have been significant developments in educational technology. Bond, Zawacki-Richter, and Nichols (2019) reviewed papers published between 1970 and 2018 in the British Journal of Educational Technology (BJET) and outlined the significant problems and core themes for each decade. In the 1970s and 1980s, the dominant technologies used for instructional purposes moved from graphical and audio-visual resources to computer-based software and online learning in the 1990s,

which later grew into interactive online learning from 2000 onwards. The research has shown that learning analytics and socially interactive learning, which rely on end-user personal technology and particularly mobile application innovations, are the main themes in BJET papers in the current decade.

Smart Education is about delivering personalized learning, anytime and anywhere (Bajaj and Sharma 2018). To deliver this learning, technological procedures are involved, enabling students to enhance their learning and understanding skills. Compared to previous years, the term "smart education" now attracts a more significant number of researchers in this field. Smart Education has become a modern-day necessity due to new inventions and technologies.

### 2.3.3 Theoretical interpretation

Building theoretical knowledge expertise to solve research questions and priorities is one of this study's critical academic contributions. This kind of knowledge is referred to in DSR as justifying knowledge or kernel theory, which advises creating a new artefact. The actual setting of the principle or understanding of reason requires some decision to describe the exact condition to construct that knowledge. Learning is a lifelong improvement of behaviour or the desire to conduct in a certain way that emerges from practise or other sources of knowledge (Schunk, 2012). This shows that educators already hold a strong degree of respect for the behavioural element of learning as one of the most quoted concepts of learning theory in the present decade. Schunk further elaborated the definition by stressing three constituent learning criteria: transition, stamina, and knowledge. The measurable part of learning by which the learning process can then be inferred is shifting behavior. It is predicted that such a transition would last for a prolonged time rather than transient or immediate. Ultimately, only a transition that comes by experience will count as learning, whether the experience is internal or external to themselves.

By analysing the two manifesting forms of the phenomenon, dimensions of learning may be understood as a responsive behavioral shift towards the external environment and an emotional mechanism inherent to the learner. In educational literature, it tends to be a convention to break learning philosophies into major schools, known as behaviourism, cognitivism and constructivism (Ertmer & Newby, 2013).

#### 2.3.3.1 Planned Behaviour approach

Behaviourism was a very distinguished pedagogic philosophy many decades ago (Anderson & Dron, 2011). While behaviorism has been eclipsed by the constructivist approach and presently dominates the educational environment, many researchers consider constructivist viewpoint as the most effective pedagogy for all situations. On the other hand, there is still general attention on the efficacy of the behaviorist approach, which is especially evident in some unique regions. There is no widely accepted definition of behaviorism—various branches of behaviorism stress elements that have been developed in multiple directions. Attitudes toward actions are thought to be founded on behavioral values, which are the beliefs of an individual about the possible effects of behavioral success (Ajzen, 2005). The intellectual theories of behaviourists developed from Watson's (1913) "methodological behaviourism" to Skinner's (1938) "radical behaviourism," from the centralization of techniques of natural science to the recognition of human thoughts and states of mind.

Nevertheless, there are many principles that most behaviorists have, despite having differences among leading thinkers. Various thinkers elaborate the principles of behaviorism according to their knowledge. For example, Bichelmeyer & Hsu, (1999) says that the universe is formed by entities, properties and relationships in a single, complete, proper form. Within individual mental states, knowledge is gained individually (Boghossian, 2006). At the same time, Skinner (1971) states that the emphasis on the measurable relationships between external factors and behavioral responses is the central topic of behaviorism.

The functions of teacher and learner are the most critical factors to address regarding behaviorism's pedagogical epistemology. Scheurman (1998) interpreted teachers as transmitters that split information or data into ordered pieces that can then be introduced in expected ways to students. Lessons or teaching assignments act as behavioral conditioning on pupils, culminating in the form of action. Instructors include motivation in a desirable way that influences learners. Thus, learners are used as recipients of physical stimulus training and respondents (Boghossian, 2006). The lack and even ignorance of learners' affective dimensions, for example, motivations and emotions, engaged in learning is another frequent critique of progressive behaviorist learning theory (Illeris, 2018). The critique, though, points at the

limitations of behaviorism, that is unlikely to affect this study. Also, in the contemporary educational sense, behaviorist insights do have their place and further analysis can support their use.

#### 2.3.3.2 Cognitive approach

The human mind's interpretation by cognitivists is seen as a distinct set of thoughts and commonly recognized as a competing school of behaviorism that opposes the emphasis on behavioral improvements in the internal thinking process (Ertmer & Newby, 2013). In 1950, cognitivism came into fame referred to as the cognitive movement era (Cooper, 1993). Early research efforts to explore the human mind's nature beyond behavioral analysis can be traced to cognitive neuroscience blooming since the 1970s (Illeris, 2018). Piaget (2005) presented a theoretical viewpoint on information processing, based on his cognitive psychology work on infant literacy. Learning occurs as the learner takes new experiential knowledge and incorporates it into their pre-existing cognitive systems or modifies the current frameworks to handle contradictory experiences.

#### 2.3.3.3 Constructivist approach

In the great contrast of behaviorism, constructivism has recently contended with cognitivism. Constructivism, based on cognitivist psychology, is correlated with learning ideas about how people think and an epistemological approach that seeks to explain the essence of understanding (Hein, 1991). There are several different forms of constructivism, much as behaviorism. Among the differences, Von Glasersfeld (1989b) outlined the two key concepts claimed by constructivists, firstly, awareness is not gradually gained by the cognizing subject but actively constructed up and secondly, the role of cognition is adaptive and serves the organising of the experiential world of perception, not the exploration of ontological truth. Duffy and Jonassen (1992) suggested that while constructivists accept the real world's existence, they claim that humans create concepts instead of individually occurring phenomenon. This means perception of the world is different for everyone, interpretations vary from one another. The exploration and construction of definitions through subjective perceptions of the learner is called knowledge. (Boghossian, 2006). Whereas behaviorists view learning as an acquisition of objective knowledge, constructivists view learning as the process

by which people from their previous experience construct their knowledge. In this sense, teaching is seen as the support teachers provide for knowledge building for learners (Bichelmeyer & Hsu, 1999). The teacher's role in constructivism is that of a facilitator and collaborator with students in Scheurman's (1998) comparison of behaviorism and constructivism. Teachers guide students and collaborate with them to assimilate data. In addition, teachers should assist students in the instruction process to develop their reflection on reality. In the constructivist view, therefore, learners are the subject of learning, and through facilitated experience and skills, they can build knowledge on their own (Duffy & Jonassen, 1992).

Scholars widely debate the volume and type of instructional guidance that can achieve optimum preparation, success and learning efficacy and quality. Extreme constructivists such as Von Glasersfeld (1989a) contend that the behavioral method of teaching and learning only works well where the aim is the reliable imitation of an observed action by students. One of the results of this perspective is that the behaviorist approach ignores the status of understanding. Boghossian (2006) points out that behaviourists do not consider information as subjective lies in the metaphysical origins of behaviourism in positivism, where there is not even a dualism between subject and object. Subjective aspects are called artificial and can distract people from the interpretation of objective reality. A teacher-centered approach, or direct-instruction paradigm, is generally related to behavioral learning theories since it is based on the idea that information is conveyed directly from teachers to learners. Hirsch (2001) indicated that critiques of developmental pedagogies appear to find their origins in the appreciation of constructivists' natural method of learning. He also determined that conventional pedagogies are primarily criticized because of their artificial viewpoint on learning. They are meant to be made up of forced processes that condition behaviors (Hirsch, 2001).

In comparison to behaviorists, constructivists claim that the effectiveness of learning only happens as information is built from the experiences of learners themselves. Instructors' assistance should not be too prescriptive or directive and, therefore, generally constrained (Jonassen, 1991). Learning as a dynamic process has different facets that a standard theory does not entirely answer. It isn't easy to neatly distinguish learning theories and models as behaviorism or constructivism, as both approaches have added to our understanding of human psychology. In distinct research fields, both

are important and fruitful. Also, in their method of addressing research questions, learners and teachers often draw from other ideas and integrate different thoughts (Schunk, 2012). A synthesised interpretation by learning theory can be accomplished after a thorough investigation of the relevant research subject matter. The discussion between the two schools of thought was tethered epistemological questions. The evaluation of instructional designs, however, remains focused on observational results. Most researchers maintain that both behaviorism and constructivism have their qualities in separate directions of the teaching approaches in practise (Richard E. Clark, 2009; Fletcher, 2009). Both have added value to the discussion on learning while also carrying their own sets of limitations, therefore, neither should be negated nor accepted uncritically. Instead, the trick to achieving successful learning is to situate multiple hypotheses into their adaptive domains. This is highly prevalent in e-learning courses, as the optimal mix of behaviourism and constructivism is encouraged to be discovered by course planners (Carr-Chellman & Duchastel, 2000). A behavior shift in the students is obviously anticipated, while awareness and cognitive change are fundamental in determining the students' mastery.

### 2.3.4 Positioning of mobile-based learning

It is understood that a mobile-based learning environment has features that enable a great degree of customisation by allowing learners control over their learning techniques (Piccoli, Ahmad, & Ives, 2001). In addition, such learning ownership usually contributes to the successful promotion of a self-regulated learning approach (Chang, 2010). Clark and Mayer (2016) specifically outlined the role of e-learning in technical training that emphasises skills and enhancing performances. A new artefact is anticipated, which comes under the categorisation of smart education to improve and enable the learning and teaching procedures to empower the ability to boost employability quality of students for industry enabled requirements.

## 2.4 Research gap analysis

The research covered in the preceding section informs an examination of current learning and teaching attributes and the inability of the employability perspective to quantify the quality of education in the higher education sector. E-learning incorporates online features into LMS strategies. Mobile-based applications have

demonstrated their usefulness in integrating LMS for service delivery. Casany et al. (2012) suggested a mobile-based solution for integrating educational applications with web-based services (Casany et al. 2012). User-friendliness was the key driving force for end-users' needs due to the intricate interaction between mobile and educational applications.

None of the mobile or web-based platforms, focuses on developing a learning management system (LMS) that addresses both employment and industry involvement difficulties, allowing education users to receive direct participation and knowledge exchange from industry. These studies do not give appropriate end-user technology, such as user-friendly GUIs, nor do they provide general IS design based on real users' demands, such as those of students and educators, employing replicable development techniques that provide principled design knowledge. The literature confirms the possibilities of the mobile based technologies and advanced methods to ease the process of learning and teaching. Targeted area of the research found as advancement in teaching technologies, but industry active involvement found as ignored in the literature. To fill the substantial gap found in the literature is going to be considered in this research study. Design science research (DSR), as an influential IS design technique, is particularly relevant for modern-day IS solution research, according to Hevner et al. (2004) is considered to fulfil the research gap.

### 2.5 Requirement analysis

The study presented the results of a systematic literature review in the newly emerging smart education sector, which served as the foundation for the development of a new solution framework. Further associative research is required in the area of smart education. The necessities of designing innovative solutions are changing quickly in relation to students' demand to advance the education system and make it smarter. The literature analysis delivered the latest technological provisions and their significance in the development of innovative smart education artefacts. A novel, ground-breaking solution paradigm that could examine students' perceptions of a positive learning environment is required, focusing on three main factors: social, pedagogical, and technical bases (Chisanu et al. 2012). To eradicate the distance and build a bond between educational institutions and employers, students’ encouragement to pursue their careers in the real world (Green et al. 2015) is vital. In other words, employers

may assist students in a variety of ways, including providing work experience, apprenticeships and promoting the growth of employability skills (Bimrose et al. 2014).

The study covers the theoretical analysis for the rationale of smart education. Technology today has developed enormous projections for the people who utilise the information dissemination and social media technologies of the modern era. Universities, in which students, teachers and employees generate a population that is open to test, adopt, consume and promote new inventions (Fortes et al. 2019). The needs and demands of the students have been addressed by this study by smart phone application as per industrial requirements. The giant data collected through different parts of the application could be utilised to produce a specialised report using big data analysis, that would be useful for students' learning decision making.

Simultaneously, there is a need to help students organize their studies based on personalised learning (Baker & Inventado, 2016), enabling customisation of course material and documentations. Therefore, constructivist educational designs may benefit more directly from these approaches. The traditional learning system requires proper student attendance in the classroom to learn and study which does not provide flexibility to the aspirants (Göksu and Atici 2013). On the contrary, modern technology in which mobile-based applications are involved gives a vast possibility for learning practices as mobile devices can be treated as the mediator in teaching and learning (Hamdani 2013). A more robust system is required to provide better student engagement concerning the traditional learning environment.

A lack of employers input covers a significant part of the limitation and is found as a major research gap in the previous studies. The proposed study aims to involve the employers who hire IS students covered as participants to provide their input towards the system.

### 2.6 Research Question:

These following research questions have been developed to address the requirements analysis.

- How could we develop a new systematic Learning approach for enhancing industry active participation in higher education (e.g. a new learning management system- LMS)?
- What functionality would add value to an effective LMS?
- How undergraduate students plan their career in their own learning stream?
- What are the benefits students get with industry participation in career development?

## 2.7 Chapter Summary

This chapter described problems and research concerns arising from the thorough literature review inside intelligent education and LMS. This chapter provides a base for the theoretical foundation of the solution—the present scenario and concerns related to the different stakeholders elaborated along with the detailed conceptual interpretation. Industry involvement is a big gap in the study where a good understanding of the employers' involvement is required in the LMS. A detailed case context of smart education provides a thorough background understanding of the related areas of concerns. Most prominently, issues that may exist for the stakeholders in employment and employability procedures have been described and constructed as theoretical impressions. The next chapter discusses the methodological framework, procedures and guidelines.

# CHAPTER 3 - METHODOLOGY

This chapter describes the methodology used in the proposed study. This aims to follow a relatively new research methodological trend called the Design Science (Simon, 1996) that distinguishes artificial sciences from the natural sciences. Designing information systems-based solution artefact can be considered artificial knowledge, this study anticipates the need to connect contemporary methodology with traditional qualitative and quantitative methodologies to provide effective and useful guidelines to conduct design research that further aims to offer appropriate support and pathways. Design science is defined as the scientific research and development of artefacts as they are created and used by people to solve practical problems of general interest (Johannesson & Perjons, 2014). The design science research methodology intends to design, develop and communicate as a solution artefact (Miah, Vu, Gammack, & McGrath, 2016).

This chapter includes the research paradigm, Design Science Research (DSR) Methodology and explains the various research processes involved in the DSR. It also talks about the chosen process relevant to the current research study. The process further links to the conceptual and theoretical elaborations on the following:

- Reasons for choosing this research methodology.
- A comparative analysis of various alternative research frameworks and models.
- Design cycle
- Process and steps involved in research using DSR.

## 3.1 Theoretical basis of Design Science Research

The methodological aspect of the research is defined as the study's theory that comprises the values and assumptions initiatives for the research. The criteria and standards used in reaching the conclusions and interpreting data (Basili, Selby, & Hutchens, 1986). Design science is viewed as a scientific study domain for developing solution artefacts by people and for people to solve practical problems (Johannesson & Perjons, 2014).

The research is described as the systematic study of sources and materials to determine the facts and bring out fresh findings (Naidoo, 2011). The reasoning is separated from

reality, whereas; research is pragmatic and turns the world around us. The research aims to self-correct and rigorously test the results and methods and open it up to scrutiny and criticism from users (Weale, 2001).

The proposed research highlights developing and evaluating a new problem-solving approach as an online learning tool that enables employers' participation in current LMS. Table 1 is a description of various research done based on Design Science Research. The philosophy of design science attempts to expand individual and organisational limits by developing novel and creative artefacts. (March & Smith, 1995).

| Author | Source articles | Key topic areas | Used methodology | Key purpose and target users |
|---|---|---|---|---|
| Miah, Vu et al. 2017 | A Big Data Analytics Method for Tourist Behaviour Analysis | Smart city Big data Internet of things Smart Environments Cloud Computing Distributed computing | Quantitative Methodology using Hevner's Design Science Research Methodology | This study aims to design and evaluate a 'big data analytics' method to support strategic decision-making in tourism destination management. |
| Miah, Hasan et al. 2017 | Healthcare support for underserved communities using a mobile social media platform | Underserved citizens Decision Support Healthcare information m-Health Design Science Social media | Hevner's Design Science Research, evolutionary prototyping method | Design and evaluation of an innovative mobile decision support system (MDSS) solution for rural citizens healthcare decision support and information dissemination. |
| Gregor and Hevner 2013 | Positioning and presenting design science research for maximum impact | Design science research (DSR), knowledge, design artefact, knowledge contribution framework, publication schema, information systems, computer science discipline, engineering discipline, DSR theory | Design Science Research | The essay aims to help researchers (1) appreciate the levels of artefact abstraction, (2) understand knowledge roles in DSR, (3) understand and position the knowledge contributions, and (4) structure a DSR article. |

| | | | | |
|---|---|---|---|---|
| Dresch, Lacerda et al. 2015 | A Distinctive Analysis of Case Study, Action Research and Design Science Research | Research methods; research approaches; case study; action research; design science research | Design Science Research | This paper analyses the disparity between traditional operational management (case study and action research) approaches to study in DSR. |
| Venable, J. 2011 | Incorporating Design Science Research and Critical Research Into an Introductory Business Research Methods Course | Business research, research methods, design science research, critical research, curriculum design, teaching | Design Science Research | This paper describes how DSR and CR (Critical Research) have been successfully incorporated into an introductory business research methods course, which introduces students, regardless of their specific business discipline, to business research. |
| Ozdenizci, Aydin et al. 2010 | Design Science Perspective on NFC Research: Review and Research Agenda | Near field communication, design science research, review | Design Science Research | To facilitate the analysis of the literature, a research framework has been proposed and organize the NFC literature into four major categories (theory and development, applications and services, infrastructure, ecosystem) |

Table 3.1: Design Science Research in different problem domain

## 3.2 Research paradigm

Making research operationalize and shaping it through a philosophical lens plays a vital role (Wahyuni, 2012). It is a broad picture that aims at knowledge development in the research design. It seeks to understand the project associated with data collection and learning, known as a knowledge claim. These claims are philosophical assumptions, epistemologies, paradigms and ontologies (Creswell, 2003).

### 3.2.1 Rationale of the Research

According to Simon (1996) there are two distinct science species, namely natural science and design science. Since the early 1990s (March & Smith, 1995; Walls,

Widmeyer, & El Sawy, 1992) the ground-breaking advocates of DSR in IS have generally adopted this dichotomy. Natural science is concerned only with how things are in socio-technical environments; on the other hand, design science looks at how things must achieve goals (Simon, 1996). In IS science, the architecture and behavioral paradigms are viewed as complementary as well as dichotomous.

According to (Creswell, 2003) four philosophical assumptions are proposed as research paradigms: constructivism, postpositivism, advocacy or participatory, and pragmatism. Table 3.2 shows all four segments.

| POSTPOSITIVISM | CONSTRUCTIVISM |
|---|---|
| Determination | Understanding |
| Reductionism | Multiple participant meanings |
| Empirical oberservation and measurement | Social and historical construction |
| Theory verification | Theory generation |
| **ADVOCACY/PARTICIPATORY** | **PRAGMATISM** |
| Political | Consequences of actions |
| Empowerment issue-oriented | Problem-centered |
| Collaborative | Pluralistic |
| Change-oriented | Real-world practice oriented |

Table 3.2: Four Philosophical Assumptions, Source: (Creswell, 2003, p. 6)

According to table 5 this proposed study follows fundamentals of constructivism based on qualitative research approaches. Qualitative research processing includes text, sound, photographs, pictures and video clips which operate on qualitative data. It is believed that reality is constructed by social actors and people (Wahyuni, 2012) in which people seek understanding of the world in which they are living. In this type of research, the reliability factor on the viewpoint provided by the participants is highest. The open-ended questions provide an opportunity to gather broader ideas and views of the participants (Creswell, 2003). The questions are based on real-world problems in which the researcher and participants have close involvement and cooperation to achieve experiential learning (Lukka, 2003).

It has been argued that IS should pay primary attention to organisations and society's adoption of technology rather than the fundamental advancement of ICT applications (Avison et.al, 2006). However, IS research's core subject has been evidenced as an ICT

artefact (Orlikowski & Iacono, 2001). The proposed research uses DSR as a research paradigm for this study. The design science paradigm seeks to extend the capabilities and possibilities of humans and organisational abilities by introducing new and innovative artefacts (Hevner, March, Park, & Ram, 2004). This research follows the path of a brief conceptual framework and guidelines for the understanding, execution and evaluation of the study. This paradigm includes understanding the problem and its relevant solution through conceptualising and designing the solution artefact.

According to (Kuechler & Vaishnavi, 2012) the key elements of DSR are:

- It can explore new and un-theorised areas.
- Instead of statistics DSR uses constructivism
- It can generate and test the theory

### 3.2.2 Intended outcome of DSR

Unlike other research paradigms, the DSR procedure involves designing and developing new artefacts in which evaluation plays a vital role (Venable, Pries-Heje, & Baskerville, 2016). Output can be design theory and design artefact (Hevner et al., 2004). According to Hevner et al. (2004) artefacts are generally defined as:

**Construct:** It provides a conceptualization language in which problems and solutions are communicated and defined (Schön, 1983).

**Model**: To represent real-world situation models use constructs, the design problem and its solution space (Simon, 1996). This form of artefact makes a series of suggestions or declarations that convey connections between constructs.

**Method**: Methods define processes. They provide direction on how to resolve the problem and how to find the solution space. This may include mathematical algorithms that describe the discovery process directly. This kind of artefact establishes a set of phases used to complete a task (Hevner et al., 2004).

**Instantiation**: According to instantiation, constructs, models, or methods can be employed in an operational structure. They establish the viability of an artefact's suitability for its function. It also explains the real world, how appropriate it is to the real world and how it affects the world. It is the realization of the artefact in the practical environment (March & Smith, 1995).

Peffers, Rothenberger, and Kuechler (2012) classified two groups for the artefacts mentioned above. They categorised them as conceptual and formal logic instructions mentioned in table 3.

| Conceptual Artefacts | Formal Logic Instructions |
|---|---|
| These artefacts incorporate models, constructs, methods and frameworks in which directives or recommendations are logical, theoretical and actionable. | These artefacts are categorised as classifications of algorithms. An algorithm is a method or solution that is mostly represented in individual instantiations known as hardware or software implementations. |

Table 3.3: Categorization of artefacts

The proposed study is based on formal logic instructions, so using instantiations as an artefact. Constructs, models, and methods are operationalized by instantiation. An instantiation, however, precedes the full articulation of its underlying structures, templates and techniques. Instantiation has great importance in computer science, defining it as an empirical discipline. March and Smith (1995) further explain that an experiment is any new program that is created. It poses a question to nature, and its behavior provides suggestions for the answer. This methodology integrates instantiation validity consideration to demonstrate the relationship between artefact characteristics and the proposed design principles (Lukyanenko et al., 2014).

In DSR, theorization is a vital outcome and Gregor and Jones (2007) reinforced with importance to descriptive theory as a kernel theory of the artefact, as it states details of the construction of the artefact. Via DSR operations, Rossi and Sein (2003) suggested the possibility of building better theories. On the one hand, DSR's methodological construction may be viewed as a theorising mechanism that theoretically offers beneficial reasons or justifications for various study fields. On the other hand, the artefact itself can be seen as the characterization of its components and their relationships, implying that the artefact can contribute to theorising as it works (Vaishnavi & Kuechler, 2015). The proposed research aims to use descriptive theory as its core theory. Descriptive theory and DSR go hand in hand in this proposed study.

### 3.2.3 Researcher involvement

Research started from the beginning of 2017 where the researcher was in his infantry stage of his research. In parallel to gathering the basic understanding of research patterns, an idea developed to cater to students' needs in the form of LMS. The researchers' part was to design the interface, functionality and features of the artefact framework in collaboration with the app developer. The research methodology requires the development of a mobile application. The involvement of app developer participants contributes substantially to the research to gather the research data. Upon completing the design artefact, the researcher's role requires focus on the dissemination and implementation of information about the artefact to the students, teachers, and employers. These stakeholders who are potential participants of the SCAS artefact.

Researchers study the stakeholders' active involvement in the first-year data collected by taking structured interviews of students, teachers, and employers. This started as a pilot study, which boosted the major research in which most of the data was collected. The formal research was initiated by an exercise linked to professional practice to gather the observations and lessons gained from the pilot implementation. The researcher was ideally placed to pursue a practical job as a design science research expert. Investigation into how undergraduate students is involved with the LMS to enhance employability enabled practices. As a researcher, the study's requirement involved practical involvement in improving the system (Richardson, 2000). The research specialist's definition is less important per se than that of the practitioner who can guide high-level comprehension, growth, and improvement (Lester,2004). The research professional is the one who is a vehicle for self-managed growth as a leading professional in an area of practice (Doncaster and Lester, 2002). This research requires multiple roles to play for the researchers during research phases as research professional. A researcher, an interviewer, an analyst, a trainer and a designer at various times. In the start, performing research was a task of a researcher followed by an artefact designer, leading to interviews to collect data as an interviewer and redirect the data analysis.

## 3.3 Research method

DSR is a research procedure to produce advanced creations that intend to resolve the real world's problems. This procedure further leads to contributing to the knowledge

in which it is applied (Lukka, 2003). According to (March & Smith, 1995) it is a way to explore innovations and solutions to solve complex problems. A DSR Framework is used to structure the research processes due to its explorative nature (Hevner et al., 2004). DSR strives to use systematic approaches to the assessment and concept artefact creation. The inspection accomplishes research Rigor by similar users of the existing models within the problem field and according to the created artefact requirements. This ensures that the artefact is rigorously coherent, defined and internally constant according to the need of industry requirements (Miah, Kerr, & von-Hellens, 2014).

The DSR model is constructed based on the Hevner et al. (2004) model, which has seven guidelines mentioned in Table 3.4. The designing, development and communication of the system process is an overarching description. The data includes information and the student learning records and employers job information. This covers three phases, such as identifying the problem, artefact development and its evaluation and result. The project contains a series of procedures that positions the fundamental problems of the current system. The model involves instantiations and leverages with construct, model and method that are valid in the development of artefact (Hevner et al., 2004). This categorises the seven guidelines into 3 discrete phases of the development, which are as follows:

1) Determining the problem & required artefact design

2) Development and Evaluation of artefact

3) Distribution and knowledge generation

According to Hevner et al. (2004), the framework used in the proposed system is categorized accordingly. Table 4 describes these guidelines,

| Project Phases | DSR Guidelines | Proposed Design |
|---|---|---|
| **Determining the problem & required artefact design** | Guideline1: Artefact Designing<br><br>Guideline 2: Problem Relevance | The suggested structure is intended to create a clear picture for policy and operations of processing.<br>The current system delivers the student learning system, there is a lack of knowledge about industry participation and details. |

| | | |
|---|---|---|
| | | In order to eliminate this problem, the new framework would provide a detailed understanding of the scenario. |
| **Development and Evaluation of artefact** | Guideline 3: Design Evaluation<br>Guideline 5: Research Rigor<br>Guideline 6: Design as a Search Process | Evaluation is an important aspect of the analysis process. Test data set would allow case scenarios and exercises and the data collected would have relevance and evaluation.<br>Rigor is the way analysis is carried out, but it also stresses the importance of rigorous intervention.<br>An artefact built using efficient modeling techniques for app creation.<br>Mathematical modelling is conceived to include the need for the solution in designing the proposed mechanism which may involve such constraints and which lack of employers involvement could be one of the main constraints in the implementation of the proposed process. |
| **Distribution and knowledge generation** | Guideline 4: Research Contributions<br>Guideline 7: Communication of Research | The artefact of nature is part of a research and is part of the culture including students, teachers and employers. However, as a qualitative approach, let a foundation for methodological and theoretical contribution.<br>The suggested framework is valuable for both students and businesses, in that data interpretation has a key role to play in creating an understandable model. |

Table 3.4: DSR Framework

It is essential to define DSR in the broader sense of synergistic interactions between technology and science (Mokyr, 2002; Arthur, 2009; Kelly, 2010; Ridley, 2015). By applying the scientific method, the research aims to extend the natural world's descriptive knowledge base and human behavior. We achieve a greater understanding of how the universe functions by doing so. The technology aims to build the prescriptive information base with deliberately crafted objects to physically and

psychologically strengthen human capacities. By developing design theories in the abstract types of models, methods, principles and rules, a researcher must be able to make direct contributions to the accelerated speed of technological advancements while at the same time offering a greater understanding and generalisation of these enhancements. A more intentional and designed analysis of how the technology performs and how it can be successfully appropriated in several related implementation settings can then inform these new emerging hypotheses. In this research, we are using this wider sense of DSR for conducting design and development. But the forms of the research vary according to the design artefact. Hevner et al. (2004) proposed seven guidelines that help develop a complete framework to generate a proper design artefact.

The research includes the design of instantiation as artefact. Substantially, it's a combination of technologies. For instance, cloud computing and Big Data Analytics runs at the back end of the mobile application. This API works to provide a valuable perspective for consumers through Big Data Analytics. This seeks to promote the interests of students and employers in terms of jobs and recruitments. Hevner et al. (2004) outline seven recommendations that offer overall steps to address needs by implementing and assessing evidence to deliver a design-based approach.

### 3.3.1 Determining the problem & required artefact design

By offering the opportunity to study innovative solutions to relevant real-world challenges, technology teaches research (Arthur, 2009; Kelly, 2010).

#### 3.3.1.1 Problem Relevance

The research problem and the researcher's prior experience often affect how the material analysis is done (Capelle et al., 2003). To achieve the best possible outcome in the interpretation of the sample results, the researcher must also make choices when applying this methodology (Dresch et al., 2014). Determining the Learning Management System (LMS) current situation gives an idea about the various technological advancements currently running on various sources. Most of the institutions use their learning systems in which they usually capture the students' learning requirements. For example, RMIT University, Australia using Blackboard, Blackboard Collaborate and ePortfolios as their learning and teaching tools (RMIT University, 2017). Monash University (Monash University, 2017) and Central

Queensland University (Central Queensland University, 2017) uses Moodle as their learning platforms. Victoria University (VU), VU Collaborate satisfies the information needs of both the students and teachers. This system does not need the industry employment demand and their forecasting for the benefits of students. Various research provide evidence of having different mobile applications for LMS whereas there is a lack of industry employment perspective.

The proposed study strives to play a vital role in developing and evolving the educational and employment framework. The data generated through the application aims to understand the students and employers' needs and requirements individually. The lack of employer involvement in the current LMS is a significant gap found in the previous related study. The proposed framework aims to design a clear image that further portrays the processing operations and strategies.

#### 3.3.1.2 Artefact Designing

According to the theory of artificial intelligence, information is split into declarative and procedural forms (Jaques et al. 2013). The DSR theory is seen as a prototype of artefact instantiation within an expert framework. Expert programs use observational information to forecast the effect of raw data provided and to diagnose faults. In many ways, such programs play a very valuable role in making proper decisions (Kamel Boulos, 2012), as teachers (Hwang et al. 2011) in the evaluation of mathematical expertise, especially in tutoring (Jaques et al., 2013). The DSR method was used in this analysis in designing the artefact. In the context of construct, model, process and instantiation, DSR requires several measures to generate artefacts (Hevner et al., 2004). In directing the study's artefact creation portion, Hevner's seven design science research guidelines will be used. The existing LMS provides students with all the relevant information required to perform learning procedures. However, there is a lack of details (relevant to the employer's perspective). To eradicate this problem, the proposed system aims to include a detailed understanding of the employer.

##### 3.3.1.2.1 Conceptual Model

This research aims to proceed with developing an effective solution framework, through which the process of teaching and learning helps the student develop their graduate capabilities as aligned with the employers' recruitment procedures. The

proposed framework helps establish a system through which all the key concerned actors can perform and participate collaboratively to ease employment.

This proposed artefact facilitates students, teachers and employers, respectively. According to Figure 1, the students insert their professional records in audio-video files and images of their report cards and degrees. However, in the form of coursework, exercises, and assignments, teachers participate in the collaborative platform. These exercises, assignments, and case studies in the form of coursework can help the students develop their career path according to the practical needs. The third aspect of this system consists of employers. This system aims to extract employers' input in new job postings and job descriptions. After posting jobs, they can find the categorised database to further hunt for their potential candidates.

The next step formulates a big data analysis based on the given information. This information generated through various query languages and coding aim to provide valuable insight for the end-users. This aims to strengthen the students, teachers and employers with related understanding extracted from the solution artefact. Figure 3.1 explains the conceptual model,

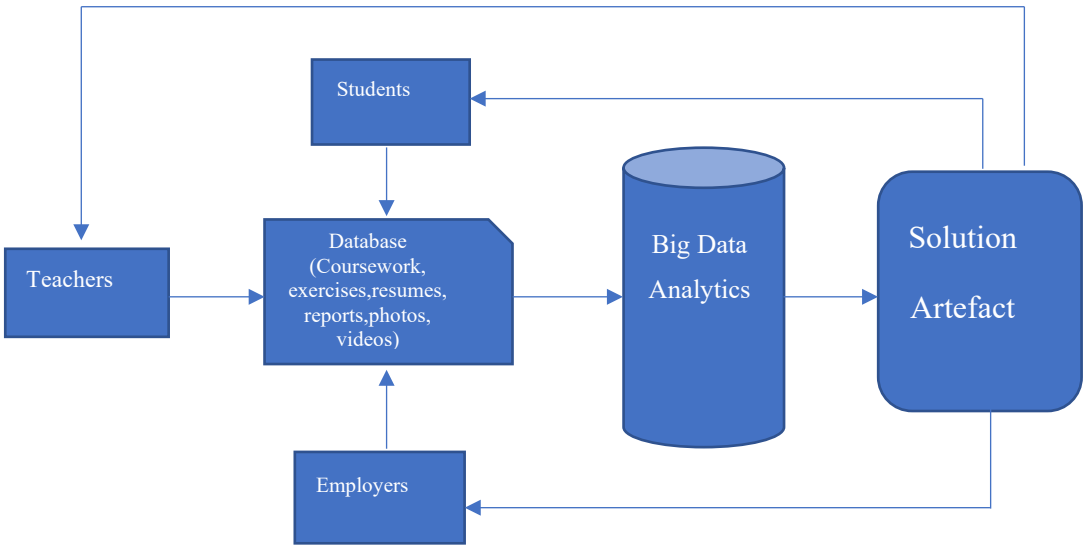



Figure 3.1: Conceptual Model

An evolutionary prototype is an effective modelling strategy for transforming system requirements into a responsive solution design to enable future system users to see advantages or conceptual effects. A newly developed artefact can be a solution for problem recognition, according to Hevner et al. (2004). The construction of a

prototype covers the understanding of the problem and the design of the artefact solution. The experience and comprehension of the institutional practitioners were extracted. Questions relating to the mechanisms and specifications of existing learning systems and practices have been asked from participants such as employers, professors and students. We have seen participants' interest in seeking a mobile solution that could connect student recruitment provisions with LMS both for students, teachers and employers. To that end, we collected data using a descriptive approach to explain the model's usefulness and suitability further.

#### 3.3.1.2.2 Application Model

The goal of this research is to come up with a novel strategy to meet the need for students' career opportunities. In this study Design Science Research Methodology is used to incorporate the viewpoints of important users such as students, instructors, and employers in order to inform the design of an integrated learning artefact. The Students Career Assistance System (SCAS) is an initial creative strategy that incorporates employment demand into the education system so that students, academics, and learning and teaching staff members can engage based on strategic career opportunities. The SCAS is a smart education provision that would be an important component of Learning Management Systems (LMS). Article-4 gives detailed information about the designing processes of SCAS. In which majority of the artefact development processes, components, navigations and user interfaces are described. A wide range of qualitative and quantitative data gathered interviews and surveys.

### 3.3.2 Development and Evaluation of artefact

DSR entails creating the product as a solution to or alleviation of practical problems, evaluating the artefact, and using the feedback to improve the design. This cycle can be summarised as creating design options and assessing them against requirements until a good design is found. In section 6 Article-4 the guidelines and development of artefact is defined predominantly along with the evaluation based on DSR model.

#### 3.3.2.1 Design Evaluation

This step relates to the critical evaluation of the artefact produced. Various methods may be used in this step to assist the researcher, such as simulation and cost analysis

(Takeda et al. 1990) In line with guideline, a descriptive evaluation method (Farnaz, Mohammad Hasan, & Ahmad, 2015) is employed for testing the prototype with students, teachers and industry users. It is crucial to evaluate the data in terms of the research process (Hevner et al., 2004). Testing dataset-enabled exercises and case scenarios give an outlook of the working process of the proposed artefact design. Implementation of new IT artefacts builds new technological infrastructure. Evaluation involves the incorporation of the artefact into the market environment's technical infrastructure. Hevner et al. (2004) recommended five evaluation techniques: observational, analytical, experimental, testing, and descriptive. In this research, we are using a descriptive analysis technique to demonstrate the usability of the developed artefact's. The researcher uses current claims in the literature or creates situations to illustrate the usefulness of the artefact in various ways to demonstrate its usefulness, further mentioned in chapter 4.

Any concept artefacts to serve human purposes and resolve human problems are essential to evaluate (March & Smith, 1995; Simon, 1996). To prove its importance by presenting facts or how the target users approach the requirements such as relevance, usefulness, consistency and effectiveness, the design artefact must be assessed (Gregor & Hevner, 2013). Hevner et al. (2004) suggested several techniques of assessment of artefacts, for example observational, analytical, experimental, descriptive and testing approaches. The descriptive method is referred to as a form of evaluation that can rigorously demonstrate an artefact's usefulness.

#### 3.3.2.1.1 Data collection and analysis

Requirement analysis generated from the previous published article further elaborated in the form of data collection and analysis. For the collection of data, structured interviews were organized. Structured interviews produce a significant volume of qualitative data. The data collected in the form of text needs to be evaluated.

#### 3.3.2.1.2 Pilot Study

As part of a research process, a pilot study was carried out to measure whether this project was indeed possible and how the findings would help me prepare the more extensive study measures. There were 2 teachers and 5 students for the pilot study of this research. Participants were chosen based on their level of comprehension and level

of action. For this purpose, prior suggestions were taken from the class teachers. The questions asked are related to the current learning system. Both pros and cons were mentioned about the current system. The proposed system projects to be a valuable requirement for the betterment of the learning system in terms of recruitment related decision-making processes. This pilot study further helps the researcher carry out deep research about the more concerning aspects of the proposed research framework. From this pilot study, some aspects, including safety and data security concerns were raised, which need to be eradicated while developing an artefact. This pilot study was based on the conceptual, verbal understanding of the artefact as a physical application was not developed at the time of the study. This was developed in the later stages, used in taking the interviews in the significant study.

#### 3.3.2.1.3 Questionnaire development

It is profoundly suggested to begin each interview with warm-up questions to establish a good rapport. Since the knowledge collected during this portion of the interview is typically relevant for contextualising the participants' responses. Doing small talks or establishing connections and getting to know the participants and their daily lives to learn how and why they do things. How and why are often related to human histories of life and lifestyles (Arsel, 2017). For this research, a questionnaire is developed for students, teachers and employers, respectively. The questionnaire is divided into 3 sections: knowledge base, practice, and a new approach. This knowledge base covers the introductory part of the interview in which various questions related to general knowledge about technology and current solutions are asked to students and teachers. Employers' questions are a bit different as it is assumed that employers might not know about the current learning systems. The second part gathers information related to the practical knowledge about the existing systems. The third part majorly focuses on the interviewees understanding of the proposed system. In this case, SCAS, a mobile application, is taken into consideration.

#### 3.3.2.1.4 Data resource

Data were obtained from in-depth interviews with relevant practitioners by using an ethical procedure of convergent interview methodology. In this scenario, a series of profound interviews are conducted with professors, students and employers. The data

collection from relevant practitioners was essential to grasp the challenge and develop a creative approach. There were 3 professors, 3 employers and 5 students included in the interviews. According to their degree of comprehension and level of activity in higher education, the participants were chosen. For the current system, both pros and cons were discussed. This criterion for developing the learning system in terms of employment decision-making is defined in design programs.

#### 3.3.2.1.5 Data Collection Method

The data is collected via in-depth interviews with relevant practitioners. In this case, teachers, students and employers are interviewed, it is necessary to consider the issue and the advancement of its possible solution for the participants closely associated with the initial research. In the qualitative researcher's toolbox, interviews are a significant instrument. In the case of collecting observational studies, they are essential, as interviews aim to understand people and their activities (Silverman, 2005). An interview is defined as a verbal interaction in which an interviewer seeks to extract information, views or opinions from another person, mostly face to face (Silverman, 2005). Due to the COVID 19 situation and the social distancing restrictions, all the interviews happened online using the online streaming service streamyard.com. This analysis used structured interviews to explore critically related information regarding current learning systems to the proposed one. All the interviews lasted about one hour and took place online. Every interview was audio recorded using audio recording software Audacity and then transcribed with the student's consent.

#### 3.3.2.1.6 Reflection on the findings

The findings suggest that the model presented shows its usefulness in employers' rigorous involvement in the learning environment. Based on security and privacy issues, it is necessary for students to have their rights to information and who will have access to it if the information of the students is shared with the outside industry. A security and access management process must be present in the mechanism to ensure confidentiality. This measure must be taken to keep it secure and safe to use for security purposes. The study's reflection considers the participants' interest and involvement through their responses in the interviews. Because of its architecture, accessibility, and most notably, the integration of employers into the scheme, the proposed system

stimulates students' continuous career development as it can lead them towards their desired job objectives.

#### 3.3.2.1.7 Major Research Evaluation

The significant research was performed using the data collected from the structured interviews with the participants. A cohort of IS students, teachers and employers participated in the organized structured interviews. All the participants were volunteers, which means the participants volunteer themselves to be interviewees for the research. Each group of participants presented the prospect of detailed and rich explanations of the proposed SCAS artefact. The interview offered the ability to engage with the participants and discuss their hopes and opinions of the usability and usefulness of SCAS. The purpose of the participant interviews was to include details and experiences of each interviewee's about SCAS. To hire the participants, an email was circulated around each group, including an attached document 'Information to the participants', which outlined every aspect of the interview to the interviewees. While taking the interview, the participants signed a written consent and returned to allow the interview process. All the participants of the interview reserve the right to withdraw at any time. Article-4 mentions about the information of the data collection and evaluation processes.

#### 3.3.2.1.8 Data Analysis

A researcher must be sure that the data analysis takes place both during data collection and after the data analysis (Erlandson et al. (1993). So, the data analysis started at the first stage when the participants' cohort was identified for the interview. On the other hand, data analysis is already initiated while reading and sorting out the related literature. From the details gathered through the pilot study and the primary research, data was evaluated to analyse it according to the system's requirement. Analysing data can be found in Article-4.

#### 3.3.2.1.9 Data analysing tool

For software-assisted evaluation, the first move is to pick the software. Currently, the list of choices available is vast, some of the softwares are taken into consideration, such as MaxQDA, NVivo or dedoose from that list. It can be overwhelming,

particularly as each choice comes with its relevant benefits and limitations. It is necessary to bear in mind that the software does not provide a theoretical or analytical context for the researcher during a comparison of software choices. It can just provide tools for promoting data processing and analysis (Levins et al., 2007). Our research needed a software package that would allow us to collaborate easily and perform the type of analysis further mentioned. Among the different options available, NVivo software best suited our needs, as at Victoria University full version of NVIVO is provided to the students who are using it for research purposes. NVivo was used, which is widely used as a quality data analysis, to analyse the data collected from relevant practitioners. According to Deakin, Wakefield and Gregorius (2012), NVivo is one type of CAQDAS (computer-assisted qualitative data analysis software) accessible to students for collection, arrangement, interpretation, or qualitative presentation data. The data, including interviews, documents, questionnaires, surveys, audio, video and images, were facilitated by NVivo (Deakin et al. 2012). To evaluate the perception of participants, information recorded from the in-depth interviews were coded.

NVIVO uses coding as the base for data evaluation. Coding is the act of assigning text or other content segments to nodes that are better understood as containers or storage areas (Bazeley, 2007) that contain references to a particular topic, place, individual or another field of interest (Bryman, 2008). A primary benefit of carrying out data evaluation through NVivo is that it can be easily modified, extended, reused and exchanged because everything is contained in one central file. The software can also be used in conjunction with several other applications, such as Endnote, Mendeley, RefWorks, or Zotero referencing tools. As to manage referencing, Endnote x9 was used in this research.

#### 3.3.2.2 Research Rigor

This is accomplished by ensuring that the development technique, the created solution prototype, and its functionality are all well-defined, coherent, and internally consistent with industry standards. It is how research aims to work but overemphasizes rigor lessens the relevance. With the proper involvement of rigor and the effective use of mobile app development tools, an artefact is going to be constructed. In this study the initial phase of the app is developed in Adobe XD and the final part is designed in

Android Studio. To check the rigor of the artefact functionalities, various tests performed using smart mobile devices and simulators.

#### 3.3.2.3 Design as a Search Process

The exploration for a suitable artefact requires the use of current means to accomplish the desired purpose when complying with regulations in a troubled environment. Mathematical modeling design involves the need for the solution in developing the proposed system. There is a possibility of involving some constraints; lack of employers' input strengthens one of the proposed system's significant changes.

### 3.3.3 Distribution and knowledge generation

#### 3.3.3.1 Research Contributions

To begin design science study, fundamental and initial expertise comes from the knowledge base. To fulfill the requisite research rigor and perform proper research, it is necessary to select current relevant knowledge effectively (Genemo, Miah, & McAndrew, 2016). However, in the absence of current information, creativity and ingenuity are alternative and practical sources or processes.

In this study, learners, educators and employers are incorporated into the LMS to perform sectional tasks in the design artefact. In this study, the qualitative approach is used as a foundational and methodological contribution. This research further aims to contribute to the theory of constructivism. Through the technological involvement in this study, a solution framework is designed as an artefact. This artefact further aims to enable the student to learn through their own experience about the industrial demands.

#### 3.3.3.2 Communication of Research

This proposed framework is designed to benefit both learners and employers who play an essential role in creating rational design through Big Data Analytics. User satisfaction through the solution artefact is vital during this stage of the study. This is achievable through system evaluation and demonstration to the target users and stakeholders within the case industry. The prototype can use general and specific examples within the industry exercise.

This platform works under the most modern supervision of technological classifications. A cloud-based mobile application consists of four major components. The framework of the SCAS, the cloud-based application, caters to the requests and demands from each facet and aims to provide access simultaneously.

### 3.4 Combined Requirement Perspective

The goal of the proposed study is to create a collaborative cloud-based system that allows students, teachers, and recruiters to engage for a variety of reasons such as teaching, learning, and employment. Data access to this online platform is likely to assist these stakeholders. This artefact approach makes use of a variety of teaching resources, including as case studies, exercises, and other discipline-specific information, all of which are closely tied to the changing needs of employers. This solution framework is built on the design science method's rules, and it will be evaluated based on the key stakeholder requirements.

A dedicated research on the topic is initiated, which performs an initial research on the topic. This dedicated research was further published as an IEEE conference paper in 2017 for the 4$^{th}$ Asia-Pacific World Congress on Computer Science and Engineering.

The following paper is attached here:

1) **H. Singh** and S. J. Miah, "A Cloud-Based Collective Platform: Combined Requirement Perspectives of Learners, Educators, and Employers," 2017 4th Asia-Pacific World Congress on Computer Science and Engineering (APWC on CSE), Mana Island, Fiji, 2017, pp. 154-158, doi: 10.1109/APWConCSE.2017.00034.

H. Singh and S. J. Miah, "A Cloud-Based Collective Platform: Combined Requirement Perspectives of Learners, Educators, and Employers," 2017 4th Asia-Pacific World Congress on Computer Science and Engineering (APWC on CSE), 2017, pp. 154-158, doi: 10.1109/APWConCSE.2017.00034.

### 3.5 Research phase

The prototype design requires an appropriate design methodology for turning device specifications into a practical model design so that future users can see advantages or implementation results. According to Hevner et al. (2004) a prototype is a newly designed prescription or an instantiation used for various purposes, including observation, problem identifying and its solution and implementation (Hevner et al., 2004). The construction of a prototype covers the understanding of the problem and the design of the artefact solution. Therefore, three stages for prototype construction have been taken into account, as mentioned in Figure 3.


Figure 3.2: Research Design phases

#### 3.5.1 User-Centric Understanding

In this analysis, end-user interaction is significant because the SCAS artefact is originated from design science research. The research has been involved in developing and implementing innovative IT-based frameworks since its inception (Keen & Gambino, 1983). To explore the relationship between users and artefacts (contextual knowledge) and assess their effectiveness (validation of the tool category), SCAS evaluated. The technological rule is based on implementing a causal model based on descriptions in which a practitioner intervenes to achieve operational validity by using his or her

expertise, deep understanding of the context and knowledge of the technical rule (Aken, 2004).

In the first step, an understanding was derived and knowledge was generated associated with the institutional participants. Teachers and students were asked questions about existing learning frameworks and practices, processes and standards. They were also asked about the aspects that could prove to be beneficial if embedded in the current systems. Findings administer a lack of understanding and interest about the current system in both students and teachers.

### 3.5.2 Practitioners Requirements

In the second step, taking account of students and teachers specifications and needs, a prototype design is created that can respond independently to the user's needs. In this step, both teachers and students register to help develop the database distinctly to disseminate the information to both parties distinctively. This part follows the requirements of practitioners, here we are targeting IS students and Teachers of VU. This stage addresses research question 1 stated in chapter 2.

- How can we develop a new systematic learning approach for enhancing industry active participation in higher education (e.g. a new learning management system- LMS)?

### 3.5.3 Design Validation & fulfillment

The third step is based on how to complete the requests that have been made. This phase ensures further assessment and confirmation and assesses the suitability and practicalities involved. The artefact may be strengthened during validation to accomplish the goals of the stakeholders better. We are using Technical Action Research (TAR) (Wieringa, 2014). The use of an experimental artefact to assist a client and to learn about its results in practice is TAR. The artefact is experimental, meaning it is still under development and has not yet been transferred to the context of the initial problem. A TAR analysis is a way to verify the object in the field. It is the last step in the process of scaling up from laboratory conditions to unprotected practice conditions. In TAR researcher plays three vital roles in this environment: (a) a technical researcher who designs an instantiation of an artefact, (b) an analytical researcher who examines the instantiation and meaning of the artefact, and (c) a helper who enhances the artefact to assist a client (Wieringa, 2014). The key concept of TAR's approach is to define these three positions and hold them differentiated conceptually.

This stage addresses further research questions stated in chapter 2.

- What functionality would add value to an effective LMS?
- How undergraduate students plan their career in their own learning stream?

- What are the benefits students get with industry participation in career development?

This phase is the third and the last phase of research design in which Designing the initial prototype, evaluation and final production of the artefact involves.

The building is constructing an artefact for a particular purpose (March and Smith, 1995). The initial instantiation of the SCAS prototype was designed with various user-friendly user interfaces (UI). The researcher and project supervisor originally evaluated the prototype. They insert the data into the application and perform analysis using various user interfaces for student, teacher and employer. The assessment or the evaluation of the prototype is assessing how well the artefact operates (March & Smith, 1995). To assess if the device functionality meets end-user criteria, students and teachers were invited to use the SCAS prototype. In interacting with the device, it was necessary to understand the user interface and recognise any problems related to the prototype's usability, effectiveness and efficiency.

A dedicated study based on the design of mobile based LMS for incorporating employment demands is conducted and published in the Education and Information Technologies Journal. This sectional study is based on DSR methodology, in which the design architecture and initial model of SCAS is discussed in detail.

This following article is attached here.

**Singh, H.,** Miah, S.J. Design of a mobile-based learning management system for incorporating employment demands: Case

context of an Australian University. *Educ Inf Technol* 24, 995–1014 (2019). https://doi.org/10.1007/s10639-018-9816-1

Singh, H., Miah, S.J. Design of a mobile-based learning management system for incorporating employment demands: Case context of an Australian University. Educ Inf Technol 24, 995–1014 (2019). https://doi.org/10.1007/s10639-018-9816-1

### 3.6 Ethical Consideration

Ethical approval (HRE17-184) is gained through Victoria University's Human Research Ethics Committee to commence in-depth interviews inside the campus. For this approval, all the documentation is related and compulsory for the application and is submitted accordingly. For this, informed consent and information to the participants is also submitted along with the application.

Before taking interviews, the signed informed consent was taken from the participants and the sheet named 'information to the participants' was handed over to them. And they confirmed that they read it and ask any question if they find any doubt in it. And it was conveyed to them that their identity would be kept anonymous or pseudonyms would be used wherever necessary. All the interviews were audio-recorded and transcribed for doing research. All the data is kept confidential.

### 3.7 Chapter summary

This chapter derives an overall idea about the research design and methodology. It summarizes the whole study, including the design science paradigm and research methodology. It worked on Hevner et al. (2004)'s guidelines. The proposed system develops a solution artefact targeting IS students and endeavours to involve the participation of employers. According to the data collected through in-depth interviews, the proposed system with employers' involvement sets a foundation for future learning and recruitment systems. This chapter discusses the future and present aspects of the study, some of the required sections are given in the following paragraphs.

# CHAPTER 4

# ARTEFACT DESIGN

The chapter describes a new mobile-based smart education support system that provides information assistance for educators and students to harness the employability demands. Previous studies in this domain have failed to identify the requirements of aligning the employability demands with teaching practices, although a few cases have focused on siloed employability functions of learning management systems. Using design research methodologies, the proposed artefact as a method called SCAS (Students Career Assistance System) which is a solution that adopts a more holistic approach to integrating employment demands into the education system so that students, academics, and learning & teaching staff members can offer appropriate contents and learning features. The SCAS itself is a smart education provision that would be an essential part of LMS. It is anticipated that enhancing the educational measures and learnings that the developed mobile based LMS shows promises in improving students' self-management in terms of both their learning and career development for a better future.

In this age of technological development when society is continuously evolving, education service craves innovations and advancements to benefit future aspirants. This advancement majorly affects the teaching and learning processes by promoting the educational use of technologies, such as mobile devices (Bai, 2019). Mobile learning technology has found its way into learning and education purposes (Hooshmandja, Mohammadi, Esteghamti, Aliabadi, & Nili, 2019). Koole, McQuilkin, and Ally (2010) believe that mobile technology improves and enhances the interaction capabilities and wireless accessibility of the students' information (Hooshmandja et al., 2019). This accessibility provides students an opportunity to learn and interact with the university learning systems (e.g. learning management platform) at their convenience (Kumar & Sharma, 2019).

As mobile technology is being developed and expanded, more interest grows to use mobile-based learning applications instead of having web-based or online learning solutions (Aayat Mahmoud & Randa, 2019). Today, the advancement of various forms of ICT provisions for higher education has turned into designing conventional

education methods into technique-based methods of education. One example of ICT innovations is the use of mobile applications in student educational programs to enhance the experience of developing their employability skills compared to industrial requirements. (Ameri, Khajouei, Ameri, & Jahani, 2020).

This study aims to bring up an idea to develop an innovative approach to cater to the need of students employment after graduation. An initial innovative approach called the Students Career Assistance System (SCAS) is a solution that integrates employment demands into the education system so that students, academics and learning & teaching staff members can design appropriate contents and learning features. We used a four-design phase-based approach developed from Hevner' et al. (2004) seven design research principles. The SCAS itself is an artefact as a smart education provision that would be an essential part of LMS. Research works in the field of smart education are the foremost concern. As mentioned earlier, to enhance the educational measures and learnings, we aim to design a mobile-based LMS in which students can manage their learning and career development for a better future. The framework addresses the concern pertaining to the lack of industrial exposure.

The traditional LMS by offering smart education provisions for the modern-day student's demands for their own career development. This platform works under the modern methodological guidance that enables the latest technical provisions into innovative artefact design (Miah and Genemo 2016; Miah et al. 2008; Miah and Gammack 2014). Following the design principles in conducting design research, we conceptualised the SCAS design into four major components. The following section presents the relevant research works as a background of the proposed design work reported in the paper.

This chapter includes the following paper:

1) **Singh, H.**, Miao, Y., Miah, SJ., Ahmed, K., (2021) An Innovative Smart-education Solution: Employing a Design Perspective for Addressing Employability Issues in an Australian University. *British Journal of Educational Technology* (currently under review)

researching a novel idea, it can be said that the probability of descriptive studies is strong. The content analysis is classified as thematic investigation. The investigator relies on analytical techniques to search for trends and patterns in the results. This assessment is described as a qualitative model that seeks to pay attention to students' comprehensive learning and present a definition of their learning status to change, enhance, and improve students' knowledge skills and attitudes towards employability standards. In recent years, many efforts have been made to reform and improve the educational system (Farnaz et al., 2015). Among these efforts, we should refer to efforts to improve the education system, including advances in students' evaluation of learning as teaching methods have profound impacts. In this analysis, student and teacher involvement offered more advantages than drawbacks for producing and evaluating the SCAS system. Benefits included recognising the need of a student and teacher in an LMS.

Moreover, further possibilities of improvements are gathered through the employer's participation. This provides an idea about the challenges, specifications, and system requirements, ensuring further enhancement requires building a prototype that meets the users' needs. The descriptive approach for assessing the artefact delivers proper usable data to make a compelling case for the artefacts' usefulness and construction information (Hevner et al., 2004).

**5.2 Descriptive content analysis:**

Qualitative descriptive studies concentrate on the definition of low inferences, which increases the probability of several researchers agreeing. The distinction between high and low inference approaches is not a rigorous one but refers to the amount of logical reasoning needed to move from hypothesis-based evidence to a conclusion. Researchers who use qualitative definition can choose to direct their studies using the lens of an associated interpretive theory or conceptual framework, but they are prepared during the research to adjust that framework as appropriate (Sandelowski, 2010). Sandelowski's qualitative overview (2000, 2010) is an excellent methodological choice for the designer, practitioner, or researcher because it offers rich, informative material from the subjects' viewpoint. The qualitative definition makes it possible for the investigator to choose from any theoretical models, sampling methods, and techniques for data collection.

### 5.2.1 Aim of the evaluation:

Evaluation is the systematic assessment of merit, value, and importance, such as a resource for information, a health care program, or technological services (Hevner & Chatterjee, 2010). In the evaluation of IS, several methods have been used, and there is substantial overlap between them. For the calculation of IS characteristics, each method includes various features (Miah, Debuse, & Kerr, 2012). There are multiple goals defined in the previous research. Such as Dix et al., (2004) states three main goals of the evaluation. The thing is to assess the complexity and usefulness of the system's software, ensuring that the system's functionality satisfies user expectations and performs the task effectively. The final evaluation is aimed at identifying specific design problems. Problems may refer to unexpected outcomes are obtained by the system against the intended context by the user. These problems can be connected to the accessibility and usability of the architecture.

### 5.2.2 Efficiency evaluation:

The evaluation can be done to define the efficacy of the artefact. Efficacy is the evaluation scale at which the artefact generates or achieves the desired result (Venable, Pries-Heje & Baskerville, 2012). Often, effectiveness is distinguished from efficacy (Prat et al., 2014). Klein and Methlie (1995) proposed testing, evaluating, and assessing the consistency of the method to validate data, expertise, and model. In the presented research data, the researcher and the project supervisor initially checked the system functionality. They were finally validated in the interview with the targeted people provided the SCAS mobile application. The accuracy of the measurement method is concerned with reliability (Straub et al., 2004). The same findings are generated in similar situation on different occasions by a consistent assessment process (Preece et al., 1994). For example, irrespective of the order in which the input data is given, a reliable system will produce the same results (Klein & Methlie, 1995). The SCAS was verified using different data from different individual end-users to achieve similar objectives.

### 5.2.3 Selection of prototype evaluation method

For the successful production of the SCAS prototype, DSR methodology is used. The DSR process model has four steps: awareness of the problem, proposal, development, and evaluation, including analytic sub-phase in the evaluation phase. (Vijay Vaishnavi, 2019). The assessment's primary emphasis is on the evaluation of outputs of design science (Venable, Pries-Heje & Baskerville, 2016). In the proposed study, the evaluation design aimed to determine the user experience and the role of artefact in addressing user-related needs and the system's ability to help a user successfully carry out their expected tasks (Miah, 2009). On the effectiveness and performance of the SCAS prototype, standardised interviews were performed sequentially with the students, teachers and employers. Information on their learning experience and satisfaction with the current learning system was collected. This data were then analysed and statistically merged to produce an observational description of the method's application in the study results. The design can be validated from the evaluation of the scheme by its efficient results. Section 6 of Article-4 provides detailed information about the prototype evaluation.

### 5.2.4 Analysis limitation

While, as discussed above, the content analysis method has many advantages but even when similar, it does possess few limitations. According to Bryman & Bell (2015) the design of the study must consider whether the frequency of occurrence has any linkage with the theory or not. Apart from self-examination and the data gathered through the application, it is vital to generate in-depth interviews examining the content according to the artefact development requirement.

## 5.3 Collection of data

Collecting data regarding the phenomena under review is a central task of every scientific research study. Data collection techniques are used for this purpose. The obtained data can be primarily empirical, referred to as quantitative data, such as the number of code lines or the number of search results. Text, sound, pictures and video often fall in qualitative data, which provides other categories of data. Five of the commonly used data collection techniques are interviews, questionnaires, observation analysis, focus groups and record analyses. Some of these data collection techniques

have been closely linked to such study methods, e.g. surveys usually use questionnaires, and observation is often used in ethnographic studies. Section 6 of Article-4 states detailed information about the collection of data and its evaluation. However, in theory, with a given research approach, any data collection method may be useful. The researcher's traditional association should not limit the selection of an acceptable data collection method (Johannesson & Perjons, 2014).

### 5.3.1 Mode of Data Collection

Interview chosen as an approach used to collect data for the research. An interview is a meeting between a researcher and a respondent in which the researcher sets the agenda by posing questions at the respondent. While questionnaires are ideal for collecting clear and straightforward data, interviews are more appropriate for the collection of complex and sensitive data. Thus, interviews are also used by respondents to suggest thoughts, perceptions, viewpoints, and experiences. Research interview is a bit specific and advanced as no biased intervention is allowed in this. For example, interviewees cannot be directed through a specific line of enquiry to acquire biased results. Interviews are particular and natural. Interviews allow for a dialogue between the interviewer and the respondent that is more or less structured. Interviews are classified into three types: structured interviews, semi-structured interviews and unstructured interviews.

#### 5.3.1.1 Structured Interviews

A predefined protocol follows a structured interview similar to a questionnaire as it draws on a predefined list of questions that can be answered by choosing from a set of answers. Structured interviews benefit from being relatively easy to conduct because the interviewer may not have to decode the answers. This is a very standardised form of an interview in which an interviewer has a specific order and amount of questions that can be asked according to sequence and recorded accordingly. This type of interview benefits the interviewer to be more prepared than semi and unstructured interviews, as the interviewer has a set of questions at hand for the interviewee.

#### 5.3.1.2 Semi-structured Interviews

A semi-structured interview is mainly focused on several questions, but it can be handled in a versatile way and is flexible, meaning that the respondents can express the answers. Also, it has the flexibility to ask randomly related questions. The addition and omission of the questions is possible, but a proper theme needs to be followed, keeping the interview's larger focus intact. When it comes to researching complex topics, a semi-structured format is more accessible, as respondents can convey their thoughts and emotions in a more unregulated manner. Semi-structured interviews were conducted to identify the subjective norms, attitude, and perceived behavior (Talebi, Tanbakouchian, & Amiri, 2020).

#### 5.3.1.3 Unstructured Interviews

The interviewer is as unobtrusive as possible in an unstructured interview and allows the respondent to chat openly about a subject without being confined to particular questions. Similar to semi-structured interviews, respondents can convey their emotions and thoughts freely. This form of the interview contains informal conversation related to any topic. You can conveniently guide the flow of the interview. One of the many advantages of interviews is that a researcher can get in-depth and complex data. Another advantage is that there is usually a high reaction rate in interviews. A downside is that interviews, particularly the transcription and interpretation processes following an interview, are time-consuming.

#### 5.3.1.4 Preferred mode of Interview

For the collection of data, structured interviews were taken into consideration. While questionnaires are ideal for the collection of simple and straightforward data, interviews are more appropriate for the collection of complex and sensitive data. To collect data, various interview sessions have been conducted. The interview guide consisted of a collection of open-ended questions intended to collect descriptive data on participants' experiences with the LMS. In contrast, these topics provided a structure for the discussion that allows participants to explain their experiences as broadly and deeply as possible. A structured interview includes a list of closed questions to be answered and moderately defined topics. To enrich the result generated from the

interview, purely technical questions and subject suggestions should be avoided. As long as it keeps the discussion specific to the topic during the interview, interview questions should show a certain degree of generality. Questions not on the list may also be addressed, if new variables or ideas appear in an interviewee's explanations. Such support provides the researcher with valuable resources to arrive at a more detailed understanding. A significant amount of dialogue between researchers and interviewees is facilitated by organized interviews to concentrate on relevant subjects. The experiences of the interviewees in qualitative interviews are central to the investigation. Their interpretations of fact are requested extensively. It offers insight into what the interviewee sees as significant and appropriate (Bryman, 2008). The interview framework is carried out in a flexible way that provides more space for interviewees to share their thoughts without restrictions. Usually, surveys are the structured method of gathering data for members of the population through face-to-face interviews, telephone or in the current scenario of online interviews given the Covid-19 pandemic. Therefore, taking into account the subject of this study, the population consisted of students and teachers from the IS sector of VU and the employers who hire IS students as interns or freshers. As per the DSR methodology stated in Chapter 3 - Methodology SCAS artefact is developed, mentioned and elaborated in Section 4 of Article-4. Section 6 details the processes carried out for gathering the qualitative and quantitative data from various sources and its evaluation.

### 5.4 Findings & Discussions

New technologies and solutions in the existing learning management systems are becoming a new paradigm in smart education. Intelligent technologies such as Big Data, Cloud Computing, the Internet of things (IoT), Learning Analytics are the harbingers of Smart Education's growth. In the proposed study, an emphasis is placed on the growing role of big data, which predominantly focuses on capturing and analysing and subsequently directing the development of a system that improves the learning and teaching processes with potential employers' potential in the proposed Learning Management Systems. This section elaborates the discussions and findings concerning the proposed artefact. This research follows DSR methodology, which establishes its paramount importance in the related field. The assessment details of the prototype SCAS are listed in this chapter. As per the description about the development

of artefact mentioned in section 3.3.1.2 Artefact Designing, the requirements are fulfilled to develop SCAS artefact. This study thoroughly analysed the instantiation artefact as part of the design analysis to validate how well the application accomplished the predetermined objectives of this proposed study involving students, employers and educators. A practitioner-oriented technique is used to perform the assessment. The primary purpose of this analysis is to achieve an interpretation of the suitability of the instantiation artefact. In line with the HMPR guidelines (Arnott & Pervan, 2012) in DSR, well-executed assessment methods were required, with recommended guidelines. The topics discussed in this chapter include principles of system assessment, priorities, processes, outcomes and results interpretation using various approaches.

### 5.4.1 Recruitment of the Participants

The participants' recruitment from the focused group is not statistically robust because participants are not randomly chosen, unlike survey research. In usability testing, a random sampling method is inefficient for selecting the target population. Further drawbacks of random sampling include logistical problems, such as participants being close enough to the session's location, with the availability to participate and voluntarily so, especially during business hours.

To check the usability and the ability of the artefact, students, teachers and employers were invited as participants for the interview. It was a challenge to hire student participants because of the pandemic situation. It was impossible to advertise on campus via notice boards or any other similar source which involved face-to-face interactions. As a result of this, the hiring procedures for participants got affected. Therefore, the strategy to approach students altered differently. An email was circulated to the students to participate in the interview. Also, a flyer was developed to advertise for hiring candidates for the interview. It was then posted on the wall of the relevant Facebook groups. Selected students were taken into consideration to participate in the structured interview sessions. To hire teachers, emails were sent to the staff for which the contacts were gathered from the VU website. A deep search was undertaken via social media and newspaper adverts to find the businesspeople who hire freshers and students from universities for internships and placements to hire employers.

### 5.4.2 Qualitative findings

A variety of ideas are generated from the study conducted in VU with the professional participants, including students from Victoria University, Deakin University, Swinburne University and La Trobe University. This includes the pros and cons of current and previous learning systems and the new system's requirements, which endeavors to provide an overall base for learners' employment opportunities. This study is conducted for the first time in VU as earlier research projected the need for collaborative learning and employment procedures. The study was conducted based on the learning systems. However, previous researchers presented the employer's perspective related to the recruitment procedures. But there are always some inadequacies in the existing LMS; a MORE collaborative framework was never conceived earlier.

For this study, the DSR is considered ideal because researchers design a useful artefact through this approach and prove that the design artefact can solve real-world business problems (Miah, 2009). In a DSR project, an artefact in the IS discipline is a concrete socio-technological example that can be encountered, discussed, evaluated, measured, modified, strengthened, expanded, etc. Objects occur in different ways in the IS discipline: e.g., templates such as Unified Modeling Language (UML) and class diagrams, semi-products or prototypes of software, wireframes, visual designs or mock-ups. They suggest the implied existence of the unfinished or premature design that motivates further iterative changes or requirements (Koppenhagen, Gaß, & Müller, 2012).

#### 5.4.2.1 The initial stage of the prototype evaluation process

In the research phase of design science, evaluation is a key aspect. The designed IT artefact is a socio-technical entity that resides within a setting that sets out the criteria for its assessment. Such an artefact assessment involves the description of suitable metrics and possibly collecting and analysing relevant data. (Hevner & Chatterjee, 2010). In this evaluation process, the researcher and project supervisor evaluated the artefact prototype before assessing the related target users. The SCAS system, a mobile application, the initial phase was generated in android studio as an android application. Initially, it was tested on a web simulator through which the application performs

exactly as it looks on the phone. In this test, various possibilities of improvement were found, such as the requirement of multiple dashboards for different users for an extensive user experience alongwith an ease for explanatory purposes.

#### 5.4.2.2 Secondary Stage with Interview Sessions

To capture the qualitative findings, in-depth interviews were conducted. Due to the effect of COVID-19 and social distancing measures, all the interviews were conducted online. Students and Teacher interviewees were selected from the VU precinct and employers who volunteered themselves for the research. In the formal interviews, 40 students participated in the structured interviews. Along with that, 10 teachers and 10 employers participated in the interviews. The questionnaires for the respective interviews are provided in Appendix A: Interview Questionnaire for Students, Appendix B: Interview Questionnaire for Teachers, Appendix C: Interview Questionnaire for Employers. A specialised recording system was placed to record all these sessions and a mobile recorder acted as a back-up plan. Online voice call sessions using Skype, Google Hangouts and StreamYard are used to carry out the online interviews. These online sessions were captured using a Skype-attached conversation recording program and Audacity with interviewees' informed consent. For interpreting the research, these audio scripts are completely transcribed.

A variety of ideas are generated from the study conducted with students' professional participation. This includes the pros and cons of current and previous learning systems and the new system's requirements, which endeavors to provide an overall base for learners' employment opportunities. This study is conducted for the first time in VU as earlier research outlined the need for collaborative learning and employment procedures. The study was conducted based on the current learning systems. However, previous researchers only presented the employer's perspective related to the recruitment procedures, and a dearth of a more comprehensive and collaborative platform led to the emergence of this proposed research paradigm.

For this study, the DSR is considered ideal because researchers design a useful artefact through this approach and proved that the design artefact can solve real business problems (Miah, 2009). In a DSR project, an artefact in the IS discipline is a concrete socio-technological example that can be encountered, discussed, evaluated, measured, modified, strengthened, expanded, etc. Objects occur in different ways in the IS

discipline: e.g., templates such as UML and class diagrams, semi-products or prototypes of software, wireframes, visual designs or mock-ups. They suggest the implied existence of the unfinished or premature design that motivates further iterative changes or requirements (Koppenhagen, Gaß, & Müller, 2012).

#### 5.4.2.3 Interview Outcomes

To capture the qualitative findings, in-depth interviews are conducted. Again, owing to the COVID-19 pandemic and social distancing norms, all the interviews were conducted online. Students and Lecturer were selected as interviewees and employers volunteered themselves for the research. A specialised recording system was placed to record all these sessions and a mobile recorder acted as a back-up plan. Online video call sessions using online softwares, such as Zoom and StreamYard, carried out to have the online interviews. Apart from that Skype and Google Meet software were also prepared for these sessions as a backup plan. These online sessions were captured using an inbuilt conversation recording program and Audacity with interviewees' informed consent. For research, these were then completely transcribed.

The thematic analysis of the gathered data is carried out by evaluating the inputs from the interviewees. These inputs in the form of data are then coded by allocating different themes to different participants' viewpoints. For conducting this task, an efficient qualitative research software NVIVO is used. Categorised findings can be found in section 6 of Article-4. From this, some of the valuable insights were grouped according to the participants category, which are described below.

##### 5.4.2.3.1 About the Current system

It is found that the current system lacks in providing industry integration effectively. Some of the functions are available for employment purposes, but there is a significant ignorance about students and lecturers.

It is also discovered that most of the students found themselves in a confusing stage after completing their studies. They don't know what they are going to do after graduation.

5.4.2.3.2 About the proposed framework

It is found that having industry integration in the LMS, a considerable advantage could be extracted for students. Based on assessments and descriptive performance analyses, the suggested method is concluded that SCAS has the possibility to deliver substantial benefits to students and employers through the development of bonding between students and employers.

5.4.2.3.3 Benefits to the Students

It was found to be a secure place for students to perform their learning-related tasks. It encourages students to plan their careers and enables them to be more dedicated to learning. It also increases opportunities for successful employability procedures. Students get an opportunity to illustrate their skills and knowledge with the teacher's approval, which increases the possibility of placement in the field of study. They get exposure to the practical environment with a possibility of getting hired while studying in the classroom.

5.4.2.3.4 Benefits to the Employers

It is found that more reliable communication would be possible. SCAS creates a bridge between students and employers so that they can ease the process of hiring. The expert opinion of the teachers would be an added advantage to the employers. The method of Jobs and Portfolios saves a considerable amount of time and money for the employers. There will be no need for the cumbersome recruitment process that involves a substantial amount of human resources.

5.4.2.3.5 Concerns about the proposed system

Although most participants agreed with the effectiveness of SCAS, some of the concerns found in the artefact have the room for improvement. The tool requires an extended level of security related to data transfer and sharing, though a consent aspect is part of the proposed study. Search and Job sections are instrumental, but it is found that mapping is needed between student profile and student search engine at the employers' site.

5.4.2.3.6 Application Cost Considerations

The overall SCAS prototype user experience was positive. It is found user friendly, useful for students in developing profiles, portfolio & applying for jobs. It is also worthwhile for businesses. Concerning the employers' charging money, it is believed that employers should pay some money to get access to the SCAS as no money brings no seriousness. It can also self-fund the proposed Learning Management System SCAS.

### 5.4.2.4 Online Survey conducted for the participants

An online survey was conducted using Qualtrics online survey portal. Interview candidates were further invited to perform an online survey by sending a survey link. Most of the participants favor the new technology in the form of SCAS. A total of 27 participants participated in the survey. Out of this survey, some factual findings were gathered.

This survey brings out that the proposed artefact is found to be useful and users found it agreeable to working procedures' usability and efficiency. Participants of the survey rated the collaborative artefact as 4.47. This is an impressive figure. It indicates the succeeding researchers delve deeper into this proposed study and other existing studies to evolve with ever-changing technologies, making the smart education really smarter.

## 5.4.3 Contribution of the study

The research is based on LMS artefact developed to ease the process of employability procedures of the users and stakeholders. The research is conducted to materialise the working processes of LMS based on the research questions mentioned in chapter 2, which are,

How could we develop a new systematic Learning approach for enhancing industry active participation in higher education (e.g. a new learning management system-LMS)?

The existing approach to the learning pattern is determined to be ineffective at facilitating industry integration. Some of the duties are available for job purposes, although there is a lot of unawareness found between students and lecturers. SCAS is a multitasking mobile application that introduces various practicality-enabled features

to enhance active participation of industry in higher education. The functional contribution of this analysis is a new mobile based SCAS artefact, which is majorly beneficial for students. This enables them to upgrade their decision-making skills to target and focus on their employability needs. The artefact is user-friendly, useful and reliable. The SCAS functional model illustrates the different interfaces, their applicability and how various tasks will be performed. This is a single application for students with the capacity to scale the inclusion of employers along with students and the teachers. Following salient features and functionalities provide the significant contributions that make SCAS a real-time solution to Smart education in the form of a more advanced and comprehensive LMS:

**User-friendly:** The SCAS is a user-friendly device adequately built for the requirement of students, employers and teachers. Its navigation system is developed in a way that gives an ease to non-IT users also. The artefact is straightforward to use and effectively uses the navigation system that adds a substance to the proposed research.

**Secure interface:** Security and data safety issues cater to the artefact as the security of the data generated and gathered through various sources is a matter of great concern. To manage that, a secure data encryption provided by google is integrated in the system. More security and privacy provisions can be created with the new technologies that will keep emerging with each passing day.

**Social Interaction:** SCAS is capable to provide user interaction through chat and discussion sections provided in the student's area. This feature makes this artefact indispensable as it is effective, efficient and engaging at the same time. This also helps the users to be self-directed, adaptive and technologically enriched.

**Mobile Platform:** The artefact is a mobile-based application constructed on an Android-based framework to channelise the inclusion of iOS and windows-based devices. This feature keeps the users abreast of the changes in the world. It will also help integrate social media, especially Linkedin and augment their openness and independence on collaborative learning.

**Intellectual Output:** The collaboration of teacher and student with a focussed course-based education leads a student to get the most intellectual output from SCAS. This application provides various auto-generated notifications from the industry to provide a particular field requirement and requirement. This gives a student an idea about

where to focus and target for their employability goals. This will be an edge for the students to acquire formal and informal learning as this is a unique, innovative and collaborative platform where students can communicate with prospective employers and experienced educators.

Let's consider the sub research questions, which are:

- What functionality would add value to an effective LMS?
- How undergraduate students plan their career in their own learning stream?
- What are the benefits students get with industry participation in career development?

It has been discovered that by integrating industry into the LMS, students can gain a significant edge. The proposed framework is based on evaluations and descriptive interpretation of findings, and SCAS has the potential to give significant benefits to students and companies in the development of student-employer bonding.

It is recognised as a safe environment for students to perform their educational tasks. It encourages students to plan their careers ahead of time and allows them to devote more time to their studies. It also improves the chances of employability procedures going well.

It has been discovered that more reliable communication is feasible. SCAS serves as a link between students and companies, facilitating the recruitment process. For employers, the Jobs and Portfolios strategy saves a significant amount of time and money.

The overall user experience with the SCAS prototype was positive. Participants found it simple to use and considered it to be beneficial for students in establishing their profiles, portfolios, and job applications. It was found to be beneficial to businesses. With regards employers being charged money, it is believed that firms should pay a fee to have access to the SCAS because doing so would have the employers develop a more serious attitude towards the process.

# CHAPTER 6

# CONCLUSION

This chapter summarises research conducted as a part of this study and details recommendations for further research. This chapter is divided into four sections; section 1 reiterates the study goals and the methodological research activity while section 2 summarises the key findings from the study, followed by section 3 which describes the contribution to the knowledge and learnings. The fourth section details the research strengths, limitations and offers suggestions for further research.

## 6.1 Study goal and research

The study's original goal was to figure out a way to constitute the industry's active participation to improve students' learning approach. Other points of consideration were, what functionality would add a practical value to learning in the current LMS? How can university students plan and own careers in a better way? To achieve this aim, a DSR based approach was followed to help students make rational choices for their job preparation and stay competitive. A development of artefact is required in the DSR approach for which an artefact is developed named SCAS. A comprehensive literature review was undertaken before designing the DSR prototype, emphasizing the discipline of pedagogical and learning processes. The overall research architecture was based on a DSR methodology. Seven guidelines developed by Hevner et al. (2004) were explicitly introduced, recommending the implementation of a technology-based approach to solve issues.

The user-friendly artefact SCAS created and tested primarily to fix and resolve emerging issues. In this study, the innovative SCAS was designed to aid students in making strategic decisions while developing their online portfolios and profiles. The designing and development processes of SCAS are mentioned in Section 4 of Article-4. The SCAS prototype introduced the students as self-motivators for planning their careers ahead of time.

Android Studio is used to develop SCAS artefact and the active use of Adobe Suite Adobe XD product. This program allows the development and deployment of a graphical interpretation of a mobile application to perform user interface functionality.

Furthermore, while programming in Android Studio, database access for 3 major users were developed for providing access through a login screen. The SCAS application is a small-scale LMS explicitly designed for the decision-making needs of students.

Several interviews were conducted to gather information and knowledge about the efficiency and feasibility of the application.

### 6.2 Summary of Key Findings

This section summarizes the evidence gathered from the data collection process in interviews and the results found from the online surveys conducted by using the online service Qualtrics. These evidence and references of data collection processes and evaluations can be found in section 5 of Article-4. Further recommendations provided for other inclusion in the solution artefacts recommended for improvements originated from findings.

The study of current LMS features found that most LMS's have substantial inadequacy concerns in terms of awareness about employability functionalities. It was found that the current systems lack in providing effective industry integration. Some of the functions are available for employment purposes, but a significant ignorance is found between students and lecturers. It is, however, discovered that after finishing their study, most students find themselves in a perplexing situation. They are unsure about their study's scope and relevance and the subsequent career options after they graduate.

It has been discovered that by integrating industry into the LMS, students will gain a significant edge while creating student-employer bonding in a professional context.

SCAS is recognized as a safe environment for students to complete their learning-related tasks. It inspires students to prepare for their careers ahead of time and devote more time to their studies. It also improves the chances of getting hired in their preferred fields, hence adding security and assurance about their career prospects during the study time.

SCAS makes a bridge between students and employers, making recruitment less complicated and challenging. The method of Jobs and Portfolios saves a considerable amount of time and money for the employers and adds a sense of security for the students.

While most participants accepted the functionality procedures of SCAS as a mandatory approach, some of the artefact concerns contain room for improvement. The tool necessitates a high degree of data transfer and sharing confidentiality. While it is observed that the Search and Job sections are helpful, a need for mapping between the student profile and the student search engine on the employer's website is also felt. Additionally, it is recommended that a student's profile be matched with their course description then further mapped with the employers search progressions. This can be a real-time hit for both students and employers.

The overall user experience of the SCAS prototype is positive and it is also found worthwhile for businesses. In terms of providing access to the employers, a suggestion is provided by a few of the participants interviewed during data collection that the employers should pay a fee to gain access to the SCAS. In this way, the LMS can self-fund a few of the aspects of its extended operations.

### 6.3 Contribution to Knowledge

This proposed research contributes to the constructive learning approach. Constructivism is a philosophy of knowledge that argues that humans produce knowledge through an interaction between their experiences and their concepts (Mogashoa, 2014). Traditional teaching method widely includes students' coverage of the meaning and rote memorization, it does not involve students in innovative thought or activities. The future educational developments have modified the current scenario and followed the constructivist approach that is moralistic and more focused on creative practices and information learning. Thus, students' academic outcomes in constructivist classrooms are higher than in conventional classrooms (V & Yadav, 2016). The central aspect of the theory of constructivism is to learn from experience. Students leverage themselves by getting involved in the hiring procedures and teachers can share the study material and exercises relevant to the employability requirements. The majority of students and teachers state that students get motivated via the working functionality of SCAS. Another aspect of the theory of constructivism is that teachers are facilitators. In SCAS, teachers facilitate students in focusing on their studies and in their career development. They become a bridge between student's employment careers. This study develops the curiosity of learning in students. They would be more eager to learn and gather the information that could help their career development.

Developing a portfolio to attract the employers towards their skills and understanding making them curious to learn and manage a robust academic profile.

The study develops an idea of industry participation in the LMS. Remarkable outcomes are gathered out of qualitative research in which interviews of Students, Lecturers and Employers constitute a significant part. Data collection and evaluation of each of the participants discussed and documented are in Section 5 of Article-4. Substantial insights were found after discussing the work procedures and data flow processes with the participants. The application is seen as a bridge between student and employer in which university lecturers can be great contributors and motivators in paving the career path for the students and providing heads on to the employers, undoubtedly it will ease the process of recruitment, saving a tremendous amount of time and also the financial and human resources. The study assembled a variety of functionalities helpful in employment procedures. It became clear that artefact still needs some comprehensive additions for the improvements related to data mapping and data security. As per the participants' suggestions, more detailed features and functionalities can apply to the next level. This idea of incorporating employers' part in LMS brings more possibilities of research in this field.

This research confirms and also presents an extension to the theoretical knowledge generated by Mann and Percy (2014) in which new requirements of employer engagement were articulated about work-related education for providing "opportunities for learners to improve their knowledge and understanding of, and skills for, the world of work, enterprise and entrepreneurship" (p.497). Although it is an evolving research area of exploring diverse Information and Communications Technology (ICT) based applications for improving learning and teaching pedagogy, LMS applications must be researched further and can increase overall system resilience for increasing industry uptake in learning-teaching aspects.

Proposed analytics based LMS artefact has been used to track and record how and in what context learning and teaching resources are used. Such information should comply with formal educational meta-data standards. Comparing to various meta-data standards for the learning resource management (e.g. Dublin Core, Metadata for Learning Opportunities, Learning Resource Metadata Initiative, IEEE's Learning Object Metadata) this research also adopts a meta-data standard by Horn et al. (2018)

both to merge the structures of big data used and to provide useful information to learners and employers.

### 6.4 Limitations and suggestions for the future research

The application of DSR has received little attention in other studies and is one of the research's major strengths to encourage learning with SCAS. This study bridges the gap between the employer and the prospective employee for the students in their career development needs and portfolio management. The study, however, had several issues to consider. Following that, new research approaches are considered to improve the advancement of theories and techniques and a potential research subject in a realistic context.

The future of the study depends on the participation of the users in the solution artefact. This artefact enables the students to develop a better future career. It helps them grow and fulfill employers' dream of recruiting the desirable workforce generated through the proposed system. Academically, this research sets a milestone for researchers who want to research related fields such as amalgamation of learning and recruitment processes, both in Design Science Research and Design Science Artefact, providing a great scope for succeeding researchers

This proposed learning platform also calls for another field of research related to security and privacy concerns. This system is based on a learning environment that helps students manage their professional engagement, achievement, and documentation. These all need to fulfil the ethical requirements to save the information from vandalism. Security concerns such as intrusion detection, entity authentication, data integrity, information confidentiality and privacy (Bahry et al. 2015) would be good subsets for further investigation in this study.

Compared with the current learning platforms, the proposed framework comprises modern interfaces to blend in and facilitate the development and maintenance of a continuous interaction and conversation between student, employer and the educators' experience and knowledge. There is a range of online products and helpful gadgets to tackle the problems at the end level which could be incorporated while pursuing the future aspects of the study. This proposed LMS would benefit educational institutions and employers/organisations alike while the students will get a competitive edge in the market while studying.

The study covers a major part of designing and evaluation of the SCAS artefact to facilitate the smart education environment. The study has the capacity for theoretical contributions to various behavioural aspects of educationists.

### 6.4.1 Scope of theoretical contribution

Theory is a statement of ideas and their interrelationships that shows how a phenomenon happens and why (Gioia & Pitre, 1990). A more generalised form for this is, what is a theoretical contribution? It is more constructive to ask for the researcher to answer. That is, what does a significant theoretical development in our understanding of a phenomenon entail (Corley & Gioia, 2011)? This states that there is room for contribution in the process of developing a new hypothesis about the work of theory building itself. Pursuing the same criteria for consideration we have already checked, an unaddressed potential for our discipline to take the next mature move forward by widening our definitions of what constitutes a theoretical contribution (Corley & Gioia, 2011).

This study's academic contributions develop descriptive ideas to answer the research questions and achieve the research goals. This kind of modern descriptive theory is referred to as justifying knowledge or kernel theories that lead to developing a new artefact (Gregor & Hevner, 2013). A new theory is not going to be generated from scratch by most organisational researchers. Instead, they usually focus on enhancing what happens till now. In that sense, what constitutes enough of a contribution to merit publication (Whetten, 1989). This study contributes towards the theory of planned behavior and the theory of constructivism in an efficacious way.

#### 6.4.2.1 Theory of Planned Behaviour

A core theory of planned behavior (TPB) is that a person's desire to act is an immediate determinant of their intended actions. TPB is defined in three constructs, such as, attitude (perceived effects of conducting a behavior), subjective norm (perceived social obligation to conduct the behavior) and perceived behavioral control (the degree to which an individual feels competent or unwilling to conduct a behavior) (Ajzen, 1991). Three fundamental beliefs further clarify these constructs. Attitude is described by behavioural beliefs (beliefs about the effects of a behavior); normative beliefs (beliefs about how people important to the participant wish him or her to behave) describe

subjective norms; and regulation beliefs (beliefs about influences that encourage or hinder a behaviour) describe presumed behavioral control (Ajzen, 2019). The Theory of Planned Behaviour (TPB) (Ajzen, 2006) has been determined by De Leeuw et al. (2018) to identify beliefs of the student's underlying behavior. The TPB was a popular and legitimate social cognitive framework representing human behavior changes, e.g., using new technology procedures. The proposed design study can be conceivable in the TPB framework by evaluating the personal beliefs and impacts using the proposed solution artefact.

The proposed study is based on three elements, behavioral beliefs that produce results and evaluation of personal beliefs and normative beliefs that lead to motivation in the direction of expectations, and control beliefs which relate beliefs about the presence of the facts, and the precise TPB (Ajzen, 2006).

This study is in the process of introducing an innovative analytical approach that combines the fields of e-learning and teaching and learning pedagogy to create a clever application by influencing behavior and standards through target users. By applying TPB principles, this study develops new mobility-based approaches to education that would be a unique contribution to both e-learning pedagogy and IS solutions.

Our primary aim was to use the TPB to test the contribution of attitude, subjective norms and perceived behavioral control in predicting students' intention to use the SCAS LMS to perform all their learning activities and interaction with the industry-enabled services in the proposed LMS. A secondary aim was to describe fundamental attitudes that characterize the general mindset, social standard and presumed behavioral influence of students about the SCAS LMS to improve their knowledge about industry demands. This thesis produces new knowledge that represents the well-structured relationship between previous and latest technological applications for linking the higher educational systems with industries that would be simplifying the contemporary learning and recruitment processes. This lays a foundation for further related studies in the proposed field of study.

#### 6.4.2.2 Theory of Constructivism

Constructivism is an approach to teach and learn focused on the idea that mental construction arises from cognition, also defined as learning. In other words, students can learn by integrating new knowledge with what they already know (Bada &

Olusegen, 2015). Constructivists claim that understanding is influenced by the context in which an idea is taught as also by the values, experience, and attitudes of students. Constructivism is a philosophy of learning found in psychology that describes how individuals can learn and gain information. Consequently, it has direct relevance to education. The theory suggests that humans experience creates information and meaning (Bada & Olusegen, 2015). Educational styles, including behaviorism, cognitivism, humanism, and constructivism, have often focused on instructional design. Most of the focus has been transferred to constructivism in the last two decades since it facilitates constructive learning through knowledge building (Koohang, Riley, Smith, & Schreurs, 2009). The learning theory of constructivism is characterised as the active creation of new knowledge based on prior experience (Koohang et al., 2009).

Constructivism is essentially a philosophy of how people learn, based on observation and empirical research. It notes that by experiencing things and reflecting on those experiences, people develop their understanding and awareness of the world (Bereiter, 1994). This study focuses on the learning and teaching pattern of educationists. This study explains the constructivism hypothesis that people will try to make sense of all the information they experience and that each person will construct their meaning from the information. Its consequences are immense on how teachers educate and learn to educate. If our efforts are to succeed in reforming education for all students, we have to concentrate on students. Till now, the most significant contribution of constructivism might well be an emphasis on student-centered learning. For teaching and learning, constructivism's concepts are increasingly influential in the organisation of classrooms and curricula in schools. Our contemporary views of learning and knowledge appeal to the standards but in contrast with traditional practices. SCAS is a mobile-based LMS in which students can perform their tasks according to their experiences and what they are doing for a long time. Still, they are approaching an advanced system to get integrated into the existing one to leverage their needs towards the learning attitude and their employability needs. This could be a great reference for future research in the field of constructivist learning patterns.

#### 6.4.2.3 Contribution to IS design research

The study's key objective is to create an innovative artefact following the DSR model that could address the requirements of an LMS in accordance with students'

employability skills. The current LMS in terms of students' educational participation works fine from the past few decades, but it's not up to the mark as per the industry's requirement. As the current system doesn't have any dedicated section to cater to students' employability demands. The study then suggested an approach using artefact development to create SCAS applications for the universities. The development and assessment of IT artefacts are key to the framework to design and innovate methods, processes and systems (Botts, Schooley, & Horan, 2008). In this research paradigm, design science research offers a tremendous opportunity to raise IS research's importance and scope. There is a clear desire to develop new fields of expertise to enhance practice (March & Smith, 1995). DSR is an inventive or innovative problem-solving operation in which emerging innovations are the main products (Venable, 2006).

The system Hevner et al. (2004) is best adapted to the proposed project context since the six criteria are sufficiently flexible for the concept analysis. It is a fit for the planning, implementing, and communicating design stages from the problem recognition stage. We establish three stages of design tasks, for example, problem identification, artefact development and assessment & results. The seven design guidelines that supported the proposed solution model design became the basis of our design methodology. Besides, the directed seven principles are more helpful in applying the design approach during the three distinct phases of the project: 1) problem-solving & design of the artefact; 2) artefact development and evaluation; and 3) distribution and generation of knowledge.

This research adds to the efforts of DSR defining a creative artefact development approach. This development's technical criteria were examined in this analysis through the literature review in Chapter Two. Through which, a prototype issue domain is evaluated for the suitability of the latest IT artefact. Subsequently, using a generic architecture approach, the solution concept was illustrated. As per the DSR methodology requirement, this further needs to be evaluated by the specified guidelines categorised by Hevner et al. (2004). Findings gathered through the evaluation should provide the utilities and usefulness of the developed artefact in terms of the betterment of the students learning environment as per their employability needs. Thus, this study adds to the body of design research knowledge in IS by following design research criteria. This research as a documented solution for developing SCAS artefact using

DSR methodology benefits researchers in their future endeavors in the field of IS design research.

## REFERENCES


Aayat Mahmoud, S. & Randa, O. (2019). Quiz Tool Within Moodle and Blackboard Mobile Applications. International Journal of Interactive Mobile Technologies, 32.

Abas, M. C., & Imam, O. A. (2016). Graduates' Competence on Employability Skills and Job Performance. International Journal of Evaluation and Research in Education, 5(2), 119-125.

Abdel-Basset, M., Mohamed, M., Manogaran, G. & Rushdy, E. (2018). Internet of things in smart education environment: Supportive framework in the decision-making process. Concurrency Computation.

Adeyemi, O. J., Afolayan, D. G., Ariyo, M., Adetiba, E., Popoola, S. I., & Atayero, A. A. (2018). Exploration of daily internet data traffic generated in a smart university campus. Data in Brief, 20, 30–52.

Ahmed Ahmadi (2019). Work-Integrated Learning and Employability. A Different Perspective on Work-Integrated Learning. 215-223. 10.21125/edulearn.2019.0095.

Ajzen, I. (1991). The Theory of Planned Behavior. Organizational Behavior and Human Decision Processes. 50. 179-211. 10.1016/0749-5978(91)90020-T.

Ajzen, I. (2005). Attitudes, personality, and behavior (2nd. ed.). Milton-Keynes, England: Open University Press/McGraw-Hill International.

Ajzen, I. (2006). Behavioral Interventions Based on the Theory of Planned Behavior.

Aken, J. E. v. (2004). Management research based on the paradigm of the design sciences: The quest for field-tested and grounded technological rules. Journal of Management Studies, 41(2), 219–246.

Al-Ani WT. (2013) Blended Learning Approach Using Moodle and Student's Achievement at Sultan Qaboos University in Oman. Journal of Education and Learning. p. 96-110.

Al-Debei, M. M., & Avison, D. (2010). Developing a unified framework of the business model concept. European Journal of Information Systems, 19, 359–376.

Allen, E. & Seaman, J. (2008). Making the grade: Online education in the United States [PDF File]. The Sloan Consortium. Retrieved from https://files.eric.ed.gov/fulltext/ED529698.pdf

Al-Sadi, J. & Abu-Shawar, B. (2009). M-Learning: The Usage of WAP Technology in E-Learning. International Journal of Interactive Mobile Technologies, 3, 10-16.

Al-Sadi, J., & Abu-Shawar, B. (2009). M-learning: The usage of WAP technology in E-learning. International Journal of Interactive Mobile Technologies, 3, 10–16.

Ameri, A., Khajouei, R., Ameri, A. & Jahani, Y. (2020). Acceptance of a mobile-based educational application (LabSafety) by pharmacy students: An application of the UTAUT2 model. Education and Information Technologies: The Official Journal of the IFIP Technical Committee on Education, 25, 419.

American University, W. D. (2017). Ready Hire. http://www.american.edu/hr/careers/staff/ready-hire.cfm

Amichai-Hamburger, Y., & Etgar, S. (2016). Intimacy and smartphone multitasking–A new oxymoron? Psychological Reports, 119, 826–838.

Anderson, T., & Dron, J. (2011). Three Generations of Distance Education Pedagogy. International Review of Research in Open and Distance Learning, 12(3), 80-97.

Ang, L., Seng, K. P., Ijemaru, G. K., & Zungeru, A. M. (2019). Deployment of IoV for smart cities: Applications, architecture, and challenges. IEEE Access, 7, 6473–6492.

Anshari, M., Alas, Y., Hj Mohd Yunus, N., Pg Hj Sabtu, N. I. & Sheikh Abdul Hamid, M. H. (2016). Online learning: Trends, issues, and challenges in the big data era. Journal of E-Learning and Knowledge Society, 12, 121–134.

Anshari, M., Almunawar, M. N., Shahrill, M., Wicaksono, D. K., & Huda, M. (2017). Smartphones usage in the classrooms: Learning aid or interference? Education and Information Technologies, 22, 3063–3079.

Anttila, J., & Jussila, K. (2018). Universities and smart cities: The challenges to high quality. Total Quality Management & Business Excellence, 29, 1058–1073.

Arnott, D., & Pervan, G. (2012). Design Science in Decision Support Systems Research: An assessment using the Hevner, March, Park, and Ram guidelines. *Journal of the Association for Information Systems*, 13(11), 923-949.

Arsel, Z. (2017). Asking Questions with Reflexive Focus: A Tutorial on Designing and Conducting Interviews. Journal of Consumer Research, 44(4), 939-948. doi:10.1093/jcr/ucx096

Arthur, W. (2009). The nature of technology: What it is and how it Evolves. New York, NY: Free Press

Avison, D. E., & Elliot, S. (2006). Scoping the discipline of Information Systems. In J. L. King & K. Lyytinen (Eds.), Information Systems: The State of the Field (pp. 3-18). Chichester, England: John Wiley & Sons.

Azjen I. (2019) Theory of planned behavior with background factors. https://people.umass.edu/aizen/tpb.background.html.

Bada, & Olusegen, S. (2015). Constructivism Learning Theory: A Paradigm for Teaching and Learning.

Bahry, F. D. S., Anwar, N., Amran, N., & Rias, R. P. M. (2015). Conceptualizing security measures on Mobile learning for Malaysian higher education institutions. Procedia - Social and Behavioral Sciences, 176, 1083–1088.

Bai, H. (2019). Preparing Teacher Education Students to Integrate Mobile Learning into Elementary Education. TechTrends: Linking Research and Practice to Improve Learning A publication of the Association for Educational Communications & Technology, 63, 723.

Bajaj, R., & Sharma, V. (2018). Smart education with artificial intelligence based determination of learning styles. Procedia Computer Science, 132, 834–842.

Baker, R. S., & Inventado, P. S. (2016). Educational data mining and learning analytics: Potentials and possibilities for online education. In G. Veletsianos (Ed.), Emergence and Innovation in Digital Learning (pp. 83-98). Edmonton, CA: AU Press, Athabasca University.

Basili, V. R., Selby, R. W. & Hutchens, D. H. (1986). Experimentation in Software Engineering. IEEE Transactions on Software Engineering, 12, 733-743.

Baskerville, Richard & Kaul, Mala & Storey, Veda. (2015). Genres of Inquiry in Design-Science Research: Justification and Evaluation of Knowledge Production. MIS Quarterly. forthcoming. 10.25300/MISQ/2015/39.3.02.

Bazeley, Pat (2007). Qualitative data analysis with NVivo (2nd ed.). Thousand Oaks, CA: Sage.

Bereiter, C. (1994). Constructivism, socioculturalism and Popper's World 3. Educational Researcher, 23 (7), 21-23

Beynon-Davies, P. (2013). Business Information Systems. London, UK: Palgrave Macmillan Press. (2nd ed.)

Bhakare, S. (2014). Technology enabled teaching -learning initiatives: A learner centric innovative approach to commerce curriculum. Journal of Commerce & Management Thought, 5, 295–305.

Biasutti, M. (2015). Assessing a Collaborative Online Environment for Music Composition. Journal of Educational Technology & Society, 18(3), 49-63.

Bichelmeyer, B. A., & Hsu, Y.-c. (1999). Individually-Guided Education and Problem-Based Learning: A comparison of Pedagogical Approaches From Different Epistemological Views. Paper presented at the Selected Research and Development Papers Presented at the National Convention of the Association for Educational Communications and Technology (AECT), Houston, TX.

Biggs, D., Hovey, N., Tyson, P. J., & MacDonald, S. (2010). Employer and employment agency attitudes towards employing individuals with mental health needs. J Ment Health, 19(6), 505-516. doi:10.3109/09638237.2010.507683

Bimrose, J., Brown, A. & Behle, H. (2014). Understanding the link between employers and schools and the role of the National Careers Service. BIS Research Paper Number 206.

Boghossian, P. (2006). Behaviorism, Construnctivism, and Socratic Pedagogy. Educational Philosophy and Theory, 38(6), 713-722.

Bond, M., Zawacki-Richter, O., & Nichols, M. (2019). Revisiting five decades of educational technology research: A content and authorship analysis of the British Journal of Educational Technology. British Journal of Educational Technology, 50(1), 12-63.

Bostock, J. (2019). Engaging Students, Staff, and Employers in Developing Student Employability. In A. Diver (Ed.), Employability via Higher Education: Sustainability as Scholarship. Cham: Springer International Publishing pp. 201-214.

Botes, R., Goede, R., & Smit, I. (2014). Demonstrating an Interpretive DataCollection and Analysis Process for a DSR Project. International Academic Conference on Engineering, Internet and Technology:Proceedings of IAC-EIaT 2014 (pp. 98-106).

Botts, N., Schooley, B., & Horan, T. (2008). Learning Object Development and Repository Design for Digital Government Instruction.

Brusilovsky, P (2003). A Distributed Architecture for Adaptive and Intelligent L.M.S.

Bryman, A. (2008). Social Research Methods (3rd ed.). Newyork: Oxford University Press.

Burgess, S., Sellitto, C., & Karanasios, S. (2009). Effective web presence solutions for small businesses: Strategies for successful implementation. Hershey, New York: Information Science Reference.

Chang, C. Chang, C. K. and Shih, J.-L., Motivational strategies in a mobile inquiry-based language learning setting, System, vol. 59, pp. 100-115, 2016.

Cantabella, M., Martínez-España, R., Ayuso, B., Yáñez, J. A., & Muñoz, A. (2019). Analysis of student behavior in learning management systems through a big data framework. Future Generation Computer Systems, 90, 262–272.

Capelle, M. C. A., Melo, M. C. O. L., & Gonçalves, C. A. (2003). Content analysis and discourse analysis in social sciences. UFLA, 5(1).

Carl, A., & Strydom, S. (2017). e-Portfolio as reflection tool during teaching practice: The interplay between contextual and dispositional variables. South African Journal of Education, 37(1). doi:10.15700/saje.v37n1a1250

Casany, M. J., Alier, M., Mayol, E., Piguillem, J., Galanis, N., García-Peñalvo, F. J., & Conde, M. Á. (2012). Moodbile: A Framework to Integrate m-Learning Applications with the LMS. Journal of Research & Practice in Information Technology, 44(2), 129-149.

Central Queensland University, A. (2017). Moodle Courses. http://moodle-archive.cqu.edu.au/login/index.php

Chacón, R., Posada, H., Toledo, Á., & Gouveia, M. (2018). Development of IoT Applications in civil engineering classrooms using mobile devices. Computer Applications in Engineering Education, 26, 1769–1781.

Chang, C. K., Reisman, S., & Tovar, E. (2017). Advances in learning technologies. Computer, 14.

Chang, M.-M. (2010). Effects of self-monitoring on web-based language learner's performance and motivation. CALICO Journal, 27(2), 298-310.

Chen, D. Q., Preston, D. S., & Swink, M. (2015). How the Use of Big Data Analytics Affects Value Creation in Supply Chain Management.

Chi, Y., Qin, Y., Xu, H. & Song, R. (2018). Knowledge graph in smart education: A case study of entrepreneurship scientific publication management. Sustainability (Switzerland), 10.

Chisanu, J., Sumalee, C., Issara, K., & Charuni, S. (2012). Design and develop of constructivist learning environment on learning management system. Procedia - Social and Behavioral Sciences, 46, 3426– 3430.

Clark, R. C., & Mayer, R. E. (2016). E-learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia learning (4th ed.). Hoboken, NJ: John Wiley & Sons.

Coates, H., James, R., & Baldwin, G. (2005). A critical examination of the effects of learning management systems on university teaching and learning. Tertiary Education and Management, 11, 19–36. https://doi.org/10.1007/s11233-004-3567-9

Collet, C., Hine, D., & Plessis, K. (2015). Employability skills: Perspectives from a knowledgeintensive industry. Education + Training, 57(5), 532–559.

Connolly T, Begg C, Holowczak R (2013). Business Database Systems: Pearson Education Limited.

Connolly T, Begg C. (2009). Database Systems: A Practical Approach to Design, Implementation, and Management, Global Edition (5e) USA: Pearson Higher Ed.

Cooper, P. A. (1993). Paradigm shifts in designed instruction: From behaviorism to cognitivism to constructivism. Educational Technology, 33(5), 12-19.

Corley, K., & Gioia, D. (2011). Building theory about theory building: What constitutes a theoretical contribution? Academy of Management Review, 36(1), 12-32. doi:10.5465/amr.2009.0486

Creswell, J. W. C., John W. (2003). Research design: qualitative, quantitative, and mixed methods approaches, Sage Publications, Thousand Oaks, Calif.

Cristina, M. (2017). A point of view on new education for smart citizenship. Future Internet, 9(1), 4.

Cuena, J. and Molina, M. (2000). The role of knowledge modelling techniques in software development: a general approach based on a knowledge management tool, International Journal of Human-Computer Studies, 52: 385-421.

Dalsgaard, C. (2006). Social software: E-learning beyond learning management systems. European Journal of Open, Distance and elearning, 9(2).

Daniel Q. Chen, David S. Preston & Morgan Swink (2015) How the Use of Big Data Analytics Affects Value Creation in Supply Chain Management, Journal of Management Information Systems, 32:4, 4-39, DOI: 10.1080/07421222.2015.1138364

De Vass, T., Shee, H., & Miah, S. J. (2018). The effect of "internet of things" on supply chain integration and performance: An organisational capability perspective, Australasian Journal of Information Systems, 22. https://doi.org/10.3127/ajis.v22i0.1734.

Deakin, H., Wakefield, K. & Gregorius, S. (2012). An Exploration of Peer-to-Peer Teaching and Learning at Postgraduate Level: The Experience of Two Student-Led NVivo Workshops. Journal of Geography in Higher Education, 36, 603-612.

Denscombe M (2014) The good research guide: for small scale research projects, 5th revised edn. Open University Press

Dix, A., Finlay, J., Abowd, G., & Beale, R. (2004) Human Computer Interaction, England: Pearson Education Limited (3rd ed.)

Doncaster, K., & Lester, S. (2002). Capability and its development: experiences from a work-based doctorate. Studies in Higher Education, 27(1), 91-101.

Dresch, A., Lacerda, D.P. & Antunes, J.A.V. (2014). Design Science Research a method for science and technology advancement.

Dubey, R., Roubaud, D., Foropon, C., Gunasekaran, A., Childe, S. J., Luo, Z., & Wamba, S. F. (2018). Examining the role of big data and predictive analytics on collaborative performance in context to sustainable consumption and production behaviour. Journal of Cleaner Production, 196, 1508–1521.

Duffy, T. M., & Jonassen, D. H. (1992). Constructivism: New Implications for Instructional Technology. In T. M. Duffy & D. H. Jonassen (Eds.), Constructivism and the Technology of Instruction: A Conversation (pp. 1-16). Hillsdale, New Jersey: Lawrence Erlbaum Associates.

DUMANČIĆ, Mario (2019). Smart Education in Smart City and Student Model, Bucharest: "Carol I" National Defence University. doi:http://dx.doi.org/10.12753/2066-026X-19-077

El Janati, S., Maach, A., & El Ghanami, D. (2018). SMART education framework for adaptation content presentation. Procedia Computer Science, 127, 436–443.

Elaish, M. M., Ghani, N. A., Shuib, L. & Al-Haiqi, A. (2019). Development of a Mobile Game Application to Boost Students' Motivation in Learning English Vocabulary. IEEE Access, Access, IEEE, 7, 13326-13337.

Elo, S., & Kyngäs, H. (2008). The qualitative content analysis process, Journal of Advanced Nursing, 62, 107–115.

Erlandson, D., Harris, E., Skipper, B., & Allen, S. (1993). Doing naturalistic inquiry: A guide to methods. California: Sage Publications.

Ertmer, P. A., & Newby, T. J. (2013). Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective. Performance Improvement Quarterly, 26(2), 43-71.

Farnaz, O.-A., Mohammad Hasan, B. & Ahmad, S. (2015). Descriptive Qualitative Method of Evaluation from the Viewpoint of Math Teachers and Its Comparison with the Quantitative Evaluation (Giving scores) Method (A Case Study on the Primary Schools for Girls in Zone 1 of Tehran City). Mathematics Education Trends and Research, 50. doi:10.5899/2015/metr-00078

Fortes, S., Santoyo-Ramón, J. A., Palacios, D., Baena, E., Mora-García, R., Medina, M., Mora, P. & Barco, R. (2019). The campus as a Smart City: University of Málaga Environmental, learning, and research approaches. Sensors (Basel, Switzerland), 19.

Gabriela, K., Nadezhda, A., & Lina, Y. (2018). The potential of augmented reality to transform education into smart education. TEM Journal, 7(3), 556–565.

Genemo, H., Miah, S. J. & Mcandrew, A. (2016). A design science research methodology for developing a computer-aided assessment approach using method marking concept. Education and Information Technologies, 21, 1769-1784.

Ghalib, M. F. M., Sahrir, M. S., Daud, N. M., Hassan, H. & Mohin, M. (2014). iCollect Mobile Application for e-Portfolio: Experiences from an Instructional Design Perspective. Malaysian Journal of Distance Education, 16, 1-14.

Gioia, D. A., & Pitre, E. (1990). Multiparadigm perspectives on theory building. Academy of Management Review, 15: 584–602.

Göksu, İ., & Atici, B. (2013). Need for Mobile learning: Technologies and opportunities. Procedia - Social and Behavioral Sciences, 103, 685–694.

Gomede, E., Gaffo, F. H., Briganó, G. U., Mendes, L. S., & DE Barros, R. M. (2018). Application of computational intelligence to improve education in smart cities. Sensors (Switzerland), 18.

Graves, C. A., Negrón, T. P., Chestnut, M. I., & Popoola, G. (2015). Studying smart spaces using an "Embiquitous" computing analogy. IEEE Pervasive Computing, 14, 64–68.

Green, A., Atfield, G. & Barnes, S.-A. (2015). Employer involvement and engagement: Talent match case study theme report. [Sheffield]: Centre for Regional Economic and Social Research.

Gregg, D.G., Kulkarni, U.R. & Vinzé, A.S. (2001). Understanding the Philosophical Underpinnings of Software Engineering Research in Information Systems. Information Systems Frontiers 3, 169–183. https://doi.org/10.1023/A:1011491322406

Gregor, S. & Jones, D. (2007). The anatomy of a design theory. Journal of the Association of Information Systems, 8, 312-335.

Gregor, S., & Hevner, A. R. (2013). Positioning and Presenting Design Science Research for Maximum Impact. MISQ, 337-356, 37(2)

Grosan C., Abraham A. (2011) Rule-Based Expert Systems. In: Intelligent Systems. Intelligent Systems Reference Library, vol 17. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-21004-4_7

Gruber, T.R. (1993). "A Translation Approach to Portable Ontology Specification", Knowledge Acquisition, 5(2): 199-220.

Gunasekera, K., Borrero, A. N., Vasuian, F., & Bryceson, K. P. (2018). Experiences in building an IoT infrastructure for agriculture education. Procedia Computer Science, 135, 155–162.

Hadjiconstantinou, S. (2017). E-portfolios as professional identities for university learners in an English for communication and media program. International Journal of Language Studies, 11, 151-166.

Halper, Leah & Craft, Caleb & Shi, Yang. (2020). Expanding the Student Employment Literature: Investigating the Practice of Reflection in On-Campus Student Employment. Journal of College Student Development. 61. 516-521. 10.1353/csd.2020.0045.

Hallebone, E. (2009). Business and management research : paradigms & practices / Erica Hallebone and Jan Priest, Basingstoke [England] ; New York, Palgrave Macmillan.

Hamdani, D. S. A. (2013). Mobile learning: A good practice. Procedia - Social and Behavioral Sciences, 103, 665–674.

Handy, T. (2017). How Data Analysis Can Link the Army Program to Financial Statements. Armed Forces Comptroller, 62(2), 34-38.

Hary, S., Ahmad Mursyidun, N., Andika Bagus Nur Rahma, P. & Jehad, A. H. H. (2017). Developing an LMS-Based Cross-Platform Web Application for Improving Vocational High School Students' Competitiveness in ASEAN Economic Community. Jurnal Pendidikan Sains, Vol 5, Iss 3, Pp 72-79, 72.

Hein, G. E. (1991). Constructivist Learning Theory. Paper presented at the The Museum and the Needs of People: CECA (International Committee of Museum Educators) Conference, Jerusalem Israel. http://www.exploratorium.edu/ifi/resources/research/constructivistlearning.html

Hevner, A. R., & Chatterjee, S. (2010). Design research in information systems: theory and practice: Springer.

Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). Design science in information systems research. MIS Quarterly, 28(1), 75-105. doi:10.2307/25148625

Hil, R. (2015). Selling Students Short: Allen & Unwin.

Hirsch, E. D. (2001). The Roots of the Education Wars. In T. Loveless (Ed.), The Great Curriculum Debate: How should We Teach Reading and Math? (pp. 13-24). Washington, D. C.: The Bookings Institution.

Hooshmandja, M., Mohammadi, A., Esteghamti, A., Aliabadi, K. & Nili, M. (2019). Effect of mobile learning (application) on self-care behaviors and blood glucose of type 2 diabetic patients. Journal of Diabetes & Metabolic Disorders, 18, 307.

Hwang, G.-J., Chen, C.-Y., Tsai, P.-S., & Tsai, C.-C. (2011). An expert system for improving web-based problem-solving ability of students. Expert Systems with Applications, 38, 8664–8672.

Igoe, D., Parisi, A., & Carter, B. (2013). Smartphones as tools for delivering sun-smart education to students. Teaching Science, 36.

Illeris, K. (2018). An Overview of the History of Learning Theory. European Journal of Education, 53(1), 86-101.

Iskandar, K., Thedy, D., Alfred, J. & Yonathan (2015). Evaluating a Learning Management System for BINUS International School Serpong. Procedia Computer Science, 59, 205-213.

Jackson, D. (2014). Testing a model of undergraduate competence in employability skills and its implications for stakeholders. Journal of Education and Work, 27(2), 220–242.

Jamir, L., Duggal, M., Nehra, R., Grover, S., & Singh, P. (2019). Epidemiology of technology addiction among school students in rural India. Asian Journal of Psychiatry, 40, 30–38.

Januszewski, A., & Molenda, M. (2013). Educational Technology: A Definition with Commentary: Routledge.

Jaques, P. A., Seffrin, H., Rubi, G., Morais, F. D., Guilardi, C., Bittencourt, I. I., & Isotani, S. (2013). Rulebased expert systems to support step-by-step guidance in algebraic problem solving: the case of the tutor PAT2Math. Expert Systems with Applications, 40(14), 5456–5465.

Jenson, J. D., & Treuer, P. (2014). Defining the E-Portfolio: What It Is and Why It Matters. Change, 46(2), 50-57. doi:10.1080/00091383.2014.897192

Jiaosheng, Q. (2019). A Survey and Analysis of Mobile Learning of Local Undergraduate College Students. Journal of Language Teaching & Research, 10, 1245-1250.

Jo, J., Park, K., Lee, D., & Lim, H. (2014). An integrated teaching and learning assistance system meeting requirements for smart education. Wireless Personal Communications, 79, 2453–2467.

Johannesson, Paul & Perjons, Erik. (2014). An Introduction to Design Science. 10.1007/978-3-319-10632-8.

Jonassen, D. H. (1991). Objectivism versus Constructivism: Do We Need a New Philosophical Paradigm? Educational Technology, Research and Development, 39(3), 5-14.

Just, O. (2014). Finding great employees: The best kept secret. Fairfield County Business Journal, 50(36), 7.

Kamel Boulos, M. N. (2012). Expert system shells for rapid clinical decision support module development: an ESTA demonstration of a simple rule-based system for the diagnosis of vaginal discharge. Healthcare Information Research, 18,252–258.

Kassab, M., Defranco, J. & Voas, J. (2018). Smarter education. IT Professional, IT Prof., 20.

Katrina, S. & Loganathan, M. (2015). Application of big data in education data mining and learning analytics – a literature review. Ictact journal on soft computing, 1035.

Keen, P. G. W., & Gambino, T. J. (1983). Building a Decision Support System : The mythical man-month revisited, Building decision support systems (pp. 133-172).

Kelly, K. (2010). What Technology Wants. New York, NY: Penguin Publishing Group.

Kent, E. P. (2008). Education and smart growth policies in U.S. cities: A response to Lenahan O'Connell. Social Science Quarterly, 89, 1378.

Kim, Y., Soyata, T., & Behnagh, R. F. (2018). Towards emotionally aware AI smart classroom: Current issues and directions for engineering and education. IEEE Access, 6, 5308–5331.

Kivunja, C.(2014).Do you want your students to be job-ready with 21st Century skills? Change pedagogies: A pedagogical paradigm shift from Vygotskyian social constructivism to critical thinking, problem solving and Siemens' digital connectivism. International Journal of Higher Education, 3 (3), 81–91. doi:10.5430/ijhe.v3n3p81

Klein, M., & Methlie, L. B. (1995). Knowledge-Based Decision Support Systems with Applications in Business. West Sussex: John Wiley & Sons Ltd. (2nd ed.)

Ko, K., & Jun, K.-N. (2015). A Comparative Analysis of Job Motivation and Career Preference of Asian Undergraduate Students. Public Personnel Management, 44(2), 192-213. doi:10.1177/0091026014559430

Koh, J. H. L., & Kan, R. Y. P. (2020). Perceptions of learning management system quality, satisfaction, and usage: Differences among students of the arts. Australasian Journal of Educational Technology, 36(3), 26-40. doi:10.14742/ajet.5187

Koneru, I. (2017). Exploring Moodle Functionality for Managing Open Distance Learning E-Assessments. Turkish Online Journal of Distance Education, 18, 129-141.

Koohang, A., Riley, L., Smith, T., & Schreurs, J. (2009). E-Learning and Constructivism: From Theory to Application. Interdisciplinary Journal of E-Learning & Learning Objects, 5, 91-109.

Koole, M., Mcquilkin, J. L. & Ally, M. (2010). Mobile Learning in Distance Education: Utility or Futility? Journal of Distance Education, 24, 59-82.

Koppenhagen, N., Gaß, O., & Müller, B. (2012). Design Science Research in Action - Anatomy of Success Critical Activities for Rigor and Relevance. In: Poster präsentiert auf 20th European Conference on Information Systems (ECIS 2012), Barcelona, Spain, June 10-13, 2012.

Kortuem, G., Bandara, A. K., Smith, N., Richards, M., & Petre, M. (2013). Educating the internet-of-things generation. Computer, 53.

Kuechler, W. & Vaishnavi, V. (2012). A Framework for Theory Development in Design Science Research : Multiple Perspectives. Journal of the Association of Information Systems, 395-423, 13

Kumar, B. A. & Sharma, B. (2019). Context aware mobile learning application development: A systematic literature review. Education and Information Technologies: The Official Journal of the IFIP Technical Committee on Education, 1.

Lee, J.-S., & Kim, S.-W. (2015). Validation of a tool evaluating educational apps for smart education. Journal of Educational Computing Research, 52, 435–450.

Lee, L. W. (2007). Development of multimedia learning resources for children with learning disabilities in an undergraduate special education technology course.

Leem, J., & Sung, E. (2018). Teachers' beliefs and technology acceptance concerning smart mobile devices for SMART education in South Korea. British Journal of Educational Technology.

Lefoe, G. (1998). Creating constructivist learning environments on the web: The challenge in higher education. Ascilite, 98, 453.

Lester, S. (2004). Conceptualising the practitioner doctorate. Studies in Higher Education, 29(6), 757-770.

Lewins, Ann & Silver, Christina (2007). Using software in qualitative research: A step-by-step guide. London: Sage.

Lijuan, W., Sau-ching Ha, A., & Xu, W. (2014). Teaching Perspectives of Chinese Teachers: Compatibility With the Goals of the Physical Education Curriculum. Journal of Teaching in Physical Education, 33(2), 213-231.

Lin, J., Pu, H., Li, Y., & Lian, J. (2018). Intelligent recommendation system for course selection in smart education. Procedia Computer Science, 129, 449–453.

Lipton, A. (2017). The Internet of People Delivers New Ways of Learning. People & Strategy, 40(3), 48-51.

Lukka, K. (2003). The Constructive Research Approach.

Lukyanenko R., Evermann J., Parsons J. (2014). Instantiation validity in IS design research. In: M. C. Tremblay, D. VanderMeer, M. Rothenberger, A. Gupta, V.

Yoon Advancing the (Eds) Impact of Design Science: Moving from Theory to Practice. Lecture Notes in Computer Science, Vol 8463. Berlin: Springer.

Lytras, M. D., Visvizi, A., Sarirete, A., Daniela, L. & De Pablos, P. O. (2018). Social networks research for sustainable smart education. Sustainability (Switzerland), 10.

Machado, M. and Tao, E., (2007), October. Blackboard vs. Moodle: Comparing user experience of learning management systems. In 2007 37th annual frontiers in education conference-global engineering: Knowledge without borders, opportunities without passports (pp. S4J7). IEEE.

Macquarie University, A. (2017). Work with Us. Retrieved from https://www.mq.edu.au/about/about-the-university/offices-and-units/campus-life/work-with-us

Magee, M. D. (2007). Decision Support Systems. Encyclopedia of small business. Hillstrom, Northern Lights : www.encyclopedia.com/thomsongale.

Mahmud, A., Alwi, N. H., & Sulaiman, T. (2014). A qualitative study on the perspective and teaching practice of novice lecturers in a paramedic course. Education in Medicine Journal, 6(1), e45-e49. doi:10.5959/eimj.v6i1.194

Maqbool, A., Hafiz Syed Muhammad, B., Muhammad Asif, R., Jawad, K., Sungyoung, L., Muhammad, I., Mohammad, A., Taebong, C., Soyeon Caren, H., & Byeong Ho, K. (2017). IoTFLiP: IoT-based flipped learning platform for medical education. Digital Communications and Networks, 3(3), 188–194.

March, S. T., & Smith, G. F. (1995). Design and natural science research on information technology. Decision Support Systems, 15(4), 251-266. doi:10.1016/0167-9236(94)00041-2

Maslov, I., & Nikou, S. (2020). Usability and UX of Learning Management Systems: An Eye- Tracking Approach. In (pp. 1-9): IEEE.

McNamara, J. P., Hanigan, M. D., & White, R. R. (2016). Invited review: Experimental design, data reporting, and sharing in support of animal systems modeling research1. Journal of Dairy Science, 99, 9355-9371. doi:10.3168/jds.2015-10303

Miah, S. (2009). End User as Application Developer for Decision Support. AMCIS.

Miah, S. J., & Gammack, J. G. (2014). Ensemble artifact design for context sensitive decision support. Australasian Journal of Information Systems, 18(2), 5–20.

Miah, S. J., & Genemo, H. (2016). A design science research methodology for expert systems development, Australasian Journal of Information Systems, 20. URL. https://doi.org/10.3127/ajis.v20i0.1329.

Miah, S. J., Debuse, J., & Kerr, D. (2012). A Development-Oriented IS Evaluation Approach: Case Demonstration for DSS. Australasian Journal of Information Systems, 17(2). https://doi.org/10.3127/ajis.v17i2.694

Miah, S. J., Gammack, J. G., & McKay, J. (2019b). A Metadesign theory for Tailorable decision support. Journal of Association for Information Systems, 20(5), 570–603.

Miah, S. J., Gammack, J., & Hasan, N. (2017a). Extending the framework for Mobile health information systems research: A content analysis. Information Systems, 69, 1–24.

Miah, S. J., Kerr, D. & Von-Hellens, L. (2014). A collective artefact design of decision support systems: design science research perspective.

Miah, S. J., Kerr, D., Gammack, J., & Cowan, T. (2008). A generic design environment for the rural industry knowledge acquisition. Knowledge-Based Systems, 21 (8),892–899.

Miah, S. J., McGrath, M., Vu, H. Q., & Gammack, J. (2017b). A big data analytics method for tourist behaviour analysis. Information and Management, 54, 771–785.

Miah, S. J., Vu, H. Q., & Gammack, J. G. (2018). A location analytics method for the utilization of geo-tagged photos in travel marketing decision-making. Journal of Information & Knowledge Management, 18(01), 1950004.

Miah, S. J., Vu, H. Q., & Gammack, J. G. (2019a). A big-data analytics method for capturing visitor activities and flows: The case of an island country. Information Technology and Management, 20(4), 203–221.

Miah, S. J., Vu, H. Q., Gammack, J., & McGrath, M. (2016). A Big Data Analytics Method for Tourist Behaviour Analysis. Information & Management. doi:http://dx.doi.org/10.1016/j.im.2016.11.011

Mihail-Vâduva, D. (2019). Quality Characteristics of Mobile Learning Applications. Informatica Economica, 23, 76-88.

Minister of Finance. (2018). Improving the employment potential of graduates. https://www.senatorbirmingham.com.au/improving-the-employment-potential-of-graduates/

Mogashoa, T. (2014). Applicability of Constructivist Theory in Qualitative Educational Research.

Mokyr, J. (2002). The gifts of Athena: Historical origins of the knowledge economy, Princeton, NJ: Princeton University Press.

Monash University, A. (2017). Online Systems and apps. Retrieved from https://www.monash.edu/get-started/prepare-for-uni/online-systems-and-apps

Monash University, A. (2017). Online Systems and apps [Online]. Monash University, Australia. Available: https://www.monash.edu/get-started/prepare-for-uni/online-systems-and-apps [Accessed].

Mu-Yen Chen, a., Francis Mou-Te Chang, a., Chia-Chen Chen, a., Mu-Jung Huang, a., & Jing-Wen Chen, a. (2012). Why do Individuals Use e-Portfolios? Journal of Educational Technology & Society(4), 114.

Naidoo, N. (2011). What is research? A conceptual understanding. Journal of Emergency Medicine, 1.

Ng, K. H., Bakri, A. & Rahman, A. A. (2016). Effects of persuasive designed courseware on children with learning difficulties in learning Malay language subject. Education and Information Technologies: The Official Journal of the IFIP Technical Committee on Education, 21, 1413.

Nica, E. (2017). Techno-pedagogy knowledge in smart learning environments. Economics, Management, and Financial Markets, 12, 75–81.

Nichols, M. (2016). A comparison of two online learning systems. Journal of Open, Flexible & Distance Learning, 20, 19–32.

Nudelman, G. R. (2017). Engineering identity: analysing e-portfolios in a professional communications course. South African Journal of Higher Education, 31(2), 211-225. doi:10.208535/31-2-791

Oraison, H. M., Konjarski, L., & Howe, S. T. (2019). Does university prepare students for employment? Alignment between graduate attributes, accreditation requirements

and industry employability criteria. Journal of Teaching and Learning for Graduate Employability, 10(1), 173-194. https://doi.org/10.21153/jtlge2019vol10no1art790

Orlikowski, W. J., & Iacono, C. S. (2001). Desperately seeking the 'IT' in IT research: a call to theorizing the IT artifact. Information Systems Research, 12(2), 121-134.

Papamitsiou, Z., & Economides, A. A. (2014). Learning analytics and educational data mining in practice: A systematic literature review of empirical evidence. Journal of Educational Technology & Society, 17(4), 49-64.

Peffers, K., Rothenberger, M., & Kuechler, W. (2012). Design Science Research in Information Systems : Advances in Theory and Practice. 7th International Conference, DESRIST 2012, Las Vegas, USA, May 14-15, 2012

Peffers, Ken & Tuunanen, Tuure & Rothenberger, Marcus & Chatterjee, S.. (2007). A design science research methodology for information systems research. Journal of Management Information Systems. 24. 45-77.

Piaget, J. (2005). The Psychology of Intelligence: Taylor & Francis e-Library.

Piccoli, G., Ahmad, R., & Ives, B. (2001). Web-based virtual learning environments: A research framework and a preliminary assessment of effectiveness in basic IT skills training. MIS Quarterly, 401-426.

Pinka, K., Kampars, J., & Minkevičs, V. (2016). Case study: IoT data integration for higher education institution. Information Technology and Management Science, 19(1), 71–77.

Polat, S. (2015). Content Analysis of the Studies in Turkey on the Ability of Critical Thinking. Educational Sciences: Theory & Practice, 15, 659-670.

Politis, J., & Politis, D. (2016). The Relationship Between an Online Synchronous Learning Environment and Knowledge Acquisition Skills and Traits: The Blackboard Collaborate Experience. Electronic Journal of e-Learning, 14(3), 204-222.

Powell, K. S., & Jankovich, J. L. (1998). Student Portfolios: A Tool to Enhance the Traditional Job Search. Business Communication Quarterly, 61(4), 72-82.

Prat, Nicolas & Wattiau, Isabelle & Akoka, Jacky. (2014). Artifact Evaluation in Information Systems Design Science Research ? A Holistic View. Proceedings - Pacific Asia Conference on Information Systems, PACIS 2014.

Preece, J., Rogers, Y., Sharp, H., Benyon, D., Holland, S., & Carey, T. (1994). Human-Computer Interaction : Addison-Wesley Publishing Company (1st ed.).

QILT, Employer Satisfaction. (2017). QILT - Quality Indicators for Learning and Teaching, https://www.qilt.edu.au/qilt-surveys/employer-satisfaction

Qudah, M. F. A., Albursan, I. S., Bakhiet, S. F. A., Hassan, E. M. A. H., Alfnan, A. A., Aljomaa, S. S., & AlKhadher, M. M. A. (2019). Smartphone addiction and its relationship with Cyberbullying Among University students. International Journal of Mental Health and Addiction, 17, 628.

Rezgui, K., Mhiri, H., & Ghédira, K. (2017). Ontology-based e-Portfolio modeling for supporting lifelong competency assessment and development. Procedia Computer Science, 112, 397-406. doi:10.1016/j.procs.2017.08.041

Richardson, L. (2000). Writing: A method of inquiry. In N. Denzin & Y. Lincoln (Eds.), The handbook of qualitative research (2nd ed.). Thousand Oaks: CA: Sage.

Ridley, M. (2015). The evolution of everything: How new ideas emerge. New York, NY: Harper Collins.

RMIT University, A. (2017). Learning Hub: The Learning Hub is the point of entry to online learning and teaching resources for staff at RMIT. RMIT University, Australia. http://www1.rmit.edu.au/browse;ID=090zabl0wvqr1.

Rossi, M., & Sein, M. K. (2003). Design Research Workshop: a Proactive Research Approach. Retrieved from http://www.cis.gsu.edu/~emonod/epistemology/Sein%20and%20Rossi%20-%20design%20research%20-%20IRIS.pdf

Rowe, F. (2014). What literature review is not: Diversity, boundaries and recommendations. European Journal of Information Systems, 23, 241–255.

Salah, A.-M., Lela, M., & Al-Zubaidy, S. (2014). Smart education environment system. Computer Science & Telecommunications, 44, 21–26.

Sandelowski, M. (2000). Whatever happened to qualitative description? Research in Nursing & Health, 23, 334–340.

Sandelowski, M. (2010). What's in a name? Qualitative description revisited. Research in Nursing & Health, 33, 77–84. doi:10.1002/nur.20362

Sanders, N. R. (2016). How to Use Big Data to Drive Your Supply Chain. California Management Review, 58(3), 26-48.

Santana-Mancilla, P. C., Echeverría, M. A. M., Santos, J. C. R., Castellanos, J. A. N., & Díaz, A. P. S. (2013). Towards smart education: Ambient intelligence in the Mexican classrooms. Procedia - Social and Behavioral Sciences, 106, 3141–3148.

Sarrab, M., Elgamel, L. & Aldabbas, H. (2012). Mobile Learning (M-Learning) and Educational Environments. International Journal of Distributed & Parallel Systems, 3, 31-38.

Schaeffer, L. E., Ahmed, S., Rahman, M., Whelan, R., Rahman, S., Roy, A. D., Nijhum, T. A., Bably, N. N., D'Couto, H., Hudelson, C., Jaben, I. A., Rubayet, S., Baqui, A. & Lee, A. C. (2019). Development and evaluation of a mobile application for case management of small and sick newborns in Bangladesh. BMC Medical Informatics And Decision Making, 19, 116-116.

Schaffhauser, D. (2018). IOT has arrived (JUST not in the way you expected). T H E Journal, 45, 6–10.

Scheurman, G. (1998). From Behaviorist to Constructivist Teaching. Social Education, 62(1), 6-9.

Schön, D. A. (1983). The reflective practitioner : how professionals think in action, Basic Books.

Schunk, D. H. (2012). Learning Theories: An Educational Perspective (6th ed.): Pearson.

Schwarz, A., Mehta. M, Johnson, N. & Chin, W. (2006) Understanding frameworks and reviews: a commentary to assist us in moving our field forward by analyzing our past. 38(3), 29–50.

Sedova, K. (2017). A case study of a transition to dialogic teaching as a process of gradual change. Teaching and Teacher Education, 67, 278-290. doi:10.1016/j.tate.2017.06.018

Shafique, M. N., Khurshid, M. M., Rahman, H., Khanna, A., & Gupta, D. (2019). The role of big data predictive analytics and radio frequency identification in the pharmaceutical industry. IEEE Access, Access, IEEE, 9013.

Shee, H., Miah, S. J., Fairfield, L., & Pujawan, N. (2018). The impact of cloud-enabled process integration on supply chain performance and firm sustainability: The

moderating role of top management. Supply Chain Management: An International Journal, 23(6), 500–517.

Shneiderman B, Plaisant C. (2005). Designing the user interface: strategies for effective human-computer interaction: Pearson Education, Inc.

Silverman, D. (2005). Doing qualitative research (2nd ed.). Thousand Oaks, CA: Sage Publications.

Simões, T. M. C., Rodrigues, J. J. P. C., & de la Torre, I. (2013). Personal Learning Environment Box (PLEBOX): A new approach to E-learning platforms. Computer Applications in Engineering Education, 21, E100-E109. doi:10.1002/cae.20537

Simon, H. A. (1996). The Sciences of the Artificial (3rd ed.). Cambridge, MA: MIT Press.

Skinner, B. F. (1938). The Behavior of Organisms: an Experimental Analysis. New York: Appleton-Century-Crofts.

Skinner, B. F. (1971). Beyond Freedom and Dignity. New York: Knopf.

Spector, J. M., & SLFG. (2018). Smart learning futures: a report from the 3rd US-China smart education conference. Smart Learning Environments, 5(1), 1–10.

Spiezia, V. (2011). Are ICT Users More Innovative? An analysis of ICT- enabled innovation in OECD firms. OECD Journal, 2011(1), 99-119.

Stoica, M., Mircea, M., Ghilic-Micu, B., & Uscatu, C. R. (2018). From a smart education environment to an eco-school through fog & cloud computing in IoT context. Informatica Economica, 22, 5–14.

Straub, D., Boudreau, M., & Gefen, D. (2004). Validation Guidelines for IS Positivist Research. Commun. Assoc. Inf. Syst., 13, 24.

Sykes, E. R. (2014). New methods of Mobile computing: From smartphones to smart education. TechTrends: Linking Research and Practice to Improve Learning, 58, 26–37.

Takeda, H., et al. (1990). Modeling design processes. AI Magazine, 11(4), 37–48.

Talebi, K., Tanbakouchian, A. & Amiri, A. B. (2020). Identifying the Indicators of the Theory of Planned Behavior in Successful Entrepreneurs of Small and Medium-Sized Enterprises. Iranian Journal of Management Studies, 13, 441-465.

Tan, P., Wu, H., Li, P., & Xu, H. (2018). Teaching management system with applications of RFID and IoT technology. Education Sciences, 8.

Thinnukool, O., Khuwuthyakorn, P., & Wientong, P. (2017). Pharmacy assistant Mobile application (PAMA): Development and reviews. International Journal of Interactive Mobile Technologies, 11, 178–194.

Tomy, S., & Pardede, E. (2019). Map my career: Career planning tool to improve student satisfaction. IEEE Access, Access, IEEE, 132950.

Ugolini Francesco, C., & Orazi, R. (2015). Constructing an e-portfolio of competences with higher education students of postsecondary age group. Technological issues and outcomes. Research on Education and Media, Vol 7, Iss 1 (2015)(1). doi:10.1515/rem-2015-0008

V, D. & Yadav, A. (2016). Constructivism: A Paradigm for Teaching and Learning. Arts and Social Sciences Journal, 7.

Vaishnavi, V. K., & Kuechler, W. (2015). Design Science Research Methods and Patterns: Innovating Information and Communication Technology: Crc Press.

Van Aken, J.E. (2005), Management Research as a Design Science: Articulating the Research Products of Mode 2 Knowledge Production in Management. British Journal of Management, 16: 19-36. https://doi.org/10.1111/j.1467-8551.2005.00437.x

Venable, J. (2006). The role of theory and theorising in design science research. First International Conference on Design Science Research in Information Systems and Technology.

Venable J., Pries-Heje J., Baskerville R. (2012) A Comprehensive Framework for Evaluation in Design Science Research. In: Peffers K., Rothenberger M., Kuechler B. (eds) Design Science Research in Information Systems. Advances in Theory and Practice. DESRIST 2012. Lecture Notes in Computer Science, vol 7286. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-29863-9_31

Venable, J., Pries-Heje, J., & Baskerville, R. (2016). FEDS: A framework for evaluation in design science research. European Journal of Information Systems, 25(1), 77-89.

Vijay Vaishnavi, B. K., and Stacie Petter. (2019). Design science research in information systems [Online]. Available: http://www.desrist.org/design-research-in-information-systems/ [Accessed].

Von Glasersfeld, E. (1989a). Cognition, Construction of Knowledge, and Teaching. Synthese, 80, 121-140.

Von Glasersfeld, E. (1989b). Constructivism in Education. In T. Husen & T. N. Postlethwaite (Eds.), The International Encyclopedia of Education (Vol. 1, Supplement, pp. 162-163). Oxford/New York: Pergamon Press.

Wahyuni, Dina 2012, The research design maze: understanding paradigms,cases,methods and methodologies, Journal of applied management accounting research, vol. 10, no. 1, Winter 2012, pp. 69-80.

Walls, J. G., Widmeyer, G. R., & El Sawy, O. A. (1992). Building an information system design theory for Vigilant EIS. Information Systems Research, 3(1), 36-59.

Wang, L., Xu, H., Zhang, X., & Fang, P. (2017). The relationship between emotion regulation strategies and job search behavior among fourth-year university students. Journal of Adolescence, 59, 139-147. doi:https://doi.org/10.1016/j.adolescence.2017.06.004

Watson, J. B. (1913). Psychology as the Behaviorist Views it. Psychological Review, 20, 158-177.

Weale, A. (2001). Your Research Project – A Step-By-Step Guide for the First-Time Researcher by Nicholas Walliman Sage Publications, London, 2001, 322 pages, £17·99, ISBN 0 761 96539 4. Journal of Advanced Nursing (Wiley-Blackwell), 35, 307-307.

Whetten, D. A. (1989). What Constitutes a Theoretical Contribution? Academy of Management Review, 14(4), 490-495. doi:10.5465/AMR.1989.4308371

White, L. (2009). The staffing agency "scoop" on how to find employment. MLO Med Lab Obs, 41(2), 24.

Wicaksono, G. W., Juliani, G. A., Wahyuni, E. D., Cholily, Y. M., Asrini, H. W., & Budiono. (2020). Analysis of Learning Management System Features based on Indonesian Higher Education National Standards using the Feature-Oriented Domain Analysis. In (pp. 1-6): IEEE.

Wieringa, R. (2014). Design science methodology for information systems and software engineering, Springer.

Wilson, A., Watson, C., Thompson, T. L., Drew, V., & Doyle, S. (2017). Learning analytics: Challenges and limitations. Teaching in Higher Education, 22, 991–1007.

Wong, L., & Tatnall, A. (2010). Factors Determining the Balance between Online and Face-to-Face Teaching: An Analysis using Actor-Network Theory. Interdisciplinary Journal of Information, Knowledge & Management, 5, 167-176.

Xerri, D., & Campbell, C. (2016a). E-portfolios in teacher development: the better option? ELT Journal: English Language Teaching Journal, 70(4), 392-400. doi:10.1093/elt/ccw032

Xerri, D., & Campbell, C. (2016b). E-Portfolios in Teacher Development: The Better Option? ELT Journal, 70(4), 392-400.

Yamagata-Lynch, L. C. (2014). Blending Online Asynchronous and Synchronous Learning. International Review of Research in Open & Distance Learning, 15(2), 189-212.

Yang, A., Li, S., Ren, C., Liu, H., Han, Y., & Liu, L. (2018). Situational awareness system in the smart campus. IEEE Access, 6, 63976–63986.

Yastibas, A. E., & Yastibas, G. C. (2015). The Use of E-portfolio-based Assessment to Develop Students' Self-regulated Learning in English Language Teaching. Procedia - Social and Behavioral Sciences, 176, 3-13. doi:10.1016/j.sbspro.2015.01.437

Young Ju, J., Nari, K. & Nam Hee, K. (2016). Factors predicting online university students' use of a mobile learning management system (m-LMS). Educational Technology Research and Development, 64, 611.

Yu, T. (2011). E-portfolio, a valuable job search tool for college students. Campus-Wide Information Systems, 29(1), X70-76. doi:10.1108/10650741211192064

Zhao, B. A. O., & Ping, L. U. O. (2015). How college students' job search self-efficacy and clarity affect job search activities. Social Behavior & Personality: an international journal, 43(1), 39-51.

Zhu, Z.-T., Yu, M.-H., & Riezebos, P. (2016). A research framework of smart education. Smart Learning Environments, 3, 4.

Zsófia, Kocsis & Gabriella, Pusztai. (2020). Student Employment as a Possible Factor of Dropout. Acta Polytechnica Hungarica. 17. 183-199. 10.12700/APH.17.4.2020.4.10.

Zydney, J. M. & Warner, Z. (2016). Mobile apps for science learning: Review of research. Computers & Education, 94, 1-17.

# APPENDIX A: INTERVIEW QUESTIONNAIRE FOR STUDENTS

1. Which part of the current LMS encourages learning in terms of career development?
2. Do you think industry involvement is needed? Why do you think so?
3. What benefits do you think the 'JOBS' function can provide students?
4. How do you think the development of 'PROFILE' according to the job requirement help students? Do you think embedding Linkedin Profile would benefit the system?
5. What benefits a student achieve out of employers involvement in LMS?
6. How the cost for employers should be involved in terms of their access to SCAS?
7. Who should have the right of data sharing University, Student, Teachers or Administrators and why do you think so?
8. Please explain which function of SCAS you like the most?
9. Do you have any suggestions for improvements?

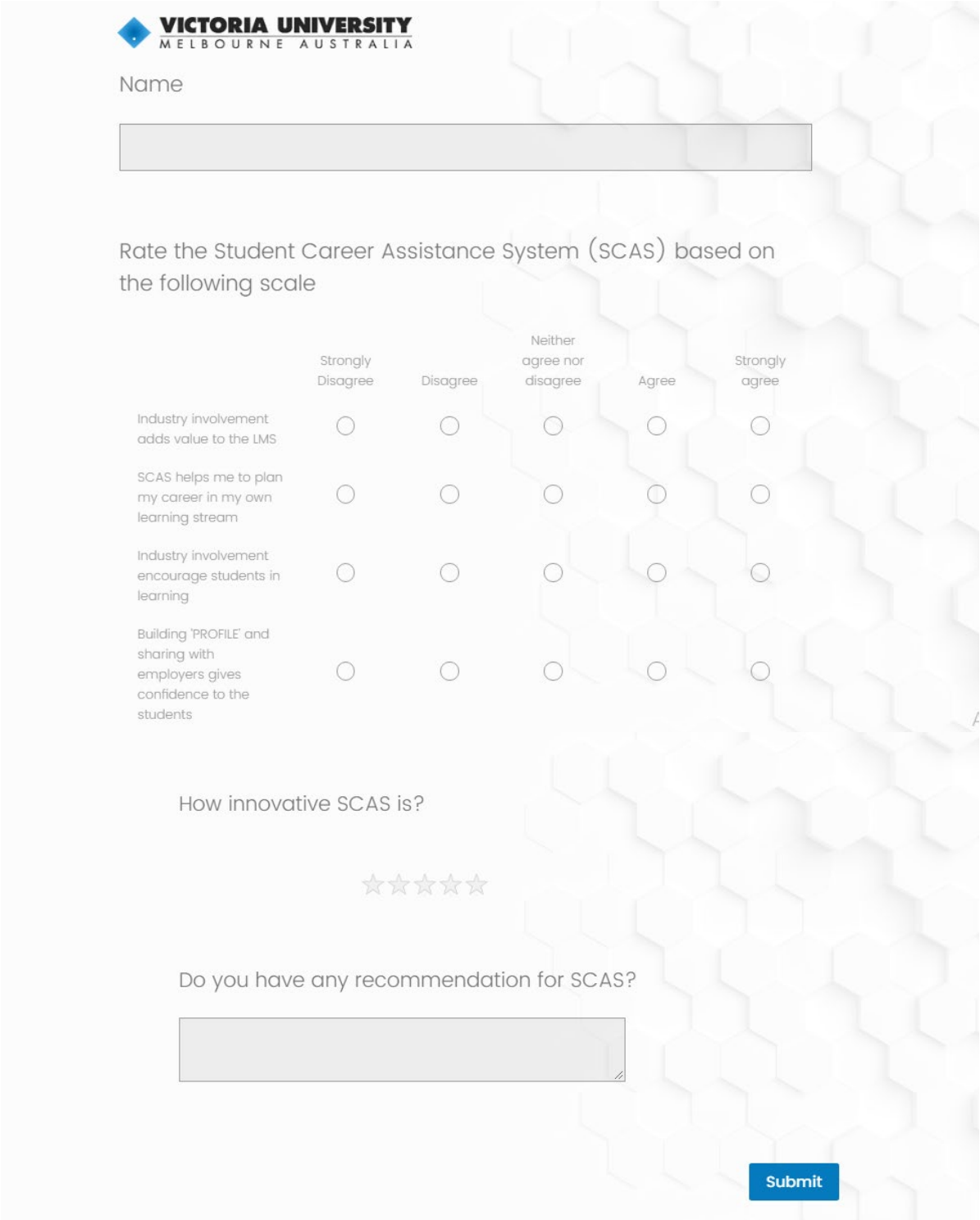
# APPENDIX B: INTERVIEW QUESTIONNAIRE FOR TEACHERS

1. Which part of the current LMS encourages learning in terms of career development?
2. Do you think industry involvement is needed? Why do you think so?
3. What benefits do you think the 'JOBS' function can provide students?
4. How do you think the development of 'PROFILE' according to the job requirement help students?
5. What benefits a student achieve out of employers involvement in LMS?
6. How the cost for employers should be involved in terms of their access to SCAS?
7. Who should have the right of data sharing University, Student, Teachers or Administrators and why do you think so?
8. Please explain which function of SCAS you like the most?
9. Do you have any suggestions for improvements?

# APPENDIX C: INTERVIEW QUESTIONNAIRE FOR EMPLOYERS

1. Do you think industry involvement in the universities Learning Management Systems is beneficial? Why do you think so?
2. What benefits do you think the 'SEARCH' function can provide employers?
3. How do you think the 'JOB' function helps in employment procedure? Why do you think so?
4. Why till now employers not involved in the university system?
5. How the cost for employers should be involved in terms of their access to SCAS?
6. Please explain which function of SCAS you like the most?
7. Do you have any suggestions for improvements?

# APPENDIX D: ONLINE SURVEY USING QUALTRICS



## APPENDIX E: INFORMATION TO PARTICIPANTS INVOLVED IN RESEARCH

# INFORMATION TO PARTICIPANTS INVOLVED IN RESEARCH

**You are invited to participate**

You are invited to participate in a research project entitled '**An Innovative Learning Management Approach for improving learning practices in Australian University Context'.** This project is being conducted by a student researcher Harpreet Singh as part of a PhD (Integrated) degree at Victoria University under the supervision of Dr. Yuan Miao, Head, Information Technology Discipline College of Engineering and Science, Victoria University, Ballarat Road, Footscray

**Project explanation**

The aim of this research project is to capture the views of the students, teachers and employers on a proposed design of a combined online platform. The stakeholders are expected the benefit out of the data analytics done through this platform. This artefact provides help to students in employability requirements and employers in hiring procedures.

**What will I be asked to do?**

Firstly, the consent form needs to be signed. After that there would be total 9 detailed questions and 5 rating related survey question, under the protocol of structured interview with audio recording done on an online streaming software. The interview session will be of half an hour to an hour depends on the understanding and usability of online recording and broadcasting system. The session will be recorded and then transcribed into a word document for you to review. The transcripts then will be used as the part of the research to analyse the data. You reserve the right for the information provided by you to be excluded at any time.

**What will I gain from participating?**

You are giving valuable time and information for this research. You will get a detailed information about the project and its impacts. This is the first study of its kind in Australia. Interested participants will receive a copy of the final report upon request. My contact details are given below.

**How will the information I give be used?**

All information will be treated kept strictly confidentially and will be used in the thesis developed for PhD Thesis.

**What are the potential risks of participating in this project?**

Participants in this interview do not undertake any risks. The research interview will be audio recorded and your verbal consent will be taken prior to the beginning of recording.

**How will this project be conducted?**

The project will be conducted through the structured interview based on online interactions.

**Who is conducting the study?**

Professor Yuan Miao
Chief Investigator of the Project
Head, Information Technology Discipline
College of Engineering and Science
Victoria University
Ballarat Road, Footscray, VIC 8001 Australia
Tel: 61 3 9919 4605,
Email: Yuan.Miao@vu.edu.au

Harpreet Singh
Associate Investigator of the Project
Student
College of Business, Victoria University, Australia
Tel: +61 450 588 384,
Email: Harpreet.singh32@live.vu.edu.au

Any queries about your participation in this project may be directed to the Chief Investigator listed above. If you have any queries or complaints about the way you have been treated, you may contact the Ethics Secretary, Victoria University Human Research Ethics Committee, Office for Research, Victoria University, PO Box 14428, Melbourne, VIC, 8001, email researchethics@vu.edu.au or phone (03) 9919 4781 or 4461.

## APPENDIX F: CONSENT FORM FOR PARTICIPANTS INVOLVED IN RESEARCH

# CONSENT FORM FOR PARTICIPANTS INVOLVED IN RESEARCH

**INFORMATION TO PARTICIPANTS:**

I would like to invite you to be a part of a study that investigates the requirement for the designing process of a new online collaborative platform for students, teachers and employers.

The current system caters the needs of the students and their professional development along with the ease of recruitment process for the employers. Though, many researches have been done on the requirements of employment procedures and the existing problems in the recruitment process. But those past researches lack the collaborative feature related to the needs of students and employers. Therefore, the aim of this research is to develop a combined platform using big data analytics as a core technology. So that the stakeholders, such as, employers or recruiters can get some analytical insights generated from learners and educator's activities. These include doing case studies, exercises and other discipline specific active learnings. A structured Interview will be conducted for every participant.

This research interview will be taken on Zoom Meeting and will be recorded and your verbal consent will be requested at the beginning of the recording. The information obtained will be kept strictly confidential. Only the researcher will view the raw data. You do not need to answer a question that you feel inappropriate.

**CERTIFICATION BY PARTICIPANT**

**I ……. of ……(Organisation/Address)** certify that I am at least 18 years old* and that I am voluntarily giving my consent to participate in the study: 'An investigation of designing a new online collaborative platform for students, teachers and employers' being conducted at Victoria University by: Chief Investigator Dr. Shah J Miah and Associate Investigator Harpreet Singh.

I certify that the objectives of the study, together with any risks and safeguards associated with the procedures listed hereunder to be carried out in the research, have been fully explained to me by:

Harpreet Singh

and that I freely consent to participation involving the below mentioned procedures:

- verbal consent will be asked to record the interview content and to reconfirm interview participation
- participate in a maximum 60 minutes interview, answering 10 questions.

I certify that I have had the opportunity to have any questions answered and that I understand that I can withdraw from this study at any time and that this withdrawal will not jeopardise me in any way.

I have been informed that the information I provide will be kept confidential.

Signed:

Date:

Any queries about your participation in this project may be directed to the researcher Dr. Shah Jahan Miah, phone (03) 9919835.

If you have any queries or complaints about the way you have been treated, you may contact the Ethics Secretary, Victoria University Human Research Ethics Committee, Office for Research, Victoria University, PO Box 14428, Melbourne, VIC, 8001 or phone (03) 9919 4781.