THE ROLE OF INDUSTRY TECHNOLOGIES IN IS EDUCATION: A SOUTH AFRICAN CASE STUDY

Submitted by

SHALOAM MUTETWA

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ABSTRACT

The issue of determining the most appropriate software tools for instructional purposes is not new. As the tools keep changing and evolving and considering the vast number of existing tools that are there, this process of selecting the best tools for students may become quite challenging and it is important that the dynamic be explored. This research targets studying factors that have impact on tool selection, implementation of tools in the curriculum, and impact of tool use on students. The study also uses Activity Theory as the theoretical framework in holistically exploring how these tools are implemented in an undergraduate Information Systems curriculum.

The research adopts an interpretivist approach and follows an exploratory research design using qualitative methods to gather data and thematic analysis for data analysis. This case study is of a South African university, which was chosen using convenience sampling. Data was collected through interviews with 10 lecturers and 8 students at the Information Systems Department and analysis of course outlines.

Key findings point to alignment with industry needs, affordability, availability of supplementary resources, and software functionality as some of the important criteria used by educators when selecting software products. The study also identifies primary and secondary contradictions as per the Activity Theory and these highlight the inconsistencies which exist in the department's use of technologies.

It is important to note the lack of studies in this area, where existing research mainly focuses on tools used in specific courses in Information Systems, but none have looked at the Information Systems discipline as a whole. The study also highlights the different roles played by technology companies in facilitating the use of tools in courses, which to the researcher's knowledge, has never been done before. Thus, the research contributes to literature and fills the stated gaps in research and answers the research questions.

PLAGIARISM DECLARATION

I, **Shaloam Mutetwa** hereby declare that the work on which this assignment is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university. Part of this work, the appeared in earlier submissions and publications. I authorize the University to reproduce for the purpose of research either the whole or any portion of the contents in any manner whatsoever.

Signature: ……**Mutetwa**……. Date: **14 / 02 / 2022**

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CHAPTER 1: INTRODUCTION

There has been an unprecedented and exponential growth of technology and artificial intelligence capabilities over the past ten years which is challenging current work practices and affecting all areas of society (Moscardini et al., 2020). South Africa's workforce is changing because of the increased automation of the global sectors, and the IT sector is by far the fastest-growing sector globally. Badat (2010) emphasizes that the economic and social development of higher education institutions in South Africa depends on being able to contribute to the global digital industry. For example, there is a need for a workforce that is skilled in the migration of banking systems from paper to the cloud (Chen et al., 2012). Cloud architects and engineers will be needed to attain a globally competitive banking sector. As a result, educators in Information Systems (IS) utilize industry technologies to try and simulate real-life scenarios where students use tools to design, develop and analyze business processes and systems, thus giving them the practical experience that is needed (Chen et al., 2012; Fedorowicz et al., 2004). In accordance, Parker (2010) writes, "Software technology use in a course should simulate as closely as possible an enterprise experience because employers expect graduates to understand the basic functionalities of companies' systems in today's economy, which means they need to have knowledge of business processes and the technologies used to support them".

Given the importance that these technologies have in higher education, it is surprising that there is a lack of recent studies around them specifically on IS. Understanding the role that these technologies play in IS education is key as that will also make it possible to investigate the number of issues that evolve around them. For example, studies show that the selection and implementation of industry technologies for use in the IS curriculum is difficult not only because actual industry software are used, but because there is no formal approach to guide the process. The large number of technologies which exist is overwhelming and it does not make the process easier. How does one go about choosing between SAP, Oracle, or PeopleSoft, or assessing the pros and cons of Microsoft Azure and AWS in an educational setting? Both students and lecturers should be able to focus on essential course concepts rather than struggling with details of a complex technical software product. Therefore, this study investigates the role of industry technologies in IS education and addresses the gaps that exist. The study uses the Activity Theory as a theoretical

framework as it allows the researcher to use a holistic approach and view processes as systems and thus, help answer the research question. The study contributes to the existing body of literature as it provides a broad look into these technologies used in IS, which to the researcher's knowledge has never been done before. This chapter introduces the topic and explains the research questions and objectives.

Definition of Key Terms

Finding a specific definition of industry technologies was a difficult task, owing to the issue that there is little research on this, and the available studies referred to these technologies using different terms. Terms used to describe the term were educational technologies, computer technologies, courseware, and institutional software. This study uses the term *industry technologies* as it most closely describes the technologies being discussed. To the researcher's knowledge, Parker (2010) is the only author who uses the term although no definition of the term is provided. This study defines industry technologies as, "Information Technology (IT) applications or software packages used by lecturers to demonstrate certain practical concepts in class or as support for the theoretical concepts for courses in IS which are mostly used in industry." Examples include making use of SAP™, Microsoft Dynamics™ or Odoo™ for teaching enterprise systems (Mwalemba, 2019; Zadeh et al., 2020), IBM BigInsights™ for teaching Data/Business Analytics (Zadeh, Zolbanin, Shadra, 2021), Python™ for programming (Smith & Jones, 2021), and AWS™ for cloud computing (Katiyar & Bhujade, 2018). The study focuses on undergraduate IS education therefore the research will investigate the use of these industry technologies in undergraduate IS education.

Research Problem and Justification

IS lecturers, periodically go through the process of selecting the most suitable technologies for their courses. From database administration to web development, project management, cloud computing or enterprise systems. IS is a field which is very dynamic since technology keeps evolving each day, therefore, this results in a large variety of candidate software packages which are available on a variety of platforms. Software tools such as IBM, AWS, SAP, Oracle, and Microsoft have such dominant name recognition in industry and students often desire experience with those systems to enhance their job prospects. However, there can be problems with using these packages in an educational setting. Challenges usually arise when it comes to selecting and evaluating which tools to use because of the various factors which need to be considered for these

tools. Needs for students can be overlooked sometimes, and in most cases, environmental factors might also come into play. For example, Beise (2006) compares personal database software such as Microsoft Access to complex and expensive enterprise database software such as Oracle and PeopleSoft and suggests that because of how affordable it is for educational institutions, Microsoft Access can be a more attractive option. However, one might wonder why Oracle is not a better option as it is one of the leaders in enterprise systems, and exposing students to this, would give them an edge when applying for jobs as they would have the skills that are sought after in industry but that could also be very expensive. Other external factors exist, such as the department's policy on which tools to use, or accessibility of software by the institution.

The challenge is these decisions are often based on individual agendas or familiarity with a package rather than on a formal evaluation that allows software to be analyzed in a consistent, structured, and replicable manner (Denton & Peace, 2003). A formal process might be needed because the selection and evaluation of software tools must be done in a consistent, quantifiable manner to be effective. Given how common such decisions are, and how frequently they must be made, one would expect numerous studies, specific to the topic. Existing studies have mainly focused on generic technologies, not specific to IS, such as web 2.0 and virtual technologies such as wikis, blogs, podcasts, and social networks (Harris & Rea, 2009), emerging educational technologies such as course generating materials, planning tools for concept mapping and lesson planning and electronic research and reference tools (Ball & Levy, 2008). However, there is a great need to investigate industry technologies and their use and impact in IS education, as there is an increased emphasis on the need to equip students with practical skills needed in industry as it is the responsibility of the education system to do so (Lightfoot, 1999). It is important to understand not only which industry technologies are used in IS teaching but also how they are selected and implemented into the curriculum as well as the short and long-term implications of exposing students to such technologies.

One might wonder if the problem is unique to IS. Almost all fields must make choices on which software application to use for teaching. For example, Parker (2010) does a similar study, not focusing on just IS curriculum but the IT curriculum as well. The process of selecting and implementation of tools used in a course largely depends on the philosophy of the institution and the course as well as the type of course as stated by Lee (2001). This means that the process differs

from one subject to the other due to various factors as will be explained later in the course. The study focuses on IS education mainly because of the lack of recent studies in this discipline and because of the demanded skills of IS students, the area remains a relevant subject to unpack.

Research question and objectives

Main research question: *How are IS industry technologies selected and incorporated into teaching?*

*The **sub-questions** are as follows:*

1. What industry technologies do lecturers use when teaching undergraduate information systems?

2. What are the implications of using these industry technologies on the students?

The research poses the main research objective, "Understand how to select which industry technologies to be used and how they are incorporated into teaching and the resultant implicants."

The following are the sub-objectives:

1. Evaluate critically, the Activity Theory and apply it as a theoretical framework for this study.
2. Give recommendations on how lecturers can select these technologies.

Importance of industry technologies in Information Systems

The effective teaching of IS goes hand in hand with the demonstration of how the technology is used within a given organizational context or how it's customized and implemented in a given context (Fedorowicz et al., 2004). The use of industry technologies in undergraduate studies in IS offers something which cannot be offered by any book, or theoretical concepts, no matter how well-elaborated it may be. They offer a hands-on experience of the technologies they might be using when they go into the market, which makes them more valuable and gives them an added advantage when they enter the industry. Also, implementing these technologies in an undergraduate curriculum can increase learner's skills which enables them to serve as technical experts in the industry, as they will be exposed to a broader range of technologies (Hruskocy et al., 2000). Being experts does not mean being proficient in just one technology, but because of the exposure to different technologies, one is able to easily adapt to a new tool, and one could argue

that this is the most important aspect of using these tools in a technology-oriented subject such as IS. In some cases, using industry technologies provides universities with discounts, training of academic staff, and ongoing support, thus enriching the academic resources faculty that can provide to their students. Vendors can also benefit from industry-university collaborations from this by increasing the supply of skilled graduates that can support their product thereby enhancing its marketability (Topi, 2019). The importance of exposing students to practical skills lies in better teaching and reinforcing IS concepts (Hawking et al., 2000), creation of experts not just users (Hruskocy et al., 2000; Mwalemba, 2019) as well as graduates who are better prepared for industry (Bain, 2017; Fedorowicz et al., 2004; Radermacher & Walia, 2013).

Outline of Study

This research contains six chapters. This chapter is the introduction which has explained the background to the research and put forward the research argument. Chapter 2 is a literature review which consists of the definition of important concepts, a review of the relevant literature and the research framework. Chapter 3 addresses the methodology employed in this research including the research philosophy and design, data collection and analysis methods as well as the trustworthiness and credibility of the research. Chapter 4 describes the results of the data analysis according to the research framework. Chapter 5 discusses the interpretation and implications of the research. Chapter 6 concludes the research study and makes recommendations for future research. The Appendices are attached at the end of this study consisting of consent forms and invitation letters to participants as well as research instruments used in this paper.

CHAPTER 2: LITERATURE REVIEW

This literature review aims at evaluating the state of knowledge according to the broader concept of industry technologies, thereby, contributing to a deeper knowledge on the subject. Hence, it largely focuses on giving a comprehensive understanding and background of past studies around the topic which has already been documented. The review starts by looking into the roles and importance of higher education at a broad level, then narrows to the discipline of information systems, and the tools used in the discipline. The literature review was done through a comprehensive Google Scholar search, as well as standard search in databases such as Web of Science.

Higher Education and its importance

The exponential growth of technology and artificial intelligence capabilities which are challenging current working practices have been seen to play a prominent role in the way that society develops. Universities have always played a significant role in the development of society (Badat, 2010). Therefore, it is important to study how the role of universities need to be modified to meet this challenge and develop proactive responses to the new form of society that is emerging (Moscardini et al., 2020).

National higher education systems in South Africa consist of highly differentiated and diverse institutions, with universities characterized by different missions, varied social educational purposes and goals, differing size, different configurations of academic programmes, differing admission requirements, and varying academic standards as appropriate to specific purposes and goals. Badat (2010) states that the roles that institutions or individuals play in society are shaped by the purposes and goals that they have defined for themselves and/or that have come to be defined for them by society. This suggests that universities are also a subject to more implicit pressures from society, and this combination of implicit and explicit pressures, coupled with local and universal functions generates contradictions in their roles (Astakhova et al., 2016; Brennan et al., 2004; Moscardini et al., 2020). Toohey (1999) also reiterates that these roles are also transmitted down to the various faculties and disciplines within the institutions and together they are instilled in the individual departmental values and thus, guides the teaching of various courses.

It is important to explore the historic role of universities. Moscardini et al. (2020) explains how the first university is thought to have a role which mirrored Plato's philosophy and concentrated on producing an 'educated man'. The author explains that universities used some combination of WHAT (understanding and meaning), HOW (vocational training-hands), and WHY (recognizing one's place in society). Badat (2010) translates these three roles into more modern definitions, the **academic** role, **vocational** role as well **community engagement**. The academic role is defined by Badat (2010) as the production of knowledge, while the vocational role is defined as the dissemination of knowledge, or in simpler terms; education or training directed at a particular occupation and its skills. Badat (2010) goes on to reiterate that the academic role that universities play, advances understanding of the natural and social worlds, and enriches humanity's accumulated scientific and cultural inheritances and heritage. The researcher notes that this creative urge to understand and to manufacture knowledge is instrumental in the founding of universities and continues to hold and guide the roles of many institutions today.

With the vocational role, the goal is to produce graduates that, ideally can think effectively and critically, have achieved depth in some field of knowledge and have a critical appreciation of the ways in which we gain knowledge and understanding of the universe of society and the general public. This can be seen through the collaboration between industry and universities that exists and the teaching of current practices in industry. From the very beginning there was a tension between the academic role and the vocational role which differed from country to country. This has raised questions such as are the requirements of the job market a major factor in determining the purpose of a university and how much should their structures align with the demands of society, whether political, economic, cultural, or social? Community engagement essentially engages students in activities where both the community and students are primary beneficiaries and where the primary goals are to provide a service to the community (Badat, 2010; Moscardini et al., 2020). Brennan et al., (2004) states that each university should clearly define its purpose usually by a mission statement and this usually includes the benefits to the nation and society in which it resides. This shows that institutions are meant to contribute to the socio-economic development of the country, and this is driven by the declared by the lived values of the institution. Higher education thus invests into students and equips them with foundational skills which enable them to use those skills and contribute to the development of society, thus engaging with the larger

community. It is important to note that all three roles exist together and are interlinked to form the current and ongoing operation of higher education institutions today.

Universities have historically played a major role as ideological apparatuses, expressing the ideological struggles present in all societies (Moscardini et al., 2020). They have always been mechanisms of selection and socialization of dominant elites. However, today's institutions most frequently emphasize that the function of universities is the training of a skilled labor force (Badat, 2010; Brennan et al., 2004). Thus, faculties within institutions try to align their own values with the values held by the institutions themselves, and this is shown even in how curriculum is developed and how it contributes to the. Seeing, how information and communication technologies (ICT) sector is the fastest growing sector globally, it plays a significant role in all aspects of modern society in automating and developing systems, therefore, it is important to explore more in this field and how their roles and purposes affect the communities.

Information Systems (IS) Discipline

IS focuses on developing better systems for businesses and people to become more responsive to our needs and it has an important role in the lives of all individuals, organizations, and societies, explicitly or implicitly (Lightfoot, 1999). This is closely associated with the rapidly changing world of work, where artificial intelligence and IT driven automation is changing job roles and relevancy of various professions at a pace that often exceeds the human capability to adapt (Larsson & Boateng, 2009; Topi et al., 2010). At the same time, physical and digital systems are increasingly fully integrated, and the actions of individuals in many contexts and even at the most minute level are captured and analyzed more closely than ever before.

According to Topi (2019), the most important role of the IS community is to educate new generations of professionals whose work focuses on the use of IS to transform the ways in which organizations and societies are structured and operate to achieve their goals. This is usually done in two ways. Firstly, students are equipped with the necessary skills in current industry practice to satisfy an entry level job (Aydin et al., 2013; Lightfoot, 1999). In addition, it is also important for students to be exposed to real life case scenarios which can help them grasp very important concepts and provides students with the fundamental background and abilities to learn new skills throughout their career (Westfall, 2012). In essence, preparing future IS professionals for the

dynamic environment by teaching current skills helps students secure their first jobs, whereas teaching fundamentals helps them get subsequent jobs and grow in their career.

It is now more important than ever to ensure that students get educational experiences that are both effective and comprehensive, reaching from technical expertise to new business models and value-based ethical analysis of impact (Strong et al., 2006). Whilst there are other important factors such as the lecturers or industry, the IS curriculum should be developed with students at the center of it. In curriculum development in IS, there is an increasing emphasis of professional competencies which students are meant to have foundational skills in. These competencies, according to Larsson & Boateng (2009), are mapped to the industry needs and the knowledge students are expected to have. These competencies are shown in Figure 1 below. IS programs should be tailored to the specific needs of students, allowing them to select courses that emphasize the learning units most important to their chosen career path. Furthermore, the IS program should have several generic courses within each career track that are designed to teach the latest technology and trends.

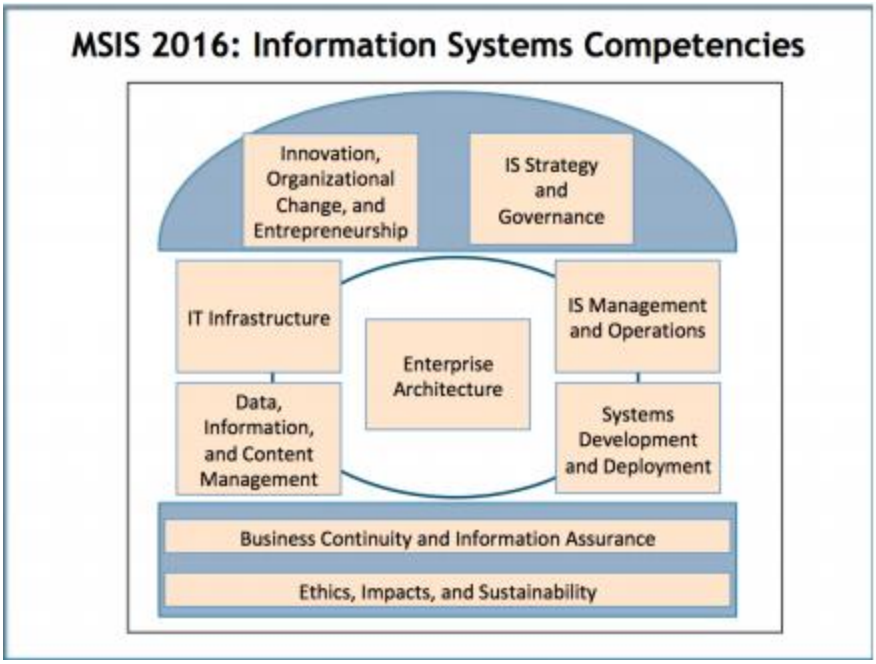


Figure 1: Areas of IS Competencies (Topi et al., 2017)

As stated previously, students must acquire the necessary skills in current industry practice to satisfy requirements for an entry level position. This why the competencies shown in the above diagram, are informed with industry practice. The role of IS graduates is not to develop the component technologies, but rather, to contribute to bringing business and computing -based

solutions together in a way that allows organizations to achieve their goals (Larsson & Boateng, 2009; Topi et al., 2010). In effect, teaching current skills helps students secure their first jobs. IS educators are constantly trying to determine how best to provide meaningful hands-on experiences for students. In most cases, lecturers utilize various software tools to cement these concepts, fundamentals as well as skills to give the practical experience students need to be able to graduate and then land a job, as recruiters look to see if graduates can apply the skills they need in industry. These tools are also used widely in industry and used to give students a real-life experience of how systems are designed, developed, and analyzed. The next section takes a deeper look into these tools, and how they are implemented into the curriculum.

Industry technologies

Various authors described technologies used to give practical experience using different terms, *educational software, educational technology, industry software and computer technology* were some of the terms used to describe these technologies. The search for literature on the topic started with a series of ill-conceived searches that included the phrase "**educational software**". While the search returned a large result set, a large portion of the studies used "educational software" to describe software for primary school children (Parker, 2010). In addition, most of the studies on "educational software" failed to give examples of the type of software they were talking about, as the studies were descriptive detailing process for reviewing and selecting educational software (Foshay & Ahmed, 2003; Parker, 2010). Educational software has been defined as, "any software that is used in an educational context, whether or not it was specifically designed for educational use". Apart from the lack of use of this term in a higher education context, the term fails to specify what the technologies are being used for.

Another term which can be used to describe these technologies is "**computer technology**" and Abd & Halim (2019) used this term and define it as, "Technologies used to *support* the learning and teaching of courses." Students were not learning actual concepts from the technologies, but using the technologies to just support their lectures etc. Other terms used to describe the technologies are institutional software, courseware, and educational software, but no specific definitions were provided. However, these studies describe various tools used to either facilitate the teaching of courses but not specifically in IS and therefore fail to fit the description of the tools being discussed in this study, hence might not be germane to the purposes of this study. For

example, Glover (2020) looks into the use of Google Forms to facilitate discussion in a history class and Lancor & Katha (2013) looks at various PHP based web frameworks and evaluates which framework can be used to teach a software engineering course in Computer Science . Thus, this study aims to fill this gap in literature by looking into technologies used to facilitate teaching of courses in I and these technologies are also used in industry.

As stated earlier in this research, the term "industry technologies" is not widely used in literature but the researcher finds the term to best describe the software being discussed in this study. Software used in Information Systems programs is most often professional-grade software, used in industry. This term best fits the description of the technologies being discussed. Thus study defines "industry software tools" as technologies used in IT/IS which are used to help students learn practical concepts, and these are also used in industry. Examples of these technologies include SQL Server and MySQL to teach databases (Beise, 2006), SAP for Enterprise Systems (Beise, 2006; Fedorowicz et al., 2004; Strong et al., 2006), Microsoft Azure/ AWS for cloud computing (Chen et al., 2012; Katiyar & Bhujade, 2018). Industry technologies generally seems to be of five basic types: tutorial, drill and practice, simulation/game, information, and management and assessment" (Parker, 2010). The following table consists of the mentioned types of technologies in their basic types and gives examples. It is also important to note that the lack of studies on these technologies is rather alarming considering the need for students to gain practical experience in a technology-oriented subject such as IS.

Below is a table with a detailed breakdown of the types of software that exist.

Table 1: Types of Teaching technologies

Name/Type	Definition	Example
Tutorial	Provides a complete direct teaching/ learning experience, centered on presentation, practice and feedback, together with introductions, summaries, and other organizational/ learner control devices	QUIA: UA History SOL Vocabulary Review
Drill and practice	Provides repetition and reinforcement of knowledge and skills previously learned.	Scratch for programming, Math Board, Flash cards+
Simulation/ game	Provides an opportunity to manipulate an environment. Microworld, and view the consequences of the manipulation, sometimes with supplementary feedback mechanisms which make visible aspects of the simulated system not perceived in "reality".	ConceptDraw MINDMAP, SimCity, Scratch
Information and management	Provides factual content in the form of text, pictures and/or other multimedia. Often organized for a particular type of use (such as exploration, reference or review) by a particular type of user.	Managed learning environments; Moodle, Google classroom. Microsoft Teams (makes relatively fewer assumptions about the use and the user than is true with the three above software types.)
Tool	Automates (typically low-level) tasks of data preparation, analysis and organization, handling and storage.	Microsoft Office, Tableau, AWS, Google tools, Oracle, IBM, Microsoft Access, PostgreSQL, MySQL,

The technologies discussed in this study fall under tools, as they are typically used in industry and these tools can be used together with the other types in the table.

Selection and evaluation of tools

The nature of the IS field itself contributes to the difficulties in tool evaluation and selection because there is often a large variety of candidate software packages (Denton & Peace, 2003), technology evolves rapidly and continuously (Larsson & Boateng, 2009), evaluation paradigms are inadequate, software packages may be available on a variety of platforms and many individuals may not have the required skills (Humble et al., 2019; Mwalemba, 2019). This leaves a lot of possibilities when selecting which tool to use, and this has been seen to be a rather difficult decision as it depends on a lot of different factors. Before incorporating a specific technology to the curriculum, it goes through a series of reviews and evaluation processes, whether explicitly or implicitly. Foshay & Ahmed, (2003) gives an interesting and rather unique and comprehensive perspective on the selection of industry technologies. The authors view a tool as a system with four subsystems, the software, content, instructional and instructional management, and assessment subsystems.

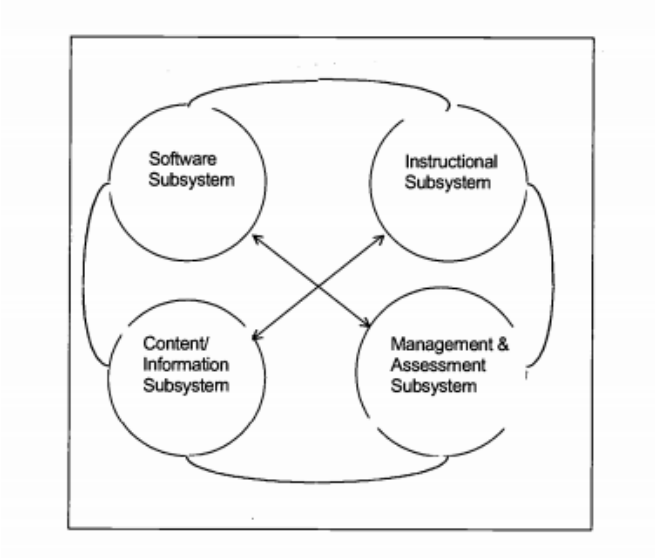


Figure 2: Educational Software as a learning system with 4 subsystems (Parker, 2010)

According to Foshay & Ahmed (2003), a balanced approach to evaluating or analyzing software technologies should examine all four subsystems and their interactions and synergies. The subsystems are explained below.

1. *Software Subsystem*

This category encompasses various software traits like system requirements, operating system limitations, source availability model and software feature set. The system requirements of a software package, whether it is a student, academic, or full version, include hardware as well as operating system requirements. Operating system dependence refers to the dependance of a tool on a particular operating system platform (Parker, 2010). For example, some tools are dependent on Windows OS, and some are Linux or MacOS. It's important that the software in use be compatible with student's PCs. It would be unfortunate for a lecturer to select software which is compatible with only MacOS while a huge proportion of the class has windows OS. So, it's really important that software requirements be made a priority as there can be issues of access as well.

Whether a tool is open-source versus proprietary is another important issue and this refers to the entity that controls the evolution of the software tool. For example, Microsoft is responsible for additions, deletions, or modifications to SQL Server. Contrary to that, MySQL is an open -source database and can be modified by any member of the open-source community. The choice to use which tool to use largely depends on the faculty's values and what they prioritize. A comparison can be made between two converging departments, IS and Computer Science. Studies suggest that most computer science departments in higher education make use of open-source tools as opposed to proprietary tools. This is because of how the department prioritizes contributing to open-source projects where it cultivates an awareness of how tools and languages piece together (Grossman et al., 2017). Given the nature of the field of computer science, focusing on developing the technical aspects of programing and software development through concepts such as AI and cloud computing, open-source tools would give students the opportunity to work with different platforms and learn how to easily adapt to a new technology (Grossman et al., 2017).

Proprietary tools on the other hand, come with a lot of administration when it comes to access. Open-source tools tend to be free therefore come at a cheaper price as opposed to proprietary where a license must be purchased and one would have to negotiate for a discount, but most entities provide their products at a cheaper price and sometimes, free when it's for academic purposes.

Educators mostly go for proprietary software because of the nature of the IS discipline (Beise, 2006; Parker, 2010). IS focuses on developing better systems for businesses and people to become more responsible to our needs. So, it's important for students to be exposed to real life business use cases, which offer them the opportunity to see how they are expected to analyze these systems accordingly (Strong et al., 2006).

Also, the technologies that are chosen usually to have the features that these proprietary tools have. A full feature set versus limited feature set refers to the fact that some software tools lack certain features (Foshay & Ahmed, 2003). That may be because some software tools are more capable than others. For example, Microsoft Access does not support stored procedures or triggers, while those are a feature of SQL Server, Oracle, MySQL, etc. If employers expect students to know how to create stored procedures and triggers, then the software tool selection process should take that into account. In other cases, an educational (or evaluation) version of a software tool with a limited feature set may have been developed especially for teaching or assessment purposes. In some instances, this results in a huge cost reduction in terms of purchasing licenses (Denton & Peace, 2003; Foshay & Ahmed, 2003). Elements include operating system, processing power, compatibility or required peripherals, storage space, network capacity, ease of installation and setup of the software, technical support, security and stability and speed.

2. *The Instructional System*

Regardless of type, these technologies need to be designed to fill a particular role in a plan of curriculum and instruction. Foshay & Ahmed (2003) uses six factors to determine how well it will fill its role; the software's organization, internal consistency, learner control, flexibility, interactivity, and the way in which it defines the teacher's role.

- Organization: As stated earlier, industry technologies are usually used to teach concepts in Information Systems, and these are technologies that are used in real life organizations so that students can see how the concepts are applied in a realistic manner. Parker (2010) states that it is important to check to see if the organization will be logical to learners as these technologies should help learners to see both the "big picture" and the minute details of these concepts. When lecturers use actual companies as case studies for students to get a clear picture of how business processes work in real life they will look for the company

which closely represents what is being taught, and which will help students grasp basic concepts (Fedorowicz et al., 2004; Strong et al., 2006).

- Internal consistency: This refers to the consistency that should exist between the objectives of the curriculum and the outcome of the technologies used (Foshay & Ahmed, 2003). Lecturers should therefore ensure that technologies used achieve the goals of the course as stated in the curriculum. Using tools that do not help achieve the goals set in the curriculum defeats the whole purpose when used because it is important that the tools used help students grasp core course concepts. The IS2020 model curriculum provides a guideline of the skills that students are supposed to have, and these technologies should ensure that students are equipped with skills and concepts that align with this guide (Parker, 2010; Topi, 2019; Topi et al., 2010).
- Flexibility: Some kinds of software are monolithic in structure and can be used in only one way. Other kinds of software, such as SAP, emphasize modular structure and can be used in many ways but may require more preparation on your part to use the software effectively. Availability of teaching material in this case would have to be a factor in determining whether a particular technology is suitable for the course since class exercises and tutorials would be helpful for students to learn on their own how the software works (Beise, 2006; Fedorowicz et al., 2004). The flexibility of the software will allow you to use it as you wish. The more flexible a tool is, the better because one can tailor it according to what one wishes. This means the lecturer can personalize the tool to suit the needs of the student.

3. Content/Information Subsystem

This is characterized by the following components.

- Completeness and Accuracy: Content should be correct, current, accurate and complete at the level of detail appropriate for the learners and the purpose, assuming neither too much nor too little prior knowledge. The "big ideas" and central concepts of the topic should be emphasized, and the connections within and between topics and disciplines should be explicit.
- Alignment: Look at how well the objectives or topics of the software correspond to the objectives of your curriculum. The curriculum guides which content students are meant to

know, depending on the skills that they are supposed to have. Topi (2019) states that the IS2020 curriculum, which is the model curriculum for the IS course, dictates what skills IS graduates are supposed to have. Therefore, tools selected should also make sure they enable students to be equipped with these skills and offer them the chance to carry out the course objectives.

- Prior Knowledge: Some tools used need students to have some background knowledge, whether in a business context or even technical term. One should ask themselves if the software's assumptions about the learner's prior knowledge are appropriate to the learners. IS is a discipline which accommodates learners from different disciplines ranging from humanities to science. This means that not everyone might not have a technical background, and this should factor into the evaluation process.

4. *Instructional management and assessment subsystem*

This subsystem is made up of accessibility components.

- Access: Accessibility for students, both on and off-campus, is another important consideration. This encapsulates the ease and cost for students of acquiring and installing the software on their computers if needed, to use it away from campus. Some of the technology tools require institutional technical support, particularly if installed on a campus server linked to a campus network and subject to security requirements, which can restrict or keep access from off-campus, and possibly struggle with the tools' configuration.

While Foshay & Ahmed (2003) approach to evaluating industry tools give a comprehensive cover core aspects that should be considered during the selection of these tools, the approach does provide a certain level of structure since it tries to cover all necessary aspects. However, it fails to specify the level of flexibility the model is, considering the dynamic nature of these technologies. The evaluation process is very subjective, where one's choice in tool might differ from another is because of different factors or reasons. Foshay & Ahmed (2003) states that "This means that tools useful in educational settings must be able to perform tasks which are part of the curriculum, in ways which correspond to the curriculum. They must be easily mastered by the learners (and teachers!), and they must use language and assume knowledge and have a frame of reference which corresponds to that of the learners". Foshay & Ahmed (2003) goes on to highlight that educator

need to make assumptions about the tasks for which these tools will be used, the users as well as what the goals will be.

Additional Factors that may affect which tools are used:

Pedagogy

Pedagogy as a factor means that people choose tools because of the specific functions and features that support the concepts they want students to learn in the course (Beise, 2006; Denton & Peace, 2003). Institutions mostly rely on model curriculum, industry demands, and a lot of other sources to know which information is relevant to the student. The choice of tool which will be selected for a particular course depends on whether the technology will possess the functionalities which will equip the student with the required skills. This is the primary factor, as the technologies which will influence which tool to use as students are meant to be taught information that aligns with the curriculum as well as industry needs.

Costs

Parker (2010) emphasizes that software cost includes two criteria: financial cost and availability of an academic version. Reasonable financial cost refers to the price to acquire the technology. This may involve individual packages or a site license for a network version. Factors to explore include academic discounts for educational institutions, alliances in which the university or department can enroll, or the availability of a free, downloadable trial version (Parker, 2010). For example, Microsoft offers a university license which offers a discount for students, so most institutions get access to Microsoft's tools at a cheaper price (Katiyar & Bhujade, 2018). The availability of an affordable version of the software tool allows students to install the development environment on their personal machine, making it convenient for them to work on their assignments even when the computer lab is not accessible especially now, in the COVID-19 pandemic. If a student version is unavailable and the department uses a network-based version, then students may have to work on assignments in campus labs, restricted by hours of operation, availability of transportation, etc. The cost factor is another reason why a lot of institutions choose

to use open-source software as opposed to proprietary software (Beise, 2006). Open source or free software presents an alternative to commercial enterprise

Industry relevance

This category refers to the degree to which the software tool under consideration has been embraced by the professional community (Parker 2010). Students must be taught content that aligns with the current practices and offers them skills in tools used in industry as it will help them perform better when working as well (Bain, 2017; Recker & Rosemann, 2009). Oracle is one of the most common tools to be used in undergraduate database courses now. This is because of its widespread use in industry and the edge it gives students when looking for an entry-level job (Beise, 2006). Industry relevance, also known as industry penetration, can be assessed based on current and projected usage, as well as the number of current and projected usage, as well as the number of current and projected job openings that require familiarity with the tool. Software tool selection is often driven by demand in the workplace, i.e., what employers actually use (Denton & Peace, 2003).

Faculty skillset and support

This category looks at the level of and need for documentation, training, and support for both instructors and students. Availability of documentation and support considers the availability of support staff, including computer lab staff and/or network administrators, to support the teaching and administration of a software tool. Beise (2006) notes that some packages require institutional technical support, especially if installed on a campus server linked to a campus network and subject to security constraints, which can limit or prevent access from off-campus, and potentially conflict with the software configuration. This criterion should also consider the availability of support through forums or listservs on the Internet, as well as vendor support. Training includes not only the training required for instructors and support staff, but also the time needed to learn a software tool and the availability of qualified instructors to teach a course using that tool (Parker, 2010). The long-term success of being able to sustainably incorporate technologies in IS highly depends on the ability to create a large pool of faculty who are knowledgeable and willing to take on the challenge (Fedorowicz et al., 2004). The challenge lies in finding and retaining faculty who have

enough experience or training to not only teach but also continuously develop the necessary teaching materials and data sets (Mwalemba, 2019). The attractive industry salaries for IT specialists and the amount of effort required to prepare the needed teaching materials result in this shortage of faculty with the needed skills to teach using these technologies (Mwalemba, 2019).

Institutional values

The authors found a suitable framework for integration of the software into the institution and customizing it to suit the institution's needs and highlighted those institutional guidelines and policies relevant to selecting proper software must be taken into account, as must specific evaluation criteria (Parker, 2010). This is a common challenge, in cases where a new tool or technology is introduced within the curriculum. In some cases, conflicts can occur between teacher's beliefs and their actual practices which are as a result different personal experiences, values, etc. (Toohey, 1999), defined curriculum ideologies as the value premises from which choices about practical educational issues are made of. A. D. Tatnall (2010)t goes on to explain that these beliefs are a result of our past encounters of education, especially our comprehension of our discipline and our own social, cultural, or political values. These can also be consciously held and can be clearly articulated, the result of a process of examining and refining their values and working out how these might be applied when selecting tools to be used for the practical elements of the lesson (A. D. Tatnall, 2010; Tytler et al., 2011).

Implementation of technologies in the curriculum

Lecturers have adopted several frameworks for adopting industry software/ tools in the curriculum and these include those which classify the adoption of industry technologies into the IS or business curriculum in terms of its depth and breadth. The depth of adoption refers to the level of immersion or adoption at which the ERP system is introduced into a curriculum, and this can be done incrementally. Guthrie and Guthrie, (2000) describe five levels of ERP adoption depth into the business curriculum. The least immersive means is the level where systems are discussed at a theoretical level, requiring students to understand conceptually what ERP systems do but not use the actual ERP system. At the tutorial students simulate transactions using a Web browser, or CD-ROM, simulation tool or tutorial. At the laboratory Project level and higher, students must enter transactions into the actual ERP system. The most immersive means of adopting ERP education

into the classroom into the classroom is the Integrated Practicum level with a full ERP system, requiring students to use hands-on exercises with assignments which merge business disciplines so that they can experience the full integration capability of the system. These levels can thus, be grouped into three approaches, which in this study will be referred to as *lecturers only*, *tutorial*, *and hands-on approach*. The breadth of the solutions used in a programme are characterised into four levels, and these apply to the active approaches. The breadth of the educational experience will increase as the involved team grows from a single faculty to a multi-faculty team from different departments and faculties.

Level of Immersion	Description	Advantages	Disadvantages
Enterprise Model	Exposure to ERP through class lectures and demonstrations.	• Requires only individual faculty expertise. • Does not require massive installation or databases to support student work. • Cost Effective.	• Students lack hands-on exposure to integrated functional areas. • Program lacks prestige of having ERP integrated curriculum.
Tutorial	Web and CD-ROM based training in specific systems that students perform outside of the classroom.	• Requires little faculty expertise. • No ERP installation necessary. • Students gain near hands-on, exposure to ERP without a massive investment in resources. • Cost Effective.	• Assignments and exposure is tertiary to course experience. • Inflexible materials.
Laboratory Project	Some level of ERP is implemented so that student's perform hands-on assignments, requiring them to access, manipulate and report information using the ERP system.	• Offers hands-on, relevant exposure to ERP. • Students acquire marketable ERP skills. • Provides practical integration of business disciplines in the classroom.	• Requires higher level of faculty and organizational support. • Need integrated database to support assignments. • Need to restyle existing curriculum to integrate ERP.
Dedicated Course	An entire course dedicated to teaching the particular skills and concepts associated with the ERP system.	• Offers hands-on, relevant exposure to ERP. • Students acquire marketable ERP skills. • Provides practical integration of business disciplines in the classroom.	• Requires higher level of faculty and organizational support. • Need integrated database to support assignments. • Need to add new course to existing curriculum.
Integrated Practicum	Integrated, term-long project in which students use ERP systems as they would in industry.	• Offers hands-on, relevant exposure to ERP. • Students acquire marketable ERP skills. • Provides practical integration of business disciplines in the classroom.	• Requires higher level of faculty and organizational support. • Need integrated database to support assignments. • Need to add new course to existing curriculum.

Figure 3: Level of adoption depth adapted from(Guthrie & Guthrie, 2000)

Recker & Rosemann (2009) states that the approach for implementation highly depends on the course being taught. The authors use Business Process Modelling as an example and highlight that using familiar case domains (such as Amazon or Deloitte) for this course is optimum and popular as it is allows students to focus within the assignments on the knowledge transfer of process modelling methods and methodologies, rather than just mere demonstration of concepts. Studies suggest that students will not transfer knowledge across domains unless they master the problem-solving methods and techniques they are seeking to apply. In the context of information systems, this suggests that students should be presented with a learning environment in which they can strengthen and deepen their methodological and technical knowledge so that they can apply this knowledge across the domains they will be confronted with in business practice (Radermacher & Walia, 2013; Recker & Rosemann, 2009).

Related work

Lancor (2008) also gives a detailed explanation of the process of evaluation and selection of technologies for a collaboration tool set to describe the experiences of selecting a collaboration tool for a software engineering course that requires group work throughout the semester. The selection process was less structured than the studies previously discussed, focusing on type (project management or collaboration tool type), pricing, installation requirements, and other common features. This study, focused more on the tool selected rather than the selection process for the tool. This is a particularly interesting study because it identifies social factors being part of the process as well. Details about the lecturers and students themselves, might come into play in shaping their personal experiences. Apart from institutional and faculty values, personal values matter when using these technologies. The role that they play will in turn, differ as a result of differing opinions and forces that exist. This is different from the initial study Lancor & Katha (2013) as the selection processes for the tools differ as it might be the same course, but different components of the course which means there are different approaches to it. The personal experiences the staff comes into play especially one being for project management and one for software engineering course.

Another study is that done by Parker (2010) does a comparative study in database software tool selection used in IT and IS. The study draws from previous studies such as Beise (2006) and

Denton & Peace (2003), which have done similar studies. The study provides a structured approach to software tool selection and argues that a formal approach is needed to deal with inconsistencies and subjectiveness which come up in the initial study. The software selected for use in database courses can generally be categorized as one of three types: commercial enterprise software, such as Oracle or IBM's DB2, Microsoft Access or open-source software, such as PostgreSQL or MySQL (Denton & Peace, 2003). Beise (2006) derives several criteria that determine the choice of software, including cost, technical support, supporting resources, industry relevance and accessibility. The author points out that the results of the analysis are consistent with that of Denton & Peace (2003) whose criteria included cost, ease of use, security, functionality, job market appeal and compatibility.

How to effectively improve the use of technologies when teaching

Clegg (2000) proposes several sociotechnical principles for system design, where the meta-principles discussed by Clegg (2000) will be considered as they can also be applied to the design of a policy for selecting industry technologies for undergraduate studies in IS. These principles are suitable with this study as they collaborate with the Activity Theory, which is the theoretical framework used in this study. The following are listed below:

1. *Design is systemic*

A sociotechnical perspective explicitly embraces the idea that all aspects of a system are interconnected, that none should take logical precedence over the other, and that they should be designed jointly. Therefore, all the nodes in the activity system deduced in this chapter should be treated equally and with the same consideration throughout. Consider the introduction of a new tool to the curriculum for a particular course. What impact will this have on the students' skills development, and on the lecturer's teaching and how will they respond to such change? What impact does this have on the existing policy and practices that student use? Will the introduction of the tool require additional resources and support? Lecturers should make every effort to trace through the possible impacts of the choices they make for example, from how it impacts the relationship with existing vendors, as well as the cost structure at large.

2. *Values and mindsets are central to design*

Values and underlying mindsets are critical to a sociotechnical perspective. They can be articulated in several different ways but in this study, include both institutional, faculty and departmental

valuers at large. For example, some institutions prioritize accessibility of tools to students, where students should be able to use a tool without having to incur additional costs meaning if a tool fits the purpose, the university should cover the cost of the tool itself. Academic licenses usually decrease these costs and makes it better for the department at large. Personal values will also come into play, and this is crucial as such a policy would have to recognize that decisions can be subjective, where lecturers and students will have different perspectives. The study recognizes that lecturers can have different approaches to teaching IS, highlighted in different implementation choices, or types of tools used, and this is based on the goals that the lecturers intend to achieve. Clegg (2000) argues for the need to challenge existing practices and norms by asking questions such as "What are the roles of the humans in this system", "What alternatives ways are there of configuring the work", "What are the costs and benefits of the alternatives at hand". Existing tools should always be open to criticisms and raising such questions and challenges these practices.

3. *Design involves making choices*

There are always choices that need to be made in the design of sociotechnical arrangements (Clegg 2000). This entails recognizing all the various factors that might come into play, ease of use, popularity in industry, software requirements needed, ease to teach, considering academic background of students and others. Key choices then include how the overall system will be impacted, and what changes need to be managed and organized, what types of technology will be required, or what teaching style is needed to support the use of these tools.

4. *Designs should reflect the needs of the business, its users and their managers*

A system needs to be useful, to meet some articulated purpose, to meet the needs of the businesses, it's users and their managers. Such practical concerns may be based on current or future needs where in this case, it would be based on the faculty needs of investing in work ready graduates

Literature Review Conclusion

Figure 5 below shows a summary of the factors which affect the selection of industry technologies identified in previous studies.

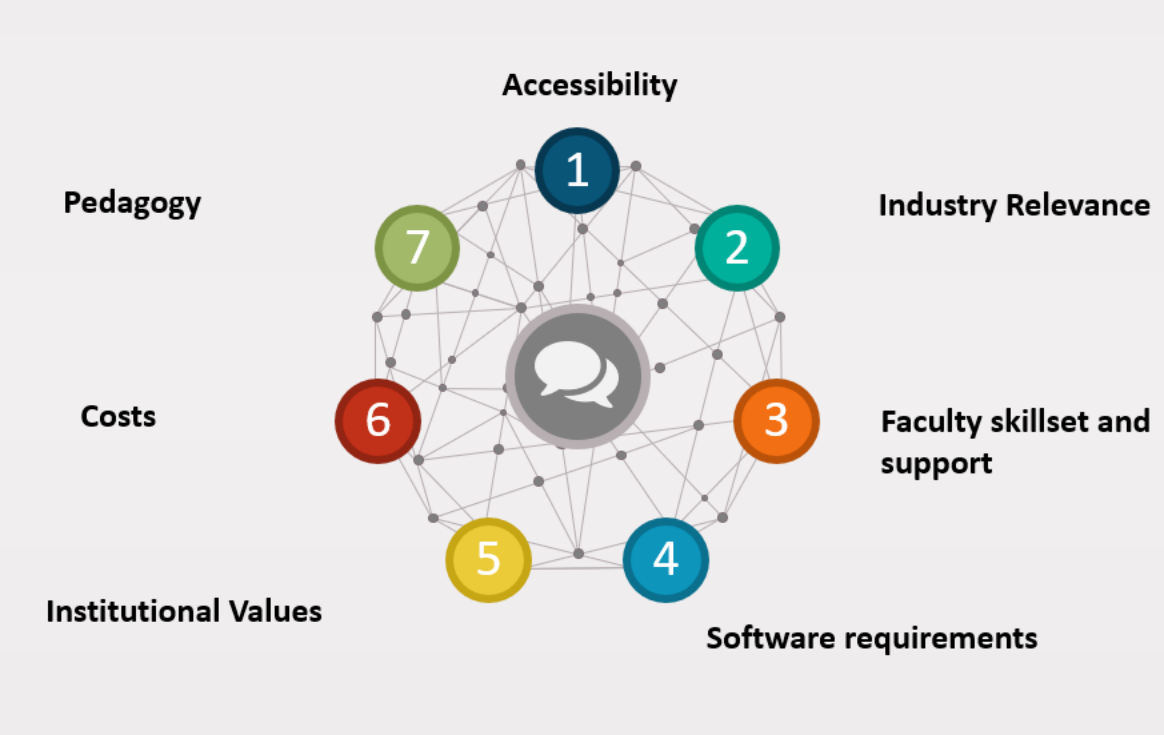


Figure 4: Factors affecting selection of industry technologies

While the studies do provide a comprehensive analysis of the selection of tools, and Parker, (2010) even better so, investigates tools used in IS, there is still a lack of more recent studies. Considering the dynamic nature of the field, the atmosphere in the industry now will still make it difficult to keep up with these technologies. More so, the roles of the institutions themselves and the faculty values and staff themselves need to be understood, and these studies did not provide a broader view on this. This study seeks to contribute to the existing body of literature by giving a comprehensive or broad approach at seeing what roles information systems industry technologies play in higher education. Therefore, there will be a need to use a holistic theoretical framework to understand the many rich interlinking concepts that exist in a higher education context. The study proceeds to the methodology, using key concepts detailed in this chapter to formulate data collection and data analysis methods.

CHAPTER 3: THEORETICAL FRAMEWORK: THE ACTIVITY THEORY

According to Karanasios (2014), the Activity theory (also known as the cultural-historical theory), which is also known as the cultural-historic activity theory has its roots in the concepts of the school of Russian psychology, which drew largely upon the works of Vygotsky (1978) and others such as Leont'eve (1987). The Activity Theory can be used to analyze and understand many concerns around higher education, such as teaching and learning (Bligh & Flood, 2017). The theory has a strong reputation for being imported from other departments such as sociology and psychology (Bligh & Flood, 2017). Bligh and Flood (2017, p.5) defined the concept of activity as, "The relationship between the subjective and objective within a single reality, where the reality is presumed to exist before individual human experience, to be socially and culturally produced, and to be immensely dynamic notwithstanding apparent stability or regularity." Activity theory makes a clear distinction between *activity*; meaning collective, sustained human effort, *action*; individuals or sub-groups time-bounded pursuit of goals; and *operation* meaning what individuals do without pre-meditation (Bligh and Flood, 2017). It is important to make a distinction between these terms as they can be confused resulting in the terms being used interchangeably, which should not be done. The theory centers around the unity of **consciousness** and **activity**, considering cultural and historical influences on human actions (Crawford & Hasan, 2006; Granata & Dochy, 2013; Murphy & Rodriguez-Manzanares, 2013; Russell & Schneiderheinze, 2005). The activity theory looks at a **human activity** that can be defined as an activity in a specific social setting. A model of the structure of the activity system is depicted below. This model shows how different components of activity interact using tools (instruments or artifacts) to mediate the activities, showing the impact of the other elements; division of labor, community, rules, and outcome as presented below.

According to, (Hashim & Jones, 2007; Karanasios, 2018; Wolff-Michael, 2004), an activity system consists of **subjects**, who exist in a **community**, that act on an object to produce a certain **outcome**, which is the overall purpose that motivates an activity. The viewpoint of the subject is the one which is adopted, although the theory acknowledges the views of all the elements in the system, a concept given the name **multi-voicedness** (Bligh & Flood, 2017). This is the source of transformation in the system, as members of an activity system carry their diverse histories and

the system itself carries multiple layers and strands of history engraved in its artifacts, rules, and conventions (Korpela et al., 2002). Taking the activity of teaching IS using industry technologies as an activity system, the lecturers (*subject*) act on student's understanding to equip students with current skills that are vital for use in industry (**outcome**).

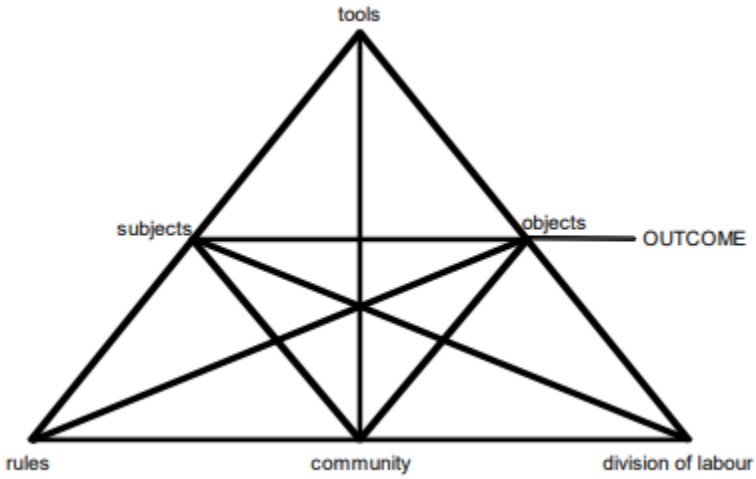


Figure 5: An AT perspective on the use of industry technologies in the teaching of IS at the undergraduate level

The **subject** does not operate directly on the object but makes use of tools to interact with the object. The **object** refers to the raw material or problem space at which the activity is directed, and which is molded or transformed into outcomes with the help of physical and symbolic, external, and internal tools and this precedes and motivates activity. **Tools** mediate the object of activity. This can be external, material e.g. textbook or a computer or internal, symbolic e.g., language, which can be desired or unexpected. Tools can enable or constrain activity.

Community refers to the participants of an activity system, who share the same object. The **division of labor** involves the division of tasks and roles among members of the community and the divisions of power and status (Bligh & Flood, 2017). This entails who makes the most important decisions, around the curriculum, the teaching, from top-level management to lectures are involved in the teaching of the subject in higher education institutions, whilst curriculum bodies, oversee revising the curriculum. **Rules** are explicit and implicit norms that regulate actions and interactions within the system. This can be in the form of IS curriculum ideologies that are

held by the lecturers, which can be explicitly or implicitly defined, brewing from personal experiences, opinions, and cultures that the department holds.

Principle of contradictions

This study uses the principle of contradiction to analyze the data gathered in this study. Contradictions are very important in the study of social settings because of the way they result in change and development. The way they bring about change in a setting vary depending on the contexts. In some contexts, they appear as tensions, in others as breakdowns, conflicts or clashes between people, their cultures, practice or beliefs, dilemmas, discoordination. Studies within an educational setting suggest that contradictions are often dressed in forms of limited tools and infrastructure, training of teachers, misalignment of academic calendars, culturally inappropriate pedagogical models, academic socialization, technological access, methods of learning accreditation and diversity in backgrounds, cultures, values and beliefs of students (Kamanga & Alexander, 2020; Marwan & Sweeney, 2019).

There are four main levels of contradictions according to Ekundayo et al. (2012): primary, secondary, tertiary and quaternary. Primary contradictions describe what are referred to as ‘inner contradictions. These types of contradictions occur within each constituent element of the central activity system. Ekundayo et al. (2012) uses disagreements in practice of students because of indifferences in their backgrounds, cultures, or beliefs as an example of a primary contradiction. Secondly, secondary level of contradictions exists between the constituent elements of the central activity system. For example, Ekundayo et al. (2012) identified contradictions between subjects and division of labor within a school setting with regards to ICT integration; a teacher was willing to use ICT in her teaching and even make use of various technologies in her courses but finds the support of school administration rather insufficient. Both the primary and secondary levels of contradictions exist within a single activity system. The tertiary level: contradictions in this case, appear between the dominant form of activity with the object of a culturally more advanced activity. Lastly, is the quaternary level of contradictions. These are seen between the central activity and its neighbor activities within its network relations; in other words, quaternary contradictions exist between each entity of the dominant activity and the entity-producing neighboring activity.

Why the Activity Theory?

The study contributes to the existing body of literature by serving as a lens for analyzing elements at work in an activity system, and dynamics that arise in the relationships (Russell & Schneiderheinze, 2005). Furthermore, the theory gives a rich holistic understanding of how individuals do things along with the help of sophisticated tools in complex dynamic environments (Russell & Schneiderheinze, 2005). The theory underpins the analysis of the dialectic interactions between individuals and how technologies shape and are molded by human action Crawford & Hasan (2006). The model; relates activity as a collective and multi-voiced endeavor, taking into consideration multiple points of view, traditions, interests and interactions between participants (Ekundayo et al., 2012). Furthermore, the theory emphasizes the mediation between the elements of activity within the system, where mediation represents the nature of relationships existing within and between participants of an activity in each community (Ekundayo et al., 2012). *In other words, the relationship between the subject and object is mediated by tools, that between the subject and community are mediated by rules, and the relationship between the object and community is mediated by the division of labor* (Ekundayo et al., 2012) . Thus, the AT, makes a perfect fit for this research as it focuses on mediation between elements found in the teaching and learning of Information Systems in universities using industry technologies.

Key Findings and Assumptions

This study describes industry technologies as, "IT applications or software packages used by lecturers to demonstrate certain practical concepts in class or as support for the theoretical concepts for courses in Information Systems which are mostly used in industry." The selection and implementation of these tools is based on several various factors including cost, familiarity, feature set, software, personal values and experiences, demand in industry and institutional factors. The study uses the Activity Theory and explains the various roles of each node in an Activity System. The nodes are subject, object, tools, division of labor and community and these all work together to produce an outcome. Activities also develop **contradictions** which are historically accumulating structural tensions within an element of an activity. For instance, in the introduction of new technology, lecturers could find it challenging to incorporate the new technologies into the already existing curriculum because of conflicts between teacher's beliefs and their actual practices. There are four types of contradictions, including Contradictions also indicate

inefficiencies, inconsistencies, or incompetence, as a result revealing emerging opportunities for change and improvement (Hoffmann et al., 2020).

One of the problems stated in the beginning of this chapter, is the lack of studies around the topic. There is a substantiate number of papers which go beyond 2005 such as (Lightfoot, 1999; A. Tatnall & Gilding, 1999; Toohey, 1999). These papers were all published in 1999, which is more than twenty years ago. One turns to wonder if concepts in older studies will still hold in the present and soon. The IS discipline is a dynamic one, with constantly changing technologies, and recent studies could be considered as more helpful in this. The next chapter looks into incorporating the theoretical framework in the research study, together with the research questions to formulate a methodology which seeks to achieve the research's objectives.

CHAPTER 4: RESEARCH METHOD

This chapter consists of the methodology and philosophical aspects of the study. It contains details on how the study was carried out, what data was collected, the analysis, as well as the main paradigms, research approach and philosophical constructs. The chapter gives a detailed account of how data was collected, including what methods were used, participant information how the data was analyzed, and the time frames included in this study. The study hopes to answer the following research questions; **Main research question**: *How are IS industry technologies selected and incorporated into teaching?*

The **sub-questions** are as follows:

1. *What industry technologies do lecturers use when teaching undergraduate information systems?*

2. *What are the implications of using these industry technologies on the students?*

Epistemological Position

This study adopts an interpretivist approach as its epistemology. The interpretivist's epistemology centers around the notion that people's perception is subjective (Saunders, Lewis, Thornhill, 2009). Interpretivism argues that the study of social phenomena requires an understanding of the social worlds that people inhabit, which they have already interpreted by the meanings they produce and reproduce as a necessary part of their everyday activities together (Kivunja & Kuyini, 2017). Interpretivism suits this study well because the study seeks to explore the various factors and dynamics which go into the process of selecting, implementing, and using industry tools in an undergraduate IS curriculum using the Activity Theory. The study recognizes an activity as an 'instrumented' structure of activity within a 'system of interrelationships' between people, therefore interpretivism suits the study more.

The chosen epistemological stance is also motivated by how perfectly it aligns with the Activity Theory. The interaction between subject and object, using tools, is seen as social (Russell & Schneiderheinze, 2005). This is because the lecturer's choice of technology or strategy is influenced by the various actors surrounding the subject. This interaction consists of community,

rules, division of labor and these components work together to produce an outcome, which is what motivates the use of interpretivism. Thanh and Thanh (2015), in agreement with this, point out that interpretivism usually seeks to understand a particular context. The core belief of the interpretive paradigm is that reality is socially constructed. This is the same for the students' use of industry technologies.

How people view reality depends upon the social context. Interpretivism, therefore, advocates that the researcher must understand differences between humans in our role as social actors (Mead et al., 1995) . Interpretivist researchers discover reality through participant's views, backgrounds, and experiences (Thanh and Thanh, 2015). The researcher uses these experiences to construct and interpret their understanding from the gathered data. For this study, the researcher aims to understand the world of participants Cohen and Manion (1994) through gaining insight into their backgrounds, beliefs, and experiences on their teaching practices and use of technologies in IS (Cresswell, 2003; Yanow and Schwartz-She, 2011) which will then help answer the research questions formulated.

Another reason for using an interpretivist approach is that the main alternative philosophy, positivism, is incompatible for this study. Positivism assumes reality is objective and is independent of people's perspectives (Kilani & Kobziev, 2016). This would mean that all lecturers, regardless of faculty and institution, use the same technologies for IS and follow a guided process for the selection of these tools where they do not need to rely on their intuition and knowledge on how to implement these tools (Braun & Clarke, 2006; Kilani & Kobziev, 2016). This view conflicts with the literature on the use of industrial technologies in IS which emphasizes that the choice to use technologies depends on various underlying factors as these factors help in achieving the ultimate goal, of equipping a student with the most current, and searched for skills needed for an entry-level job (Bain, 2017; Beise, 2006; Fedorowicz et al., 2004; Mwalemba, 2019). Positivists also accept only one view, while interpretivism is much more inclusive as it accepts multiple viewpoints of different individuals from different groups (Thanh and Thanh, 2015). An interpretive paradigm is suitable for this study as the study accommodates multiple perspectives on how the technologies impact the student.

Ontological Position

The study adopts a subjectivist ontology. Saunders, Lewis & Thornhill (2016) define ontology as the assumptions made about how the world works and the nature of things. Subjectivism centers around the notion that reality is created/ shaped in the mind (Kivunja and Kuyini, 2017). The study aims to understand what goes on in the mind of a lecturer and student while presented with the dilemma of having to choose technologies and implement them. The decision-making process is motivated by external forces as highlighted by the AT, but literature shows the decision rests on the lecturer (Beise, 2006; Nemchinova & Sayani, 2006; Toohey, 1999) It is important to look into one's perceptions, beliefs, and values.

Subjectivists also focus on what is happening between people as they join to create realities (Saunders, Lewis & Thornhill, 2016). The AT highlights that an activity system is characterized by various elements whose interactions or activities are ultimately social and these activities between subject and object or subject and external elements result in change and achievement of the outcome or contradictions which might inhabit these achievements.

Purpose

This study adopts an exploratory research design. Exploratory research aims to make discoveries about phenomena and thus tend to focus on phenomena on which little research has been done (Saunders, Lewis & Thornhill, 2016). An exploratory design is therefore appropriate because, as outlined in the literature review, there is very little research on how industry technologies are selected, used, and implemented in the curriculum and how these tools impact the student. Exploratory studies typically employ qualitative methods that are used to obtain deep meaning and understanding from the perspective of the research subject (Altieno, 2009; Creswell, 2013). Alternative research designs are not appropriate for this study.

Research approach

This study makes use of abduction as the research approach. Kovac's and Spens (2005) describe abduction as systematized creativity or intuition in research to develop 'new' knowledge. This approach is often used to explain anomalies that cannot be explained using an established theory. Abduction uses intuition and this is what differentiates it from induction and deduction. Abduction is also helpful in analyzing concepts that have not been investigated in much detail and this is another reason why this study uses this approach. The study used participant's views on the subject

to build broader themes and generate theories interconnecting the themes. The study essentially uses the AT to explore the surrounding phenomena of industry technologies in IS education. (Soiferman, 2010, p.1) defines induction as, "…moving from the specific to the general".

Another reason for approaching this study using abduction is, the alternative approaches, deduction, and induction, would not be appropriated as it would not help in answering the research questions or in achieving the goals and objectives set. Induction as a research approach is widely used in qualitative research as shown in previous studies but would not be suitable for this study because the research is using an existing theory already and uses this, as well as data collected from the study to help informed conclusions. Soiferman (2010) defines the deductive research approach as arguments based on laws, rules, or other widely accepted principles. These studies are usually best suited for quantitative studies and since this study is qualitative, no set hypothesis needs to be disproved or proved, therefore, making a deduction, not possible.

Strategy

This study employs a case study as its strategy. A case study allows analysis of phenomena to be investigated in a real-life scenario (Saunders, Lewis & Thornhill, 2016). According to Ponelis, (2015), the purpose of case studies is to provide an intensive, holistic description and analysis of a single, bounded unit situated in a specific context to provide insight into real-life situations. Interpretivism tends to favor case studies like these can give rich data that is necessary for interpretivists to fully understand contexts. Human behavior is significantly influenced by the setting in which it occurs; thus, one must study that behavior in those contexts. A case study is suitable for this study because it allows the researcher to understand the use of industry technologies by looking at a Department of IS in a real-life scenario and be able to look at the unit of analysis as a whole and understand how students and lecturers operate the teaching and learning of IS. Research must be conducted in a setting where all the contextual variables are operating (Atieno, 2009). The choice of the case study method is supported by the literature review which demonstrated that previous research on this topic also predominantly employs case study methods. A case study can consist of single or multiple cases (Levitt et al., 2018). In this study, a single case will be examined to obtain the necessary depth of understanding. Given the time constraints of the research project (1 year) a single case is also more practical. A case study should also employ

multiple sources of data such as observations, documents, interviews, and reports (Levitt et al., 2018). This study used interviews and document analysis as data collection methods.

Research choice

This research makes use of qualitative methods. Researchers believe that the interpretive paradigm predominantly uses qualitative methods. Interpretivism views the world through a "series of individual eyes" and chooses participants who "have their interpretations of reality" to encompass the worldview. Instead, according to defenders of interpretivism, qualitative methods are approachable means for examining reality. Following the above points, Levitt et al., (2018) states that "qualitative research is a means for exploring and understanding the meaning individuals or groups ascribe to a social or human problem". To understand the contradictions which arise in the IS community, we must use qualitative methods to understand and retain the deep and meaningful insights from the participants. (Cao Thanh & Thi Le Thanh, 2015) state that, "In educational research, if scholars seek understandings and experiences of a group of students or teachers, qualitative methods are likely to be the best-suited methods." In that case, using quantitative research, which describes the world in numbers and measures instead of words, is not likely to be productive, thus only qualitative methods will be used.

Time horizon

The study was cross-sectional which means it was done within the space of two years. The nature of the research questions and the type of data collected was seen that it was possible to collect the data within two years, also considering the convenience of the data collection process as data was collected out of convenience.

Techniques and Procedures (Data Collection and Analysis)

Case Description

This study employs a constructive approach, and, in this case, the context is important in understanding the phenomena. The unit of analysis is an IS department at one of South African top universities. The Department of IS forms part of the Commerce Faculty, together with the Economics, Management, Accounting, Finance and Tax, as well as the Graduate Schools of Business. The department is also part of the School of IT, which was launched in response to the growing needs of the South African and global tech industry, and the increasing demand for

university -qualifications in the sector. The school of IT acts as a bridge between the faculties of Science, Commerce and Humanities and offers a wide variety of courses and programmes to suit a student's personal interests and aptitudes. The department has a range of staff members with many years of experience and a broad range of technical skills, non-technical skills, and research methodology knowledge. The department of IS has 20 IS lecturers, who have different positions in the department, varying from lecturer, professors, and associate professors. A closer look at the department shows that it consists of a wide catalogue of qualifications and courses accommodating students from 1st year to postgraduate levels as well.

The study focuses on the undergraduate curriculum, and this department uses a curriculum which is aligned with the IS2020 international standard for IS. The IS degree is offered under the Faculty of Commerce, Science as well as Humanities. The BCom degree is offered as BCom IS module and either a combination of either IS and Computer Science or IS and finance and in other instances, students can major in other subjects as well. The study finds students important to answer the research questions because it's important to understand students' perception on how these tools are used and incorporated in their studies. Grossman et al. (2017) explains the importance of putting students at the center of curriculum development as, every decision made affects them at the end. Answering the research question, "What are the potential implications on the student?" ultimately helps us understand the role of these technologies in IS Education by also looking at these tools from the student's lenses.

Description of data sources

Primary sources

The study interviewed ten lecturers from the Department of IS, nine of which lecture IS at an undergraduate level. One is the Head of Department (HOD) from the department and has less teaching duties, however he oversees the staff and offered a high-level perspective of the department, thus, is crucial to the study. Table 5.1 shows the diverse nature of the lecturers who were interviewed. Out of the 20 lecturers, only 10 responded to the email invitation and this is owing to the COVID-19 pandemic which could have limited the number of responses. (Biggam, 2008) states that fifty percent of the population is deemed a suitable sample size to work with when it comes to qualitative studies. The table is characterized according to role, years of experience, course convenor. Of the 10 respondents, 2 were lecturers, 3 senior lecturers, 4 Associate professors

and 1 head of department (H.O.D). These participants all varying years of experience with the minimum being 2 years, and maximum 21, who are more senior lecturers and therefore have been in the department for quite a long time. Only 3 lecturers are not course convenors, and these are the HOD, and 1 senior lecturer as well as a newly joined lecturer. Most of those interviewed were 'course conveners', a title used within the university to refer to the academic staff responsible for the overall running and administration of a specific course. While a course may have multiple academics teaching on it, it only has one convener providing educator oversight.

Table 2: Participant information - Lecturers

Codes	Role	Years of Experience	Course Convenor
L01	Associate Professor	6	Yes
L02	Lecturer	2	No
L03	Associate Professor	21	Yes
L04	Lecturer	3	No
L05	Senior Lecturer	9	Yes
L06	HOD	21	No
L07	Professor	18	Yes
L08	Senior Lecturer	5	Yes
L09	Associate Professor	14	Yes
L10	Senior Lecturer	12	No

The study also interviewed full-time students who studied IS at an undergraduate level at the same university. A total of eight students participated in the study, and their information is displayed in table 5.2 below. At the time of data collection, the students were doing postgraduate studies, either

honors or master's at the university, majoring in either IS and/ or Computer Science. The students interviewed did BCom, Business Science and Bachelor of Science. Two of the students, majored in both IS and Computer Science, whilst all the other students majored in IS. The participants represented the student body of the IS department, and the number of respondents were also limited due to the pandemic and online learning since it was difficult to reach out to students through an online platform.

Student Information

Table 3: Participant information - students

Code	Undergraduate Degree	Current level	Majors
S01	Commerce	4th Year	IS
S02	Commerce	4th Year	IS
S03	Commerce	4th Year	IS
S04	Commerce	4th Year	IS
S05	Science	4th Year	IS and CS
S06	Commerce	4th Year	IS
S07	Commerce	Master's	IS and CS
S08	Commerce	4th Year	IS

Secondary sources

Secondary data was extracted from 10 course outlines which were coded as below. The 11th document was a document which was compiled from a workshop carried on in the department in 2019.

Table 4: Course Outlines

Code	Description of Course Outlines
C01	Information Systems 1
C02	Systems Design and Development
C03	Business Intelligence and Analytics
C04	Information and Communication Technologies
C05	Systems Development Project
C06	BPM and Enterprise Systems
C07	Electronic Commerce
C08	Business Analysis and Systems Analysis
C09	Application and technology development
C10	Enterprise systems and BPM 4
C11	IS2019 workshop excerpts

Data Analysis

Data was analyzed using a thematic analysis approach to identify themes that emerged from the collected data. Thematic analysis is a method of analyzing qualitative data whereby the researcher closely examines the data to identify common themes, topics, ideas, and patterns that come up repeatedly (Aydin et al., 2013). The process was iterative, in that it was done in a various number of different approaches namely, familiarization, coding, generating themes, reviewing themes, defining and naming themes, and writing up. These processes were done twice to ensure consistency and to make sure the data was done thoroughly ensuring all the themes are identified in the data. The thematic analysis gives the data a lot of flexibility in interpreting the data and allows the researcher to approach large data sets more easily by sorting them into broad themes

(Aydin et al., 2013). This also helps in looking into the individual nodes identified in the AT, i.e., the subject, object, etc., and explore the common themes that come up during the data collection process. Studies show that thematic analysis is used when you are dealing with interview transcripts to find out people's views, opinions, knowledge, experience, or values, hence this makes it a good data analysis tool in comparison to other analysis methods such as content analysis (Aydin et al., 2013). The nodes that were coded are well represented in the table below, as well as the number of occurrences drawn from the codebook attached to appendices below.

Instrument Design (Instruments in Appendix)

For this study, two research instruments were used to facilitate the existing data collection methods. The first is an interview guide which was constructed using the themes surrounding the topic which were listed at the beginning of this study and have been used to structure open-ended questions around the topic, and it was a set of questions one for the students, the other for lecturers. These questions were based on the themes which were found in the literature review such as cost, pedagogy, faculty skillset, and institutional and personal values, cultures, and experiences. The last and final category; had questions around how the lecturers perceive the implications of the use of technologies on students. The Activity Theory was also used to structure the important questions by looking at the various nodes in the activity system and constructed questions around each node.

For document analysis, the researcher went through the department's course outlines as secondary data to supplement the primary data.

Pilot Study (Strategy)

A pilot study was conducted before finalizing the research instruments. The pilot study was aimed at testing if the research instrument was suitable and applicable to the study. The instrument was be tested on two respondents from a university in South Africa. This was done to identify issues, constraints, problems within the data collection process, and means to refine it and make it more applicable and better. The pilot study also aimed to ensure the reliability and validity of the study. The following questions were asked after the pilot study:

- How long did the participants take to consent to the interview?
- How long did the interview last for?

- Did the participants understand the questions?
- Did the participants feel free to answer the questions?
- Do you think all aspects surrounding the use of industry technologies were covered?

Another pilot study was done for the document analysis. Documents collected from the faculty were to be analyzed and the following questions asked:

- How long did it take to gain access to the documents to be analyzed?
- Did the information gathered from the documents answer the research questions provided?
- How long did it take for the researcher to analyze a single document?
- Did the researcher understand the information gathered from the document analysis?

Sampling and Population

The target population for this study is a university in South Africa, as the study is a South African case study. The choice of university was based on convenience. The convenience is because of the researcher being a student at the university in question. Invitations were sent out to lecturers and students in the Department of IS who teach and learn Information Systems at the undergraduate level specifically as soon as ethics was cleared. The participants were chosen voluntarily, i.e. those who respond to the email that was sent out.

Ethics and Confidentiality

Firstly, an ethics application form was submitted to the University's Ethics committee to gain approval to carry out the study. Kelman (1982), proposed 4 measures for which to evaluate the ethics and confidentiality in a study.

1. *Harm and Benefits*: The questions asked during the interview were reviewed by an experienced researcher so that they do not cause any physiological/emotional trauma to the research subject.
2. *Privacy and Confidentiality*: There was no disclosing of personal information to any unauthorized persons or in this study whatsoever. Participant's information was mainly used for the sole purpose of answering the research questions. The name of the university where the department of is kept anonymous throughout the research.
3. *Informed Consent and deception*: The research obtained informed consent from the participants by sending out consent forms with a detailed write-up of all the proceedings

of the study, and what is required from them. Participants were required to sign the consent form for the interview to be carried out. Participants were allowed to drop out of the study at any point in time, and all information related to them would be deleted as well. Transcribed recordings of the interview will be submitted to the university as well as the participants to ensure complete transparency.

4. *Social Control*: The researcher respectably conducted themselves avoided misconduct. The researcher also worked closely with a supervisor who monitored the researcher's progress and also ensured that the appropriate procedures were followed.

Data Management

As previously mentioned, the researcher collected data from the participants and these interviews were recorded on Microsoft Teams and stored on the cloud. When downloaded, these recordings were analyzed and stored on a personal computer which is password protected as well to ensure that no unauthorized persons had access to this data. Research results will be made available on the university's open website where past research is posted, to make it available to future researchers who might want to refer to the thesis. This is according to the university's data management policy

It is important to also note that Data collected was used solely for research purposes. Interview recordings and transcripts will be stored in a secure online folder, where only the supervisor and the researcher will have access to. The data will be kept safe and if the participants wish to have their details deleted, this will be respected.

Timeline

As mentioned, the study was cross-sectional. A timeline of each of the milestones is represented below.

Table 5: Timeline of submissions

Tasks	**Due Dates**
Research design submission	12/09/2020
Ethics submission	12/11/2020
Interviews and document analysis	28/08/2021
Data Analysis	15/11/2021
Final dissertation submission	14/02/2022

CHAPTER 5: ANALYSIS OF RESULTS/ FINDINGS

This section presents the findings after data was collected and analysed. The chapter opens by providing a comprehensive summary of the tools used in the department. A descriptive analysis of the findings is given followed by a deeper analysis based on the theoretical framework. The chapter concludes by providing a discussion and review of lessons learnt in the study.

Selection of tools

The department does not have a formal approach or document to dictate which tools are selected and implemented in the IS curriculum. Lecturers decide which tools to use on their own, and in some instances even leave it up to the students to choose which tools they find most suitable. This is shown in the comments from respondents L07 and L08:

L07: "It's a discussion that happens within the department, but it's amongst different convenors. It is not one person then just decide."

L08: "You know it is a matter of being out there and being exposed to different tools and you will research for all these projects. The onus or responsibility is on us as we guide as naturalists, but in a third year and honours level, we expect students to start researching on their own."

Lecturers decide which tools to use and how they can implement these tools in the curriculum. There is no standardized method that lecturers follow during selection of these tools. This gives rise to several different challenges in the department owing to the large variety of tools used in the IS industry at the moment and also the dynamic nature of the field. The decision to use a particular technology depends on several different factors. These factors are subjective, as different lecturers have different preferences. They teach different courses to different students and as a result, limited resources also affect the use of these technologies in higher education settings.

Tools used by lecturers

Lecturers in the department recommend a wide range of tools for various reasons. Table 1 shows a list of the tools used or recommended by lecturers. The department at large is Microsoft oriented, in that most of the tools and programming languages used are Microsoft. Microsoft Office, being the main tool in use, C sharp as the programming language used and Visio, SQL. The department prioritizes three most important aspects when selecting and implementing tools: accessibility, cost

and demand in industry. Paying closer attention to the accessibility and cost of these tools, lecturers interviewed clearly stated that the tools used, should in no way be inaccessible to students, nor be expensive, because students would be unable to afford these tools.

Table 6: A detailed breakdown of the courses offered in IS and the tools used

Course Name	Course Components	Technologies Used
Information Systems	Introduction to IS Data Analysis Databases Web Development	Microsoft Office Microsoft Excel Microsoft Access Python and HTML Anaconda Navigator
Commercial Programming	Planning and developing software programs using C#	Microsoft Visual Apache Studio IDE Miro
Accounting Information Systems	IS for accounting	Pastel
Business Intelligence and Analytics	Business Intelligence and BA, data warehousing, data marts, decision support systems, OLAP, data mining, data visualization	Tableau
Applying Database Principles	Database concepts Advanced database design and implementation Database architecture Modelling	Microsoft Excel SQL, Microsoft Access
System Analysis	Object oriented systems analysis	Microsoft Visual Studio Code Miro
Systems Design and Development	Implementation of systems development process	Microsoft Visual Studio Code
Information and Communication Technologies	Security and Networking Cloud Services E-Commerce IT Architecture	IBM Security Module Wix
Systems Development Project 1	Project Management People Management Capstone project (Problem Analysis and/or Software Development)	Microsoft Visual Studio 2019, Visual C# Code. Microsoft Azure Cloud Aris, Microsoft Projects
Electronic Commerce	Website design, business models and strategies, business use cases, web Development	HTML, CSS, Wix, WYSIWYG Vue.JS,
BPM and Enterprise Systems	Enterprise Systems Business Process Modelling	SAP Aris, Visio

It is also important to note whether the type of tools used in the department are proprietary or open source. Table 5.4 below shows a more granular view of the technologies showing details of the cost structure as well. As shown in the tables, for some technologies, the university covers the cost whilst in some technologies are free/ used on a free trial. The university also has academic alliances with some companies, and they result in discounts. Students usually have access to this software for free or it is part of their fees. Some academic licenses also give cost-free access to student.

Table 7: Breakdown of costs and types of tools used

Technology	OpenSource/Proprietary	Freemium/ free	Academic licence and Free	Academic licence and paid
Microsoft Office	Proprietary			√
Pastel	Proprietary			√
Microsoft Projects	Proprietary			√
Microsoft Visual Studio Code	Proprietary			√
SAP	Proprietary			√
Tableau	Proprietary		√	
Aris	Proprietary		√	
Miro	Proprietary	√		
Microsoft Azure Cloud	Proprietary			√
IBM Security	Proprietary			√
Visio	Proprietary			√
Ubuntu	Open Source	√		
Vue.Js	Open Source	√		
Linux	Open Source	√		
Wix	Proprietary			

Factors affecting tool selection – lecturers

There is a wide variety of tools that lecturers can use because of the dynamic nature of the tools, and this results in different lecturers using different tools. Implementation of these tools also differ where some of the courses are flexible enough for students to use choose their own tools, whereas some courses do not leave any room for this. For example, for the course business and systems analysis, lecturers use Miro, a collaboration tool which enables students to work together in real time to draw UML diagrams. Students are also allowed to use whichever tools they find useful,

such as Visio, Draw.io or eDraw. For the Enterprise Systems course for Enterprise Systems, where they only use SAP, students do not have the option to use other technologies.

1. **Alignment with course objectives or model curriculum**

The IS2020 curriculum is the latest in a series of model curricula for undergraduate degrees in IS. It builds on the foundation formed by this earlier work, but it is a major revision of the curriculum and incorporates several significant new characteristics. It also informs many decisions on what faculties should teach, as it contains the skills students are expected to learn. In addition, the IS2020 curriculum informs on the skills students should have in IS and this guides lecturers on what tools they should consider. The model curriculum, however, is generic and does not recommend any specific tool, it leaves room for lecturers to decide on their own. A comment by respondent L08 highlights this below:

> *L08: "And then I also look at what are the core skills that an IS student needs to needs to learn, right? And usually, it will be for me. It gets informed by the IS global curriculum. It used to be IS 2010, but there is a new one coming out or being worked out. It's now IS2020 I think, so I always look at that to sort of see what are the skills that are expected globally for an IS career."*

If tools can give the necessary skills that are being taught, then they fulfil the first requirement. A good example of how this factor is highlighted is the move from using Scratch to Python for the web development introductory course. One could argue that the skills obtained from Scratch are not directly transferable to a language such as Python, as Scratch, as opposed to Python, is for beginners and will not bring much value as explained by respondent L01 below:

> *L01 "Yeah. So, I mean the decision to move from Scratch to Python was more a pedagogical decision more than a tool decision. Even though you know the pedagogical decision resulted in a change of tool in a way."*

For many lecturers, there is a major focus on modelling and designing programs in an object-oriented manner but the main purpose of programming in IS is to introduce programming concepts in a comprehensive, but not too simple, manner. Scratch did not seem to fit the purpose of what the lecturers desired to teach, which are foundational concepts of object-oriented programming.

The language is now introduced at earlier stages in school such as primary and high schools, so one sees the need for the department to use a language of a higher level. Learning Python does not require any programming background, and therefore it is very popular amongst developers in industry as well. Furthermore, it is easy to use, powerful and versatile, making it a great choice for beginners and experts alike.

One of the most important aspects of using industry technologies is the ability to transfer skills from the use of one tool to another tool. This is an important consideration when selecting tools to use. In some courses, this can be determined by one's technical skills and/or one's general learning curve. L05 gives the term intellectual stimulation and explains this below:

> *L05: "And also, I think intellectual stimulation or rather intellectual enrichment. You need to be thinking of this key as something that will not only be relevant for industry, but also something that is intellectually enriching for the students. So, this, as a skill will be valuable for the student to do many other things. For instance, if I were to compare learning Scratch and Python. There is no comparison there. If you learn Python, you will be able to be a data scientist."*

While the IS2020 model might not have the details on specific tools to use, it offers guidance on these issues and the responsibility lies with the lecturer to make sure the tools used offer the right skills to students.

2. University and faculty needs.

University policies or norms also affect which tool is used. The findings show that the department uses Microsoft tools mainly because the university supports and pays for Microsoft on a higher level and these tools are used by a lot of departments. If the university cannot support use of the tool, lecturers must use their own resources or negotiate for license cost themselves. Thus, it seems more convenient to use the tools which align with or are used by the university.

> *L05: To some extent it also depends on the universities' choice of technologies. So, the university has an ICT service firstly. And then the faculty level. We have commerce IT, and so they responsible for the ICT infrastructure and labs and so on, and software and so to*

> *some extent we use. Uh, whatever is offered so in terms of like the productivity suites I mean, using Microsoft Office, why do we use Excel in the test your program. Because that is the tool that is available to teach data analysis.*

The faculty of Commerce forms a solid foundation in driving what is taught in IS. The commerce faculty is mainly industry-oriented; therefore, lecturers will use tools that align with their sponsor's needs in industry. L06's response above shows that selection is also historic as sometimes, lecturers just find it easier to use what is currently being used.

> *L06: "So the university's got two options, one, we teach what the companies want and are currently using. 2, we teach Open source that we believe companies should be using and by teaching it to students, we think that companies will change."*

> *L07: So, first year we did Microsoft. Pretty much the department when I came in was a bit of a Microsoft shop, so I think in a way that's driven by the needs of the faculty, because it's commerce, it's very much driven by industry needs and what companies want.*

Companies can come and want to recruit students from the department, and it is important that students have the skills they need. Lectures continuously keep up with industry needs and are always working on teaching the current technologies used in the real world. Industry needs are explained in more detail in the next section below.

3. Industry needs

The most frequently mentioned factor when selecting tools was their popularity or use in industry. For example, SAP is mainly used for its widespread use in industry and the edge it gives students when looking for entry-level jobs. Seeing that most IS graduates go and work in corporate environments which are business-process oriented, this ends up being very marketable for the students if students show some level of proficiency in a tool such as SAP.

Tools used by most lecturers are tools which have been well embraced by the professional community. Python is a very popular programming tool, not only in the field of IS, but in a lot of

other disciplines as well, and in industry too. L08 explained why they use python in the programming course:

> *L08: "It is very much around the popularity. OK, two reasons. The first one is obviously the popularity in that Python is quite a popular coding language, not only for IS or technology practitioners, so it made sense because it's a service course that deals with most other BCom and humanities students that they learn in coding language that's relevant* `to them. You know, in the work environment that was the one thing."`

Marketability of students is another important factor that lecturers consider when selecting tools to use. Software tool selection by the staff is often driven by the demand in the workplace, i.e., what employers use. L3 and L7's responses below explain the importance of student's marketability when it comes to tool selection.

> *L03: "That project was designed over 10 years ago with Ernst and Young. And they have a big division which audits particularly in the SAP space, so we were always supportive of using SAP as a tool because we know Ernest and Young, and most firms wanted their consultants to be able to work in that space."*

> *L07: "So there was no other department saying you need this when it came to ERP tools, SAP is the one with the high salaries, are most demand most used, so it's sort of the market leader but also, when I started lecturing, the university had an agreement that we could use our training system at the university at no cost, so it was easy"*

Making sure students graduate with critical skills highly demanded in industry is the goal of the IS department. Lecturers are consistently keeping up with the latest developments in industry and try to tailor the curriculum according to the industry's requirements.

4. Accessibility

Access to these technologies is just as important for the students as it is to the lecturers. For example, Microsoft Visio works well with Windows OS and a lot of people use Windows, so lecturers are more likely to recommend this tool because students have access to these technologies. The university also covers the cost of Visio, as it is a Microsoft tool, so students do not have to incur their own costs when they decide to use the tool.

> *L02: "Yeah, so at first, we used to use Visio. When I started, we used Visio because Visio is accessible. It was accessible on Windows. A lot of people are using Windows, so it's very much accessible to anyone can use it even in the lab, students can go to their labs. It's available in the labs, so it was very simple to just tell the students that you now use Visio"*

Access also encompasses availability of teaching resources which lectures expressed was key to tool selection. This is an important aspect as using technologies is highly dependent on the material which needs to be taught. Teaching material include tutorials/ exercises, the software, cost measures, availability of support, and these are covered in detail below.

5. Cost

The university does not cover the cost of all tools that lecturers may want to use when teaching. The department of IS leaves it up to its lecturers to organize how the tools will be paid for, in instances where the tool cannot be paid for by the department. Course convenors or lecturers in charge of these courses are responsible for negotiating for these licenses. For example, L03 explains the challenge of using Miro, a tool used for a modelling course:

> *L03: "The only problem is that the university doesn't have a license, it's a very expensive product. But it's brilliant. I've spoken to CILT. They have also motivated for that, but because it's such as unique and specialized application, not all departments are using it. But what the Miro company did for me, which I really appreciate was fantastic. They give free education licenses for when you have 100 users. And when I explained to them my situation with 400 students. And what we going to do, they increased my free subscription to 200 users. And that was fantastic because we have. We put food for people on a team so and I could give them access without making students pay"*

Acquiring a license is not a difficult task, but in some cases negotiating for one can be quite tedious as often, communication can be difficult to establish with some companies. The administration of negotiating for a license is one of the main reasons why some lecturers choose to use open-source tools which are free, as highlighted in the previous section.

6. Software requirements

The software requirements of a particular tool are a very important factor which needs to be considered, as it is not sustainable to use a tool which uses up a lot of resources. It ends up being expensive for the department to keep maintaining and updating these tools, and this, as per findings, was the challenge with the use of Cognos (a performance management and business intelligence software used in ERP systems). The tool needed to be installed on the server and it needs a lot of RAM as well and ended being too expensive to maintain.

> *L01: "We used to previously use Cognos, which is an IBM tool and that was phased out for the simple reason that it was very, very resource intensive. Uhm, and so as much as it's a nice tool to use, it began it. Also, it's not free, so you would have to sign up for the licenses, which is not a train smash that could have done that, but it just became it used to crash quite often. It was very problematic, and it hogged a lot of resources, so it became really, difficult to manage."*

These software requirements resulted in a change of tool, to Tableau, which was a much better option because it is compatible with both Windows and Mac operating systems, and it does not take up a lot of space or resources. Making sure students have access to computers on campus is also key. In 2020, during the pandemic which resulted in universities closing, therefore students had to work from home, the department had to make sure students had PCs. If their systems could not manage the load, students are able to connect to the university computers through remote desktop.

7. Availability of resources

Availability of resources considers the availability of support staff, including computer lab staff and/or network administrators to help with the use of the tool, documentation, and teaching material such as exercises and tutorial material, to aid in the teaching of the tool. Support in this study encompasses documentation and tutors who can offer practical help in terms of how a tool can work. A good example is how SAP was a viable option for the department to use because of the large amount of SAP-related learning material available from the company, third-party software and consulting vendors, and independent book companies such as Amazon.com. Because

of the presence of academic and/ or university alliances, it is easier for lecturers to go to the supplier of the software and report an issue.

> *L01: "With ERP systems, lecturers must come up with the teaching material which can sometimes be difficult. SAP has a wonderful university alliance program, where SAP provides comprehensive support to faculty, e.g., faculty have access to an online curriculum repository, free faculty workshops, as well as the ESEFA program. Here lecturers can exchange teaching material which includes class exercises and tutorials".*

There is a wide range of tutorials, troubleshooting guides, and online support which students can freely get online. Support also comes in the form of tutors. With tutors, lecturers feel that if they leave room for students to use any other tool of their choice, getting help or assistance with a tool which tutors are not even familiar with might be an issue. Below is a response from a student which shows the importance of tutors for tool selection:

> *S01: In 3rd year it was set out like this is the technology we put forward for example with the E commerce project with the tutorials we were using Wix so lecturers left room for us to use any other technologies if we understood that support might in a way be limited. For example, you will find all the tutors will be experienced with Wix because they might have used it the previous year, or what's being taught in class, but if you are using your own tool, some tutors might not be able to help you with it.*

8. Open source versus Proprietary

The results show that the department uses mostly proprietary tools as opposed to open-source tools. Figure 5.2 shows a pie chart showing that only 29% of the tools used in the department are open-source tools and 71% of the tools used are proprietary.

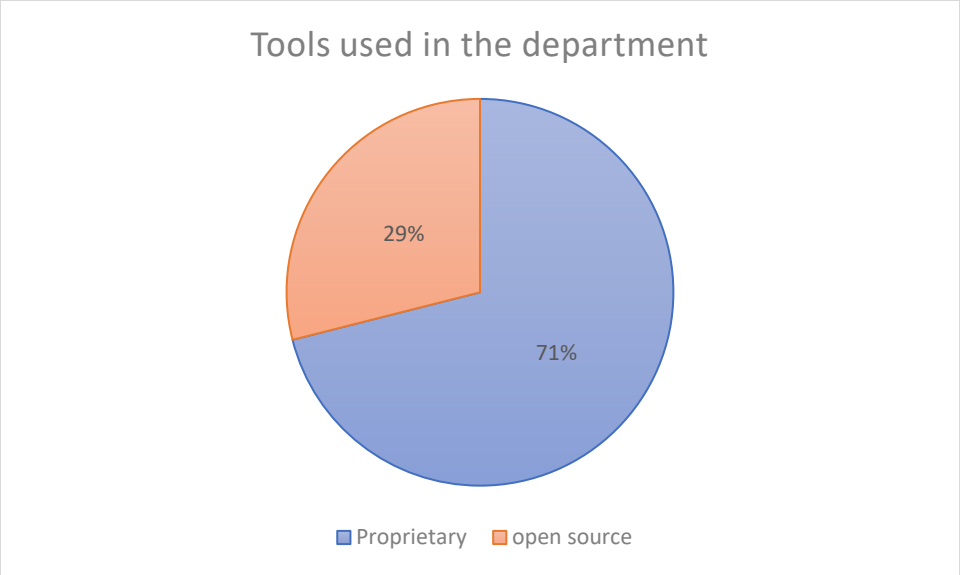


Figure 6.2: Distribution of tools used in the department

This is because of the different preferences that arise with different lecturers owing to various factors discussed. This also goes back to lecturer's personal values and how they view the field.

Accessibility as explained above, is one of the most important factors influencing lecturers when selecting which tool to use. Accessibility suggests the use of open-source tools as they are available to anyone and free, making them suitable for use by students. The availability of online tutorials, forums, troubleshooting guides and support on the internet also makes it a better option as students can easily turn to the documentation as support for when they encounter difficulties.

> *L10: "So as a lecturer, you're given an option to use whatever you want to use, right? But obviously you must know that it needs to be accessible to students. Students shouldn't pay for it. So free online tools we use quite a lot as lecturers. So, if it's in that boundary where it's accessible, it's really can be used, and it's fine. But once there's a cost related to it, then you must start thinking about approaching the head of department and applying for it. So that's how it works."*

> *L03: "I would say that I am more of a progressive type. I use software that is open source. That's progressive that is available and it's easy to download and typically just install so I don't use any proprietary software."*

However, as Figure 1 shows, the department relies on the use of proprietary tools more than open-source tools. Other factors come in to play to explain this use as it seems to be in contradiction with the need for access. Functionality and industry needs are examples, and these are explained below in the response by L07:

> *L07: "the thing is, you can't teach open source if it's so hard. If there isn't software with the correct* ***functionality*** *out there that you can use. And I think companies will always give a kickback and students will give a kickback. So, the students will ask why we are learning this, nobody is using it. Why am I learning this? Nobody, I know is using it. Companies will go why are you teaching stuff. That's not what we use. So being a commerce faculty, I think we're different from science, science doesn't care about companies. So, I think computer science has a different approach, but I think being in commerce we've always been driven* ***by the needs of the companies*** *in the corporates."*

Functionality and the needs of companies seem to override the need of open-source technologies. Most companies in the IS space use proprietary tools, such as SAP, Tableau, Microsoft, and these are some of the big names in industry. Certain courses of action will need to be implemented to make sure that these technologies become accessible to students for example, acquiring academic licenses. Because open-source tools are free, there is no need to acquire an academic license to use the tool. If the university cannot pay for the license, the lecturer has to negotiate a payment plan, and this can be a tedious task.

> *L04: Yeah, I think the first thing is that proprietary is just that. You know it's proprietary. It is certain rules that you need to apply when it comes to downloading a specific package on your machine. Not even to mention the cost factor that's involved with proprietary software, so licensing as an example becomes the issue for me. Whereas an example with open source it's much easier. It's progressive, it's flexible for me to download, and it's also easy for the students to run. Instead of just having a piece of native piece of software that you need to install and then still try to understand that you still need to run a, I'm sorry that you need to run a license with that, and you need to go through all the process with administration just to simply order a license.*

It is also important to note that, the open-source tools that are used are used in IS are mostly on very technical courses, such as programming, cloud computing and IT security. Thirty-six percent of the tools used by students are open-source tools and these are used for programming and the technical components of their capstone projects such as testing APIs, SSL certificates and mobile apps, and cloud deployment. For the lecturers, only 18% of these tools used are open-source and they are used for the IT security modules. This shows that the nature of the module or course being taught also affects what kind of tools used. The courses stated above, are like the courses taught in the Computer Science department, and as explained above, the department utilizes open-source tools more for reasons stated previously.

9. Functionality/ Feature set

The functionality and features are some of the core factors as it important for the tool to align with course objectives. Lecturers mentioned that the functionalities that a tool has determines whether the tool will achieve the objectives set out in the curriculum.

> *L08: I would say because of the practical aspects of systems analysis and systems development and what we have now done in systems analysis to make it alive is we've used Miro. A wonderful application where students can collaborate on whiteboards in the cloud. And I found Miro as quite effective for that because you can see how you draw on the mirror board and everyone can see it so they can go into teams they can open a Miro board. And they can talk while they are on MS Teams, and they don't have to share their screens. They can all have the Miro application open and then collaborate on that while talking. So, it's almost like you have a scenario that you would have in a practical workshop which we do with systems analysis, where in real life students get to also do the work in teams. The tool mimics that and allows students to master systems analysis."*

Tools with a free trial usually have limited features, and this s also a very important factor to consider. The features a tool has determine whether the tool will be able to achieve the set course objectives in the beginning of the study.

Tools used by students

Most courses leave room for students to use tools of their own. Technologies used by students are summarized in the table 3, but it is important to note that these are not the only tools used by all students in the department.

Table 11: Software used by students in IS department.

Course Components	Technology used	Open source/ proprietary	Cost
System Analysis	Microsoft Visio	Proprietary	University cost
	Lucid Charts	Proprietary	Freemium
	Draw.io	Proprietary	Freemium
	eDraw	Proprietary	Free trial
	Miro	Proprietary	Freemium
UI Designs	Mock Ninja	Proprietary	Free Trial
	Balsamiq	Proprietary	Free Trial
	Adobe Xd	Proprietary	Free Trial
E-commerce	Wix,	Proprietary	University cost
	WordPress	Proprietary	Freemium
Programming	Microsoft Visual Studio,	Proprietary	University cost
	Node.js,	Open source	Free
	React,	Open source	Free
	Angular,	Open source	Free
	MongoDB,	Open source	Free
	Android studio,	Open source	Free
Testing APIs	Postman	Proprietary	Free
BPMN	Aris,	Proprietary	University cost
	Celonis	Proprietary	Free
SSL Certificates	Virtual Box	Open source	Free
	Apache	Open source	Free
Mobile apps and cloud	Flutter and Firebase Database,	Open source	Free
	Azure Cloud	Proprietary	Own cost

Factors affecting the selection of tools by students

1. Familiarity

Familiarity and ease-of-use have been seen to go hand in hand, and this explains why most students will choose Visio over a new tool such as Lucid Chart or any other tool. Microsoft Visio is one of the tools which is recommended by lecturers, and lecturers usually demonstrate the core concepts of Systems Analysis using this tool. Lecturers will leave room for students to choose any other modelling and analysis tools from this, but because students have already been accustomed to using Visio, they will keep using the tool unless there are other factors or reasons why they choose not to use it. Some students stated they chose a tool simply because they had prior exposure to the tool in an internship and that's how they were familiar with the tool highlighted by S06's response below:

> *S06: "I got exposed to Lucid Charts way before we did the course for systems analysis in class. The company I interned with that vacation used Lucid Charts and I really loved it. So, when the lecturer gave us an option to use a tool, I did not even look at Visio because I had enjoyed using Lucid Charts when I worked with it and because I still used the company subscription, I was able to use all the templates and functionalities that the tool had to offer."*

Having prior exposure of a tool helps with achieving the course objectives and getting great marks for the said course. The academic background of students will also affect familiarity.

> *L01: "At an introduction level as much as scratch could teach fundamentals in terms of coding a lot of students had already started learning scratch at an earlier stage, so it made more sense there. I would say probably around 60% had been exposed to scratch before 40% hadn't, so it made sense to then go on to something a little bit more complex."*

Students with a more technical background such as students majoring in both Computer Science and IS, will find a tool such as Scratch not intellectually stimulating. Some students majoring in IS only, might not even be challenged by the tool itself. Conversely, it might be harder for them to

adapt to using programming languages used in industry such as Python or Java which are not taught at great depth in Information Systems.

2. **Accessibility**

Access in this study does not only mean students being able to access these tools whilst they are in university only, but even when they graduate. Having that access when you no longer have access to UCT's resources is a big advantage where one can easily practice using a tool at home and this was one of the reasons why some students used certain tools.

> *S02: "I mean for my undergrad days; I don't know if I can still connect to a server hosted by my previous university. I probably cannot write just to check something or just to test something I can't, although I've paid for access. But then you only pay for a period."*

Access can also mean availability of support in the form of tutors. For students, having someone who will be able to help you in practicals with the use of a particular tool . Using a tool in which there is no tutor who can help you with it makes these tools not viable options to use in their class projects.

3. **Software Requirements**

Not surprisingly, software requirements were an important consideration for most of the respondents. Using tools which are not compatible with student's personal computers can be problematic as they will not be able to achieve their objectives. Even so, in this pandemic where students and lecturers were not allowed to go on campus, so they had to rely on their personal laptops. Students used tools that were compatible with their personal computers and anything that takes up too much of one's resources would be unfit for the purpose.

S05: "Because we are learning online, it was more difficult to connect to the platforms themselves. I remember last year, fortunately because of the VPN, we were able to access the computer labs on campus. But somethings are just way better to do if we were in the actual labs. Certain technologies are best to learn on campus because again not everyone's laptop can handle technologies, e.g., I'm sure no one uses Visual Studio code on their own PC, unless they've got enough RAM for it. So, most people connect to their own PC's using VPN to use Visual Studio,

because it takes a lot of processing power. And not everyone can afford the laptop with high processing power."

Implementation of tools

The department of IS at this university mainly uses an Integrated Practicum level of adoption in terms of implementation. This is the most immersive means of adopting technologies into the classroom as it includes a full system, requiring students to use hands-on exercises, with assignments which merge business disciplines so that they can experience the full integration capability of the system. These are grouped into three *main categories, lectures only, tutorial and hands-on* approach. All lecturers interviewed use both the hands-on approach, while the remaining use a combination of the three. For example, for Programming courses, the lecturers usually start with PowerPoint presentations, where they just teach students the main theoretical concepts of the course. For example, lecturers demonstrate how to use the tool in lectures then students are expected to complete exercises and/ or tutorials using the tool in practical or tests. Below are examples of how lecturers have incorporated these lectures in the curriculum:

> *L09: "Yeah, so what happens? I get into the lecture I would have prepared. You know my slides before that was COVID right? So, I would have prepared my PowerPoint slide. I go and teach for 15 minutes. The PowerPoint slides and then I'll say OK. Now let's go into it. So, then we switch We'll go to what do you call it? Now we go to the language itself, Visual Studio, and we do those concepts that I would have thought for 15 minutes, so that would be another 30 minutes. My programming is normally double, period, so. We would spend one hour plus doing this stuff. OK, so that's it though, I think there isn't a lot of technologies there involved, is just the language itself. Visual Studio and PowerPoints. So, they normally with the PowerPoints is just for them to go later and revise and all that. But it's a doing course. We spend a lot of time coding actual coding."*

Table 12: Levels of implementation

Course	Type of Adoption	Description
Programming – First year	Lecture only + Hands-on	• PowerPoint demonstration • Visual Studio coding • Assistance programming languages quite for a bit of demoing in class with the virtual environment.
Enterprise Systems and Business Process Modelling	Hands on	• Students must go and analyze processes in companies. • Course convenor works with companies every year to get case studies and access to teaching material. • Capstone project designed over 10 years with Enerst and Young. • Supportive of SAP because consultants use SAP in that space. • High adoption in industry.
Enterprise Systems	Tutorial + Hands on	• Built workshops, tutorials, practical hands-on tutorials using the software in these tutorials built by lectures from scratch. • Students carry out tutorials as part of a compulsory part of the course.
Systems Analysis	Tutorials + Hands-on	• Students work in teams in groups and do exercises given to them as a group.
E-commerce	Tutorial	• Using wix to build and design websites as per tutorials for practical submissions.

Summary of selection criteria used by lecturers and students

Below is a summary of the various factors and criteria explained above.

Lecturers	Students
1. Alignment with course objectives/ model curriculum 2. Faculty and university needs 3. Industry needs/ popularity 4. Accessibility 5. Open source/ proprietary 6. Cost 7. Software requirements 8. Availability of resources 9. Academic background of students 10. Functionality/ feature set	1. Familiarity/ feature set 2. Accessibility 3. Software requirements 4. Functionality/ feature set

Analytical Framework

The study uses the Activity Theory and centres findings around that. One Activity System was identified from the analysis of the data, with two subjects, and these are summarized in Table 5 below.

Table 13: The Activity System

Categories	Information	Comments
Subjects	Lecturers and IS students	Lecturers and IS students from the IS department act as subjects in one activity system and use industry tools to facilitate the teaching and learning of Information Systems.
Object	Fundamentals and concepts. IS Degree	Lecturers use technologies to fundamental concepts that will not only help students land a good job but be able to succeed in their job role. Students expect to achieve the learning outcomes set in course objectives. They recognize the importance of practical experience in being ready for industry
Tools	Industry technologies	Tools used include SAP, Microsoft, Tableau, AWS, Visio, Miro, Lucid Charts, Aris.
Rules	Departmental Policies, Contracts, deliverables for students.	Lack of a department policy or structure results in the autonomous structure when it comes to decision making concerning tools. Contracts and licenses which lecturers acquire from technology companies to work with them or their software. Students have deliverables they have to deliver.
Community	Advisory Board Academic/ university alliance programs School of IT Other departments Faculty of Commerce	Technology companies form the community at large as they form part of the advisory board, academic/ university alliance programs with the school. The faculty of commerce and Commerce IT also form a bigger part of the community. Students are surrounded by lecturers who help in facilitating the use of these tools. Tutors usually help them during practical and other external activities.
Division of labor	Lecturers Students Technology companies	Lecturers are to prepare learning material, conduct lecturers and/ or facilitate practicals. Lecturers also have different roles in the teaching using these tools, some just teach, some are course convenors, and they work with companies directly to prepare teaching material, negotiate licenses and have access to software. Technology companies also play an important part in teaching some courses themselves, providing discounts, and providing teaching material. Some companies also have graduate development programs. Students carry out the necessary tasks needed by using the tools. Lecturers/ Tutors help them in setting up and assisting. these tools and Commerce IT offers support for the department and students in the need of technical support.

Subjects: The subjects in this study are the students and the lectures in the IS department. The lecturers are using industry technologies as tools, to teach various courses in the program. The students are using the technologies as tools as well, to achieve various objectives in practicals and course projects to gain practical experience.

Object of the lecturer: The object of lecturers is to use industry technologies to equip students with the practical experience to produce "work-ready" graduates. This entails using technologies which give students the required skills. These tools help students when they eventually get in industry as they would also help when they are given similar tools or learn completely new tools in industry.

LR2: "So the main thing around using the tools is to give the students an idea of the tools that are available and to give them some practicals experience. But the idea is you want to be as tool agnostic as possible for the simple reason that you do not know what tools students are going to be using once they get out into the working world. So, you want them to understand the basics. I want them to understand the concepts rather than saying this is the tool so that they can apply those concepts to any tool they use."

The IS department aims to produce "world class graduates" which are very marketable to employees. This is seen by the need for the department to expand the number undergraduates studying IS and not just expanding for the sake of it but understanding and looking at the needs of the country, where there's a skills shortage in IS in ICT globally. Some companies in South Africa have ended up outsourcing key role players such as Business Analysts and Consultants, and this department investigates providing the community with this. The department has a relationship with various companies who come to recruit students for internships and graduate work and lecturers need to make sure they educate their students and equip them with the necessary skills which will be needed for them to be successful in those jobs.

LR07: "Companies come to recruit students and, in some instances, needing more students than we can actually graduate in a year, and so it's looking at this and, suppose you're

> *building the discipline not just for the sake of building an academic discipline, but also to meet the needs of a developing society"*

> *C10: The course objective for the course; Enterprise Systems and BPM – "Course exposes students to the principles and practices of Business Process Management and the Enterprise System and Business Process Integration. Highly relevant to the role and Business Process Experts, Business Architects, BI practitioners, ERP Business analytics, Enterprise Systems managers and system integration."*

These fundamentals and concepts that are taught to their students are not only for them to land a good job, but to also be successful in their job and grow into their next role and it is made possible using industry technologies used. Students are trained and are exposed to tools and use them in real life settings as would the various roles they would have in industry. It is impossible for lecturers to teach students all the existing tools, however, the foundational concepts that will be taught and the exposure to some of these tools helps students to be able to go from one tool to the other, as would have been done by a typical Enterprise Architect in industry.

The object of the student: to utilize industry technologies to carry out tasks in practical's and projects in courses. Some courses, for example the Systems Development Project which is a yearlong course combine the theoretical elements of project management with the practical implementation of these concepts through the completion of a systems development team project. The course focuses on the development of a working system using various tools which are in industry and these help students have a better picture of what is being taught. Students are expected to use tools in some cases, where they can even choose which tools to use to develop systems and websites for clients/ sponsors and in this way get an idea of how these tools are used in real life.

> *S04: "I use these tools mainly to pass my practicals and carry out my projects because you cannot do all those tasks without knowing how these tools work. I think the tools will probably come more into play when I'm in industry."*

The student and lecturers work together toward one common outcome, which is to enable the marketability of students to potential employers. This includes a combination of students passing their modules using the tools they are taught to grasp important concepts which will be fundamental and key to future industry roles.

Tools: The department makes use of industry technologies such as SAP, IBM, Microsoft, Aris, Miro, and Visio to facilitate the teaching and learning of Information Systems. Examples of tools used in respective courses are shown in Table 1 and 2 respectively.

Rules:

Policies: The lack of a departmental policy or guide on the selection of technologies entails that the decision-making structure is decentralized, leaving room for decisions to be done by either lecturers or students and also for each to consider the way they choose their technologies up to them. Some courses do not leave room for students to choose their own tools as mentioned previously and this is because of various factors that have been described in the previous section.

> *L07: "There is no formal policy that is used when it comes to the selection of tools. So, the way academic departments operate in most universities is very autonomous. So, while the easier it is existing programs that are defined and approved by the university and other courses, very often a well-established program in terms of how courses are run, in which technologies are used."*

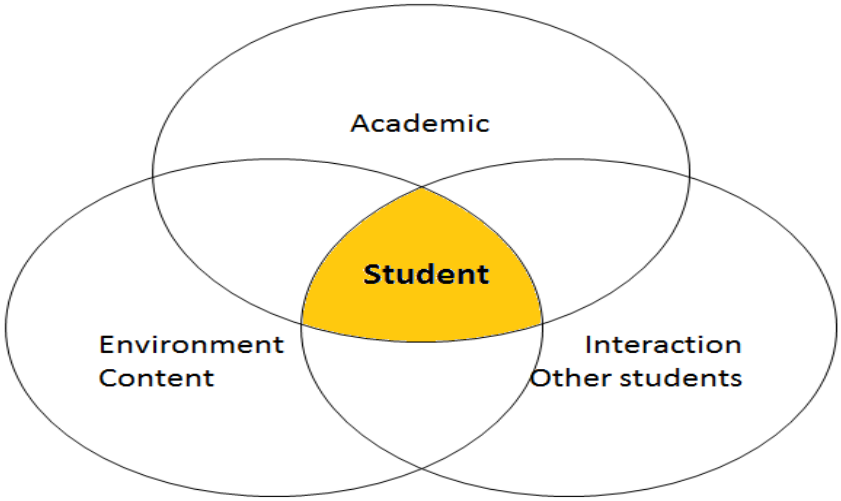
Contracts: It has been established that the department works closely with technology companies who help facilitate in various aspects around the teaching of various courses in IS. The relationship with these companies is facilitated by contracts which guide how these relationships are supposed to be managed. Course convenors are responsible for managing their personal relationships with these companies pertaining to the teaching of the course and the use of software when it comes to the use of that tool.

> *L05: Some cases, of course. It's also driven by whatever, agreements because we are approached a lot also by various vendors. So, for example the SAP, the use of SAP for enterprise systems programs these are, you know, some sort of collaboration which is a major project, with industry and scholars; Enterprise systems Education for Africa program (ESEFA). And so we see that alliance with industry that also influences the use of SAP, for example in teaching enterprise systems.*

Learning approaches: Most courses follow a **constructivist learning approach** which puts the student at the centre of active learning as shown in figure 1 below.

> *C10: "Learning is not a passive activity in which students acquire knowledge, rather it is an active approach in which students find, contextualize and process information to construct knowledge."*

Thus, students are expected to draw on their own personal experiences, interact and draw on the personal experiences of fellow students, interact with the academics, and the environment to source information and to develop knowledge. Most courses in this department operate using this approach and thus, this guides lecturers and students in the decision-making for the course.



Community: This consists of alliance programs from vendors who partner with the company, the Advisory Board, the School of IT, as well as the faculty of Commerce.

The Advisory Board also forms another important part of the department's community. This consists of South African and International; business leaders and academics who understand, and successfully navigate the complexities of the global business environment. In some instances, the department turn to them for advice on which tools to use, or if the tools being used are coherent with current business practices. The board then advises them based on the industry environment and how they can improve their curriculum to bring out the best in graduates.

> *"L07: "So, our relationship with companies is not centralized. It is a very amorphous thing. So, we had an Advisory Board that used to meet regularly since the forming of the School of IT and COVID it's been difficult The Advisory Board would give us feedback on those kind of things at an annual meeting. So, at a high level, there's that relationship with the HOD with the Advisory Board"*
>
> *L03: "We also have a department IS Advisory committee at various points in time. Sometimes we also consult and say Ok, what does the industry favour in terms of the sort of tools they would prefer us to be using to teach students various concepts. So that feeds into it."*

The advisory board is a professional body that represents the working in the IT environment that are also associated with the department. These helps provide the industry perspective and inform on what students should be tough as they know first-hand, the business processes and skills that students should have to enable them to do those tasks when given the chance. This is at the high level, but at an individual level, lecturers also have their own relationships with industry in their own courses. This might be through colleagues they worked with in the past, or people they meet at conferences or at various projects.

The department of IS also relies on other departments in the faculty or beyond. Information Systems is a subject which is built from other subjects, often referred to as socio technical. The field bridges the gap between the social aspects from business and investigates how these businesses operate and function and the technical aspects of it, to produce solutions which help in the development of businesses. Therefore, some key inputs are taken from other departments such as Accounting or Computer Science, to try give students the best of both worlds.

> *L07: "I came in and accounting pretty much determined what they wanted so the accounting department was teaching using Pastel and so we carried on doing that because that was what they had taught, and they wanted support and they were teaching in their second year."*

As mentioned in the case description, the Department of IS is also part of what is known as the School of Information Technology (IT). The school of IT was launched in response to the growing needs of the South African and global tech industry, and the increasing demand for university qualifications in the sector. The school bridges the faculties of Science, Commerce and Humanities and offers a wide variety of courses and programmes to suit a student's personal interests and aptitudes. The school of IT focuses on providing IS and/ or Computer Science courses to students depending on their academic backgrounds and their future endeavours. Advisors from this department also work on providing students with information pertaining their courses and their degrees. Students tend to change courses throughout their academic year and sometimes they need career guidance and this department offer that

There are other actors in the Department of IS that are also take part in the activity when it comes to these activities. Technical support in the department can come in the form of the *Commerce IT department*, is the Information Technology support department for the Commerce Faculty. Tasked with both staff and student computing support, Commerce IT ensures smooth operation and integration of IT in the Commerce Faculty. They help departments when it comes to installing and maintaining software on faculty labs. They also give support and help students when it comes to connecting computers to lab facilities through

Division of labour*:*

For the courses taught in the department, different lecturers are assigned on a particular course to form a *teaching team*. This consists of a section head who is in charge and oversees the course, convenor, course administrator and sometimes a head tutor. This teaching team is usually involved when making decisions on the selection of tools. Their roles are listed in the table below.

Lecturer Roles

Table 14: Breakdown of lecturer roles

Role	**Responsibility**
Head of Department	Overseeing programs offered Recruitment and management of staff Managing relationships with industry – advisory board
Section Head	Responsible for courses within a specific discipline.
Course Convenor	Oversees the course as a whole. In charge of which tool to use and manages the relationship with technical companies.
Head Tutor	Tutors offer assistance to students who need help in practicals when they use tools.
Course Administrator	They carry out the technical overhead and any other administrative tasks that might need to be done when it comes to technology setup and management.

Role of technology companies

It has already been established that the department works with different companies in industry to try and build a curriculum which aligns with current practices. These companies play different roles in different courses depending on how the lecturers implement the technologies. In some cases, these companies provide universities with low costs when it comes to using their technologies. Through *university alliance programs*, universities gain access to an ever-expanding range of exciting opportunities to engage with some of the world's leading technology companies. These alliances with industry give them several advantages including cheaper prices because of these licenses, access to teaching material and access to technical support. Table 3 above shows a breakdown of the technologies used and academic licenses, if any, are used for the respective tools,

and most of the academic licenses come from these alliance programs. Since the group of individuals making up a community have a common object, these companies that work in collaboration with the department all work toward providing material which will help expose students to real life case studies thus preparing them for life after graduation.

1. **Provision of resources**

For example, in some courses they are involved in providing teaching material or helping lecturers with how to teach the courses to fit current industry practices. For example, L01 and L02 explain below on how the department gains teaching material from companies they work with:

> *L01: "And so we are part of collaboration with other universities that are part of a project called ESEFA enterprise systems education for Africa which allows us to build curriculum and then use that curriculum for teaching and by using it, it involves students doing hands on exercises on the system to learn skills about business processes about element of programming. Just general, how processes are implemented in an enterprise system, and then they get those practical skills in this case. Also, become familiar with SAP as one of the widely used software's in that space."*

Technology companies also *provide the company with access to their technology and resources for teaching*. In some cases, companies approach the department, for them to use their technology and teach concepts related to their technologies as well. As mentioned before, this exposes the lecturers and students involved with trending concepts which are also highly demanded in industry. For example, AWS is arguably the market leader when it comes to cloud computing. Therefore, using material informed by the company would help students be marketable for the company itself because they'd be confident in knowing that future employees know concepts that are specific to their technologies.

> *L0: "We also get approached by organizations such as Amazon, AWS for Cloud Computing and in the second-year course we did introduce a course for IS majors, ICT architectures, and so there was a time where cloud computing program offered by Amazon was used."*

Using such tools, gives students an edge which gives them a competitive edge in comparison to other students in the real-world.

2. **Assistance with teaching**

Companies also assist with the teaching of some courses. Lecturers work with these companies and work on giving students a picture of what happens in industry by exposing them to real life case studies and projects which help them to understand and carry out projects. Technology companies also advise lecturers on how to use tools they provide, as well as improvements the department can make when it comes to how these tools are used. L07 explains how they do it when it comes to the use of SAP in an enterprise systems course:

> *L07: "And then we have pretty much course convenors working with industry in their own courses so, I suppose my course, I work with companies because of a project. That is, in the course where the students must go and analyse processors in companies. So, I have to liaise with these companies every year so I work with them and then I do look at the specs and they say couldn't you rather use this tool or that tool that so that has happened in the past where in a way they do influence me in that they say we use this software use that software. That project was designed over 10 years ago with Ernst and Young. And they have a big division which audits particularly in the SAP space, so they were always supportive of using SAP as a tool because they wanted their consultants to be able to work in that space. But in other courses it's the same, so the programming courses the course CONVENORS will work with companies to develop software and I suppose they would indirectly influence because if you keep going to come this and they said but why you are developing in this you know we'd much prefer that you it should filter back should."*

Lecturers must build a relationship with industry on their own. Course convenors are usually responsible for this as they oversee their courses. Of course, this responsibility is not just up to them. These relationships need to be nurtured even after they are established as they give room to more opportunities such as recruitment of students, software upgrades and discounts on these. Academic alliance programs which have already been introduced in the previous section usually perform this main role.

3. Recruitment of students

Technology companies also work with the department in organizing internships and graduate programs for IS students. The department looks at meeting the needs of a developing society in the programs offered, thus they build a relationship with industry to create opportunities for

students to be recruited and work for some of these companies. Companies in turn, get to work with students who are highly skilled in the areas that they need.

> *L09: "If it was companies coming to recruit students and, in some instance, needing more students than we can graduate in a year, and so, it's looking at this and building the discipline not just for the sake of building an academic discipline, but also to meet the needs of a developing society. Therefore, the HOD Role is to see that and oversee the programs offered"*

The role that technology companies play all help the subjects to work toward their object and produce their desired outcome. The next section will discuss contradictions identified in this study as per findings gathered in this study.

Contradictions identified in this study

1. Primary contradiction within subjects

The findings show that the object of the IS department is to educate students and prepare future IT professionals for the dynamic environment of the new era. However, the results also show that lecturer's and students possess 2 different objects. Results have shown that the only reason they use these tools is to complete their practical or projects to eventually graduate with an IS degree in the given time. In contrast to this, lecturers look at the bigger picture, which is students being more marketable to employers by possessing skills which enable them to land a good entry level job and grow in their career. L01's response below explains lecturer's long-term view of why they use these tools:

Lecturers use technologies to give students a picture of how these technologies are used in the real-world, not just to solve business cases needed for tests to pass a module. Students on the other hand tend to have a short-term view of the role of these tools. Students have deliverables they have to deliver which consist of practical, tests, projects and assignments. These tools help students carry out the designated tasks in an easier, more efficient and faster way. In addition, students look forward to graduating, and in order to do that, they need to pass their modules and tests. Some students do not even want to study IS further and just complete it as a minor. When they graduate

they focus on roles which are not IS oriented, therefore they just use technologies as a means to an end, indirectly. S08 responds to this and explains why this is so below:

> *S08: "I do find these tools useful. They've made software development and technical work very easy for me to manage. I started out doing HTML in notepad. I switched over to Visual Studio code late and when I'm coding in Visual Studio it gives you suggestions, picks up errors for you, which makes it easy for you to debug, which isn't the case in notepad. So in terms of my academics, I feel like these tools have increased my productivity. They make work more fun because I do find it fun to use these tools, especially Visual Studio Code, and Visio. However, I want to focus on Politics when I graduate so I will not be using most of these tools."*

This contradiction only exposes the student's unenviable position they are in when it comes to curriculum design. The only control students have is in selecting electives and they are usually selected because the student is personally interested in the topic or believes that it will increase the likelihood for employment after graduation.

2. Primary Contradiction within the rules

The results showed that the tools identified in this study consist of 29% of open-source tools and 71% of proprietary tools. The responses gathered in the study show a consensus of the most important factors being availability (tools, teaching material, documentation, and technical support) and cost. Given this information, one would expect the use of more open-source tools as opposed to proprietary tools, but this is not the case. This is identified as a primary contradiction, as it is a contradiction between the Rules and the subjects.

> *L07: "So the universities have two options, one where we teach what companies want and are currently using and two, we teach open source that we believe companies should be using and by teaching it to students, we think that students will change. I think there are merits to both approaches, and I think we can take either approach."*

The contradiction identified could be because of a combination of factors which were described in the early sections of this chapter. A lot of these factors work in combination as or must be prioritized to look for the best possible tool to be used. Although open-source technologies can be cheap, easily accessible or the documentation can also be easily found but these tools can't be used if they are difficult to access, expensive or doesn't align with course objectives. Lecturers have gone for proprietary tools because some of these tools align with the course objectives more or have more features or functionalities than the available tools and in some cases, are the more popular tools. As highlighted in the above quote, lecturers make use of technologies that companies use (industry needs). For example, looking at the most popular tools used for enterprise systems SAP, systems analysis; Aris, Miro, Visio, Microsoft, these are all proprietary tools and are used popularly in industry therefore they often mirror how these tools are used in the real world.

> *L07: "And the reasons why the initial decision was made to go with proprietary tools, I suppose was industry driven., I would think by asking the questions, what does industry want and it's quite a broad thing when we say industries, it's quite wide but it's tended to be."*

Looking at the department at large, it prioritizes accessibility of tools, but is also industry driven so would support the use of proprietary tools. Accessibility as mentioned earlier, also means students having access to tools even when they graduate which proprietary tools do not provide when they are acquired on an academic license, and this is where the contradiction lies.

3. Secondary Contradiction between subject and object

Some lecturers believe that the use of industry tools doesn't necessarily matter as there is no way of knowing which tool will be used once one starts working. There is a wide variety of tools that exist, and it is impossible to teach all the tools in preparing a student to go to industry. It is only through grasping the required foundational concepts and fundamentals that will enable a student to excel in industry as the skills are transferable. L03 explains below:

> *L03: "So I believe within academia we should not be using industry type software unless especially in the case such as to teach. So, I'm against using industry software within the university because at university level. We try to teach not only find a foundation, but the*

> *theoretical part of as an example, software development, software engineering, agile methodology and those other things that students will be able to understand before they touch any software. Once they master these concepts, they are able to use any tool as these skills are transferable."*

On the other hand, some lecturers strongly believe that using specific tools and mastering the concepts of this software enables students to easily grasp these theoretical concepts. This contradiction does not seem to be deliberate as lecturers have different personal experiences, values, course requirements and the nature of the tool and these all shape the ultimate decision-making process for lecturers on what tools to use. As a result, lecturers have different objectives towards their students using these tools where either, students need to just know the basics about the tool or students have a deeper understanding of the tool and master it. Some technical courses in IS such as programming, require students to just know the introduction and basic concepts of programming and IDEs whilst other courses, such as IT Architecture or Security require students to be an expert in most concepts for the student to be able to use a similar but not exact tool.

> *L05: "So there is a need for IS students to learn computational skills and programming beyond just something as simple as HTML to something a lot more. Things such as data analysis or background of foundational knowledge so that students can go out in the world a lot more prepared, or at least just have a sense of what it is because there is so much, we teach in that course, we cannot really do like a thorough job. Computer science teaches you Python from day one until end of your second year, so, by the time you finish you will be a Python guru whereas with us it is done over a few weeks. So that means we basically just introduce you to what the IDE looks like and then we make you do a little bit of coding, you know, small little things, but we do not go into object-oriented Python programming. You know we are not building large applications here."*

Because of the different approaches that lecture take, there will obviously be differences which exist in how they teach these courses. For example, some courses can present a lot more guidance where lecturers when they give a tool to students, they give them with detailed instructions and guidance, whereas in some cases, students are expected to learn these tools themselves. Some lecturers when they give a tool to students, they give them with detailed instructions and guidance, whereas in some cases students are expected to learn these themselves. As a result, it raises a lot

of concerns on the student's part. Students expect you to give them detailed steps, or components on how to use a tool as they have seen other lecturers do. As highlighted above, these different approaches lecturers use result in a lot of concerns which might even confuse students to a certain extent.

In other cases, lecturers will present more options in terms of tools, whilst some lecturers do not leave room for tools to be used. As a result, this raises some of the following contradictions which will be described in more detail below.

4. Secondary contradiction between subject and rules

The department operates autonomously, where each respective lecturer chooses which tool to use based on how they see fit. One of the statements in the course outlines analysed statements reads: "To offer democratically appropriate digitally enabled education" (C10). However, in believing this, there is still a consensus that there is a need for a guided policy or standard procedure in the selection of tools. Some lecturers in the department who have seen some of the inconsistencies which exist in this selection of these tools, reflect on what they teach, and the tools used in both undergraduate and postgraduate studies.

> *L07: "We still believe in the autonomous academics with expertise, but at the same time what tools they choose maybe should be guided by some policy."*

Lecturers are self-reflective on the factors of their teaching practices, and in some cases teaching workshops also help this reflection. Being able to recognize the various factors that are there amongst different lecturers (which would differ extensively from lecturer to lecturer and consider student's factors too and the need to provide a more structured guide for the selection process might be two contradicting factors. While the policy proposed deviates from the normal discussions that usually take place, the policy would recognize individuality amongst lecturers and recognizes the teaching team involved in decision making as their own autonomy and expertise. The main purpose of the policy would be to differentiate the IS discipline from other departments, to highlight the important considerations that exist.

5. Secondary contradiction between Subject and Rules

Another important contradiction identified in this study is the conflict between the purpose of these industry tools. There seems to be a lack of congruency in whether industry technologies should be used for teaching purposes as they are designed for industry and not necessarily teaching products.

Technologies used in the teaching of IS are taken from/ developed by industry, thus, the term "industry tools". This software is merely tools to develop and assist with the business processes and decision-making. For example, Tableau is typically a data analysis tool set and it's an industry-based package but also used as a teaching tool in university. However, there is a contradiction in that, while these tools used in industry would provide a real-world mirror for the student to see how concepts are applied in a realistic manner, some lecturers focus more on the theoretical concepts rather than the practical aspects as it is important to make a solid foundation of what they know and what will be taught in industry. When a student leaves university and starts their professional career, they might not use that tool at that organization. Therefore, more emphasis needs to be put on theoretical concepts because if a student gets to industry, they have skills specific to a particular technology and that might not be directly transferable to skills for other tools.

> *L03: "So I believe within academia we should not be using industry type software unless especially in the case such as to teach. So, I'm against using industry software within the university because at university level. We try to teach not only find a foundation, but the theoretical part of as an example, software development, software engineering, agile methodology and those other things that students will be able to understand before they touch any software. Once they master these concepts, they are able to use any tool as these skills are transferable."*

Students learn the tools and languages that are currently popular. Anyone who has been in IS for more than a few years realizes that a successful career can no longer be based on a single application or programming language because the field changes so quickly. From the lecturer's perspective, the main benefit in teaching the current applications is that it helps students get their first job out of school. This gives immediate gratification to everyone and validates that the IS program is successful, but it does not guarantee that the student will be able to learn new things and grow beyond his or her initial job. Students have also shown that when they leave university, they've never used any tool they studied in university. Most of the tools students get to use in industry or even in some instances, they must teach themselves.

> *S07: "So for the Capstone project which is like our final third year project we didn't use anything we learnt; it was things that we learnt in our free time. For example, I used to react which is a framework essentially for building websites, and that is what I used when I did an internship some time back. We were not taught how to use react, but I guess if you know the basics of programming you can teach yourself any other language."*

However, industry technologies mirror the real-life industry and give students a chance to see how they can apply the theoretical concepts taught in courses to real life applications. They do not take anything away from theoretical concepts but rather, they enhance and add on to it. In as much as theoretical concepts are the foundation of the course, the practical aspects that these technologies bring, can't even be offered by anything else, lecturers, books or any theory. They give students the chance to see how these tools are applied to the real-world, through using them to achieve the objectives in projects, tests and assignments.

Summary of Results

The chapter aimed to help answer the research questions using the findings gathered from the study. This chapter answers the first research questions by providing the tools used by lecturers and students in the case study provided. Tools used in the study range from open-source tools such as … and proprietary tools such as Microsoft, Aris, Miro, and Tableau. The chapter goes on to identify various factors used to select these tools and these include cost, accessibility, features provided by the tools, software requirements and familiarity of tools by student. Since the Activity Theory is used as the theoretical framework used by the study, the study uses the theory to give a deeper analysis and identifies the various components in the study (Subjects, tools objects, community and division of labour). Contradictions are also identified between these components. An interpretation of these results is given in the next chapter.

CHAPTER 6: DISCUSSION

This chapter primarily elevates some of the important findings identified in the previous chapter. The researcher adds their insights by linking them to literature and highlights how the study collaborates, deviates, or even contributes to literature. The chapter also provides recommendations on how to engage some of the challenges stated in the previous chapter which could be beneficial to similar studies.

The study employed third generation Activity Theory to study the use of industry technologies at a South African university. The study located the lecturer and the student's respective objects in the IS department. In addition to industry technologies being used as ways to equip students with critical skills needed to secure jobs and complement the theoretical aspects of IS courses, the study also highlighted the critical role technology companies play in the teaching of IS which includes teaching and facilitating of various courses in the department, provision of software and teaching material as well as recruitment of students. The study also identified criteria used in the selection of technologies by lecturers including costs, industry needs, departmental and personal values and access. Criteria used by students in the selection of technologies were also identified as familiarity with the tool, accessibility, software requirements and functionality/ feature set. The next section dwells on key insights from the findings identified in this study and what these insights mean for Higher Education as a whole.

1. Importance of industry technologies

Firstly, the study recognizes the need to complement the technical skills usually taught in several different technical or specification courses such as Systems Analysis, Business Process Modelling and Enterprise systems. The study highlights those employers have always expressed the need for industry-ready students and in some cases, it's difficult to train students who do not have any foundational knowledge on programming. This collaborates a study by Nemchinova & Sayani (2006) which states that there is a dissonance between what the industry expects from university graduates and what the universities offer. The authors state that universities no longer adequately prepare students for a viable career an using industry technologies has now been used as a teaching strategy to fix this gap. In addition, it is more demanding for professors and students alike, but it can also bring university education and job realities close together.

An experimental study done by Parker (2010) suggested that it is often not the choice of method or technique that matters to developing processes, but the existence of process-oriented thinking. The study shows the importance of the decision-making process that lecturers go through, and the factors that need to be considered during this process. These factors must be considered now, in terms of whether for example, the tool is affordable for the department where for the case study, accessibility/ availability, popularity, cost and support are some of the factors which are crucial when selecting such technologies. Factors also differ according to differing institutions, departments and individuals and the Activity Theory made it possible to view these aspects as a holistic system and analyze each component to find this case' factors. Some of the contradictions identified in the study, specifically the primary contradiction within the rules, showed the flexibility of the selection procedure when it comes to these tools. The deviation from the open-source tools one would expect the department to use considering the values that the department upholds, to the proprietary tools used is just one example of the factors used at play. The selection process is very flexible and allows for individuals to choose tools per their perspectives, personal experiences, and the Activity Theory becomes a perfect theory to use in this regard due to its concepts of **multi-voicedness/ multiple perspectives** explained in the literature review (Allen et al., 2013; Hashim & Jones, 2007; Karanasios, 2018).

2. **Role of institutional and personal values**

On a broader level, it is also important to note that the study has also highlighted the differences that Higher Education institutions have, from the mission statements, configuration of academic programmes, differing admission requirements as well as academic standards appropriate to specific purposes and goals as per the literature review (Badat, 2010). This study demonstrated that the use of technologies in the IS curriculum goes beyond students achieving their mid-term pass marks, or just equipping them with necessary skills. It is also about developing Africa, as a whole and contributing to the socio-economic development of not just South Africa.

The study shows that the lived practices of the IS department in this case study include developing information systems scholars and the discipline for Africa including and specifically for South Africa. The department is driven by the vision for the development and advancement of scholarship. This now drives how the teaching of courses in the study, curriculum development, recruitment of staff, research and even interaction with industry. All these components reflect these

lived practices more specifically, by thinking of everything in the context of the development of Africa. The findings showed that the department's decision making on industry technologies is driven by the needs of industry, and this reflects the department's lived practices on investing in graduates who are employable and can contribute to the development of the country. (Westfall, 2012) defines Information Systems in terms of the careers that its graduates are preparing for and going into, and the knowledge and skills they need for those positions. The author goes on to state that IS focuses on two most important stakeholders which is students and the organizations that hire them, and this correlates to the findings in this study.

The department greatly focuses on producing graduates with the required skills not only so they can be marketable to employers but also so they can contribute to the social and economic development of the country. The findings highlight that the department contextualizes the courses offered to give a representation of the real world. For example, in course design for the Introduction to Information Systems course, there are elements of local context introduced. It is just not about E-commerce, but also the tools that are used which is also recognizing the context in which you develop E-commerce in an African context. Mashingaidze (2017) states that taking the local environment into account when planning and implementing ICT education (defined as curriculum contextualization) one must consider factors that impact a curriculum's ability to meet local needs. (Ball & Levy, 2008; Mashingaidze, 2017; Toohey, 1999)believe contextual factors include the socio-economic environment where the graduates are going to work and the culture and society in which most of the students are going to work. Thus, this study collaborates with body of literature.

A distinction can be made between the Computer Science department and the IS department for the case study, which closely works with the IS department through the School of IT. According to the results in this study, the computer science department predominantly uses open-source tools. And this is highly reflective of the department of Computer Science's values as they might prioritize things differently compared to the IS department. For example, an IS lecturer would choose to use Excel, obviously because it is relevant to the role for IS graduates and chances are when they start working, they might be exposed to Excel or any related analysis tools. With Computer science, Excel would not be of much benefit to the students as they expect their students to use whatever free tools to just put data in columns and rows programmatically. The reality of Computer Science is students need to be able to use tools in a development space as with also the nature of the jobs in industry. However, for a commerce student to finish a degree at the university

not being able to master the basics of spreadsheets, it's a tragedy because their first job might be given them some Excel spreadsheets as most of them have a financial, or accounting background. They should be able to not just use Excel but be a master in the functionalities and easily learn new concepts from it as well as transfer these skills to a new tool.

3. Student's goals and impact of tools on them

Thirdly, the study showed that the goal is for students to be equipped with fundamental concepts which help them to be able to excel at their jobs in industry and be able to adapt to the changing technical needs of the workplace. Gaining proficiency in one language/ tool is only helpful if the student can use those skills and learn another new technology or tool. According to (Recker & Rosemann, 2009) there is little motivation for institutions to teach with multiple software tools as recruiters have said that the package does not matter. It is the concepts learned by students that are valuable to companies and that knowledge is transferable. The main argument for using industry technologies is to refute those who say the school is married to one vendor and is teaching that vendor's package, rather than educational concepts. For example, many graduates of SAP-based curricula are working for companies that utilize Peoplesoft, Oracle or others but because of the complex nature of SAP, they can easily adapt and be experts to other similar tools through the exposure gained while using SAP.

Industry technologies enable students to grow into their next role. (Mehring, 2016) also in accordance highlighted that "*the main lesson learned here is the need to embrace an open approach in teaching activities: focus on concepts and not on tools*." Results from this study also show that if the tool selected can demonstrate the fundamentals or concepts the students are taught, then that is important. The study agrees with these studies as shown, and it does show that the tool's value to the student is shown through the practical experience that the student obtains from the use of this tool.

4. Activity Theory's contribution to the study

Activity theory's principle of contradiction not only brings to attention various issues within an activity system, but also helps to reflect on changes that could be made which could lead to innovation or further development (Ekundayo et al., 2012; Karanasios, 2014). For example, the secondary contradiction identified between the subject and the object results in a re-evaluation of

tools that can be used to benefit the student more. The decision to use different tools has been seen to be deliberate as the department's teaching style is flexible and often leaves room for changes to be made as opposed to inconsistencies which exist in the approaches used by the lecturers. Students play a huge role in this, whereas explained before, the department follows a constructivist learning approach which puts the student at the center of active learning. This approach entails students interacting with other students and through this interaction, students get to communicate, and give feedback to their lecturers on what other tools they think they should use, or if they have any ideas on contradictions. (Murphy & Rodriguez-Manzanares, 2013) explains that contradictions emerge as disturbances, which are visible manifestations of contradictions or unintentional deviations from the script, and these usually result in change and development in the script. Therefore, the findings agree with literature in that the different teaching practices which exist amongst lecturers are simply inconsistencies which exist, even though these differences result in changes in the development and teaching of various courses.

5. Role of technology companies

The study also recognizes the different roles that are played by technology companies in the utilization of industry technologies. These roles include teaching of the subject, teaching materials, provision of resources and in some instances, giving advice on what to teach in certain courses. This is in accordance with a study done by (Topi, 2019) who states that, "In a continually evolving industry, we recognize that there are different kinds of role players, and thus companies which include large software consultancies, major users of ICT, small innovative companies, business incubators and NGOs all contribute to the teaching of ICT". An important consideration to make is the lack of studies in this area. A few studies investigated what role industry plays when it comes to teaching and learning in higher education. For example, (Aydin et al., 2013) also investigated the industry's perspective when it comes to curriculum design. Most of these studies did not take into consideration the various roles these companies play, but this study fills this gap and thus, contributes greatly to the body of existing literature.

Recommendations

The findings also highlighted that most courses are built on a Constructivist Learning Environment. (Jonassen et al., 1999) state that the epistemic assumptions of constructive learning

are different from those of traditional instruction, so classical methods of needs and task analysis are inappropriate for designing constructivist learning environments (CLEs). Activity Theory provides an appropriate framework for analyzing needs, tasks, and outcomes for designing CLEs. (Jonassen et al., 1999)) also emphasize that the instructional design community needs should be more concerned with the context in which leaning and performance, as well as the design process itself occur. More importantly, the authors recommend that researchers constantly refocus the object of interest in order to provide different views but also to advance the activity as much as possible. In this light, activity research can serve as a kind of formative evaluation where the researcher attempts to improve the outcome of the process. Therefore, this section provides recommendations on some key issues identified in this study.

Some of the notable challenges that are faced in the department include:

1. **Choosing the best tool for a course**

As highlighted before, the department is driven by industry's needs, therefore, lecturers want students to be exposed to a tool that is used a lot in industry. At the same time, there are a lot of tools used in industry, so often, lecturers struggle to choose the best amongst the available tools there, while remaining as unbiased as possible when selecting these tools. The results showed that the Department has no standard procedure on how to select and implement tools in the IS curriculum. This lack of structure has led to an autonomous structure where lecturers can decide on their own on what tools to use or not. Parker (2010) states that a formal process is needed because the selection and evaluation of software tools must be done in a consistent, quantifiable manner to be effective. However, the researcher argues that a policy could be introduced if it is not rigid and allows flexibility to leave room for individuality. By using a formal method, the justification for the selection decision is not just based on technical, intuitive, or political factors (Parker, 2010).

The study utilizes the Activity Theory as the theoretical framework and one of the foundational concepts it is built on is it is socio-technical (Hardman, 2005a). The theory is suitable for the study because it is coherent with Information Systems field in that Information Systems is about the development, management and implementation of Information Systems in organizations and these are viewed through a socio-technical lense and this entails looking at both the tools and the society during this decision-making (Hardman, 2005b; Jonassen et al., 1999). If a policy is to be introduced to dictate the use of these tools, it should recognize the nature of the field of IS as **socio**

technical. Socio technical theory has at its core the notion that the design and performance of new systems can be improved, and indeed can only work satisfactorily, if the 'social' and the 'technical' are brought together and treated as interdependent aspects of a work system. This entails recognizing the human and organizational impacts of new technologies, techniques or practices and applying these to the activity system of an IS department. A central assumption underlying this work is that social science has an interest in, commitment to, and contribution to, design, and this also entails including the factors identified in the previous chapter.

As stated in the literature review; to effectively improve the use of technologies when teaching, the department could use Clegg (2000)'s principles of socio-technical design when designing a policy. The principles entail that if a policy is designed, it should be systematic, in that all aspects of a system are interconnected, and none should take logical precedence over the other. Therefore, this means, all the actors in the activity system, from the student and lecturer to the community (which includes all the external stakeholders that are involved in the use of industry technologies). Since it has been established that values and underlying mindsets are critical to the design of a system, the policy should highlight the institutional and departmental values stated, which include industry expectations, student employability and educating the students.

The policy should also acknowledge the individuality which exists amongst lecturers and leave room for flexibility of decisions as different lecturers prioritize different factors since courses demand different things. Lastly, but most importantly, the policy should reflect the needs of all it's stakeholders, the students at the center of it, because they are the primary beneficiaries of IS education (Aydin et al., 2013; Clegg, n.d.; Parker, 2010). (Denton & Peace, 2003; Parker, 2010) additionally suggest a structured weighting process where each lecturer is asked to assign a weight to a specific criteria/ factor which is specific to the department's needs, the value of importance for each criterion, determine a list of candidate tools which comprises of software tools suggested by the faculty rather than an exhaustive list of available tools rate the tools and then calculate a weighted score. The process is mechanical and can be easily adapted to fit the needs of individual departments.

2. The dynamic nature of the IS field

Information Systems is an ever-changing field and sometimes the changing environment is hard for lecturers to keep up with because tools are always changing. From setting up the technologies, to the maintenance and continuous updates of the software tools. There is never sufficient IT staff

who understand these tools appropriately and with the pandemic, the department must come up with cloud versions that are easily usable, that don't require much admin when it comes to installations and testing them appropriately.

In addition to course offerings, the department could improve training programs and outside support to have more sufficient staff who understand the ever-changing tools. These training programs/ workshops would be specifically designed for the faculty. They would include courses such as an overview of select technologies, with hands-on activities and curriculum materials to introduce faculty to the systems. These workshops can be held on a regular basis, so that it is easy for the department to keep up with current teaching practices when it come to the use of these technologies. The department already has external training workshops which they have with some technology companies, for example the ESEFA program the department has which on addition to helping lecturers who teach enterprise systems keep up with the current teaching practices, also provides the department with access to software and technologies. (Mwalemba, 2019; Strong et al., 2006) also provide additional training and outside support as one way of trying to keep up with the dynamic nature of the IS field. The authors state that holding workshops twice a year which comprise of a modified SAP training course augmented by faculty/ led discussions about how the material might be used in the curriculum.

Furthermore, as faculty take more training in SAP's products and become more familiar with the system, they will develop an understanding of the system's logic and they will develop an understanding of the system's logic and will be able to extend their exercises, solve many of their own problems. It can also be very helpful if the department develops relationship with some company's trainers and with local experts in firms that use some of these technologies. The existing relationships need to be continuously nurtured and maintained so that the department benefits greatly from these companies.

Limitations and future research

The scope of this study is limited to IS and therefore excludes other computing disciplines. The university also has a Computer Science (CS) department that sists in the Science faculty which did not participate in this study. Including the CS department in the research would be of interest given the impact of faculty values and policies on how they use the industry technologies in the department. A study could be done to highlight the differences which exist between how the two

departments select and implement these technologies in their curriculum, considering how the two departments are interlinked and most students tend to major in both subjects. Future research should also consider replicating this study at a different South African university. The case study was done at a traditional university according to the classification used by the South African higher education department. A comprehensive university or a university of technology may have a different experience to that of the current university due to different missions that these universities might have.

CHAPTER 7: CONCLUSION

The study recognizes the importance that industry technologies have in higher education, especially in IS. Understanding the role that these technologies play in IS education is key as that will also make it possible to investigate the number of issues that revolve around them. Studies show that the selection and implementation of industry technologies for use in the IS curriculum has some challenges not only because actual industry software is used, but because there is no formal approach to guide the process. Given the number of software packages that exist, it only makes the process even more challenging. The study set out research questions and aimed to answer these questions using qualitative methods. The study adopts an exploratory research design and an abductive research approach. The study employs a case study as its strategy and allows analysis of phenomena to be investigated at a South African university. The department of IS was the unit of analysis and studies semi-structured interviews were done with 18 participants, 10 lecturers, and 8 students. The results chapter presented and discussed the data according to the Activity Theory. This chapter aims to provide an overall interpretation of the results that answers the research questions that guided this research:

Main research question: *How are IS industry technologies selected and incorporated into teaching?*

The **sub-questions** are as follows:

1. *What industry technologies do lecturers use when teaching undergraduate information systems?*
2. *What are the implications of using these industry technologies on the students?*

To integrate the findings of the individual subcategories while also structuring this chapter in a way that is easy to follow, this chapter will present the implications of the results by each research question. The chapter consists of three sections which are depicted below, where each section seeks to answer the respective research question.

How are these technologies selected and incorporated into teaching?

The tool "option" greatly depends on the requirements for the courses being taught, as well as personal, departmental, and institutional values and various selection criteria. The study showed

that the department does not have a formal approach or document to dictate which tools are selected and implemented in the IS curriculum. Lecturers get to decide which tools to use and how they can implement these tools in the curriculum. The decision to use a particular technology depends on several different factors, which are also subjective and depends on a lecturer. The factors are summarized in table 5.1 below.

Lecturers	Students
1. Alignment with course objectives/ model curriculum 2. Faculty and university needs 3. Industry needs/ popularity 4. Accessibility 5. Open source/ proprietary 6. Cost 7. Software requirements 8. Availability of resources 9. Academic background of students 10. Functionality/ feature set	1. Familiarity/ feature set 2. Accessibility/ availability of resources 3. Software requirements 4. Functionality/ feature set

An interesting observation with regards to the selection of tools for students is the factors identified in this study. Table 5.1 shows that the four main factors students considered when presented with the choice of selection of tools were familiarity, accessibility, software requirements, and functionalities/ feature set. This is following a study done by Palacios et al. (2020), who investigated students' selection of teamwork tools in software engineering education. The study confirmed **experience** as one of the main factors to consider in technology acceptance, which in this study was identified as **familiarity**. Although it is not surprising, performance and freedom, as well as social factors were also identified as the important factors to consider. The authors linked social influence with the existing gap between software engineering education and industrial needs underlined pervasively in the literature. A very important note was this study identifies student tutors and availability of documentation, and the influence of student assistants with relevant and recent experience in the industry as an important factor to consider during the selection process,

which has been detected as a gap in previous studies (Palacios et al., 2020). As explained above, the lecturers operate on an autonomous basis where there is no official structure the lecturers follow. There is a teaching team that exists for each module, and in some cases, the lecturers all contribute towards deciding on which tool to be used in that course. In some cases, the lecturer in charge of the course makes the decision themselves and is in charge of making sure there are teaching resources available for the courses. The course convenor is usually the one who facilitates communication with industry in terms of getting teaching materials, or software to use.

What industry technologies do lecturers use when teaching undergraduate information systems?

To answer this research question quoted at the beginning of this study, the study showed that the department uses a wide range of tools, including Tableau, Microsoft, SAP, and Aris. The list of tools used in the department is found in Table 5.1. The tools used consist of a mixture of open-source and proprietary tools with a higher concentration of proprietary tools. This is particularly owing to the presence of various institutional, departmental, industrial, and personal values and factors at play. Most companies in the IS space use proprietary tools such as SAP, Tableau, Microsoft, and these are some of the big names in the industry. Courses of action would need to be done to make sure that these technologies become accessible to students such as acquiring academic licenses, and some of these technologies also had access to technical support. Some courses leave no room for the selection of tools. Nemchinova and Sayani (2006) also does a study in looking at various tools in teaching university courses in Information Technology. The study defines software tools as anything that helps you build physical systems. These tools can be used when it comes to teaching. Tools identified in this study include Microsoft Visual Studio, IBM, programming languages such as C++, Java, Python, Oracle, and HTML. These tools were also identified in this study as well, but it is important to note that, different institutions use different tools as per different personal and institutional values, experiences, and other factors identified in this study including costs, accessibility, and software requirements (Parker et.al., 2016, Nemchinova and Sayani (2006)).

What are the potential impacts of these technologies on the student?

Results from this study show that the intention behind using industry technologies lies in getting practical experience from using these tools. Today it is hard to imagine system design and development without automated generation of code and documentation, professional-looking

graphical models, built-in version control, compliance with industry standards, better environment for team collaboration, ease of propagating changes throughout the system. Undoubtedly, graduates with a solid understanding of best practices of business analysis, software engineering, cloud computing, and enterprise systems, who are also comfortable with common commercial tools will have a better chance for job placement (Nemchinova and Sayani, 2006). Lecturers recognize that it is impossible to teach students every single different kind of tool for example every development platform or modeling tool. Even so, it's about learning the principles and then being able to apply that in different environments. For example, learning how to code in Java is not nearly directly transferable to C sharp, but if they had to, for example, work in a C sharp environment, it would not be so far a stretch for the students coming from a Java environment because they have learned some of the basic principles.

The practical experience that students gain from using these tools ultimately helps students land a good entry-level job. Students can see the practical application of this technology and it helps to discuss its contribution to organizations. At the undergraduate level, Information Systems are taught which looks at the role of technologies in societies and organizations. By seeing how practically these technologies work, students can unpack their roles in these organizations or society in a more meaningful way. So, practical knowledge is important for students to see how this software works. Furthermore, students can learn the software, and this gives them an advantage when they look for jobs that they have.

More practically, if you go to work and that software is being used or similar software is being used, then you can do your job much better. Contrasting to this, in a theoretical way, if you go into a company and either they have SAP or similar software or Tableau then students can work from foundational knowledge they have gathered in class. Have they've worked with the software or similar software and that way they can become productive employees a lot faster? The results also showed that students are not just interested in the long-term benefits of using these tools, but also the immediate effects. The object of the student is to graduate and finish university with a degree in IS, and this is demonstrated in the activity system depicted in the previous chapter. Thus, industry technologies also help students in carrying out their assigned tasks and their designated projects.

Another important aspect to note is that using different tools and software packages is not necessarily about what tools are used. Rather it is in the concepts that are meant to be instilled in the students. Whether AWS or Azure is used to teach cloud computing is not an issue but more so, if the specific package chosen carries out the desired task. Lecturers try their best to show that the university is not trend-based in that, the goal is to just promote companies and organizations, but

rather to promote the education of students first. Different factors will thus, come into play to determine which tool is most suitable. As the results show, the popularity of the tool in the industry, availability/ accessibility of tools for both the faculty and the students themselves, support, ease of use, and functionality, are some of the key considerations that need to be made when selecting and implementing a tool. The student is always at the center of it all. Following this, the values of the faculty did reflect that open-source tools are highly favorable because of the access they offer to students at university and even when they leave as well as the free cost that comes with them. However, because of the lack of the desired functionalities, and the presence of better tools that would help students give a better understanding of what is being taught, lecturers would rather use proprietary tools and withstand the process of negotiating for licenses as it would help in making sure students have access to the technologies without having to pay for them. The study contributes greatly to literature and more work can be done in other technical disciplines as the phenomena around industry technologies have not been explored fully.

LIST OF REFERENCES

Abd, H., & Halim, E. (2019). *JRL of the Faculty of Commerce for Investigating Tools Selection , Adoption Intention , and Acceptance of Computer Technology in Private Higher Education in Egypt : Project Management Software Casual End-User Perspective Abstract*. *January 2019*.

Allen, D., Karanasios, S., & Slavova, M. (2013). Working with Activity Theory: Context, Technology, and Information Behavior. *Journal of the American Society for Information Science and Technology*, *64*(July), 1852–1863. https://doi.org/10.1002/asi

Astakhova, K. v., Korobeev, A. I., Prokhorova, V. v., Kolupaev, A. A., Vorotnoy, M. v., & Kucheryavaya, E. R. (2016). The role of education in economic and social development of the country. *International Review of Management and Marketing*, *6*(1), 53–58.

Aydin, A., Peacock, D. C. P., Marrett, R., Peacock, D. C. P., Doblas, M., Petit, J. P., Hancock, P. L., Barka, A. A., Barron, K., Paulista, U. E., Em, P. D. E. P., Biológicas, C., Souza, I. A. D. E., Viana, A., Júnior, S., Angelier, J., Angelier, J., Mechler, P., Burini, A., … Junho, M. do C. B. (2013). Educational Research. In *Journal of Petrology* (Vol. 369, Issue 1). https://doi.org/10.1017/CBO9781107415324.004

Badat, S. (2010). *Rhodes University Centre for Higher Education*. *March*, 1–16.

Bain, L. Z. (2017). How do Information Systems (IS) programs prepare students for entry level occupations in the computer and IT industry? *Issues in Information Systems*, *18*(3), 78–88.

Ball, D. M., & Levy, Y. (2008). Emerging Educational Technology : Assessing the Factors that Influence Instructors ' Acceptance in Information Systems and Other Classrooms. *Journal of Information Systems Education*, *19*(4), 431–444.

Beise, C. M. (2006). Revisiting database resource choice: A framework for DBMS course tool selection. *Association for Information Systems - 12th Americas Conference On Information Systems, AMCIS 2006*, *4*, 2121–2126.

Bligh, B., & Flood, M. (2017). Activity theory in empirical higher education research: choices, uses and values. *Tertiary Education and Management*, *23*(2), 125–152. https://doi.org/10.1080/13583883.2017.1284258

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Brennan, J., King, R., & Lebeau, Y. (2004). The role of universities in the transformation of societies. *An International Research Project. Synthesis Report. London Available at: Http://Www. Open. Ac. Uk/Personalpages/y. Lebeau/Transfo. Pdf (Accessed 18.05. 2008)*, *November*. https://doi.org/10.3964/j.issn.1000-0593(2013)08-2071-04

Cao Thanh, N., & Thi Le Thanh, T. (2015). The Interconnection Between Interpretivist Paradigm and Qualitative Methods in Education. In *American Journal of Educational Science* (Vol. 1, Issue 2). http://www.aiscience.org/journal/ajeshttp://creativecommons.org/licenses/by-nc/4.0/

Chen, L., Liu, Y., Gallagher, M., Pailthorpe, B., Sadiq, S., Shen, H. T., & Li, X. (2012). Introducing cloud computing topics in curricula. *Journal of Information Systems Education*, *23*(3), 315–324.

Clegg, C. W. (n.d.). *Sociotechnical principles for system design*.

Crawford, K., & Hasan, H. (2006). Demonstrations of the Activity Theory Framework for Research in Information Systems. *Australasian Journal of Information Systems*, *13*(2). https://doi.org/10.3127/ajis.v13i2.40

Denton, J. W., & Peace, G. (2003). Selection and Use of MySQL in a Database Management Course. *Journal of Information Systems Education*, *14*(4), 401–407.

Ekundayo, S., Wang, W., & Andrade, A. D. (2012). The use of activity theory and its principle of contradictions to identify and analyze systemic tensions : the case of a Virtual University and its partners. *International Conference on Information Resources Management (CONF-IRM)*, 1–14.

Fedorowicz, J., Usoff, C., & Hachey, G. (2004). Teaching Tip: Twelve Tips for Successfully Integrating Enterprise Systems Across the Curriculum. *Journal of Information Systems Education*, *15*(3), 235.

Foshay, R., & Ahmed, M. I. (2003). A Practical Process for reviewing and Selecting Educational Software. *Technical Paper #8, 2005*(Feb. 10 2005).

Glover, M. J. (2020). Google forms can stimulate conversations in discussion-based seminars? An activity theory perspective. *South African Journal of Higher Education*, *34*(1), 99–115. https://doi.org/10.20853/34-1-2814

Granata, S. N., & Dochy, F. (2013). Applied PhD research in a work-based environment: An activity theory-based analysis. *41st SEFI Conference*, *41*(6), 990–1007.

Grossman, M., Aziz, M., Chi, H., Tibrewal, A., Imam, S., & Sarkar, V. (2017). Pedagogy and tools for teaching parallel computing at the sophomore undergraduate level. *Journal of Parallel and Distributed Computing*, *105*, 18–30. https://doi.org/10.1016/j.jpdc.2016.12.026

Guthrie, R. W., & Guthrie, R. A. (2000). Integration of Enterprise System Software in the Undergraduate Curriculum. *Proceedings of the ISECON 2000*.

Hardman, J. (2005a). Activity Theory as a framework for understanding teachers' perceptions of computer usage at a primary school level in South Africa. *South African Journal of Education*, *25*(4), 258–265. https://doi.org/10.4314/saje.v25i4.25046

Hardman, J. (2005b). Activity theory as a potential framework for technology research in an unequal terrain. *South African Journal of Higher Education*, *19*(2), 378–392.

Harris, A. L., & Rea, A. (2009). Web 2 . 0 and Virtual World Technologies : A Growing Impact on IS Education. *Journal of Information Systems*, *20*(2), 137–145.

Hashim, N., & Jones, M. L. (2007). Activity Theory: A framework for qualitative analysis. *4th International Qualitative Research Convention (QRC)*.

Hoffmann, D., Ahlemann, F., & Reining, S. (2020). Reconciling alignment, efficiency, and agility in IT project portfolio management: Recommendations based on a revelatory case study. *International Journal of Project Management*, *38*(2), 124–136. https://doi.org/10.1016/j.ijproman.2020.01.004

Humble, N., Mozelius, P., & Sällvin, L. (2019). Teacher Challenges and Choice of Programming Tools for Teaching K-12 Technology and Mathematics. *Education and New Developments 2019*, *1*(End), 431–435. https://doi.org/10.36315/2019v1end099

Jonassen, D. H., Rohrer-Murphy, ;, & Lucia. (n.d.). *Activity theory as a framework for designing constructivist learning environments*.

Kamanga, R., & Alexander, P. M. (2020). Contradictions and strengths in activity systems: Enhancing insights into human activity in IS adoption research. *Electronic Journal of Information Systems in Developing Countries*, *March*, 1–14. https://doi.org/10.1002/isd2.12149

Karanasios, S. (2014). Framing ICT4D Research Using Activity Theory: A Match Between the ICT4D Field and Theory? *Information Technologies and International Development*, *10*(2), 1–18.

Karanasios, S. (2018). Toward a unified view of technology and activity: The contribution of activity theory to information systems research. *Information Technology and People*, *31*(1), 134–155. https://doi.org/10.1108/ITP-04-2016-0074

Katiyar, N., & Bhujade, R. (2018). A Survey : Adoption of Cloud Computing in Education Sector. *International Journal of Computer Trends and Technology*, *60*(1), 15–25. https://doi.org/10.14445/22312803/ijctt-v60p102

Kilani, M. al, & Kobziev, V. (2016). An Overview of Research Methodology in Information System (IS). *OALib*, *03*(11), 1–9. https://doi.org/10.4236/oalib.1103126

Korpela, M., Mursu, A., & Soriyan, H. A. (2002). Information systems development as an activity. *Computer Supported Cooperative Work*, *11*(1–2), 111–128. https://doi.org/10.1023/A:1015252806306

Lancor, L., & Katha, S. (2013). Analyzing PHP frameworks for use in a project-based software engineering course. *SIGCSE 2013 - Proceedings of the 44th ACM Technical Symposium on Computer Science Education*, 519–524. https://doi.org/10.1145/2445196.2445350

Larsson, U., & Boateng, R. (2009). Towards a Curriculum Adaptation Model for IS Undergraduate Education in sub-Saharan Africa. *32nd Information Systems Research Seminar in Scandinavia*, *August*, 7–22.

Levitt, H. M., Bamberg, M., Creswell, J. W., Frost, D. M., Josselson, R., & Suárez-Orozco, C. (2018). Journal article reporting standards for qualitative primary, qualitative meta-analytic, and mixed methods research in psychology: The APA publications and communications board task force report. *American Psychologist*, *73*(1), 26–46. https://doi.org/10.1037/amp0000151

Lightfoot, J. M. (1999). Fads Versus Fundamentals: The Dilemma for Information Systems Curriculum Design. *Journal of Education for Business*, *75*(1), 43–50. https://doi.org/10.1080/08832329909598989

Marwan, A., & Sweeney, T. (2019). Using Activity Theory to Analyse Contradictions in English Teachers' Technology Integration. *Asia-Pacific Education Researcher*, *28*(2), 115–125. https://doi.org/10.1007/s40299-018-0418-x

Mashingaidze, K. (2017). *Adopting and contextualising international computing curricula: A South African case*. *March*. http://wiredspace.wits.ac.za/handle/10539/24400

Mead, N., Gurbaxani, V., & Mendelson, H. (1995). Information systems research. *International Journal of Forecasting*, *11*(2), 355–358. https://doi.org/10.1016/0169-2070(95)90075-6

Mehring, J. (2016). Present Research on the Flipped Classroom and Potential Tools for the EFL Classroom. *Computers in the Schools*, *33*(1), 1–10. https://doi.org/10.1080/07380569.2016.1139912

Moscardini, A. O., Strachan, R., & Vlasova, T. (2020). *The role of universities in modern society*. https://doi.org/10.1080/03075079.2020.1807493

Murphy, E., & Rodriguez-Manzanares, M. (2013). Using activity theory and its principle of contradictions to guide research in educational technology », Aust. J. Educ. Techonologyu, 24, 4, p. 442-457. *Australian Journal of Educational Technology*, *24*(4), 442–457.

Mwalemba, G. (2019). Confronting Challenges Facing Enterprise Systems Education in Africa. *2nd International Conference on Next Generation Computing Applications 2019, NextComp 2019 - Proceedings*. https://doi.org/10.1109/NEXTCOMP.2019.8883674

Nemchinova, Y., & Sayani, H. (2006). Using tools in teaching university courses in information technology. *Proc. - Seventh ACIS Int. Conf. on Software Eng., Artific. Intelligence, Netw., and Parallel/Distributed Comput., SNPD 2006, Including Second ACIS Int. Worshop on SAWN 2006, 2006*, 361–367. https://doi.org/10.1109/SNPD-SAWN.2006.76

Parker, K. R. (2010). Selecting software tools for IS/IT curricula. *Education and Information Technologies*, *15*(4), 255–275. https://doi.org/10.1007/s10639-010-9126-8

Radermacher, A., & Walia, G. (2013). Gaps between industry expectations and the abilities of graduates. *SIGCSE 2013 - Proceedings of the 44th ACM Technical Symposium on Computer Science Education*, 525–530. https://doi.org/10.1145/2445196.2445351

Recker, J., & Rosemann, M. (2009). Teaching business process modelling: Experiences and recommendations. *Communications of the Association for Information Systems*, *25*(1), 379–394. https://doi.org/10.17705/1cais.02532

Russell, D. L., & Schneiderheinze, A. (2005). Understanding innovation in education using activity theory. *Educational Technology and Society*, *8*(1), 38–53.

Strong, D., Fedorowicz, J., Sager, J., Stewart, G., & Watson, E. E. (2006). Teaching with Enterprise Systems. *Communications of the Association for Information Systems*, *17*(May). https://doi.org/10.17705/1cais.01733

Tatnall, A. D. (2010). Using actor-network theory to understand the process of information systems curriculum innovation. *Education and Information Technologies*, *15*(4), 239–254. https://doi.org/10.1007/s10639-010-9137-5

Tatnall, A., & Gilding, A. (1999). Actor-Network Theory and Information Systems Research. *Proceedings of the 10th Australasian Conference on Information Systems, January 1999*, 955–966. https://doi.org/10.4018/jantti.2009062304

Toohey, S. (1999). *Beliefs, values and ideologies in course design*.

Topi, H. (2019). Invited paper - EDSIGCON 2017 keynote reflections on the current state and future of information systems education. *Journal of Information Systems Education*, *30*(1), 1–9.

Topi, H., Valacich, J. S., Wright, R. T., Kaiser, K., Nunamaker, J. F., Sipior, J. C., & de Vreede, G. J. (2010). IS 2010: Curriculum guidelines for undergraduate degree programs in information systems. *Communications of the Association for Information Systems*, *26*(1), 359–428. https://doi.org/10.17705/1cais.02618

Tytler, R., Symington, D., & Smith, C. (2011). A Curriculum Innovation Framework for Science, Technology and Mathematics Education. *Research in Science Education*, *41*(1), 19–38. https://doi.org/10.1007/s11165-009-9144-y

Westfall, R. D. (2012). An employment-oriented definition of the information systems field: An educator's view. *Journal of Information Systems Education*, *23*(1), 63–69.

Wolff-Michael, R. (2004). Activity Theory and Education : An Introduction. *Mind, Culture, and Activity*, *11*(1), 1–8. https://doi.org/10.1207/s15327884mca1101

APPENDICES

Appendix A – Consent form

Department of Information Systems

Leslie Commerce Building
Engineering Mall, Upper Campus
Private BagX3 - Rondebosch - 7701
Tel: +27 (0) 21 6502261 Fax: +27 (0) 21650 2280
http://www.commerce.uct.ac.za/informationsystems/

INFORMED CONSENT FORM

Research Project Title:	The role of industry technologies on IS Education and their implications on students
Principal Investigator(s):	Shaloam Mutetwa

Voluntary Consent	
I, …….. , hereby voluntarily consent to participate in the above-mentioned research. I am aware that participation is voluntary and that I may choose to withdraw from this study at any time, should they choose to do so.	
Signature:	Date: / /

Appendix B – Invitation letter

University of Cape Town • iYunivesithi yaseKapa • Universiteit van Kaapstad

Department of Information Systems

Leslie Commerce Building
Engineering Mall, Upper Campus
Private BagX3 - Rondebosch - 7701
Tel: +27 (0) 21 6502261 Fax: +27 (0) 21650 2280
http://www.commerce.uct.ac.za/informationsystems/

Dear Sir/ Madam

Re: Invitation to participate in research study

In terms of the requirements for completing a master's degree in Information Systems at the University of Cape Town, a research study is required. The researcher in this case, Shaloam Mutetwa, has chosen to conduct a study entitled, **The role of industry technologies in Information Systems Education.**
The objective of this research is to determine how industry technologies are selected and implemented in the undergraduate IS curriculum as well as to find out the impacts of these technologies on students. The study recognizes the huge part these technologies play in equipping students with practical skills such as programming, enterprise systems and cloud computing and how they help a student land a good entry level job and maneuver their way in industry. Your participation in this research is voluntary. All information will be treated in a confidential manner and used exclusively for the purpose of this study. No personal information will be used in the study, or released, to ensure anonymity of your responses. You can choose to withdraw from the research at any time for whatever reason, in accordance with ethical research requirements.
The data collection method will be one-on-one interviews with the researcher. The collection of this data will require about 30 minutes of your time and will be conducted on Ms Teams. Kindly please be informed that the ethical aspect of the research ensures the preservation of the identity of the participants, the data collected will be used purely for academic purposes. If you are willing to participate in this study, kindly sign the attached form and return to the email address shown below.

If you have questions or wish to verify the research, please feel free to contact me on 27725480158 or email me on mttsha012@myuct.ac.za
Thank you for your time and we hope that you will participate.

Yours sincerely,
Shaloam Mutetwa (Research Student)

Appendix C – Interview guides

Interview guide for the lecturers

1. This study focuses on technologies used by lecturers to demonstrate practical concepts in class or as support for theoretical concepts for courses in Information Systems which are also widely used in industry such as SAP and SAGE. So, the questions I am going to be asking you during this interview all relate in one way or another to the selection and implementation of these technologies.
2. How would you define these tools/ what terms would you give them?
3. Do you use these technologies in teaching IS? If so, what technologies do you use and why do you personally use them?
4. Why have you chosen those mentioned technologies, as opposed to other similar technologies?
5. In using these tools, do they help you achieve your goals in teaching IS? Why or why not?
6. Who determines which technologies to use in the department and which technology is the best?
7. Research suggests that the selection of these technologies relies on specific factors which are usually considered by lecturers when selecting these technologies. Does the department use any specific criteria in choosing which technologies or recommend which technologies to use or you use underlying strategies or goals (these can be personal or related to external factors such as IS curriculum, accreditation, cost, accessibility)?

8. Lecturer values, departmental values and institutional values can influence the selection of technologies as well. What are some of the values which resonate to you, on a personal basis, as well as from the department's perspectives, which you have seen to help you make decisions when it comes to these technologies?

9. Do you ever encounter challenges when selecting these tools, or situations where there is a clash in the weighting of individual factors that you have named? If so, how do you resolve or solve these challenges and how do you draw the line between relying on your intuition and following the standardized rules in selecting these technologies.

10. How do you implement these technologies in the IS curriculum?

11. What do you expect the student to gain from use of these technologies in the subject?
12. Who is responsible for implementing and integrating those technologies in the undergraduate curriculum and how are these technologies implemented?
13. Are there any external parties/ factors outside the department who help determine which technologies you will be using for a particular course? If so, please name them and explain how they?
14. How do these external parties help in choosing these technologies, as well as implementing the tools in the curriculum?
15. Are there any rules/ conventions- formal/ informal (implicit) which, as a lecturer have helped you in determining which technologies to use for the courses or the implementation of these technologies? If so, can you say why and how, the rules could be changed?
16. Industry in South Africa has a demand for certain ICT skills. Are you aware of what these are from an IS perspective and how do you try develop these skills in your students using these technologies?
17. Like industry, society in general has particular expectations from an ICT perspective. Do these type of skills needs inform what technologies you will use for students?
18. Studies suggest that students expect their studies to prepare them for employment. Do you factor this expectation into any of your decisions? What group of people help to make sure that the curriculum aligns with the current demands for graduates?
19. In your opinion, has the use of these technologies proved to be helpful for students? Please explain why/ why not.

Students interview questions

20. These questions are tailored to try answer the research question: What is the impact of industry technologies on students?

21. This study focuses on technologies used by lecturers to demonstrate practical concepts in class or as support for theoretical concepts for courses in Information Systems which are also widely used in industry such as SAP and SAGE. So, the questions I am going to be asking you during this interview all relate in one way or another to the selection and implementation of these technologies.
22. Do you use these technologies in your IS practical's? If so, what technologies do you sue how do they help you in your IS studies?
23. Research suggests that some students expect their studies to prepare them for employment. Do you think using these technologies in your practical's helps you achieve this? Do you find these technologies useful for grasping concepts in class?
24. What are some of the challenges you encounter as a student when using these technologies?
25. Have you ever found yourself in a situation where you have to use these technologies in real life or apply it outside the school? If so, please elaborate.
26. What do you think industry technologies are used in teaching IS?
27. If not useful, do you think the use of these technologies could be adjusted to make them more useful? If yes, please explain.
28. What do you think is the lecturer's role is in facilitating your learning IS?
29. Which persons/ material during the course do you find will help you achieve what you want out of the course? How do these persons help you achieve your goal in learning IS?
30. Are there any rules/ conventions- formal/ informal (implicit) which, as a student have helped you in using these technologies?
31. If so, can you say why and how, the rules could be changed?

HOD interview questions

32. This study focuses on technologies used by lecturers in undergraduate courses to demonstrate practical concepts in class or as support for theoretical concepts Information

Systems So, the questions I am going to be asking you during this interview all relate in one way or another to the selection and implementation of these technologies. Is the purpose of my study clear or should I elaborate further?

33. What is the vision for the IS/CS Department? What values drive the department and how do you make sure these values are instilled in the decisions made in the department?
34. So looking at the department of IS/ CS, is there a policy/ structured departmental policy which dictates how these tools/software should be selected or implemented in the curriculum/courses? - can be asked but there needs to be a build up
35. Do you think implementing a formal or structured policy would help make the selection process easier for lecturers?
36. I watched your lecture on "*Computer Science in times of crisis: reflecting on societal factors for software and algorithm design*", and one interesting thing I noted is the emphasis on human and societal focus in preparing work-ready graduates.
37. I've managed to interview a few IS lecturers now, and I have seen that many of them for one reason or another prefer using proprietary (widely used tools) to demostrate concepts as well as prepare students for industry. . IS that also the case for CS? (why, why?)
38. How do you manage the relationship between the department and industry and how does the relationship benefits students?
39. I'd like to know what you think are the factors lectures should prioritize when selecting a technology.

Appendix D - Data coding

Table 1:distribution of nodes

Nodes	Number of occurrences	Response Frequency
course objectives	32	7
Proprietary/ open source	18	7
Popularity in industry	31	7
Cost	16	7
Availability/ accessibility	15	7
System Requirements	9	6
Functionality	3	5
Ease of use	4	5
IS model curriculum	6	4
Communities	6	3
Academic Background	6	3
Ease to teach	5	2
Application to real life	5	2
Popularity of technology	2	2
Technical support • Commerce IT • Documentation • Tutors • Company support	2	1

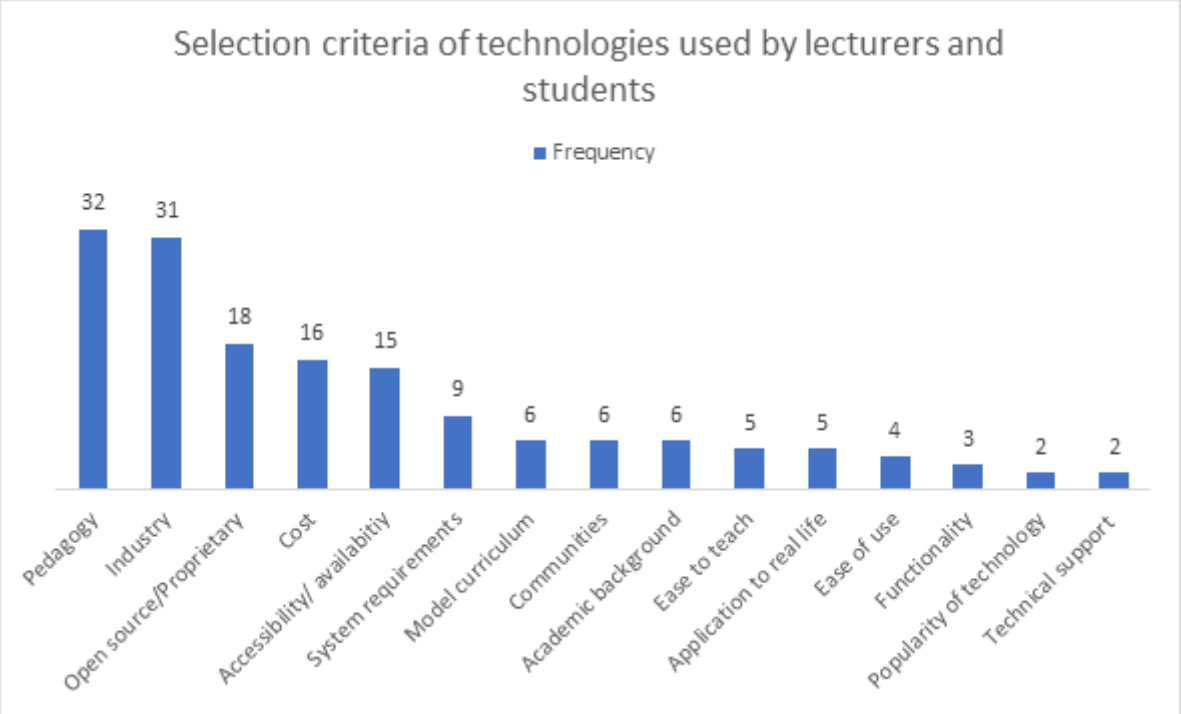


Table 2: Nodes of selection criteria used by lecturers