The development of a framework which supports the evaluation of Mobile Educational Applications

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ABSTRACT

The growth in mobile device usage creates various opportunities for the development of online learning material which could be accessed through various devices. Mobile learning has several benefits some of which include the opportunity for learners to access open educational resources, the benefit of an unrestricting learning location as well as allowing students to progress at their own pace. Educators in South Africa experience challenges to evaluate, select and use applications that will support meaningful learning in their subject field. This paper explored how an Information Systems Success (ISS) model could be utilised by teachers to successfully evaluate, select and use mobile educational applications (MEA). It aims to illustrate how each of the dimensions of an ISS model could be engaged to critically evaluate MEAs and contribute meaningfully in decision-making processes. Qualitative data was collected from three mathematics subject specialists, six teachers who specialise in various subject fields, one technology and technical expert and six further education and training (FET) mathematics classrooms. The data gathered provides novel information on how educators evaluate and select applications and how each dimension of the ISS model could meaningfully contribute to these evaluations. The research concludes that each dimension of the ISS model could be utilized to contribute to the evaluation and selection of mobile educational applications. This provides credibility for the use of the ISS model as a MEA evaluation tool.

Keywords

Evaluation, Framework, ISS model, Mobile Educational Application (MEA), Mobile learning.

1. Background

The latest developments of mobile phones and devices have been introduced at a rapid speed in the last few years. The evidence of mobile penetration is unquestionable. People from all walks of life and ages are using devices such as cell phones, tablets and laptops to communicate and stay connected with each other (Jacob & Issac, 2014). The popularity of mobile devices changed the design concept of learning activities (Hwang, Wu, Zhuang, & Huang, 2013). Mobile devices create opportunities for the development of instructional materials that learners could access through them without being bound to a fixed location. Jacob and Issac (2014) emphasized that with proper facilitation, mobile learning could be of great benefit to both learners and educators. Teachers could access services to communicate and interact with learners while they are on the move (Jacob & Issac, 2014). The mobile phone has transformed to a platform where users can learn wherever they go by means of formal training or informal support and conversation (Kukulska-Hulme, Sharples, Milrad, Arnedillo-Sánchez, & Vavoula, 2009).

In some parts of the world the ratio between phones and users exceeds 100%. This creates countless opportunities for the development of mobile applications (Vogel, Kennedy , & Chi-Wai Kwok, 2009). Vogel et al. (2009) rightfully claimed that there are pedagogical and technological issues regarding mobile learning but that the digital divide between learners and educators is increasing (Conole, de Laat, Dillon, & Darby, 2006). The use of mobile applications in learning may seem natural for digital “natives” but for digital “immigrants” this is viewed as a huge burden (Vogel et al., 2009).

In 2012 the Educause Centre for Applied Research [ECAR] survey on Mobile IT in higher education found that “67% of the surveyed students believed that mobile devices are important to their academic success and use their devices for academic activities” (ECAR, 2012). It should increasingly be noted that learners will have access to a

mobile device which could support their traditional learning activities. Subsequently, learning applications should be developed which will compliment these learning activities (Vogel et al., 2009). There are however some considerations to take into account before developing mobile applications. Vogel et al. (2009) identified the following:

- The involvement of students and instructors in the design of applications
- Identifying content, the use of technology and how interaction will take place
- The role of the educational institution

The reason for the research developed from our interest in mobile applications and how mobile applications could complement meaningful learning. The study conducted by (Vogel et al., 2009) tried to determine whether the use of mobile device applications could lead to learning or not. Their results showed that mobile applications could assist a learner in achieving better results, although their results were preliminary and not demonstrative of enhanced learning by the students. Jacob and Issac (2014) view mobile learning (m-learning) as a subset of e-learning and explain that they share commonalities in their benefits to the learners. They identified the following five benefits to learners:

1. Easy access – learners can access information wherever they are and be informed of updated information.
2. Self-study – learners can study at their own time and pace.
3. Evaluation and feedback – m-learning tools can incorporate assessment activities which provide immediate feedback to the user.
4. Access to online repository – mobile devices enable learners to access information stored online and to communicate with peers and teachers.
5. Communities of practice (COP) – a COP consist of a domain, a community and a practice. Learning takes place when learners and teachers meet online to discuss matter on a particular subject.

Taleb, Ahmadi, and Musavi (2015) emphasised that mobile devices are cheaper than personal computers and provide more people with access to information and learning opportunities. Educational applications motivate learners. M-learning enables learners to personalise their experience and to engage with information according to the learner's needs. M-learning is interactive which is complemented by interactive interfaces and can take place in an environment which is stress free (Taleb et al., 2015).

The main role of technology is to facilitate the thought processes of learners and to contextualise abstract concepts (Persico & Pozzi, 2011). M-learning has already increased learners' motivation to learn and the trust they have in themselves (Taleb et al., 2015). Taleb et al. (2015) research has shown that the use of mobile devices increase learners motivation. This means that there is a direct relationship between learner's attitude towards learning and mobile devices. Their findings are supported by similar findings of Shin, Sutherland, Norris, and Soloway (2012) and (Ciampa, 2014). In a study done by Ciampa (2014) she concluded that some mobile applications create the opportunity for learners to challenge themselves against their previous best performances. This encourages indirect competition and contributes to learning. Shin et al. (2012) proved that game technology positively impacted students' learning in arithmetic.

The rationale of this study leads to certain problem areas identified in mobile learning which will be discussed in the next section.

2. Problem Statement

Van der Walt, Maree, and Ellis (2008) found that subject matter knowledge and technical vocabulary of South-African learners are poor. Their results are supported by the Annual National Assessment (ANA) done in 2013. The results concluded that Grade 9 learners lack a wide variety of necessary skills to be successful in mathematics (DBE, 2015). Reasons for this might include the poor socio-economic background of the learners, lack of learner support material and poor quality of teachers and teaching. In a study done by Stodolsky and Grossman (1995) they found that teachers think that it is their responsibility to teach knowledge only. Therefore teachers are not taking responsibility to support learners in thinking critically and using their knowledge in real life situations. The problem with this approach is that it is teacher centred and learners do not get the opportunity to express their discomfort

with the information. Learning motivation can be increased if a teacher has the ability to implement resources consistent with learners' interests and that can personally satisfy their career goals (Vogel et al., 2009). Resources like mobile device applications have the ability to create an environment where inquiry-based learning can take place and will shift the focus from a teacher centred approach to a learner centred approach.

The development of mobile devices and applications is progressing on a daily basis. It is now possible to use the characteristics of mobile devices to develop learning platforms for educational purposes in the form of learning applications (Vogel et al., 2009). Many learning applications are developed at rapid speed and often not by education specialists. Roschelle et al. (1999) explain that the development of software applications is mainly the responsibility of computer programmers. The developers of educational software lack educational experience to develop exceptional educational software and there is insufficient evidence to prove that educators will become efficient developers of educational software (Roschelle et al., 1999). Developers are challenged to design applications that address the needs of teaching and learning. Teachers' challenge is to investigate the ease of use and usefulness of these applications in the teaching environment. This resulted in the need for education, society and technology to develop a very close relationship (Traxler, 2007). Roschelle et al. (1999) envision a platform where educators and developers can collaborate effectively. The goal is to create educational applications which meet the standards from a technical, educational, curricular and conceptual point of view.

The core problem statement for this study is that educators experience challenges to evaluate, select and use applications that will support meaningful learning in their subject field and comments on existing applications with the aim to improve their design.

3. Research Questions

3.1 Primary Research Question

- How can the application of the Information Systems Success model as proposed by Zaied (2012) be used to evaluate mobile educational applications that support meaningful learning?

3.2 Secondary Research Questions

- How do teachers evaluate and select applications?
- How could each dimension of the ISS model contribute meaningfully in educational environments?

4. Research Objectives

The objectives of the study are based on the primary and secondary research questions presented in Section 3 and can be articulated as follows:

- To investigate current literature on the use of mobile technologies in education;
- To investigate how MEAs could support meaningful learning;
- To evaluate teachers evaluation, selection and use of MEAs; and
- To propose a framework which teachers could use to evaluate and select MEAs which could contribute to meaningful learning.

5. Importance of this study

The study will contribute to an improved understanding of the following:

- How teachers evaluate and select applications;
- The factors influencing teachers' motivation to use MEAs;
- If the ISS model could be used to evaluate and select applications;
- An evaluation framework which teachers could use to evaluate and select applications.

6. Methodology

The research methodology is purely qualitative, characterised by semi-structured interviews and observations. The goal of the approach was to examine a specific phenomenon which influences learning and teaching environments (Redish, 2004). The ontology of this study was developed by using two specific models: The Technology Acceptance Model (TAM) created by Masrom (2007) and the Information Systems Success model (ISS) created by (Zaied, 2012). Interpretivism will act as the research philosophy of this study which is rooted in both anti-positivism and constructivism (Mack, 2010). An understanding of teachers' experiences was constructed with mobile applications through the interpretation of interviews and observations and comparing the results to existing literature. Evaluation research is the core strategy for this research which will provide information that can contribute to policymaking, decision-making and future improvements (Arthur & Cox, 2014). The paper focuses on how the ISS model proposed by Zaied (2012) could be used to evaluate MEAs to contribute to meaningful learning. Interviews and observations serve as the data collection techniques. Semi-structured interviews were used to attain detailed and in-depth data (Leech, 2002). The goal of the observations was to determine how teachers and learners interact with MEAs. The interviews and observations were analysed according to the ten dimensions of the ISS model identified in the conceptual framework. The samples were purposefully selected and consisted of three mathematics subject specialist, six teachers who specialise in various subject fields, one technology and technical expert and six Further Education and Training (FET) mathematics classes. The strategies for data collection are semi-structured interviews and classroom observations supported by digital voice-recordings. An inductive approach was followed to analyse the data (Thomas, 2006). Key concepts were derived from the raw data which were interpreted. The evaluation objectives were guided by the ten dimensions identified in the ISS model. The results of the data analysis were used to develop a framework which teachers could use to evaluate and select MEAs.

7. Theoretical framework

The TAM & ISS Model

The theory of reasoned actions (TRA) used in psychology research was the precursor that Davis (1989) used to develop the technology acceptance model (TAM) (Fishbein & Ajzen, 1975; Masrom, 2007). The TRA theorises that an individual's behaviour is a product of the individual's attitude and perceptions toward the behaviour. Therefore behaviour is grounded in attitudes and beliefs. The TAM model proposes that there are external variables that influence the perceived usefulness of technology and the ease with which technology can be used. In this model perceived usefulness refers to the degree people believe that technology can improve their work performance, and perceived ease of use refers to how effortless the people think using technology will be. These two factors will determine people's attitude towards technology and guide their behavioural intention to use technology. TAM suggests that an individual will only find technology easy to use and useful if their attitude towards the technology, that is, their intentions to use the technology and the actual use of the technology are positive. A user's attitude towards technology is influenced by two distinct factors namely, the belief that the use of technology can improve their learning and the human effort needed to use the technology. The TAM is depicted in Figure 1

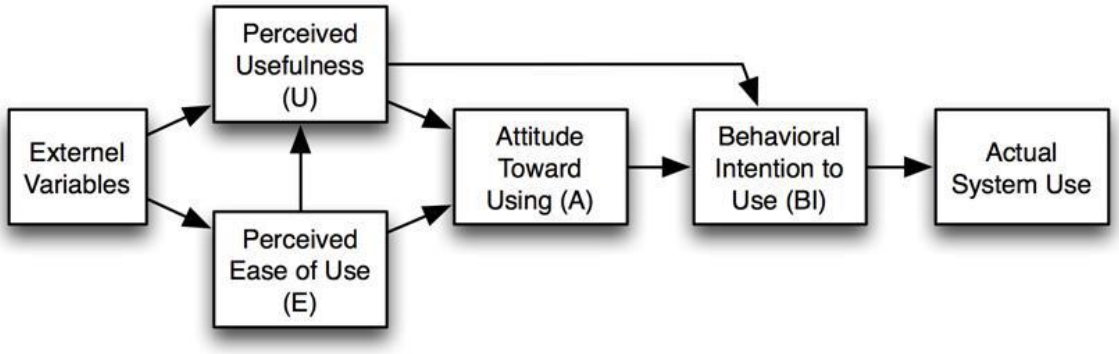

Figure 1: The Technology Acceptance Model (Davis, 1989).

In various studies the TAM model was used to test the user acceptance of information technology, for example, web browsers (Morris & Dillon, 1997), telemedicine (Hu, Chau, Sheng, & Tam, 1999), websites (Koufaris, 2002), e-collaboration (Dasgupta, Granger, & McGarry, 2002) and blackboard learning (Landry, Griffeth, & Hartman, 2006).

(Zaied, 2012) used fundamental theories and concepts of the TAM model and the updated information systems success model developed by Delone and McLean (2003) to develop a new model with the inclusion of six new dimensions for the evaluation of information systems success. This is illustrated in Figure 2. This model assesses the critical factors affecting information systems in the public sector in Egypt. The proposed model demonstrates how it can assist decision makers in the evaluation and development of information systems (Zaied, 2012). The possible utilization of an information system (IS) can increase a business's competitive advantage. It has been argued that it is not the IS itself that can create the advantage but the utilization of the IS. These systems are always advancing and therefore are very expensive. Businesses must find solutions to use the information systems in a more profitable way and have to identify key factors in the information system that can lead to success (Zaied, 2012).

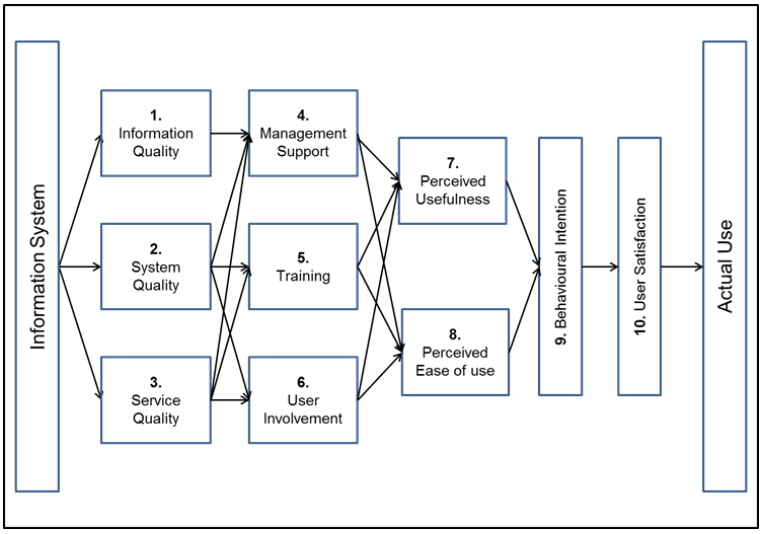

Figure 2: The Information System Success Model (Zaied, 2012).

8. Conceptual Framework

The ISS model was used as a conceptual framework for this study. The conceptual framework was also applied to determine whether the ISS model could be used to evaluate and select applications. The first three dimensions of the model could be regarded as the factors which influence the functionality of applications. Dimensions four to six are external factors which could influence the first three dimensions. Dimensions one to six have to work together to determine the perceived ease of use and perceived usefulness of applications. These dimensions have an influence on the behavioral intention of a teacher or learner which will determine the satisfaction they will derive from an application. Each of the dimensions consists of characteristics identified by literature which are measurable and achievable.

9. Evaluating the ISS model developed by Zaied (2012)

The information systems success model developed by Zaied (2012) was used to evaluate how teachers evaluate, select and use MEAs. This model was described in the theoretical framework, Section 7. The ten dimensions of this model were evaluated through semi-structured interviews and/or observations. The conceptual framework identified and explained the components in the literature which could be practically applied to this study. The conceptual framework provided clear, specific and measurable objectives according to the model which could be used to evaluate effectively and to provide successful feedback on the results. The information generated from the semi-structured interviews and/or observations generated new knowledge on how teachers evaluate, select and use MEAs. The meaningful contribution of each dimension is discussed in the conclusions section.

Evaluation process

The following figure illustrates how the evaluation process was conducted.

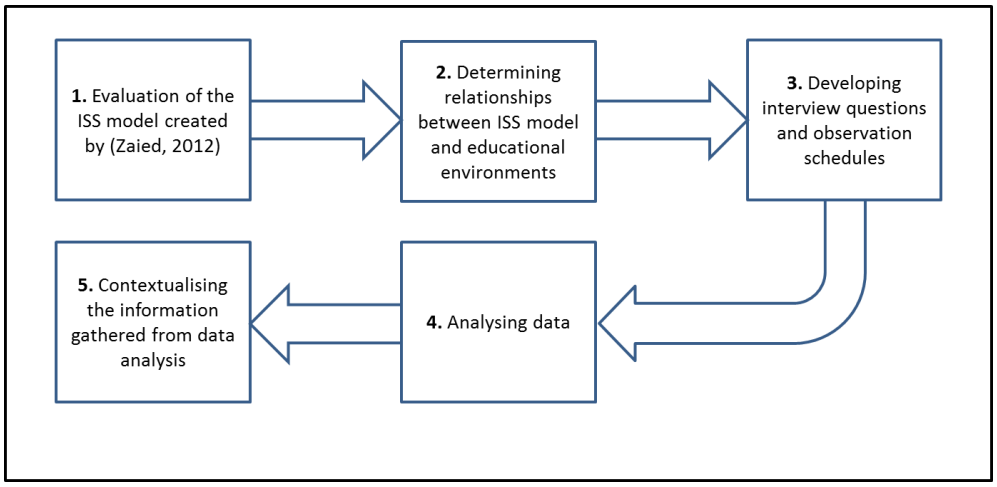

Figure 3: The Process of evaluating the ISS model (Researcher).

1. Evaluation of the original Information System Success Model created by Zaied (2012)

When it was decided to use this model as the conceptual framework for this study it was important to consider that the model was originally developed to assist businesses. It was imperative to understand the true meaning of each dimension to be able to apply it to an educational environment.

2. Determining the relationship between the ISS model and educational environments

It was important to determine the relationship between information systems and MEAs. Similar meanings related to the model's original dimension descriptions had to be found within educational environments. This was done to keep the authenticity of the model intact and to justify why this model could be used as an evaluation tool that could be trusted. The conceptual framework of this study was used to explain how the ten dimensions could be practically applied on educational environments.

3. Developing interview questions and observation schedules

The conceptual framework was used to develop interview questions and to construct an observation schedule. The interview questions were the foundation which guided conversations in the semi-structured interviews. The ten dimensions in the conceptual framework guided the creation of the observation schedule. The observation schedule guided the observations.

4. Analysing data from interview schedules and observation notes

After the data were collected from the interviews and observations, they had to be analysed. The aim was to find relationships between the conversations and observations that took place and the meanings of the ten dimensions in the conceptual framework. These relationships provided information to determine whether the ISS model could be used as an evaluation tool.

5. Contextualising the information gathered from data analysis

Although the ISS model could be used to evaluate any given information system, this study specifically focused on the evaluation of MEAs in education. It is the responsibility of the researcher to apply the ISS model as evaluation tool in the context of a study. It could happen that different contexts might require more or even less dimensions. The model could be changed to complement the context or environment of the research.

10. Key findings

10.1. System Quality

Teachers evaluate system quality mostly through the user interface. The user interface should be easy to understand and easy to navigate. MEAs could make a meaningful contribution when the application allows users to change variables, add information and change basic interface settings. These factors will mobile teachers and users to use the applications. Some MEAs require internet access that could affect the usefulness of certain applications.

10.2. Information Quality

Most applications available only support the South African curricula to some agree. Most teachers have to dissect applications in order to search for functional activities or information which will support their curricula. Consequently, their work content should be adapted to facilitate the information on these applications. This becomes a time consuming process. Not all applications are free to use.

10.3. Service Quality

The quality of service provided to users through applications are imperative to a user's perceived ease of use. An application could have many functionalities but whether or not they can contribute to a meaningful learning process, is the question that should be asked. For example, if a mathematics application provides the learner with assessment opportunities, the feedback from the activity should be prompt and reliable. The outcome of the activity should be fair.

10.4. Management support

Teachers expect the management of a school to support them in their use of MEAs. Management support could include financial support, implementation of infrastructures and teacher development.

10.5. Training

Teachers emphasized that they feel uncertain on how to implement the use of MEAs in their classrooms. Although it was mentioned earlier that there is a vast shortage of applications that could be applied to South African curricula, this specific dilemma emerged from teachers using available applications. Teachers' concerns are from a methodology perspective and they have the need to be guided in this regard.

10.6. User Involvement

Some teachers have enough experience to be able to discern between appropriate and inappropriate information in such a way that they will be able to support developers in their creation of applications. This creates opportunities for teachers to devote their extra-curricular time in conjunction with developers to produce MEAs. The assistance of educational specialists in the development of MEAs could create alternative employment opportunities.

10.7. Perceived usefulness

Teachers and learners have opportunities to conduct investigations and do research while they are on the move. The use of mobile devices and applications could assist in the development of critical thinking skills. This could improve learners' and teachers' decision making ability. Teachers have to search for and select appropriate subject specific applications. Unfortunately, this will form part of their daily activities until effective and efficient applications have been developed for the South African contexts.

10.8. Perceived ease of use

The ease of use of applications is a very subjective concept. Teachers who are frequently working with applications and mobile devices might find difficult applications easy to work with and teachers who are unfamiliar with applications and mobile devices might find it very difficult. Individuals might identify different elements in applications which are challenging for them to work with.

10.9. Behavioural intention

The introduction and dissemination of mobile devices and applications should be conducted at a very steady and measured pace. This will ensure that all teachers feel comfortable using mobile devices and applications. Teachers' fear of technology creates the impression that they have a dislike towards technology which creates tension among teachers. Their fear results from a lack of knowledge and an inability to recognize the benefits, and a lack of skill to be able to work effectively with technology.

11. Conclusions made from data analysis

It could be deduced from the data analysis that each of the dimensions of the ISS model could make valuable contributions to meaningful learning. Each of the dimensions consists of characteristics which defines each dimension. These characteristics should ensure that each dimension achieves the outcomes which were set for their intended use. To determine the meaningful contribution of each of the dimensions could be extremely subjective. A teacher or learner could find one or more characteristics useful within a dimension and still attach value to the application. This means that a teacher or learner could achieve a learning objective through the use of that application. For this study the researcher followed a holistic approach to evaluate applications using the ISS model. The researcher believes that each dimension contributes to the meaningful learning, even if it is on a very small scale. There are certain relationships that exist between the dimensions that cannot be ignored. These relationships are found in the original ISS model due to the natural influence they had on one another (Zaied, 2012). It could also be deduced that each dimension should form a coherent whole where it plays a significant role in the evaluation of applications. User satisfaction could be reached in each dimension on their own but their efficiency and effectiveness could be determined through the influence of the other dimensions. Therefore teachers and learners might not achieve all the intended learning outcomes due to the shortcomings of the dimensions caused by their incoherent working.

12. Conclusion of findings

How did the findings answer secondary question one: How do teachers evaluate and select applications?

All the inferences made on the ten dimensions of the ISS model indicated that teachers do not use a specific method to evaluate MEAs. Most teachers evaluate and select MEAs by comparing the content of the applications with the content they encounter in their curricula. The use of applications increases their preparation time due to the fact that they have to adjust their lesson planning to incorporate the content encountered in applications or they have to search for appropriate applications to fit their lesson plans. Most applications cannot be used in their totality due to their inability to address all the topics in the South African curricula. There are certain factors which influence teachers' choices of applications that they are unaware of. This research proposed that information, system and service quality could be used to assess the functionality of applications. Management support, training and user involvement influence the functionality of applications which teachers are unaware of. These factors could shape teachers' perspectives on the applications' perceived ease of use and perceived usefulness. A teacher's behavioural intentions are influenced by these factors which will lead to user satisfaction and the actual use of applications.

How did the findings answer secondary question two: How could each dimension in the ISS model contribute meaningfully in educational environments?

The inferences made on each dimension of the ISS model addressed their meaningful contribution. The researcher has shown that each characteristic in the dimensions could be evaluated or contributes meaningfully. These characteristics create aims and objectives which should be measured by educational institutions. This will assist teachers in their evaluation and selection of applications. The researcher believes that all the dimensions form a coherent whole which should work together in order to shape learners' and teachers' behavioral intention which could lead to user satisfaction and actual use.

How did the findings answer the main research question: How can the application of the information systems success model as proposed by Zaied (2012) be used to evaluate mobile educational applications that support meaningful learning?

Both secondary questions assisted the researcher to answer the main research question. The findings concluded that no methodology exists that teachers could use for the evaluation and selection of MEAs. The ISS model could be incorporated as an evaluation tool if all the dimensions function as a coherent whole. Each dimension in the ISS model should be evaluated according to the dimensions' characteristics. The characteristics should be measurable and attainable. This will assist teachers to determine whether applications could contribute meaningfully to reach learning outcomes. Teachers and learners from different environments might assign different meanings to the characteristics. Each dimension's meaningful contribution could promote meaningful learning. The neglecting of one of the dimensions could impede the meaningful learning process.

13. Final Comments

The infrequent use of applications by the participants resulted in their inability to comprehensively answer questions relating to the ten dimensions. The purpose of this study was to determine whether the ISS model could be used to successfully evaluate, select and use MEAs which would improve meaningful learning. This purpose was realised through the creation of a conceptual framework which defined how each dimension could be utilised and evaluated in educational environments. The research results and findings confirmed that the ISS model could be used as an educational tool to evaluate and select applications.

When an educational institution has the need to conduct an evaluation of MEAs, the purpose of the evaluation should be clearly defined. The evaluation of MEAs could be time consuming and establishing a goal could provide direction for evaluators. If the participants in this study engaged more with MEAs before this study was conducted, the characteristics they identified could have been different. The frequent use of MEAs would enable participants to allocate more value to its use and therefore their viewpoint on MEAs would possibly change. Although MEAs could influence the context where they are used, educational environments shape the way in which MEAs are used. For this reason the external dimensions (four to six) of the ISS model cannot be ignored. The differences between the participants and their environments in this study indicate that the external factors play a significant role in the way MEAs are used. The use of the ISS model should not be viewed as a tool to identify problems. The ISS model should rather be regarded as a tool which allows educational institutions to respond proactively.

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