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The impact of technology adoption in teaching and learning within ODeL

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Abstract

The emergence of the fourth industrial revolution (4IR) instigated various institutions of the world to move towards technology integration in teaching and learning. The purpose of the current study was to assess how impactful was Wolfram System Modeler (WSM) software to students in their studies by utilising the technology acceptance model. MS forms online survey was utilised to collect data from participating students of the Solid Mechanics (SME3701) module. SME3701 module was targeted whereby 95 students participated. Data analysis was done through IBM SPSS Statistics. The findings of the study indicated that students found the software WSM interesting as evidence of the module performance as compared to before the introduction of the technology. The module performance improved drastically as evidence of the students 'acceptability of the technology.

Keywords: *Teaching and learning; Wolfram System Modeler.*

1. Introduction

The emergence of technology during the current digital age has transformed the distance education space into what is currently. Technology is playing a fundamental role to deliver modern engineering education to the next generation (Abbad, 2011). Apparently, appropriate, and yet effective utilization of technology is tremendously important for distance education (Amanullah, Chandran, and Stojcevski, 2014). In the view of Arinto (2013), the transition of distance education emerged as far as correspondence to open distance learning (ODL) and eventually to open distance e-learning (ODeL). ODeL platform allows teaching and learning to take place due to technology enablement without the confinement of the physical building (Arinto, 2016). The teaching and learning in an ODeL platform permit learning to take in both synchronous and asynchronous (Alfonso, 2012). The University of South Africa (UNISA) is one of the distance education universities that experienced the mentioned evolution of distance education to now Ode since 1950 (Arinto, 2016; Arinto, 2013). Numerous universities all over the world are gradually shifting from a predominantly print-based mode of delivery to an online mode characterized by using virtual learning environments and various web technologies (Arinto, 2016).

Notably, the evolution of the Fourth industrial revolution is exponentially growing more than ever before while disrupting industries all over the world. 4IR is characterized by 3D printing, the Internet of Things (IoT), and the fusion of technologies (Xu, Min, Jeanne M. David, and Suk Hi Kim, 2018) influencing the education sector to follow suit. Educational technology can be defined as the study and ethical practice of facilitating learning and improving performance by creating, using, and managing suitable technological processes and resources. To recognize the value of such technology, it is essential to familiarize ourselves with the technology adoption process and the factors affecting it (Kannan, Punithavathi, and Sambandam, 2018). Hence, the current study utilizes TAM to assess technology adoption in the institution of higher learning as is preferred in various sectors.

2. Methodology

This Tavallaei and Talib, (2010) mention that research methodology refers to the researcher's general approach in carrying out the research project. As of the current study, researchers earmarked research problems to be solved within the institution of learning utilizing TAM in view of collecting quantitative data by means of an online survey (Microsoft forms) from the Advanced Diploma students at an institution of higher learning in South Africa. The quantitative research approach (Creswell, 2014) was found to be suitable for collecting quantitative information from the students utilizing the TAM survey. The collected data was focused on the Solid Mechanics IV module in the Advanced Diploma course in Mechanical Engineering for the first semester, of the 2022 academic year. The module's main content is vibration analysis. For the year 2022, seven assessments were given to students, four of the assessments were based on Wolfram System Modeller (WSM). During the assessments, students were required to analyze a physical model problem, and solve it using mathematical equations. They would then construct the physical model onto WSM, insert boundary conditions for the model operation, and then simulate to obtain and interpret the mathematical analysis on a graph.

Research samples are participants from whom data is collected (McMillan & Schumacher, 2014). In view of the current study, the module has 158 registered students, however only 138 fully participate in the assessments given by the lecturer. For this survey, 95 students voluntarily participated, as was aligned with convenience sampling which deals with the availability of selected participants (Creswell, 2014; McMillan & Schumacher, 2014). The online survey form was structured into 3 categories, sections A, B, and C. Where section A, comprised demographic information, section B concentrated on quantitative data regarding Perceived ease of use (PE), Perceived usefulness (PU), Attitude (AT), and Intention to Use (ITU). While section C collected the student's personal views and comments about WSM. A 5-point Likert scale was utilized to collect the quantitative data in section B. McMillan and Schumacher (2014) viewed Likert scale questionnaire as the supreme and most extensively used form of a scaled questionnaire. While SPSS (Statistical Package for Social Sciences) was used to analyze the quantitative data.

The validity and reliability of the research instrument provide lead to meaningful interpretations of data (Creswell, 2014) and for decision making. Statistical analysis was done to determine the internal consistency between the questions in the questionnaire. The Cronbach Alpha reliability test tabulated in Table 1 resulted in a correlation coefficient of more than 0.70 which is viewed as a high internal consistency. If the items are strongly correlated with each other, their internal consistency is high, and the alpha coefficient will be close to one as is of the current study (0.918) (Fontanilla, 2016).

Table 1. Cronbach's Alpha Reliability Test.

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.918	0.923	17

3. Results & Discussion

The results of the current study are comprised of demographic (section A), quantitative survey (section B), and qualitative analysis (section C) as explained in the above section.

3.1. Demographic results

Demographic data were gathered for all the 95 participants considered for analysis with (26%) female and (74%) male participants in the survey. With 0% in the 15-19 age group, 50.5% in the 20-29 age group, 42.1% in the 30-39 age group, 6.3% in the 40-49, and only 2.1% in the 50+ age group. The number of e-learning courses taken by the student during the semester, with 3.2% having taken 1 module, 7.4% with 2 courses, 27.4% with 3 courses, 21.1% with 4 courses, and 42.1% with above 5 courses. Only 54.7% had e-learning courses that incorporated computer simulations, these 52 students were registered for Solid Mechanics. 33.7% had 2 courses with computer simulations, 9.5% had 3 courses, 1% had 4 courses, and 1% had 5 of these courses. Out of the total number of participants, 89.5% were exposed to computer simulation software, while 9.5% have not been. 83.2% had personal computers that meet the minimum requirements for the software to run, while 8.4% had not and 7.3% of students answered may be.

3.2. Student ease of use of WSM

Figure 1 shows the perceived ease of use of WSM. The response of the students was rated on a scale from 1 to 5, with 1 being strongly agreed and 5 being strongly disagreed. Finding WSM easy to use, 47.8% of students strongly agreed. The average percentage of students learning to use WSM was 48.8% strongly agreeing. The interaction with WSM being clear to the students was on an average percentage of 48.2% strongly agreeing. The average for students being able to solve complex engineering problems related to Solid Mechanics using WSM was an average percentage of 53.6% strongly agreeing.

Perceived usefulness plotted in Figure 2 for using the WSM to enhance the student's effectiveness in learning, an average percentage of 48% of strongly agree was recorded. Using WSM to improve the student's course performance was averaged to a percentage of 47.4% strongly agreeing. For using WSM to increase the student's productivity in their course work, the average percentage was 50.4% strongly agreeing, and finding WSM useful in their studies, was averaging 45.2% strongly agreeing.

Attitudes from Figure 3, the student's results for disliking the idea of using WSM in their studies 73.8% strongly disagree. students found a generally favorable attitude toward using WSM was 45.6% strongly agreeing. For students believing that it's a good idea to use WSM for their course work 41.4% strongly agreed and among those finding WSM, a foolish idea 81.4% strongly disagreed.

Intention to Use results is shown in Figure 4. The student's response to WSM making teaching and learning interesting was 41.4% strongly agreed. Of students who intend to continue using WSM during the semester were 43.2% strongly agreeing. Students who in intend to continue checking announcements from WSM frequently averaged 46.4%. Students who intended to recommend WSM to their peers in the industry averaged 46.4%. And students who intend to be heavy users of WSM averaged 51.4%.

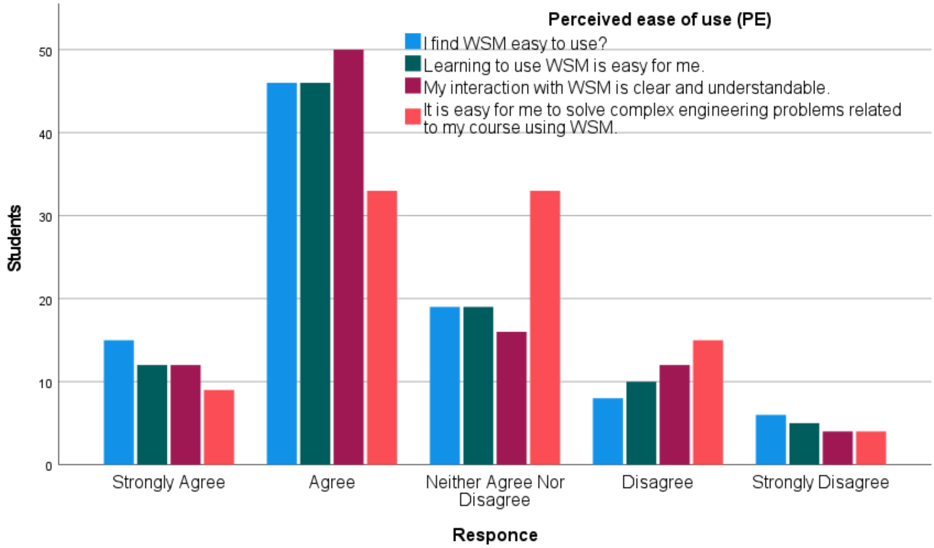

Figure 1. Perceived ease of use (PE).

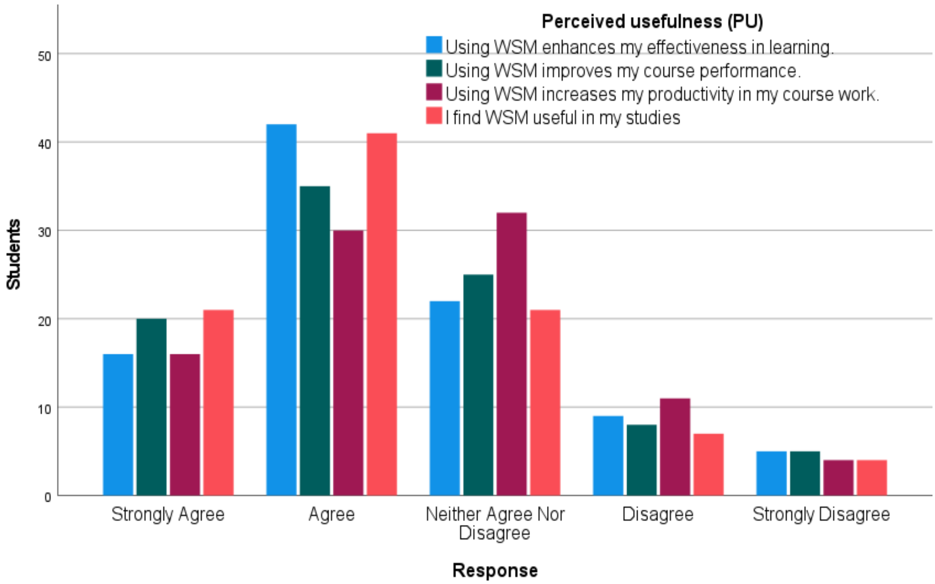

Figure 2. Perceived usefulness (PU).

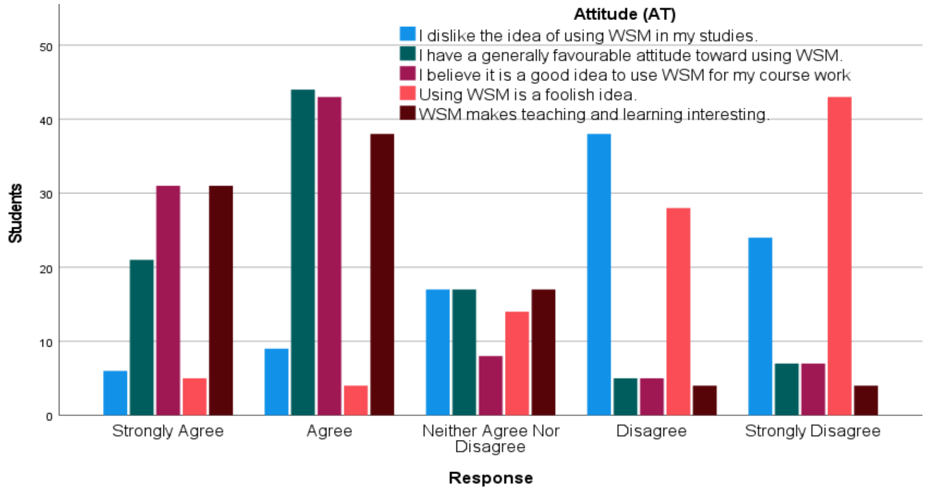

Figure 3. Attitude (AT).

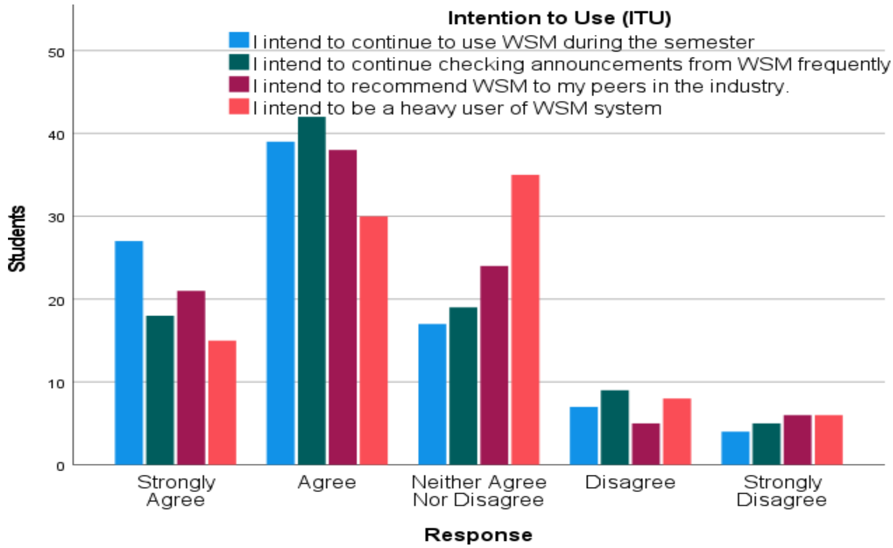

Figure 4. Intention to Use (ITU).

3.3. Student's personal views and comments about WSM

With the integration of WSM into the module, the gap between experiments and theoretical studies was bridged. With the complexity of the vibrations system, WSM was able to improve the student's understanding of the module by displaying these vibration systems, simulating the model according to various boundary conditions, and plotting various graphs to interpret the model.

Challenges were encountered by students when their computers were not able to meet the minimum requirement for the software to operate. Third-party software had to be installed to assist the software in running, this then resulted in extra resources being used for this. Cloud-based operations are recommended as they are much easier for students to access. Due to the complexity of the software, resources were provided by the lecturer, however, this does not suffice, as students must learn to navigate the software before attempting to construct the model. This is evident that a support structure must be put in place to assist students more. According to the lecture's experience with the integration of WSM into the module, students who frequently consulted were able to troubleshoot the challenges incurred.

Despite all the challenges, students' attitude towards the software was good. The student's reaction toward WSM taking the place of the theoretical approach to solving engineering problems, was that they acknowledged that the theoretical approach had to be done, and it was complemented by the software's ability to interpret the theoretical condition they inserted.

It was noted by the lecturer that since incorporating WSM in the module, the student's performance has increased. Students found that WSM contributed to their performance by giving more knowledge, however, some did mention that due to the pressure and the short duration of the semester, they were not able to use the software effectively. They also emphasize that WSM should have its separate module so that when it's integrated into the different modules, they are able to use it effectively.

When the students were asked, "Will you recommend WSM to other students?" 65% said yes. The remaining number includes those who did not know and those who felt that they had not used the software effectively to be able to recommend it to other students.

4. Conclusion

The current study utilised the technology adoption model to access how students viewed the integration of WSM into the SME3701 module at the diploma level in the department of Mechanical Engineering. As alluded to earlier, TAM focussed more on Perceived ease of use (PE), Perceived usefulness (PU), Attitude (AT), and Intention to Use (ITU). The research findings clearly indicate that the introduction of WSM software into the module brought some hope to the students as they received the initiative with open hands. It was also good that almost all students registered for the module has access to the computer and could easily interact with the software. The students were now able to simulate, plot graphs, and interpret the data without any challenges. The lecturer was able to provide background information regarding the purpose of the software and how it would assist them to understand the module better. As result, the students perceived the software and the intervention positively. They also find it userfriendly and developed a positive attitude towards it. The increase in the pass rate of the module was a good indication that students found WSM very useful. When they were asked a question if they would refer other students to this software almost 65 % agreed to indicate their intention to further utilize the system.

The findings also indicated that the age group of these students is aligned to the current technological dispensation as consistent with Porter and Donthu (2006) in their study. Young students find technology interesting, and it enhances their learning experiences.

TAM, in this regard, managed to assist in determining how students found the adoption students WSM in their SME3701 module as supported by Park (2009). Both quantitative and qualitative results concur with each other that student welcomed the integration of the WSM in their module as their positive performance speaks a volume.

The adoption of technology in teaching and learning can assist academics in better presenting their content to students since most institutions are now embracing online learning. It is therefore recommended that a similar study can be adapted to other modules in the faculty to encourage other academics still reluctant to utilize technology for teaching and learning to follow suit. The adoption of technology in teaching and learning is slowly becoming the reality in this dispensation of 4IR technologies.

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