International Journal of Learning, Teaching and Educational Research
Vol. 21, No. 12, pp. 1-20, December 2022
https://doi.org/10.26803/ijlter.21.12.1
Received Aug 29, 2022; Revised Nov 9, 2022; Accepted Dec 12, 2022

Acceptance of the GeoGebra Application in Learning Circle Theorems

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Abstract. The learning area of circle theorems is one of the most difficult topics in geometry, resulting in low student performance. GeoGebra has been shown in studies to enhance learners' proficiency in circle theorems. However, pre-service teachers' use of GeoGebra is not at the expected level in Eswathini. The adoption of an information system is reliant on its acceptance by individuals. However, little is known regarding pre-service teachers' use of GeoGebra to understand circle theorems. The goal of this study was to investigate pre-service teachers' perceptions of GeoGebra's suitability for learning circle theorems. A cross-sectional survey design was used in this investigation, with a total of 187 pre-service instructors as participants. The model explained 74.9% of the variance in the acceptability of GeoGebra for learning circle theorems by Eswatini pre-service teachers. According to the findings, task-technology fit, system quality, system compatibility, perceived ease of use, perceived usefulness, perceived attitude toward, and user satisfaction account for 74.9% of the variance in actual use. The study's findings revealed that rural Eswatini pre-service teachers' reported attitude toward using the mathematics software application GeoGebra for learning circle theorems was the strongest direct predictor of actual use. This research shows that pre-service teachers' views toward technology integration in education should be positive for educational learning applications to be successfully adopted in Eswatini teacher training institutes.

Keywords: circle theorems; GeoGebra; pre-service teachers; task-technology fit; technology acceptance model

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1. Introduction

Geometry, as a branch of mathematics, is critical in assisting mathematicians and students of mathematics in appreciating and comprehending the space, shape, and orientation of numerous bodies and objects in our universe (Jin et al., 2021). Geometry includes circle theorems, which allow "mathematicians and students of mathematics to grasp circular space, shape, and orientation in this world" (Badu-Domfeh, 2020, p. 1). Circle theorems are regarded as one of the most difficult sections of Geometry, resulting in poor student performance (Kwadwo & Asomani, 2021). According to studies (Adolphus, 2011; Erdoğan et al., 2011; Kwadwo & Asomani, 2021), the difficulty in teaching and learning Geometry, particularly circle theorems, results in poor learners' performance. For this reason, studying circle theorems, particularly in teacher training institutions, need more creative techniques that will improve pre-service teachers' circle theorems comprehension and skills (Amevor & Bayaga, 2021; Kwadwo & Asomani, 2021; Tay & Wonkyi, 2018). Some of these novel ways that are recognized to aid learners' knowledge of circle theorems include the use of educational technology, notably the incorporation of mathematics software into the teaching and learning of circle theorems (Amevor & Bayaga, 2021; Kovács, 2018; Tay & Wonkyi, 2018). GeoGebra is a popular mathematics application software in the teaching and learning of circle theorems (Adhikari, 2021; Arbain & Shukor, 2015; Tay & Wonkyi, 2018).

Studies have shown that GeoGebra software can improve learners' performance in circle theorems (Adhikari, 2021; Mushipe & Ogbonnaya, 2019; Pamungkas et al., 2020; Tay & Wonkyi, 2018; Tran & Nguyen, 2020). However, the adoption of GeoGebra is lower than expected (Ganesan & Eu, 2020; Mutambara & Bayaga, 2020c; Nwoke & Chidi, 2020). According to Padmanathan and Jogulu (2018), the proper deployment and use of an information system are dependent on individuals' acceptance.

Mutambara and Bayaga (2020c) stated in an educational context that learners' use of educational technologies is dependent on their acceptance of these technologies. According to the findings of Padmanathan and Jogulu (2018) and Mutambara and Bayaga (2020c), one can conclude that the successful adoption of GeoGebra by pre-service teachers is contingent on their acceptance of it. However, little is understood about GeoGebra's acceptance for learning circle theorems (Chen, 2020).

Mukamba and Makamure (2020) observed a scarcity of studies focusing on factors that pre-service teachers consider important when accepting GeoGebra. Additionally, Aman et al. (2020) also advocated for more research in the acceptance of GeoGebra by pre-service teachers.

A considerable amount of research has been carried out on the use of GeoGebra in the mathematics classroom (Aman et al., 2020; Belgheis & Kamalludeen, 2018; Chen, 2020; Johar, 2021; Septian & Monariska, 2021; Venter, 2015). Venter (2015) investigated in-service teachers' acceptance of GeoGebra. Septian and Monariska (2021) focused on what motivates learners to use GeoGebra for learning mathematics. However, there are very few studies that have focused on factors that influence the acceptance of GeoGebra (Aman et al., 2020; Belgheis & Kamalludeen, 2018; Chen, 2020; Johar, 2021).

Chen (2020) and (Johar, 2021) assessed the acceptance of GeoGebra by university students. Aman et al. (2020) and Belgheis and Kamalludeen (2018) looked at the factors that pre-service teachers consider important when accepting GeoGebra, but these were all conducted in developed countries, so their generalization to developing countries may be limited. Additionally, Mutambara and Bayaga (2020b) called for developing countries to carry out their own acceptance of educational technology studies, and not to follow examples in developed countries blindly. This therefore, calls for the need for investigating the use and acceptance of GeoGebra in a rural setting of a developing country.

Based on the preceding arguments, the purpose of this study was to examine pre-service teachers' acceptance of GeoGebra in the learning of circle theorems. In doing so, this study combined the technology acceptance model (TAM) and the task-technology fit (TTF) to create a new model that predicts the acceptance of GeoGebra for learning circle theorems.

2. Literature Review

2.1 Application of GeoGebra in the Classroom

Korenova (2017) investigated the use of GeoGebra among children between nine and 11 years of age on their attitudes and achievements. The findings were similar to the findings of previous studies (Sheikh Qasem, 2020; Suryani et al., 2020; Zulnaidi et al., 2020) which revealed that GeoGebra improves learners' performance in Geometry. Additionally, the results indicated that learners had a positive attitude towards GeoGebra (Safrida et al., 2020). These results concur with the findings of Boo and Leong (2016), which stated that learners were able to express their geometric imagination and understanding of mathematical concepts after using GeoGebra. The study's findings also demonstrated that GeoGebra can make classroom lessons more fun and intriguing (Boo & Leong, 2016).

In a study by Safrida et al. (2020) to investigate the effect of GeoGebra on university students' learners' performance in Geometry, the findings revealed a considerable difference in learners' pre-test and post-test scores. The results showed that GeoGebra is a useful supplement to traditional teaching. Similarly, Baltaci and Yildiz (2015) added that GeoGebra is dynamic, easy to apply, and can improve learners' performance.

Another study was carried out in Zimbabwe by Mukamba and Makamure (2020) on the effects of teaching and learning geometric transformations at Ordinary Level. The results agree with the findings of Arbain and Shukor (2015), who found that learners had positive attitudes towards the use of GeoGebra and had better learning achievement using GeoGebra. Arbain and Shukor (2015) added that GeoGebra can benefit learners' mathematics learning and diversifying learning in the classrooms.

2.2 Factors that Influence Pre-Service Teachers to use GeoGebra

The technology acceptance model was used by Kalogiannakis and Papadakis (2019) to predict pre-service teachers' acceptance of GeoGebra. Pre-service teachers' perceived usefulness (PU) was predicted by perceived ease of use (PEOU) and they were both determinants of perceived attitude towards (ATT) use (Kalogiannakis & Papadakis, 2019). The positive influence of PEOU on ATT was also supported by Pittalis (2020), who stressed that pre-service teachers'

attitude towards GeoGebra is affected by the effort required to learn to use it. These results were also supported by Aman et al. (2020) and Khlaisang et al. (2019) who together added that PU does not influence ATT only, but actual use (USAGE). The ATT construct has a strong correlation with USAGE (Aman et al., 2020; Mac Callum & Jeffrey, 2014). The positive attitude of pre-service teachers towards GeoGebra reinforces USAGE

Previous studies in educational context have empirically established that TTF positively influences both users' attitude towards technologies and actual usage of technologies (Alamri et al., 2020; Gan et al., 2017; McGill & Klobas, 2009). Alamri et al. (2020), for example, discovered that TTF has a considerable impact on students' attitude towards the usage of educational technologies. Gan et al. (2017) noted that TTF had a substantial impact on GeoGebra usage in higher education. McGill and Klobas (2009) reported that TTF extensively influences both user's ATT and USAGE. TTF was found to be affected by PEOU (Isaac et al., 2019).

Empirical studies have shown that task-technology fit is influenced by system quality (Aldholay et al., 2018; Isaac et al., 2019). Aldholay et al. (2018) found that Yemen university students' TTF is influenced by system quality. Isaac et al. (2019) also reported that TTF is influenced by both system quality and system compatibility. Congruent with the findings of Isaac et al. (2019), Alamri et al. (2020) reported that both system actual usage and TTF are influenced by system compatibility. Also, user satisfaction positively correlates with TTF (Gharbawi & Bassam, 2016).

3. Theoretical Framework

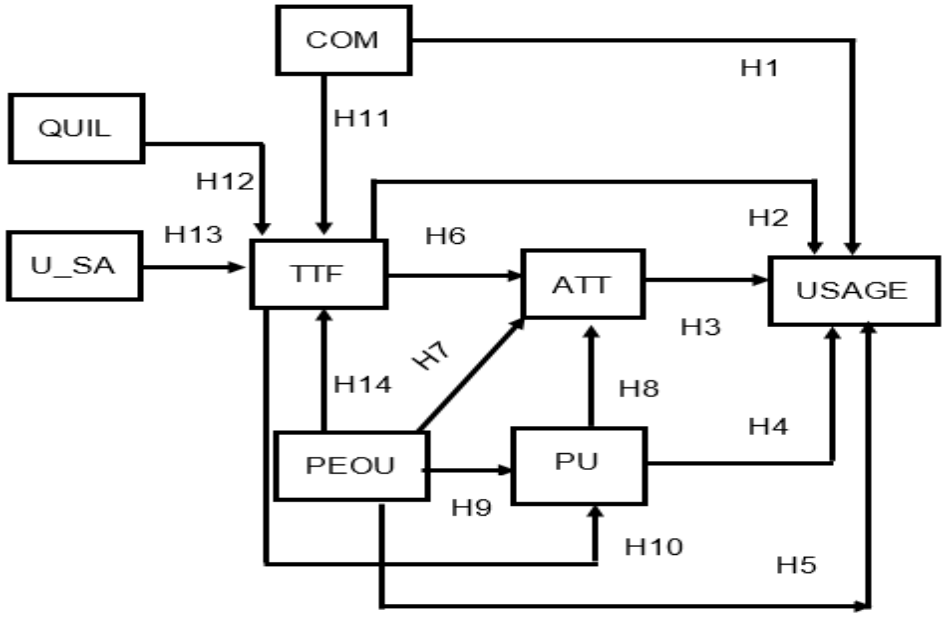
According to the TAM, people's behavioral intention (BI) to utilize a new information system (IS) is influenced by both its perceived usefulness (PU) and their attitude towards it (ATT) (Davis et al., 1989). That is, a person's attitude toward an IS Aldolic influenced by its utility and the effort required to learn how to utilize it (Mutambara & Bayaga, 2020a). Thus, the TAM postulates that PU is predicted by PEOU, and they are both influenced by external factors (Davis et al., 1989). The TAM is also considered as a well-established and robust technology acceptance theory (Chibisa et al., 2021; Mutambara & Bayaga, 2021).

Even though the TAM is considered robust in predicting technology acceptance, other researchers have criticized the TAM (Dishaw & Strong, 1999; Venkatesh et al., 2003). The TAM was critiqued by Venkatesh et al. (2003) for having a low explanatory power of users' perceptions towards IS. Venkatesh et al. (2003) suggested that adding external variables improves the TAM's explanatory power, and this was supported by several studies (Khlaisang et al., 2019; Mutambara & Bayaga, 2021; Pittalis, 2020). The TAM is also critiqued for its lack of task focus when explaining the use of new technology (Dishaw & Strong, 1999).

Information technology is a tool that allows users to complete organizational tasks (Dishaw & Strong, 1999). Furthermore, Dishaw and Strong (1999) averred that a lack of task focus when evaluating acceptance of a new information system contributes to mixed results in new information system evaluations. In dealing with these weaknesses, the current study extended the TAM by adding the TTF constructs.

4. Conceptual Framework

The use of a hybrid TAM/TTF model was appropriate for this study, given both separate models assessed different aspects of rural Eswatini pre-service teachers' acceptance of GeoGebra for learning circle theorems. Most of the TAM variables and hypotheses were retained in this new model. The TTF variables extend the TAM by considering how the task impacts use. The current study posits that the TTF construct influences perceived usefulness, perceived attitude towards, and actual usage, while the TTF itself is predicted by perceived ease of use, system quality, system compatibility, and user satisfaction. System compatibility also influences actual usage. **Error! Reference source not found.**1 shows the proposed G eoGebra acceptance hybrid model. The model constructs and hypotheses follow thereafter.



Error! Reference source not found.**1: Conceptual framework**

4.1 User Satisfaction (U_SA)

This study defines user satisfaction as the intensity with which rural Eswatini pre-service teachers find satisfaction in their individual decision to use GeoGebra to learn circle theorems. User satisfaction is regarded as among the most important indicators of the success of information systems (IS) (DeLone & McLean, 2016; Gharbawi & Bassam, 2016). Studies have shown that U_SA has a positive effect on TTF (Alamri et al., 2020; Isaac et al., 2019). This study proposed that if rural Eswatini pre-service teachers are satisfied with GeoGebra for learning circle theorems, they will find it (GeoGebra) fit for the task. Therefore, the hypothesis for the construct is:

H13: Rural Eswatini pre-service teachers' U_SA influences their TTF.

4.2 System Compatibility (COM)

The degree to which a system is technically sound, flexible, and sophisticated is defined as system compatibility (Adeniji et al., 2018). Prior studies found contradicting results on the effect of COM on TTF. Isaac et al. (2019) reported that university students' system compatibility has a significant positive effect on their

TTF. Contrary to the findings of Isaac et al. (2019), Islam and Azad (2015) revealed that system compatibility has no effect on task technology fit. This study proposed that if rural Eswatini pre-service teachers find GeoGebra to be technically sound, flexible, and sophisticated, they will perceive it fit for learning circle theorems. Therefore, the following hypotheses were proposed:

H11: Rural Eswatini pre-service teachers' COM influences their TTF.

H1: Rural Eswatini pre-service teachers' COM influences their USAGE.

4.3. System Quality (QUAL)

Isaac et al. (2019) defined system quality as the degree to which an individual perceives that an IS is simple to operate, connect, and learn, as well as pleasurable to use. Because an IS has various characteristics, such as system aspects, quality aspects, and other technical concerns, Ali and Younes (2013) defined system quality as a multidimensional process focused on multiple aspects. According to Aldholay et al. (2018) and Isaac et al. (2019), system quality has a beneficial effect on TTF. This study hypothesizes that if rural Eswatini pre-service teachers find GeoGebra easy to use, connect, and learn, as well as entertaining to use, they will consider it appropriate for learning circle theorems. As a result, the following hypothesis was established:

H12: Rural Eswatini pre-service teachers' QUAL influences their TTF.

4.4. Task-Technology Fit (TTF)

The task-technology fit model is a commonly used as a theoretical framework for measuring the influence of information technology on performance, examining usage impacts, and judging the match between task and technology features (Wu & Chen, 2017). The TTF, as described by Goodhue and Thompson (1995), is a crucial component in explaining work performance levels. It is a matter of how the capabilities of the IS meet the tasks that the user must do. According to Wu and Chen (2017), the view of whether a certain technology fits well with the current values of users, its perceived usefulness, can be used to develop perceptions of actually using the technology. Furthermore, empirical studies show that TTF influences PU; that is, when the task-to-technology fit is better, users perceive the technology to be more useful (Wu & Chen, 2017).

Previous studies in educational context have empirically established that TTF positively influences both users' attitude towards technologies and actual usage of technologies (Alamri et al., 2020; Gan et al., 2017; McGill & Klobas, 2009). This study proposes that if rural Eswatini pre-service teachers find GeoGebra fit for learning circle theorems, they will realize its usefulness, have positive attitudes towards it and will use it. It is therefore hypothesized that:

H2: Rural Eswatini pre-service teachers' TTF influences their USAGE.

H10: Rural Eswatini pre-service teachers' TTF influences their PU.

H6: Rural Eswatini pre-service teachers' TTF influences their ATT.

4.5. Perceived Attitude Towards (ATT)

Venkatesh et al. (2003) defined ATT as a person's total emotional reaction to the use of a new IS. In the current study, perceived attitude towards was defined as the overall affective reaction of Eswatini pre-service teachers towards the use of

GeoGebra. Prior studies have shown that pre-service teachers' perceived attitude towards, influence their actual use (Montrieux et al., 2014; Siyam, 2019). Siyam (2019) emphasized the importance of managing pre-service teachers' attitude towards, as ATT is the best predictor of their technology adoption. Teo et al. (2009) reported that pre-service teachers' attitude predicts their actual usage. Similar results were reported by Aman et al. (2020), who reported that pre-service teachers' actual use is influenced by their attitude. If rural Eswatini pre-service teachers have a positive attitude towards the use of GeoGebra, they will use it for learning circle theorems. Therefore, the hypothesis is that:

H3: Rural Eswatini pre-service teachers' ATT influences their USAGE.

4.6. Perceived Ease of Use (PEOU)

Perceived ease of use is user's perseption that the use of an information system will be free of cognitive effort (Davis et al., 1989). Several studies have shown that perceived ease of use influences pre-services teachers' perceived usefulness (Pittalis, 2020; Teo et al., 2015; Teo et al., 2009). The use of technology for learning involves additional effort of learning the technology (Pittalis, 2020). This work load increases when the technology is difficult or confusing to use (Teo et al., 2015). Hence, the perception that it is difficult to use GeoGebra to learn circle theorems will likely discourage rural Eswatini pre-service teachers from using it. Studies have shown that perceived attitude is influenced by perceived ease of use (Joo et al., 2018; Papadakis, 2018). Previous studies also show that PEOU influences TTF (Aldholay et al., 2018; Isaac et al., 2019). If rural Eswatini pre-service teachers found GeoGebra easy for the learning of circle theorems, then they will have a positive attitude towards it and use it. It is therefore hypothesized that:

H14: Rural Eswatini pre-service teachers' PEOU influences their TTF.

H9: Rural Eswatini pre-service teachers' PEOU influences their PU.

H7: Rural Eswatini pre-service teachers' PEOU influences their ATT.

4.7. Perceived Usefulness (PU)

Perceived usefulness was defined in educational context as a person's perception that using information communication and technology will improve teaching and learning (Mutambara & Bayaga, 2020b). Studies have shown that perceived usefulness influences perceived attitude towards, and actual usage (Lin & Huang, 2008; Siegel, 2008; Wu & Chen, 2017). Perceived usefulness is also reported to influence learners' actual usage (Lin & Huang, 2008). It can be proposed that rural Eswatini pre-service teachers' perceived attitude towards use is influenced by their belief that using GeoGebra for learning circle theorems will improve their performance. Therefore, the hypotheses for the construct PU are:

H8: Rural Eswatini pre-service teachers' PU influences their ATT.

H4: Rural Eswatini pre-service teachers' PU influences their USAGE.

5. Methodology

5.1 Research Design

This study made use of a cross sectional survey design. A survey design provides an accurate depiction of a population's attitudes by analyzing a subset of the population (Creswell, 2015). A cross-sectional survey was conducted to give a

quantitative description of the views of rural Eswatini pre-service teachers' attitudes towards the use of GeoGebra for the learning of circle theorems.

5.2 Data collection tool

A questionnaire survey was employed to assess the utilization of GeoGebra by rural Eswatini pre-service teachers for studying circle theorems. This questionnaire was employed because it enabled the gathering of a significant amount of data from rural Eswatini pre-service teachers in a short time and at a low cost. The first section of the survey included biographic information about rural Eswatini pre-service teachers. The second section was devoted to measuring the conceptual model's constructs, such as TTF, PEOU, ATT, PU, U_SA, COM, QUAL, and actual use. Items from previously validated and reliable instruments were used to assess PEOU, ATT, and PU (Mutambara & Bayaga, 2020a). The items TTF, U_SA, COM, QUAL, and actual use were adopted from the study of Gharbawi and Bassam (2016). A 7-point Likert scale was used to assess these constructs.

5.3 Participants

The participants of this study comprised of pre-service teachers studying Mathematics at a rural Eswatini colleges. Eswatini has four teachers' colleges and universities (Ministry of Education and Training, 2013). Three of them are in urban areas, while one is in a rural location (Ministry of Education and Training, 2013). As a result, the population of this study included all pre-service teachers learning circle theorems at a rural teachers' training institution in Eswatini. All pre-service teachers at the rural teachers' college, who were studying circle theorems, were asked to take part in this study. There was a total of 187 pre-service teachers chosen.

According to Hair et al. (2017), the minimal sample size for formative partial least squares-structural equation modeling, should be 10 times the number of indicators of the construct with the most indicators. In this study, perceived usefulness was the construct with the most indicators (five). The minimum predicted sample size for this investigation was 50, as per the recommendation by Hair Jr et al. (2014). This study's actual sample size was 187, which was much larger than the recommended 50. Most of the participants in this research were females (53 %), while males were in the minority (47%).

5.4 Data analysis

Descriptive statistics were used to analyze the data first, and then the model was evaluated using partial least squares–structural equation modeling. The analysis of the model was carried out in two parts. Firstly, the measurement model was assessed. Secondly, the structural model was evaluated.

5.5 Measurement Model

The extracted values of outer loadings, composite reliability (CR), and average variance extracted values (AVE) are used to assess convergent validity (Hair Jr et al., 2021; Hair Jr et al., 2017). In this study, all of the outer loadings in Table 1 and in Figure 2 were more than the cut-off value of 0.7 as per recommendation (Hair Jr et al., 2021; Hair Jr et al., 2017). These findings indicated that item reliability was satisfactory. All Cronbach's alpha (CA), rho A, and CR values were more than 0.7, indicating satisfactory internal consistency as suggested (Hair Jr et al., 2021; Hair

Jr et al., 2017). The AVE values more than the cut off value of 0.5 were considered. Convergent validity was confirmed with acceptable item reliability, AVE, and internal consistency (Hair Jr et al., 2021).

Table 1: Measurement Model

Construct	Indicator	Loadings	CA	rho_A	CR	AVE
ATA	ATT1	0.868	0.919	0.920	0.943	0.805
	ATT2	0.885				
	ATT3	0.918				
	ATT4	0.916				
COMP	COMP1	0.938	0.847	0.853	0.929	0.867
	COMP2	0.923				
PEOU	PEOU1	0.846	0.852	0.856	0.900	0.692
	PEOU2	0.853				
	PEOU3	0.833				
	PEOU4	0.795				
PU	PU1	0.759	0.855	0.869	0.901	0.696
	PU2	0.796				
	PU3	0.890				
	PU4	0.885				
QUIL	QUIL1	0.909	0.758	0.765	0.892	0.805
	QUIL2	0.885				
TTF	TTF1	0.910	0.804	0.806	0.911	0.836
	TTF2	0.919				
USAGE	USAGE1	0.930	0.936	0.943	0.952	0.801
	USAGE2	0.756				
	USAGE3	0.934				
	USAGE4	0.906				
	USAGE5	0.937				
U_SAT	U_SAT1	0.829	0.750	0.904	0.882	0.790
	U_SAT2	0.945				

The Fornell-Larcker criterion is used to assess discriminant validity (Hair Jr et al., 2017). Table 2 demonstrates that the square root of each latent variable's AVE value was greater than the latent variable's strongest correlation with any other latent variable, as stated by Hair Jr, et al. (2021). The findings revealed that each construct can be distinguished from any other construct in the model.

Table 2: Fornell-Larcker criterion

	ATT	COMP	PEOU	PU	QUIL	TTF	USAGE	U_SAT
ATT	**0.897**							
COMP	0.680	**0.931**						
PEOU	0.427	0.510	**0.832**					
PU	0.614	0.518	0.359	**0.834**				
QUIL	0.607	0.574	0.525	0.610	**0.897**			
TTF	0.669	0.762	0.463	0.483	0.532	**0.915**		

USAGE	0.838	0.691	0.504	0.527	0.616	0.687	**0.895**	
U_SAT	0.383	0.228	0.166	0.497	0.461	0.349	0.309	**0.889**

5.6 Structural model

After the measurement model's appropriateness was confirmed, the structural model was evaluated. The four-step structural model assessment by Hair Jr et al. (2021) was used in this study. The first phase, according to Hair Jr et al. (2021), is to examine the structural model for collinearity, followed by the importance and relevance of the path coefficients, the model's explanatory power, and finally the model's predictive power.

The variance inflation factor (VIF) values were utilized to test the measurement model's collinearity. Table 3 shows that all the VIF values were lower than four, indicating that the model had no collinearity issues (Hair Jr et al., 2021). The bootstrapping approach (with 5000 subsamples) was used to determine the relevance of the path coefficients. The results from Table 3 show that out of 14 hypotheses tested five were rejected, while nine were accepted.

The rejected hypotheses were having p-values greater than 0.05 and a t-value less than 1.96. The rejected paths are COMP to USAGE ($\beta = 0.102$, $p > 0.05$), PEOU to ATT ($\beta = 0.086$, $p > 0.05$), PU to USAGE ($\beta = -0.031$, $p > 0.05$), PEOU to TTF ($\beta = 0.080$, $p > 0.05$), and QUIL to TTF ($\beta = 0.029$, $p > 0.05$). The nine paths which were supported by data are TTF to PU ($\beta = 0.403$, $p < 0.05$), TTF to USAGE ($\beta = 0.136$, $p < 0.05$), TTF to ATT ($\beta = 0.454$, $p < 0.05$), PU to ATT ($\beta = 0.364$, $p < 0.05$), COMP to TTF ($\beta = 0.665$, $p < 0.05$), PEOU to USAGE ($\beta = 0.125$, $p < 0.05$), PEOU to PU ($\beta = 0.173$, $p < 0.05$), U_SAT to TTF ($\beta = 0.685$, $p < 0.05$), and ATT to USAGE ($\beta = 0.642$, $p < 0.05$).

Table 3: Structural model

Path	Std Beta	Std Error	T-Statistics	P-Values	Decision	f-squared	VIF
ATT -> USAGE	0.642	0.051	12.679	0.000	Accepted	0.671	2.452
COMP -> TTF	0.665	0.052	12.878	0.000	Accepted	0.708	1.640
COMP -> USAGE	0.102	0.075	1.361	0.174	Rejected	0.014	2.907
PEOU -> ATT	0.086	0.066	1.303	0.193	Rejected	0.013	1.313
PEOU -> PU	0.173	0.073	2.359	0.019	Accepted	0.031	1.273
PEOU -> TTF	0.080	0.055	1.460	0.145	Rejected	0.011	1.528
PEOU -> USAGE	0.125	0.058	2.145	0.032	Accepted	0.045	1.397
PU -> ATT	0.364	0.071	5.129	0.000	Accepted	0.225	1.345
PU -> USAGE	-0.031	0.044	0.688	0.492	Rejected	0.002	1.667
QUIL -> TTF	0.029	0.071	0.413	0.680	Rejected	0.001	2.028
TTF -> ATT	0.454	0.065	6.975	0.000	Accepted	0.316	1.492
TTF -> PU	0.403	0.071	5.679	0.000	Accepted	0.172	1.273
TTF -> USAGE	0.136	0.055	2.496	0.013	Accepted	0.028	2.679
U_SAT -> TTF	0.171	0.055	3.083	0.002	Accepted	0.059	1.284

The model's explanatory power was assessed using the coefficient of determination (R-squared) and effect size (f-squared) values. According to Chin (1998), R-squared values of 0.19, 0.33, and 0.67 represent a weak, moderate, and substantial level of accuracy, respectively.

Figure 2 shows that ATT, PU, TTF, and USAGE had R-squared values of 0.564, 0.257, 0.619, and 0.749, respectively. PU's R-squared value (0.257) is considered weak (Chin, 1998). The R-squared values of ATT and TTF were moderate, while USAGE's R-squared value was substantial (Chin, 1998). These results show that the total contribution of predictors; COM, PEOU, PU, QUIL, TTF, U_SAT, and ATT on the explained variance of USAGE is 74.9%. Figure 2 shows that QUIL and U_SAT are predictors of TTF. COM is a predictor of TTF and they both influence USAGE. PEOU is a determinant of PU, ATT, TTF, and USAGE. ATT is influenced by PU and TTF. PU and ATT predict USAGE.

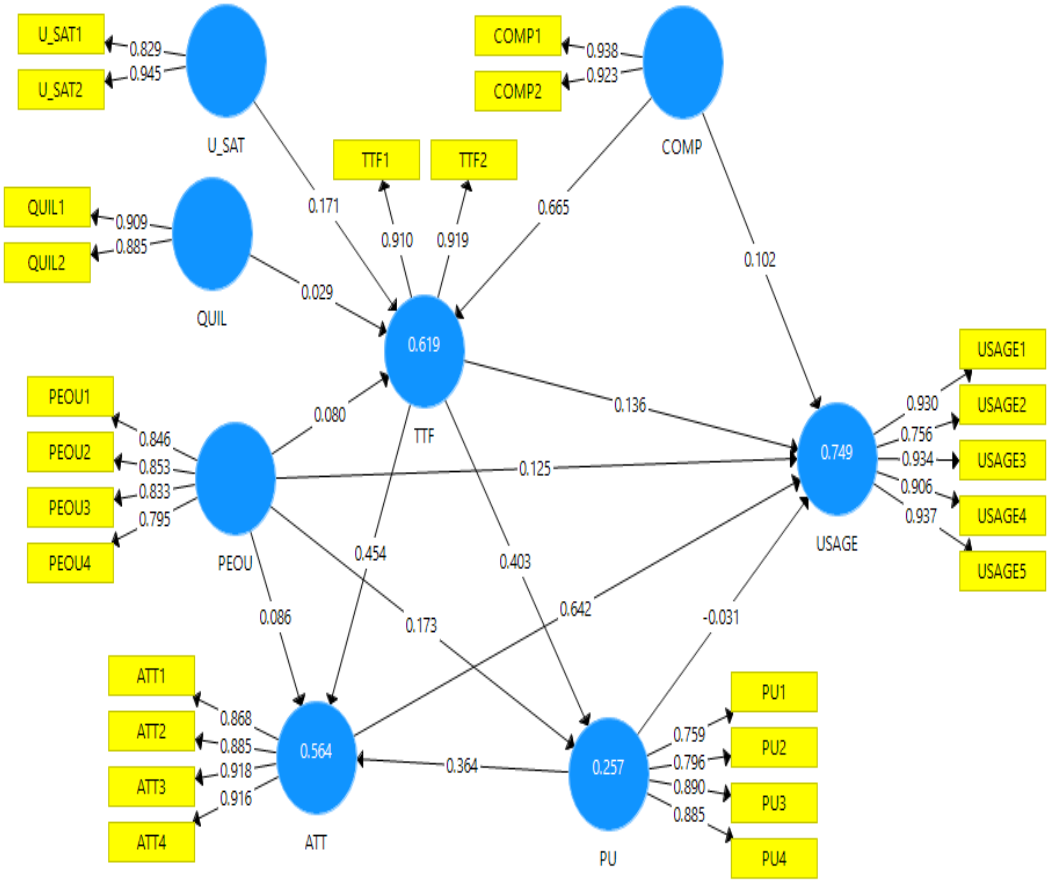


Figure 2: Structural model

The f-squared values of 0.02, 0.15, and 0.35, according to Chin (1998), correspond to effect sizes of small, medium, and large, respectively. The f-squared value of PEOU to PU (0.031), TTF to USAGE (0.028), and U_SAT to TTF (0.059) are all considered small, as seen in Table 3. TTF to PU (0.172), TTF to ATT (0.316), and PU to ATT (0.256) all have a medium effect size while the effect size of ATT to USAGE (0.671) and COMP to TTF (0.708) are considered large.

The Stone-Geisser's Q-squared statistic was used to assess the model's predictive power. The endogenous variables ATT, PU, TTF, and USAGE obtained Q-squared values of 0.448, 0.173, 0.503, and 0.593, respectively. All the Q-squared values were greater than zero, indicating that the model's predictive significance was adequate (Hair Jr et al., 2017). This means that the predictors COMP, PEOU, PU, ATT, PEOU, QUIL, and U SAT can be used to forecast the use of GeoGebra to teach circle theorems to rural Eswatini pre-service teachers.

6. Discussion

The primary goal of this research was to explore the factors that influence Eswatini pre-service teachers' acceptance of GeoGebra in the learning of circle theorems. This has been accomplished by combining the technology acceptance model and task technology fit. The hybrid model explained 74.9% of the variance in Eswatini pre-service teachers' acceptance of GeoGebra in the learning of circle theorems. This suggests that variables such as task-technology fit, system quality, system compatibility, perceived ease of use, perceived usefulness, perceived attitude toward, and user satisfaction accounted for 74.9% of the total variance. All the Q-squared values were greater than zero, indicating that the model can be used to predict Eswatini pre-service teachers' acceptance of GeoGebra in the learning of circle theorems.

This study demonstrated that rural Eswatini pre-service teachers' perceived attitude towards GeoGebra for learning circle theorems influences their actual use. This is consistent with previous research (Aman et al., 2020; Eksail & Afari, 2019; Teo et al., 2009; Teo et al., 2008). This supports Mutambara and Bayaga's (2020a) claim that increasing teachers' attitudes toward the use of technology in learning improves its actual utilization. One probable reason for this finding is that Eswatini pre-service teachers realized that GeoGebra can help them to perform better on circle theorems. Furthermore, the usability of GeoGebra promotes rural Eswatini pre-service teachers' positive attitude towards the GeoGebra adaptive technology.

Rural Eswatini pre-service teachers' perceived ease of use of GeoGebra for learning circle theorems does not influence their perceived attitude towards actual use. These findings are surprising given the body of knowledge's widespread belief that perceived ease of use influences perceived attitude (Mutambara & Bayaga, 2021; Sánchez-Prieto et al., 2019; Teo & Milutinovic, 2015) and actual use (Sánchez-Prieto et al., 2019). These results were also in contradiction with the findings of Kalogiannakis and Papadakis (2019), who discovered that pre-service teachers' perceived ease of use influences their perceived attitude towards the use of ICT in education. Two possible explanations for these findings are the timing of data collection for this study and that the survey was conducted after the pre-service teachers had completed their post-test. This suggests that the pre-service teachers were already accustomed to the use of GeoGebra in the learning of circle theorems, since the effect of perceived ease of use diminishes with practice (Mutambara & Bayaga, 2020c). The survey was conducted when the pre-service teachers had already been subjected to, and were familiar with, GeoGebra. Additionally, rural Eswatini pre-service teachers perceived the use of GeoGebra as simple for learning circle theorems.

Task technology fit was found to influence actual use, perceived usefulness, and perceived attitude towards. These results support prior studies who reported a positive influence of task technology fit on perceived usefulness (Gharbawi & Bassam, 2016), perceived attitude towards (Alamri et al., 2020; Gan et al., 2017), and actual use (Glowalla & Sunyaev, 2014; Isaac et al., 2019). The ability of GeoGebra to experiment with circles to improve cognition in circle theorems influences the attitude of rural Eswatini pre-service teachers towards GeoGebra. These findings suggest that the ability of GeoGebra to fit and enhance cognition in circle theorems influenced rural Eswatini pre-service teachers' attitude towards it and the decision to use GeoGebra. Task technology fit is a major factor in explaining job performance levels (Goodhue & Thompson, 1995). Rural Eswatini pre-service teachers realized that GeoGebra can improve their performance in circle theorems, which increases their decision to use it.

Task technology fit also played a very important mediating role between actual use and its predictors; user satisfaction and system compatibility. This finding implies that the extent to which GeoGebra is perceived to line up with the immediate requirements, values, and prior experiences of rural Eswatini pre-service teachers is insufficient to directly influence the use of GeoGebra, but it does contribute through the task technology fit.

Congruent to the findings of Kalogiannakis and Papadakis (2019) and Joo et al. (2018), their study discovered that the perceived usefulness of GeoGebra for learning circle theorems had a positive impact on the perceived attitude of rural Eswatini pre-service teachers. The findings are also in line with those of Bhattarai and Maharjan (2020), who discovered that pre-service teachers' intention to use technology in class is influenced by their belief that it improves their performance. A reasonable explanation for this finding is that rural Eswatini pre-service teachers discovered that they can easily manipulate objects inside circles after using GeoGebra when learning circle theorems. This can improve their comprehension of circle theorems. Hence, GeoGebra's ability to improve rural Eswatini pre-service teachers' circle theorem cognition improves their attitude towards it.

Rural Eswatini pre-service teachers' actual use of GeoGebra for learning circle theorems is unaffected by their perceived usefulness. These findings contradict those of Lin and Huang (2008) and Yang (2007), who found that the utility of technology influences its use by pre-service teachers. The findings of this study were unexpected, given that rural Eswatini pre-service teachers had previously used GeoGebra, and found it useful for learning circle theorems. One would expect GeoGebra's utility to have an impact on its actual use.

6.1 Theoretical Implications

The present study adds to the existing literature in five ways. First, the study provides empirical evidence that, despite the fact that the technology acceptance model was developed three decades ago (Davis et al., 1989), it can still be used to predict users' acceptance of technology.

Second, this study confirms that adding external variables that are context related improves the TAM's explanatory power (Venkatesh et al., 2003). In this study, the task technology fit, system quality, system compatibility, and user satisfaction added to the explanatory power of the TAM.

Third, this work adds to the body of knowledge by constructing a hybrid model for predicting the rural Eswatini pre-service teachers' acceptance of GeoGebra by extending the technology acceptance model. This would be a significant contribution to the acceptance of educational technology in developing countries, given that most researches to date were carried out in developed countries.

Fourth, the findings of the study showed that perceived attitude towards the use of GeoGebra for learning circle theorems was the strongest direct predictor of actual use by rural Eswatini pre-service teachers. This implies that the attitudes of rural pre-service teachers towards GeoGebra play an important role in its actual use to improve the cognition of circle theorems.

Fifth, the original technology acceptance model and technology task fit model have been applied in an educational context, and they have demonstrated that the two models can be combined to explain the actual use of technology in an educational context. This is useful for other researchers who are interested in developing conceptual frameworks for investigating the acceptance and use of electronic-learning technology in their educational contexts.

6.2 Practical Contributions

This study and its results have several practical implications. First, in practice, this research has contributed to a better understanding of the factors that can help or hinder the successful implementation of GeoGebra for learning circle theorems in rural Eswatini colleges. These factors can assist Eswatini teacher training institutions, researchers, and educational learning application-developers in creating successful educational learning applications. This is especially true in the context of African countries and other developing countries, where the situation in teacher education institutions is similar to that of Eswatini.

Second, this study discovered that user satisfaction and system compatibility are good predictors of technology task fit and through this finding, it can be implied that an educational learning application should be technically sound, flexible, and sophisticated in order for users to want to reuse it. This discovery assists educational learning application developers in inventing educational learning applications that are technically sound, flexible, and sophisticated, as this will improve their actual use.

Third, perceived attitude towards actual GeoGebra use was discovered to be the best predictor of actual use. Additionally, perceived attitude towards use was likewise discovered to play a critical mediating role between perceived usefulness and actual use. This finding implies that, for educational learning applications to be successfully implemented in Eswatini teacher training institutions, pre-service teachers' attitude towards technology integration in education should be positive. This discovery assists Eswatini teacher training institutions and researchers in determining factors that influence pre-service teachers' perceived attitude towards technology integration in education.

According to the findings of this study, perceived usefulness and technology task fit accounts for 56.4 % of the variance in perceived attitude towards use. It is critical for researchers to identify additional factors that influence pre-service teachers' attitude towards technology integration, as this plays a significant role in its actual use.

6.3 Limitation of the study

This study was conducted at one institution of higher learning in one developing country. Hence, the generalizability of the results may need to be applied with caution.

7. Conclusion

The study's goal was to identify the factors that influence rural Eswatini pre-service teachers' use of GeoGebra in learning circle theorems. The study suggested a novel model to explain the use of GeoGebra for learning circle theorems. The model was created by incorporating the task technology fit into the technology acceptance model. A questionnaire was used to collect data. Partial least squares-structural equation modeling was used to analyze the data. The model accounted for 74.9% of the variance in rural Eswatini pre-service teachers' use of GeoGebra for learning circle theorems. The study found that perceived attitude towards use, perceived ease of use, and technology task fit all had a direct impact on the actual use of GeoGebra for learning circle theorems. However, perceived usefulness was found to have an indirect effect on actual use via the mediating effect of perceived attitude towards use. The influence of user satisfaction and system compatibility on actual use was mediated by the task technology fit construct. It is critical for researchers to identify additional factors that influence pre-service teachers' attitudes towards technology integration in teaching and learning, as this plays a significant role in its actual use.

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