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Exploring structural equations modelling on the use of modified UTAUT model for evaluating online learning

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Abstract. The sudden shift from traditional face-to-face classes to online learning during the COVID-19 pandemic has created a need to understand how well online learning is crucial and being accepted, particularly in developing countries. The Internet has enabled international communication and interaction, removing distance and space barriers between Lecturers and students. In some higher education institutions, technology has been gradually integrated into their teaching methods, utilising Learning Management Systems (LMS). This study aims to assess the factors that influence students' intention and use behaviour of online resources using the Unified Theory of Acceptance and Use of Technology (UTAUT). The results show that effort expectancy positively influences students' behavioural intention to use online learning platforms such as Moodle, but facilitating conditions, performance expectancy, and social influence do not. Finally, results in this study also show that students' behavioural intention positively influences students' user behaviour to use the online learning platform. This study suggests that decision-makers should recommend and implement policies to address the challenges students learning from home might face during pandemics to ensure they can continue their education without unnecessary obstacles. This is particularly important in countries like Eswatini, where the cost of internet connectivity is high.

Keywords: COVID-19, Learning Management System, online resources, online learning, SEM, UTAUT

1. Introduction

The outbreak of the COVID-19 pandemic in recent years has inevitably catalysed the global disruption of essential services in many professional fields, with the education sector being one of the most affected, as the pandemic has brought about the unprecedented closure of numerous educational institutions around the world in an attempt to curb the spread of the virus [32]. This meant that schools and universities had to ultimately shift from the usual traditional face-to-face classes to the less common virtual style of learning and teaching [17]. This online adoption, however, challenged many institutions, especially in developing countries, as numerous students, teachers, and administrators fell short of the expertise and resources needed to institute online

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education, and this shift caught them off guard. It is clear then that understanding and adapting online teaching and learning is crucial for the success of online education.

The combination of multiple disciplines, which includes pedagogy, computer science and communication technology, is a product of online learning. Online learning employs learning management systems (LMS), web-conferencing, instant messaging, multimedia tools and video-conferencing. During the peak period of COVID-19 globally, the main alternative to face-to-face teaching is online learning through different LMS platforms, but according to Al-Karaki et al. [5], it cannot replace in-person teaching. Online learning is not introduced during the pandemic to improve student academic performance but to assist in overcoming social distancing among learners and teachers [13] without proper planning for the ideal online learning with appropriate infrastructure that supports pedagogy in a virtual environment [33].

1.1. Learning management system

Scholars have defined a learning management system (LMS) in different ways. According to Kirvan and Brush [27], a learning management system is a software application or web-based technology that facilitates the planning, implementation, and assessment of specific learning processes. It is commonly used for e-learning practices and consists of two elements: a server that performs the base functionality and a user interface that lecturers, students, and instructors operate. A good LMS should enable lecturers or instructors to create and deliver content, monitor student participation, and assess student performance. Students should also be able to use interactive features such as threaded discussions and discussion forums. Kasim and Khalid [25] found that LMS is a web-based software application designed to handle learning content, student interaction, assessment tools, and reports of learning progress and student activities. Ghilay [16] explains that LMS can assist in traditional classrooms, distance learning, or any combination of the two. LMS can also be referred to as a Course Management System (CMS), Learning Content Management System (LCMS), Virtual Learning Environment (VLE), and Virtual Learning System (VLS) [16, 45]. An LMS's components include various media and communications tools that promote learner choice [11, 26].

According to Ghilay [16], LMS can be categorised into three main types: proprietary LMSs, open-source LMSs, and cloud-based LMSs, as identified by Dobre [15]. Proprietary LMSs, such as Blackboard, D2L, and eCollege, are licensed by developers. Open-source LMSs such as Canvas, Moodle, and Sakai are freely available to all users. Cloud-based LMSs were introduced in higher education institutions as a cost-effective way of using cloud-based tools [15]. Islam [23] states that training teachers on applying LMS features could motivate students to use e-learning tools. Bradley [11] suggested that future research could provide a better understanding of the other resources an LMS offers for improving e-learning performance. Furthermore, Alghamdi and Bayaga [6] highlighted that LMS usage could blend traditional learning practices with online learning environments, serving as a medium to stimulate pedagogical processes.

Experimental research conducted by Qaddumi and Smith [35] on learners' attitudes toward English as a foreign language (EFL) and their language proficiency are affected by the LMS (Moodle) interactive language-learning activities. The findings revealed higher posttest scores attained by the experimental group, suggesting the potential for the broader use of LMS-based learning and teaching in EFL language-learning programs. The authors argue that educators

can harness the potential of LMSs like Moodle to enhance the language learning experience and develop speaking, listening, and dialogic skills in foreign languages. Such approaches can promote engagement and motivation in language acquisition among EFL learners.

1.2. Moodle-based LMS learning platform

The objective of this research is to examine Moodle, an LMS commonly used by educational institutions, in comparison to other popular enterprise-level LMSs such as Blackboard, Schoology, Adobe Captivate Prime, Docebo LMS, TalentLMS, iSpring Learn, and eFront. The UTAUT model was used to evaluate online learning students during the COVID-19 era. Moodle was selected as the platform for teaching and learning during the COVID-19 and post-COVID-19 periods at the university where this study was conducted due to its user-friendliness, accessibility, and flexibility. Moodle stands for Modular Object-Oriented Dynamic Learning Environment and was developed in 2001 based on the social constructionist pedagogical principle. It is released under the GNU General Public License (GPL), which allows modifications to the source code as long as the original license remains unchanged [25, 38].

According to Simanullang and Rajagukguk [36], Moodle is a software application that can be utilised to transform learning materials into web-based forms. One of the advantages of using Moodle as an online learning management system is that it addresses the limitations of face-to-face classes that are often used. In a study conducted in Malaysian higher institutions by Kasim and Khalid [25], the following benefits of using Moodle for teaching and learning purposes were identified: it enables lecturers to view the list of students enrolled in a course and when they last accessed the platform, it allows for integration with other systems, it provides synchronous and asynchronous interaction, a personal area for drafting and journaling, and the management of personal and private information, and lecturers can retrieve content they have developed for their courses based on teaching and learning needs. Moodle, as a learning platform, has emerged as the most used LMS for managing the process of teaching and learning. It is also an online learning environment that helps learners improve their level of ability collaboration, creativity, and problem-solving skills [34, 35, 39]. Daoud, Namir and Talbi [14] found that Moodle is built on the learner-centred concept of socio-constructivist pedagogy. Moodle data has gained significant attention in educational research, which offers valuable insights into students' learning behaviours, engagement, and performance. Moodle data also benefits researchers by exploring various data analysis techniques and methodologies when conducting research. Integrating Moodle data analysis has shown promising results in supporting instructors and administrators in making data-informed decisions to improve instructional design and students.

In a preliminary study carried out by Syara et al. [37], it was observed that most students fail to take notes on the learning material which makes it difficult for them to remember the material that the lecturer had described in previous meetings and makes the process of understanding of the materials to be slow due to short college hours.

Jeong and Hwang [24] found that Moodle has emerged as a preferred choice based on its remarkable functionality and cost-effectiveness in medicine, and the learning environment is shifting gradually from traditional in-person teaching to a hybrid educational approach. Jeong and Hwang [24] pointed out some of the features of Moodle in designing effective instructions and engaging students in learning. These include course creation and customisation, discussion

forums, assignments and assessments, online quizzes and examinations, mobile accessibility and multimedia integration.

The University of Eswatini's Moodle platform offers a range of features to support students' online learning activities. These features include tools for managing assignments, attendance tracking, online discussions through chat and forums, creating checklists, collecting feedback, uploading and sharing files and folders, conducting surveys and quizzes, hosting Zoom meetings, managing personal journals, creating pages, and more.

1.3. Empirical studies

Ghilay [16] conducted a mixed-methods study and found that Moodle's moderately or highly active lecturers are generally very satisfied with its features, such as learner support, content management, user management, communication, and monitoring and evaluation. The study also revealed that active users find Moodle flexible and effective for real-time communication and collaboration with various user groups. However, less active users are less satisfied and often complain about discomfort, lack of aesthetics, and the system's complexity in handling tests, exercises, and assignments. Simanullang and Rajagukguk [36] conducted a study on Moodle-based LMS and found that it can effectively support various student activities, such as video, discussion forums, materials, chat, and quizzes, and increase student engagement in online learning without the constraints of traditional face-to-face classes.

The Unified Theory of Acceptance and Use of Technology (UTAUT) model depends on four key constructs: performance expectancy, effort expectancy, social influence, and facilitating conditions. These constructs are directly linked to the behavioural intention of the use of the technology. Additionally, the effects of predictors are moderated by factors such as age, gender, experience, and voluntariness of use, as depicted in figure 1 [4, 31, 41]. The UTAUT model is considered a comprehensive explanation of technology usage behaviour. The UTAUT explain technology usage behaviour as a model that is much stronger than the ability of any single model, which is an extended model of other technology acceptance models [2, 7–9, 12, 22, 29, 30, 42–44]. The UTAUT model emphasises the significance of behavioural intention in determining technology usage behaviour:

- **Performance Expectancy (PE)**: According to Venkatesh et al. [41], as cited in [30], performance expectancy refers to the user's perception of how technology will contribute to their work performance. It is the degree to which an individual believes the system will help them achieve job performance. This construct is also derived from the technology acceptance model, as mentioned in [30, 31]. The UTAUT model incorporates ease-of-use expectations, social influences, and facilitating conditions to explore behavioural intentions and usage behaviours. Additionally, it proposes four possible moderating variables, namely gender, age, experience, and voluntariness of use, to investigate usage behaviour further. Compared to other technology models, UTAUT demonstrates a high degree of explanatory power in understanding people's intentions and behaviours regarding technology usage [30].
- **Effort Expectancy (EE)**: Refers to the extent to which users perceive how new technologies, systems, and applications can be easily operated. Ease-of-use expectations,

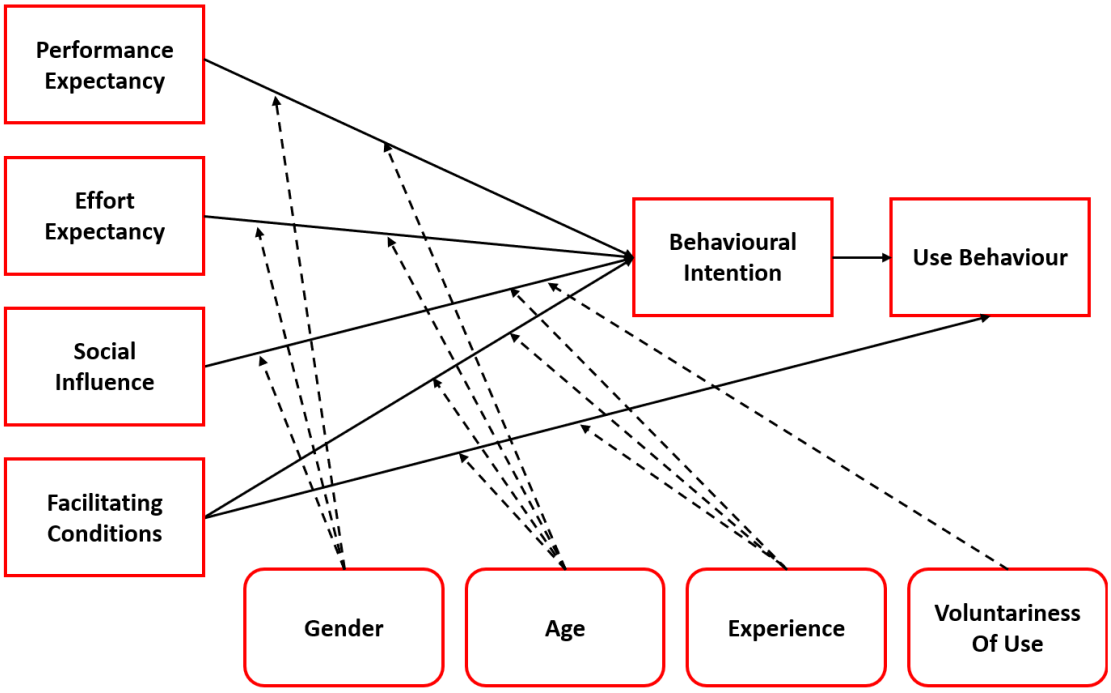


Figure 1: Unified Theory of Acceptance and Use of Technology (UTAUT) [30, 31].

influenced by factors such as gender and age, play a role in shaping this perception [30, 40]. Liu et al. [30] discovered that women and elderly individuals tend to place greater emphasis on the ease-of-use expectations of information systems. However, the influence of these expectations is also affected by the accumulation of experience.

- **Social Influence (SI)**: Social influence in the UTAUT model refers to the user's knowledge and beliefs regarding the importance of adopting a new technology or system [30, 41]. The impact of social impact is influenced by moderator factors such as gender, age, experience, and willingness [30, 46]. Liu et al. [30] discovered that young women and early adopters are particularly susceptible to the influence of their senior supervisors and colleagues regarding technology adoption. The social impact of these influencers can shape their perceptions and intentions regarding technology usage.
- **Facilitating Conditions (FC)**: Facilitating conditions, as described in the UTAUT model [30, 41], refer to the enabling factors that promote the use of information technology by users. These conditions encompass providing necessary software and hardware resources that assist users in effectively operating a system. Regarding facilitating conditions, organisational psychologists have highlighted that older individuals prioritise obtaining support and assistance in their work environments. Therefore, age is a variable that is associated with facilitating conditions [30].
- **Behavioural Intention (BI)**, as described in the Theory of Reasoned Action, is considered a function of attitude, a subjective norm. Attitude represents the individual's evaluation

and beliefs about the behaviour [3]. Observing behaviour can often be subjective, as an observer may interpret and attribute multiple explanations to the observed behaviour of an individual. The observer can consider Various causal factors when trying to understand the reasons behind the behaviour.

Liu et al. [30] conducted a research study and discovered several important findings regarding the UTAUT model. Firstly, the study confirmed the three dimensions of the model: performance expectations, social impact, and ease of use expectations. This knowledge can be utilised to enhance the motivation of middle-aged and older consumers, thereby influencing their usage behaviour. Furthermore, the study revealed that facilitating conditions were particularly significant for middle-aged and older consumers. However, motivation for use did not have a significant effect. Additionally, the degree of involvement was found to impact the motivation of middle-aged and older consumers. Based on these findings, the proposed modified UTAUT model was an appropriate framework to support this study in exploring technology use and acceptance for online teaching and learning in higher institutions during the COVID-19 era.

It is difficult to determine or measure the students' actual usage of the Moodle platform through the users' log files because most higher institutions of learning are reluctant to share the log files for many reasons, the major one being security concerns. For this reason, most researchers use questionnaires to measure actual use.

Based on the modified UTAUT, the following twelve hypotheses were formulated and tested in this study:

H1: Behavioural intention (BI) has no significant relationship with the user behaviour to online learning.
H2: Effort expectancy (EE) has no significant influence on Behavioural intention to the use of online learning
H3: Facilitating condition (FC) has no significant influence on Behavioural intention (BI) to the use of online learning.
H4: Gender has no significant influence on Behavioural intention (BI) to the use of online learning.
H5: Gender has no significant influence on User behaviour (UB) to the use of online learning.
H6: Performance expectancy has no significant influence on Behavioural intention (BI) to the use of online learning.
H7: Region has no significant influence on Behavioural intention (BI) to the use of online learning.
H8: Region has no significant influence on User behavioural (UB) to the use of online learning.
H9: Social influence (SI) has no significant influence on Behavioural intention (BI) to the use of online learning.
H10: Religion combine with Performance expectancy (PE) has no significant influence on Behavioural intention (BI) to the use of online learning.
H11: Religion combine with Effort expectancy (EE) has no significant influence on Behavioural intention (BI) to the use of online learning.
H12: Religion combine with Social influence (SI) has no significant influence on Behavioural intention (BI) to the use of online learning.

2. Methodology

Data were collected from seventy-six fourth-year students in the Department of Computer Science at the University of Eswatini (formerly University of Swaziland) using an online quantitative questionnaire (https://tinyurl.com/3my8tvus) consisting of closed-ended questions. The questionnaire items were rated on a 5-point Likert scale ranging from Strongly agree (5), Agree (4), Moderately agree (3), Disagree(2) and Strongly disagree (1). The constructs considered in this study are social influence (SI), facilitating condition (FC), effort expectancy (EE), performance expectancy (PE), behavioural intention (BI) and user behaviour (UB) and the moderating variables are gender and region. The online questionnaire consisted of 30 questions based on a Likert scale of the 5-point system. Structural Equation Modeling (SEM) was utilised to test the research hypotheses, with SMART-PLS version 4.0 being the software of choice. The 4th year student population is 80. The PLS-SEM approach seemed appropriate to the nature of the analysis being carried out and due to the small sample size.

2.1. Demographic characteristics

The participants' demographic characteristics of the fourth-year students in the Department of Computer Science selected from the four regions in the Kingdom of Eswatini are shown in figure 2, 3 and 4, respectively. For gender, 53% were females while 47% were males. Most of the participants are aged 20-24 (74%). Most of the participants who responded to the survey were from the Manzini region (41%) and HhoHho (37%).

Figure 2 shows the percentage of male and female students participating in the study. It was revealed that 53% were females while 47% were males. This shows that there are more female students than male students.

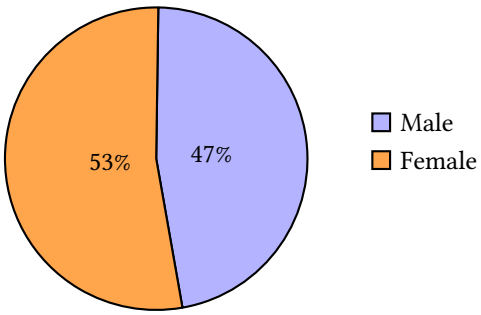


Figure 2: Gender of the participants.

Figure 3 shows the age distributions in which the participants of 20 to 24 years old had the highest percentage of 74%, followed by 25 to 29 years old (18%), 30 to 34 years old (7%). At the same time, the participants 45 to 49 years old had the lowest percentage of 1%.

Figure 4 shows the percentage of the regions where the participants are domiciled. The majority of the participants that responded to the survey were from the Manzini region (41%), followed by HhoHho (37%), Lubombo (13%) and Shiselweni (9%).

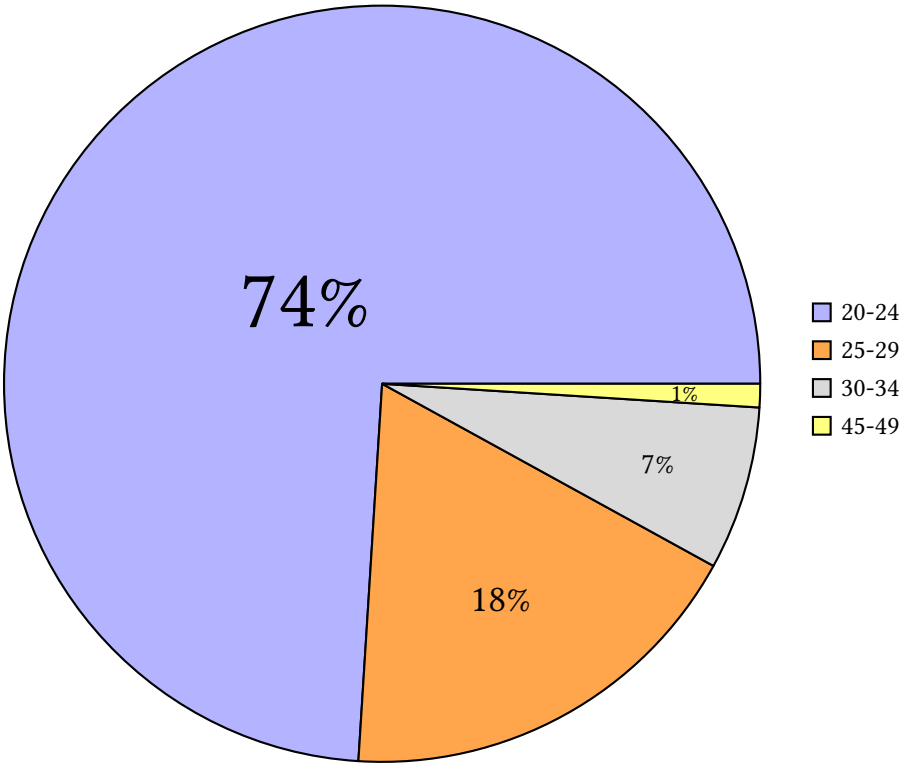


Figure 3: Age of participants.

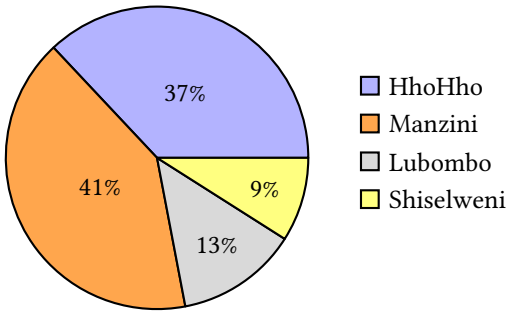


Figure 4: Region.

2.2. SEM data analysis

This paper employs a two-step approach to SEM analysis. The first step is based on confirmatory factor analysis (CFA) for measurement model validation, while the second step is based on path analysis using Bootstrapping for hypotheses testing.

2.3. Measurement model analysis

The measurement model is commonly used to validate the internal reliability indices for the constructs and their items. According to Hair et al. [19], outer loading factors less than 0.7 should be eliminated. The CFA shows that only ten items (SI2, SI3, SI5, FC2, FC4, FC5, EE4, PE3, PE4, and PE5) are eliminated in the first step. The items eliminated from each construct were due to low loadings, as shown in figure 5.

3. Results

3.1. Reliability and validity of construct variables

The reliability and validity of the construct variables test in this study were estimated with the use of Cronbach's alpha (α), composite reliability (ρ_a, ρ_c) and Average Variance Extracted (AVE) as presented in table 1.

Table 1
Reliability and validity.

Constructs	α	ρ_a	ρ_c	AVE
BI	**0.825**	**0.842**	**0.874**	**0.583**
EE	**0.833**	**0.843**	**0.887**	**0.664**
FC	**0.735**	**0.748**	**0.882**	**0.790**
PE	**0.714**	**0.714**	**0.875**	**0.777**
SI	0.517	0.517	**0.805**	**0.674**
UB	**0.852**	**0.872**	**0.893**	**0.626**

According to Hair et al. [18, 19], the threshold values for the constructs in table 1 are as follows: Cronbach's alpha greater than 0.7, composite reliability (ρ_a, ρ_c) greater than 0.7 and AVE greater than 0.5 [18, 19]. The values of the constructs are bold only if they are greater than the threshold values. According to the CFA, all of the constructs Cronbach's alpha had values between 0.714 and 0.652 except SI with 0.517, all the constructs had composite reliability (ρ_a) values between 0.714 and 0.872 except SI with 0.517, all the constructs under composite reliability (ρ_c) had values between 0.805 and 0.893 and the value of AVE varied between 0.583 and 0.790. Therefore, all of the constructs had strong convergent validity except the SI.

3.2. Model fit

The Standardized Root Means Square Residual (SRMR) was used to assess the fit in the Partial Least Square (PLS) model. A good fit is defined by an SRMR value of less than 0.10 [20, 28]. Before the elimination of the ten (10) irrelevant items from the constructs, the SRMR value in this study was 0.102, but after the elimination of the items, the model fit SRMR value was 0.100.

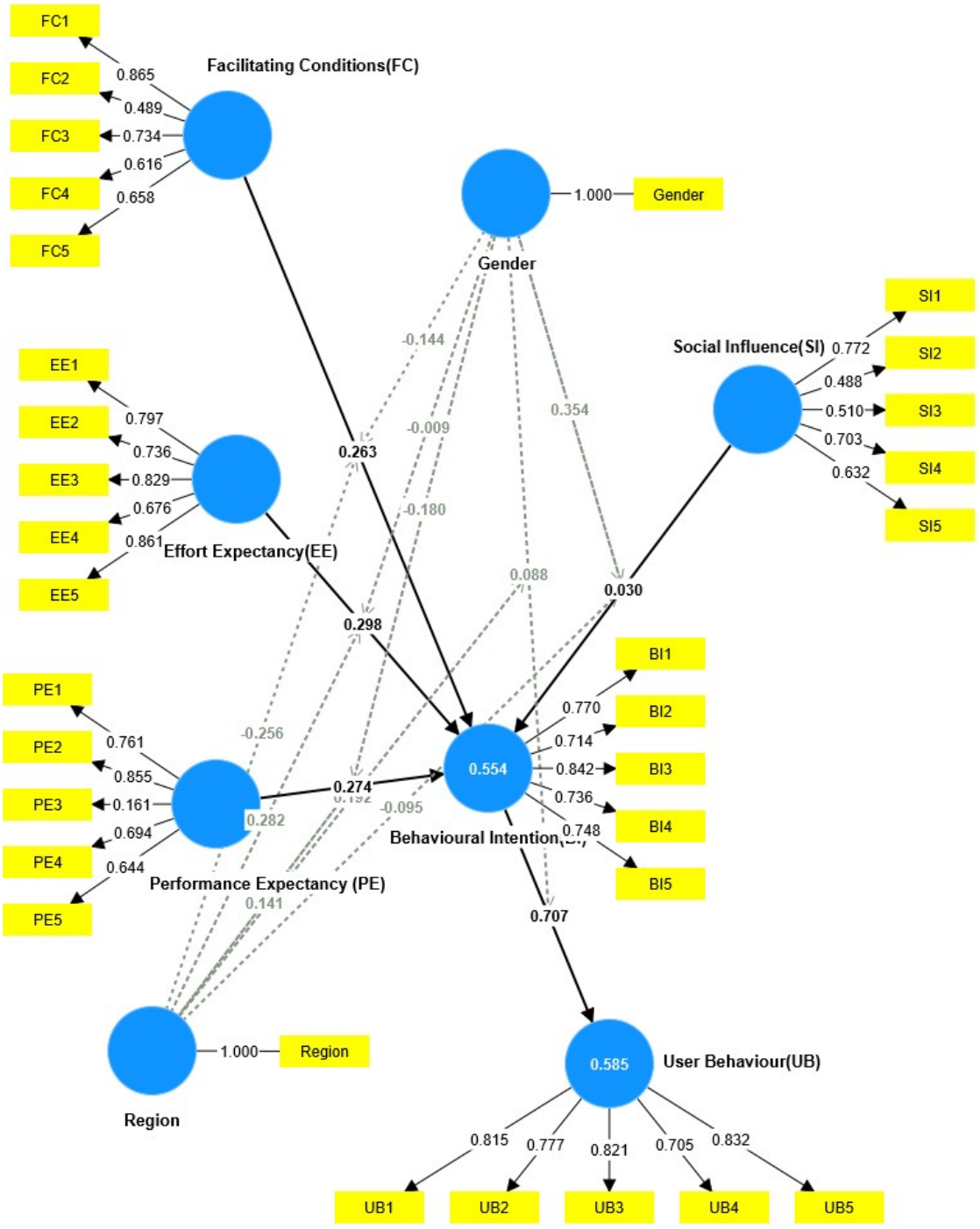


Figure 5: Confirmatory factor analysis (modified UTAUT based on figure 1).

3.3. Hypothesis testing using path analysis

To test the hypotheses, the relationships between items were investigated using path coefficients as shown in figure 6 and table 2 as the predictive power of the model [10] based on Bootstrapping.

Table 2
Hypothesis testing.

Hypothesis	Relationship	Path coefficients ($beta$)	p-values	Decision
H1	BI → UB	0.690	0.000	Supported
H2	EE → BI	0.573	0.002	Supported
H3	FC → BI	0.116	0.544	Not supported
H4	Gender → BI	0.035	0.864	Not supported
H5	Gender → UB	-0.214	0.201	Not supported
H6	PE → BI	0.286	0.226	Not supported
H7	Region → BI	0.141	0.124	Not supported
H8	Region → UB	-0.148	0.053	Not supported
H9	SI → BI	-0.073	0.661	Not supported
H10	Region × PE → BI	0.238	0.042	Supported
H11	Region × EE → BI	0.323	0.017	Supported
H12	Region × SI → BI	-0.307	0.033	Supported

The results in table 2 show the following:

- Only 5 of the 12 path analysis decisions were supported because they were statistically significant, as the p-values were less than 0.05.
- Students' behavioural intention to use online learning platforms influences student usage behaviour. The R^2 for students' behavioural intention initially was 55.4% before the elimination of the ten items but 58.2% after the elimination of the ten items. The R^2 for students' user behaviour initially was 58.5% before the elimination of the ten items but 57.7% after the elimination of the ten items.

4. Discussion

The findings of this study conform with the findings of Hunde, Demsash and Walle [21] that health sciences student's behavioural intention influences student's usage of the e-learning system at Mettu University in Ethiopia with a lower percentage of intention to adopt the e-learning system by 51% compared to this study and also the study carried out in Egypt by Abdel-Wahab [1] has a higher percentage of intention to adopt e-learning platform by 79.8% compared to this study. The reason for the differences in the percentages from Eswatini's perspective compared to Ethiopia is based on technological support the university got from the mobile network provider (MTN) and United Nations Development Programme (UNDP) strictly for the online learning platform during the COVID-19 pandemic but from Egypt perspective it is due to technological advancement over Eswatini and Ethiopia.

In this study, effort expectancy influences students' behavioural intention to use the online learning platform. The study by Hunde, Demsash and Walle [21] corroborates our findings

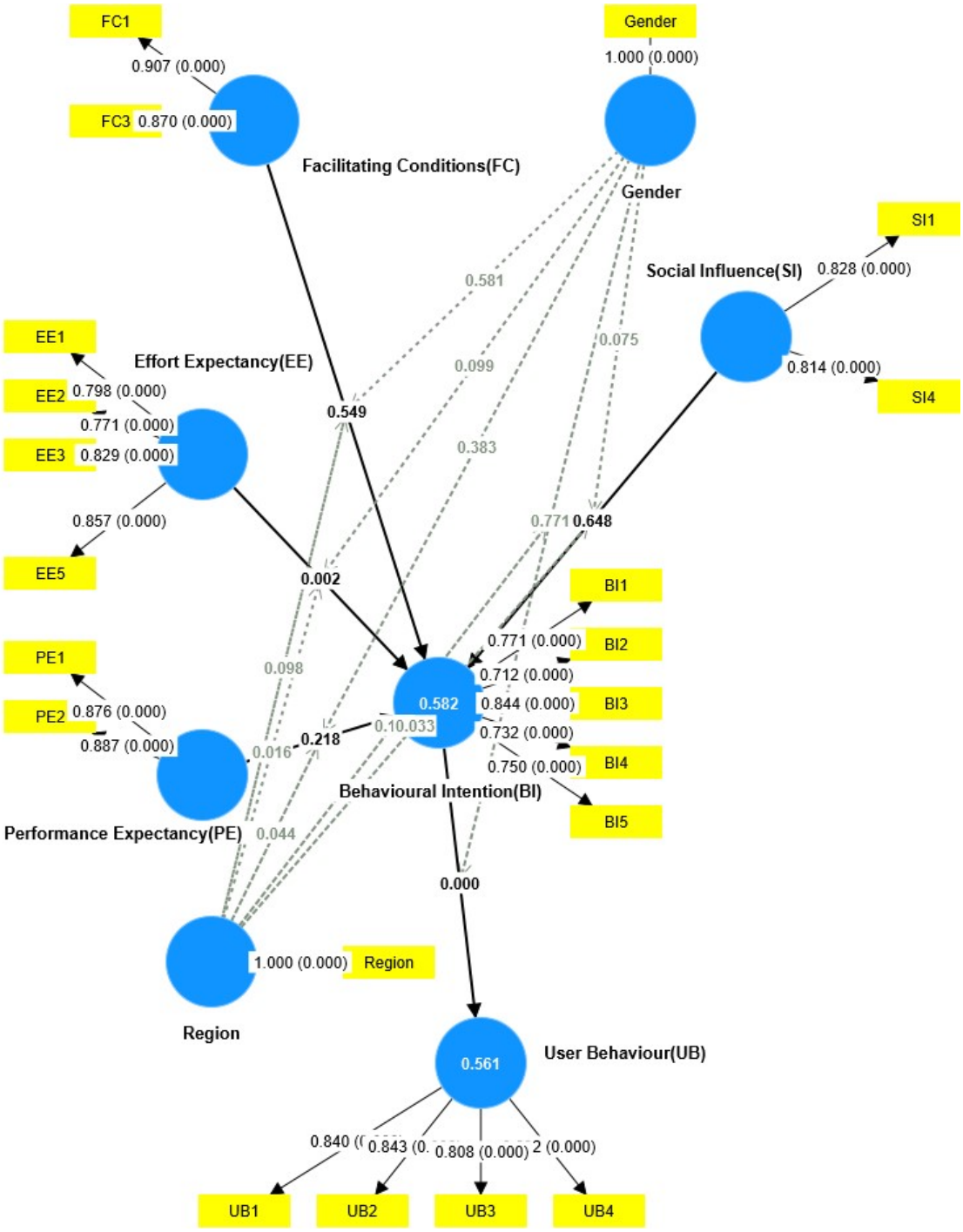


Figure 6: Modified UTAUT path analysis.

that effort expectancy influences medical students' behavioural intentions to use the e-learning system at Mettu University in Ethiopia. This proves that effort expectancy is a key construct for student behavioural intention to use online learning in higher institutions.

Facilitating conditions do not influence students' behavioural intention to use online learning. Technological infrastructural support in terms of laptop and smartphone availability to facilitate online learning is not well-established in this study, so the facilitating conditions cannot influence students' behavioural intention to use online learning. Hunde, Demsash and Walle [21] contradict the present findings that facilitating conditions influence medical students' behavioural intention to use e-learning systems.

Social influence does not influence students' behavioural intention to use online learning platforms.

Performance expectancy does not influence student's behavioural intention to use online learning platforms; lecturers, faculty tutors, and faculty administrators must pay more attention to how to leverage student academic performance. Hunde, Demsash and Walle [21] also corroborate the findings of this study that social influence and performance expectancy do not influence medical students' behavioural intention to use e-learning systems.

Students' behavioural intention was the most powerful predictor of students' behaviour when using online learning platforms.

Region and gender, as stand-alone moderating factors, do not influence students' behavioural intention and user behaviour to use online learning platforms. However, regions combined with performance expectancy, social influence, or effort expectancy influence students' behavioural intention to use online learning platforms. The region is the only moderating factor influencing students' behavioural intention to use online learning platforms when combined with constructs in this study.

5. Conclusion

One of the essential components for building society is education; for this reason, the main objective of this study was to identify the constructs in the modified UTAUT that affect students' behavioural intention and students user behaviour of the online learning platform recommended in the University of Eswatini during COVID-19 era is very important.

The results show that effort expectancy has a significant effect on students' behavioural intention to use online learning platforms, and students' behavioural intention has a significant effect on their user behaviour.

The results also show that social influence does not influence students' behavioural intention to use online learning platforms. Although the youth find it interesting to use the Internet because this is a digital era, the influence is negative for online learning. The final results also show that performance expectancy does not influence students' behavioural intention to use online learning platforms; lecturers, faculty tutors, and faculty administrators must pay more attention to how to leverage student academic performance.

The implication of the R^2 values on the students' behavioural intention and students' user behaviour on the use of online learning platforms means that as the behavioural intention increases the user behaviour decreases and this is the main reason why the effort expectancy

influence the use of the online learning platform and performance expectancy does not influence the use of the online learning platform.

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Author contributions

S. G. Fashoto: Conceptualisation, Resources, Methodology, Data curation, Formal analysis, Investigation, Validation, Visualisation, Writing – original draft, Writing – review & editing, Project administration. **A. Y. Faremi**: Draft, Methodology, Data curation, Formal analysis, Investigation, Visualisation, Writing – original draft. **E. Mbunge**: Methodology, Validation, Writing – review & editing. **O. Owolabi**: Validation, Writing – review & editing.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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