UNIFIED THEORY OF ACCEPTANCE AND USE OF TECHNOLOGY (UTAUT) MODEL AS MEANS TO MAXIMISE TEACHER COLLABORATION IN THE INDIGENISATION OF MATHEMATICS PEDAGOGY

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ABSTRACT

Prior research reveals a persistent lack of interest from teachers to engage in content-based collaborative teaching communities. This obscurity often results in teachers working in isolation, detrimentally affecting the implementation of indigenized innovative digital pedagogies. The current study investigates the interplay between teacher collaboration and the indigenization of secondary school mathematics pedagogy (SS-MP) via the UTAUT model. A cross-sectional study was conducted in South African rural secondary schools, aiming to examine the extent to which teacher collaboration contributes to the indigenization of SS-MP and how this relationship can be measured and assessed within the context of the UTAUT model. Stratified random sampling was used in selecting participants in the survey. Partial least squares structural equation modelling (PLS-SEM) was employed to analyze the measurement and structural models guided by five (5) hypotheses.

The sample comprises one-hundred and fourteen educators. The findings revealed significance of behavioural intention (BI) and attitude (ATT) in predicting the successful indigenisation of mathematics teaching practices. User behavior (UB) reveals potential for refinement in predictive performance. Policy implications do emphasise tailoring educational technology integration policies, with reference to infrastructure and supportive conditions. For managerial level, targeted professional development initiatives as well as positive social influences are crucial. The general position though is understanding of technology acceptance in secondary school mathematics, by providing practical guidance responding to culturally settings and technology integration.

Keywords: technology acceptance, secondary school mathematics, indigenisation, collaborative digital technology, PLS-SEM

INTRODUCTION

In this constantly evolving education landscape, the pursuit of effective teaching methodologies seems to be as crucial as the imperatives of respecting and acknowledging the multifaced forms of cultural perspectives, locally and across the globe (Sari and Yüce 2020). It is often argued that teachers are agents of change; their content knowledge impacts what they teach, how they teach, and what their learners learn (Jojo 2020). Therefore, teachers are crucial in effectively integrating technology and Indigenous and Local Knowledge (ILK) in Secondary School Mathematics Pedagogy (SS-MP) (Sumarni and Kadarwati 2020). It has been argued that knowledge plays a crucial role between teachers and learners during the teaching and learning process (Munna and Kalam 2021). A process through which a teacher identifies and establishes the learning objectives, develops instructional materials, and puts the teaching and learning approach into action, combining several aspects (Adedeji 2018). Additionally, Sari and Yüce (2020) argue that the significance of indigenization in education cannot be overstated. That is, the inclusion of culturally relevant scenarios that relate with indigenous problem-solving context enhances mathematics cognition. Regardless of such an important observation, usually, culturally responsive examples are overlooked. This omission hinders the creation of a truly inclusive learning environment and the development of a deeper understanding and appreciation for the subject. Consequently, there is a pressing need for the integration of technology and ILK. Hailegnaw (2022) highlights the potential achievement of this through ongoing professional development refresher programs and teacher collaboration (TC). Notably, limited attention has been given to models in this context and the acceptance and use of technology in the indigenisation of mathematics and related technologies.

What also sets the current study apart is its focus on examining the relationship between teacher collaboration and the indigenisation of mathematics pedagogy in secondary schools. Additionally, the study aims to understand how the unified theory of acceptance and use of technology (UTAUT), a widely acknowledged framework in technology adoption, can elucidate the dynamics of this educational transformation.

Other reasons justify this research. One being teacher collaborations have demonstrated a positive influence on educational outcomes in the African continent (Stelitano 2018). Authors such as Saka (2021) and Killion (2015), assert that teacher collaboration, through professional development programmes do enhance teacher quality, consequently improving learners' mathematics education. Given the current state of poor performance in secondary school mathematics too, the South African educational sector is compelled to address the epistemological need for collaboration to enable proficient teaching outcomes (Goddard, Goddard, and Tshannen-Moran 2007; Vangrieken et al. 2017).

Building on these contentions, this study utilises the UTAUT model to gain insights into secondary school mathematics teachers' experiences in teacher collaboration and its impact on integrating digital technology when indigenising SS-MP leading to the following questions:

Research questions

- RQ1: To what extent does teacher collaboration contribute to the indigenisation of SS-MP, and how does this relationship influence the context of the UTAUT Model?
- RQ2: To what extent does the UTAUT model explain the influence of teacher acceptance and use of technology on the integration of indigenous and local knowledge in SS-MP, and what are the key factors within the UTAUT framework that contribute to the successful indigenisation of mathematics teaching practices?

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Numerous theories have historically been employed to investigate technology acceptance, including the theory of reasoned action (TRA) (Fishbein and Ajzen 1975), the technology acceptance model (TAM) (Davis 1989), the motivational model (Davis, Bagozzi and Warshaw 1992), the theory of planned behavior (TPB) (Ajzen 1991), the combined TPB/TAM (Taylor and Todd 1995), the model of personal computer utilization (Thompson, Higgins, and Howell 1991), the diffusion of innovation theory (Rogers 1995), and social cognitive theory (Compeau and Higgins, 1995). Later, Venkatesh et al. (2003) amalgamated the constructs of TAM and TAM 2 to UTAUT.

The UTAUT model has found applications across diverse research domains, including education, where it has been instrumental in identifying the determinants of students' and staff acceptance of various technologies globally (Bayaga and Du Plessis 2023; Donaldson 2011; Ho, Chou and Fang 2016). Acknowledged for offering a more comprehensive prediction of user behaviour than previous models, the UTAUT model draws on eight technology acceptance models (Khechine, Ndjambou, and Lakhal 2016; Venkatesh et al. 2003). While effort expectancy (EE) showed non-significance relations with behavioural intention (BI), Bayaga and du Plessis (2023), in recent examination of the ramifications of the UTAUT among developing countries' higher education staffs demonstrated that social influence (SI), facilitating conditions (FC), and perceived performance (PP) expectancy were the principal constructs for BI. However, in the context of this study, the UTAUT framework asserts that perceived PP, EE, SI, and FC are the primary influencers, maintaining their predictive significance in BI. The framework posits that BI significantly influences use behavior (UB). The moderating factors in the framework include Age Range (AR), Attitude (ATT) toward

using technology, Teacher Experience (TE), and voluntariness of actual usage of digital technologies (VU-DT) (Venkatesh et al. 2003) (refer to Figure 1 below). The subsequent section provides a succinct narrative of these influential factors.

While existing research utilises UTAUT as a lens to explore various phenomena, gaps persist in understanding the extent to which teacher collaboration contributes to the indigenisation of SS-MP and how this relationship influences the UTAUT Model. Similarly, there is a dearth of firm research establishing the extent to which the UTAUT model explains the influence of teacher acceptance and use of technology on the integration of indigenous and local knowledge in SS-MP, as well as the key factors within the UTAUT framework contributing to the successful indigenisation of mathematics teaching practices. The following section explores some of the constructs used.

Perception of performance (PP) expectancy

In UTAUT, PP expectancy is the degree to which a user believes that using the system will help them attain gains in job performance; that is, it gives the teacher a reason to learn or act concerning the expected outcome (Venkatesh et al. 2003). The suggestion is that the extent to which an individual believes that using technology will help them improve their job performance (Amora and Fearnley 2020; Lavidas, Komis, and Achriani 2022; Nasser AL-Nuaimi et al. 2022; Pagán and Medina 2021).

Effort Expectancy (EE)

In UTAUT, EE is perceived as the degree to which a person believes that using the technology will be free of effort and easy to use (Venkatesh and Davis 2000). Meaning, users may believe using a specific technology require minimal effort, and for that reason, adopt the technology. Thus, EE shapes user attitudes and behavioural intentions towards technology adoption and usage (Nasser AL-Nuaimi et al. 2022; Pagán and Medina 2021).

Social influences (SIs)

Meanwhile, SIs tends to shape individuals' decisions in adopting and using technology (Venkatesh et al. 2003). Factors associating with SIs may range from social norms, opinions, and pressures, which intend influence users' acceptance of a technology (Mutambara and Bayaga 2020). SI thus recognises context of technology adoption, suggesting that influence of SIs factors play crucial role in the acceptance and usage of technology.

Facilitating conditions (FCs)

Facilitating conditions (FCs) tend to provide contextual indicators that support or form

hinderances to adopting and using technology (Venkatesh, Thong, and Xu 2012). The construct refers to perceived availability of adequate infrastructure as well as technical support (Venkatesh et al. 2012). Meaning, recognising that teachers could embrace technology, believing that schools provide adequate conditions for integration will facilitate the adoption of that technology (Nasser AL-Nuaimi et al. 2022; Pagán and Medina 2021).

Based on the evaluation of the previous studies, the following hypotheses have been proposed:

Hypothesis

- H1. The expectation of PP from teachers significantly influences the BI of teachers to work collaboratively in using DT in order to indigenize the SSs MP and simultaneously moderated by AR.
- H2. Teachers' EE has a positive effect on teachers' BI to work collaboratively in using DT and to indigenize the SSs MP, moderated by AR, ATT, and TE.
- H3. SI factors have a significant influence on teachers' BI to work collaboratively in the DT to indigenise MP SS moderated by AR, ATT, TE, and VU-DT.
- H4. FCs have a positive effect on teachers' BI to work collaboratively in the usage of DT (UB) to indigenise the MP SS moderated by AR, ATT, and TE.
- H5. FCs have a positive effect on the use (UB) of DT by teachers to indigenise SSs MP.

Hence, this study the proposed conceptual model in Figure 1.

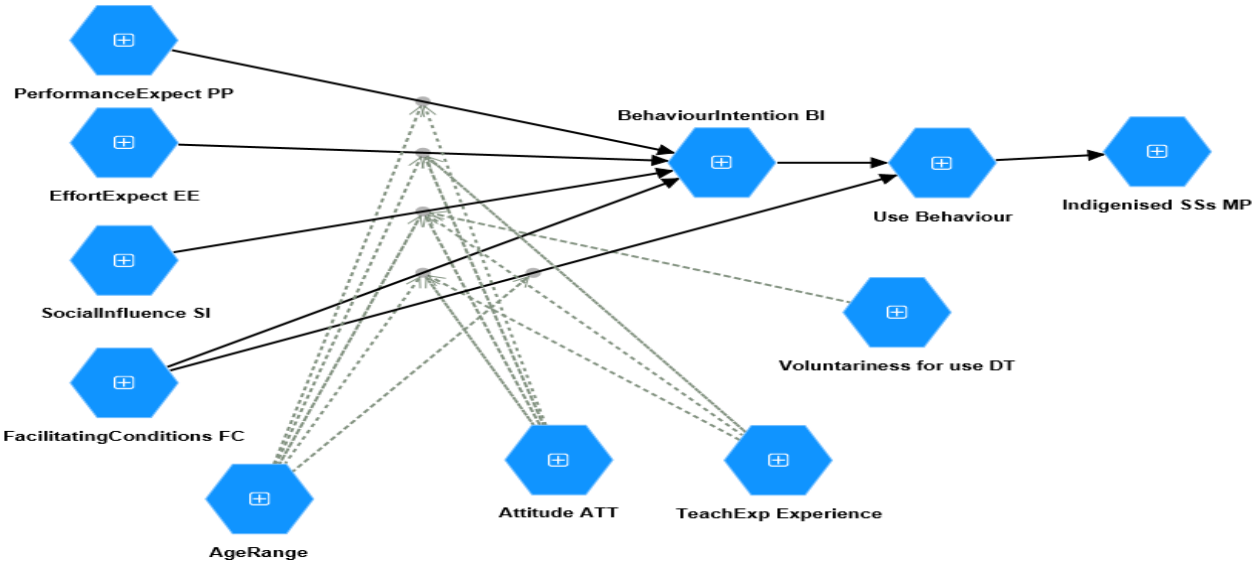

Figure 1: UTAUT model (Adapted from Venkatesh et al. 2003).

RESEARCH METHODOLOGY

Research Design

Based on the above research questions and guided by the five (5) hypotheses, this survey employed stratified random sampling in selecting participants. Survey designs are considered the most convenient instrument for theory testing, as they are known for being fast and cost-effective (Creswell 2014). For this study, the survey design was used to collect demographics and Mathematics teachers, BI to use technology at ease when indigenising the SS-MP. Essentially, PLS-SEM was used for the analyses of both the measurement and structural models guided by five (5) hypotheses.

Participants

In a rural secondary school, mathematics teachers formed the participants and were identified using stratified sampling followed by simple random sampling (Creswell 2014). Schools in the same quintiles were grouped to ensure that homogenous elements formed a stratum. Through simple random sampling, fifty mathematics teachers from each stratum were selected. Therefore, a total of one-hundred and fifty teachers were selected, and questionnaires were sent. One hundred fifty questionnaires were given out, and one-hundred and fourteen collected questionnaires.

Data collection

Procedure

A single cross-sectional test was used. By ensuring validity, the data was collected from rural high schools where digital technologies and Indigenous Knowledge (IK) are about to be introduced. As a pre-requisite, teachers used technology and IK in their mathematics pedagogy to a limited extent. The researchers gave mathematics teachers questionnaires to complete independently, which were then collected after two weeks. This research sought to examine, understand and provide information on how teacher collaboration, combined with digital technologies, can be effectively used to create culturally relevant and contextually appropriate mathematics pedagogy in the specific educational contexts of developing African countries. Central to the examinations is the need to assess the effectiveness of Teacher Collaboration, identify enabling factors, and offer recommendations for indigenising the SS's Mathematics education by aligning it with the cultural and linguistic diversity of the African continent, contributing to improved mathematics teaching and learning outcomes.

Analysis Technique

It is essential to emphasise that this study hypothesises that the expectancy of PP, the EE, SI and FC effort, in addition to the moderation factors such as AR, ATT, TE and VU-DT, are the main pillars that influence the effectiveness of teachers and ISS-MP. Thus, the conceptual model in Figure 1. Both the conceptual measurement and the structural model were examined by examine how suitable PLS-SEM was through seminal work of Hair et al. (2017). The authors argued that PLS-SEM assess' challenging-to-measure and unobservable latent variables and is ideally suited for analysing direct and indirect effects as demonstrated by Figure 1 as the relations are both moderated and mediated in nature, hence both direct and indirect effects. Additionally, PLS-SEM is for both predictive and exploratory research with goal of developing, extending, or revising a model. PLS-SEM is also suitable for the conception of the hypothesised Model, exploration of complex models containing several constructs (multiple IV, DV, moderators and mediators) (Hair et al. 2017).

Ethical considerations

The authors affirm the ethical integrity of this manuscript through the following statements. This work is an original creation by the authors and has not been published before nor under any consideration elsewhere. The content is a truthful and comprehensive representation of the authors' research and analysis. To safeguard the privacy and confidentiality of respondents, details of interviewees have been anonymised. Ethical procedures involved obtaining Institutional Review Board approval from XXX University in South Africa, under reference number H21-EDU-PGE-026. Ethical clearance was sought and granted by the research ethics committee of XXX University's Faculty of Education, ensuring adherence to norms and practices for participant protection.

DATA ANALYSIS

This section unpacks how hypothesis testing through the measurement and structural models, respectively.

Measurement model assessment (reliability and validity)

Table 1 presents the reliability and validity metrics for seven constructs: The constructs PE, EE, SI, FC, ATT, BI, and SSs MP. Internal consistency, evaluated using Cronbach's α, demonstrated high reliability across all constructs (α range = 0.773 to 0.946), so were other indicators such as Composite Reliability (CR), Average Variance Extracted (AVE), all

demonstrating robust measurement model (Hair Jr. et al. 2019).

Table 1: Measurement model

Effort Expect (EE)	**0.887**	**0.913**	**0.607**
SI	0.942	0.954	0.573
FC	0.773	0.847	0.527
ATT	0.800	0.910	0.716
BI	0.946	0.958	0.791
SSs MP	0.819	0.916	0.845

Table 2 representing the discriminant validity constructs (Fornell-Larcker criterion and AVE) for each construct met all the thresholds (Fornell and Larcker 1981).

Table 2: Discriminant validity through Fornell-Larcker criterion

Constructs	AR	ATT	BI	EE	FC	ISSs MP	PP	SI	TE	UB	VU
AR	**1.000**										
ATT	0.094	**0.846**									
BI	0.134	0.479	**0.889**								
EE	0.263	0.664	0.460	**0.779**							
FC	0.158	0.605	0.562	0.692	**0.726**						
ISSs MP	0.197	0.130	0.404	0.241	0.247	**0.919**					
PP	0.082	0.724	0.505	0.613	0.526	0.224	**0.798**				
SI	0.197	0.251	0.353	0.252	0.313	0.726	0.335	**0.757**			
TE	0.034	0.096	0.211	0.058	0.118	0.321	0.152	0.305	**1.000**		
UB	0.083	0.252	0.397	0.243	0.317	0.150	0.241	0.200	0.074	**1.000**	
VU	0.034	0.021	0.108	0.016	0.105	0.033	0.000	0.005	0.042	0.125	**1.000**

Other indicators such as Heterotrait-Monotrait ratio of correlations (HTMT) assessed discriminant validity (degree to which a one construct differs from other constructs) (Hair et al. 2017). Generally, all indicators showed satisfactory threshold.

Evaluation of the structural model

Path and moderating analysis

Table 3 reports path coefficients for the structural equation model, providing insights into the strength and significance of relationships between variables. Notably, the path from PP to BI is statistically significant ($\beta = 0.183$, SD = 0.092, t = 1.993, p = 0.046*), supporting the hypothesis and explaining approximately 2.3 per cent of the variance in BI. Conversely, the path from EE to BI is non-significant ($\beta = 0.010$, SD = 0.077, t = 0.130, p = 0.897), indicating insufficient evidence to support this relationship. SI and FC exhibit significant positive relationships with

BI (β = 0.143, SD = 0.058, t = 2.466, p = 0.014*; β = 0.299, SD = 0.077, t = 3.870, p = 0.000**), supporting their impact on BI. In contrast, the path from FC to Use Behavior (UB) is non-significant (β = -0.135, SD = 0.090, t = 1.510, p = 0.131), indicating an unsupported relationship. Effect sizes (f-squared) provide additional context, with large effects observed for BI to UB (f^2 = 0.084) and UB to Indigenised SSs MP (f^2 = 0.164), denoting substantial practical significance. These results contribute valuable information regarding the strength and directionality of associations within the model, adhering to significance levels and effect size classifications. Table 3 also presents the detailed moderated path coefficients. Notably, paths such as "AR x PP -> BI" and "AR x FC -> BI" show statistically unsupported relationships (p > 0.05), suggesting that the associations between AR and behavioural intention ("BI") through PP and FC are not significant. Conversely, the path "ATT x SI -> BI" reveals a significant relationship (β = -0.134, SE = 0.063, z = 2.149, p = 0.032), signifying that the impact of attitudes ("ATT") on behavioural intention ("BI") is mediated by SI. Meanwhile, the moderated path "TE x FC -> BI," although indicating a potential moderation effect, does not reach statistical significance (p = 0.078). Additionally, the path VU-DT x SI -> BI is examined, revealing a path coefficient of -0.043 (SE = 0.058, z = 0.753, p = 0.452). This denotes a non-significant relationship (p > 0.05) between VU-DT and behavioural intention ("BI") when mediated by SI.

Table 3: Path Coefficient

Paths	Beta	Std dev	T-values	P-values	Decision	f-squared
PP -> BI	0.183	0.092	1.993	0.046*	Supported	0.023$
EE -> BI	0.010	0.077	0.130	0.897	Unsupported	0.001$
SI -> BI	0.143	0.058	2.466	0.014*	Supported	0.023$
FC -> BI	0.299	0.077	3.870	0.000 **	Supported	0.072$$
FC -> UB	-0.135	0.090	1.510	0.131	Unsupported	0.015$
AR x PP -> BI	0.022	0.075	0.289	0.772	Unsupported	0.001$
AR x EE -> BI	0.080	0.083	0.965	0.334	Unsupported	0.003$
AR x SI -> BI	0.072	0.062	1.169	0.242	Unsupported	0.008$
AR x FC -> BI	-0.093	0.106	0.872	0.383	Unsupported	0.184$$$
ATT x EE -> BI	0.048	0.097	0.494	0.621	Unsupported	0.022$
ATT x SI -> BI	-0.134	0.063	2.149	0.032*	Supported	0.267$$$
ATT x FC -> BI	-0.050	0.062	0.812	0.417	Unsupported	0.027$
TE x EE -> BI	0.008	0.091	0.091	0.928	Unsupported	0.089$$
TE x SI -> BI	0.066	0.071	0.942	0.346	Unsupported	0.308$$$
TE x FC -> BI	-0.153	0.087	1.762	0.078	Unsupported	0.129$$$
VU-DT x SI -> BI	-0.043	0.058	0.753	0.452	Unsupported	0.072$$
BI -> UB	-0.320	0.098	3.272	0.001**	Supported	0.084$$
UB -> ISSs MP	-0.150	0.063	2.383	0.017*	Supported	0.164$$$

**Significant at p<0.05; ** significant at p<0.001*
$$$Large effect size; $$ Medium effect; $ Small effect.

Further assessment was conducted specifically R-squared (R^2) and adjusted R-squared (R^2a),

for endogenous constructs within the structural equation model as signed in Figure 1. The R^2 value represents the proportion of variance in the dependent variable explained by the independent variables, while the adjusted R^2 considers model complexity. For the endogenous construct Behavior Intention (BI), R^2 = 0.472 and R^2a = 0.428, indicating that approximately 47.2 per cent of the variance in behavioural intention is explained by the model, adjusted for complexity. Indigenised SSs MP has R^2 = 0.022 and R^2a = 0.019, suggesting that only about 2.2 per cent of the variance in this construct is accounted for by the model. Use behaviour (UB) has R^2 = 0.171 and R^2a = 0.158, indicating that approximately 17.1 per cent of the variance in use.

Mediating effects

The mediating effects were analysed. Total indirect effects in Table 4 were examined for various paths, with corresponding betas (β), standard deviations (SD), T-values, and p-values. Notably, the Age variable did not show significant total indirect effects on indigenised SSs MP (β = -0.004, p = 0.695) and use behaviour (β = 0.011, p = 0.594). ATT demonstrated a significant positive total indirect effect on indigenised SSs MP (β = 0.005, p = 0.413), but not on use behaviour (β = -0.035, p = 0.310). FC exhibited a significant total indirect effect on the Age range -> use behaviour path (β = -0.096, p = 0.009), supporting its mediating role. Specific indirect effects were also explored, revealing, for instance, unsupported effects of age range on performance expect PP -> behaviour intention BI -> use behaviour -> indigenised SSs MP. Furthermore, the moderating effect of attitude ATT x social Influence SI -> behaviour intention BI -> use behaviour was supported (β = 0.043, p = 0.082). Total effects highlighted the comprehensive impact of variables on endogenous constructs. Notable findings included the significant negative total effect of Age range on behaviour intention BI (β = -0.035, p = 0.576) and the substantial total effect of facilitating conditions FC on Use Behaviour (β = -0.231, p = 0.004).

Table 4: Total indirect effects

Paths	Beta	Std dev	T -Value	P -Value	Decision
AR-> ISSs MP	-0.004	0.011	0.392	0.695	Unsupported
AR-> UB	0.011	0.021	0.534	0.594	
ATT -> ISSs MP	0.005	0.006	0.819	0.413	
ATT -> UB	-0.035	0.035	1.016	0.310	
BI -> ISSs MP	0.048	0.030	1.594	0.111	
EE -> ISSs MP	0.000	0.005	0.103	0.918	
EE -> UB	-0.003	0.026	0.124	0.902	
FC -> ISSs MP	0.035	0.019	1.784	0.074	

Paths	Beta	Std dev	T -Value	P -Value	Decision
FC -> UB	-0.096	0.037	2.617	0.009	Supported
PP -> ISSs MP	0.009	0.008	1.143	0.253	Unsupported
PP -> UB	-0.059	0.034	1.712	0.087	
SI -> ISSs MP	0.007	0.006	1.130	0.259	
SI -> UB	-0.046	0.026	1.787	0.074	
TE -> ISSs MP	0.004	0.004	1.027	0.304	
TE-> UB	-0.028	0.019	1.457	0.145	
VU-DT -> ISSs MP	0.003	0.004	0.800	0.424	
VU-DT -> UB	-0.023	0.021	1.089	0.276	
ARx SI -> ISSs MP	0.003	0.004	0.822	0.411	
AR x SI -> UB	-0.023	0.021	1.079	0.280	
ARx EE-> ISSs MP	0.004	0.005	0.739	0.460	
ARx EE -> UB	-0.026	0.029	0.896	0.371	
ARx PP -> ISSs MP	0.001	0.005	0.233	0.816	
ARx PP -> UB	-0.007	0.025	0.282	0.778	
ATT x PP -> ISSs MP	0.003	0.005	0.542	0.588	
ATT x PP -> UB	-0.017	0.026	0.655	0.512	
ATT x EE -> ISSs MP	0.002	0.006	0.385	0.700	
ATT x EE -> UB	-0.015	0.033	0.465	0.642	
ATT x SI -> ISSs MP	-0.006	0.005	1.210	0.226	
ATT x SI -> UB	0.043	0.025	1.741	0.082	
TE x EE -> ISSs MP	0.000	0.005	0.074	0.941	
TE x EE -> UB	-0.003	0.030	0.088	0.930	
TE x SI -> ISSs MP	0.003	0.004	0.712	0.477	
TE x SI -> UB	-0.021	0.024	0.892	0.372	
VU-DT x SI -> ISSs MP	-0.002	0.004	0.531	0.595	
VU-DT x SI -> UB	0.014	0.020	0.685	0.493	
ARx FC -> ISSs MP	-0.006	0.012	0.478	0.633	
ARx FC -> UB	0.030	0.036	0.833	0.405	
TE x FC -> ISSs MP	-0.007	0.006	1.143	0.253	
TE x FC -> UB	0.049	0.031	1.556	0.120	
ATT x FC -> ISSs MP	-0.002	0.004	0.594	0.552	
ATT x FC -> UB	0.016	0.021	0.748	0.454	

Summary

Generally, the result shows the effect size- f^2 – meaning effect of exogenous variables on endogenous variables (noting that f^2 </= 0.02, = small effect; f^2</=0.15 = medium effect, but a large effect = f^2 >/=0.35) (Hair et al. 2017; Chin, 1998). Results are shown in Table 4. The authors revealed that seven relations (ATT x SI to BI, AR x FC to BI, TE x SI to BI, ATT x EE to BI, ATT x FC to BI, TE x FC to BI, and UB to ISSs MP) had large effect sizes, four relations (FC to BI, TE x EE to BI, VU-DT x SI to BI and BI to UB) had medium effect sizes. In contrast, the other last seven had small effect sizes (Chin 1998). The significance level was tested using bootstrapping procedure at $p<0.05$ and $p<0.001$ (Garson 2016). According to the results, the

supported six paths (PP to BI, SI to BI, FC to BI, ATT x SI to BI, BI to UB, and UB to ISSs MP). Meanwhile, the other twelve paths between EE to BI, FC to UB, AR x PP to BI, AR x EE to BI, AR x SI to BI, AR x FC to BI, ATT x EE to BI, ATT x FC to BI, TE x EE to BI, TE x SI to BI, TE x FC to BI, VU-DT x SI to BI, were not supported. By implication these results emphasise the nuanced interplay of moderators within the structural model, offering valuable insights into the complex dynamics of the proposed theoretical framework. The inclusion of significant moderating effects underscores the importance of considering contextual variables in understanding the determinants of behavioural intention and technology use. The intricate interplay of moderators within the structural model is evident through the various paths and variables. The paths highlighted as "supported" emphasize the importance of specific moderators in influencing the relationships between certain predictor and outcome variables.

Importance performance map analysis of constructs and indicators

In the constructs importance-performance map analysis (IPMA) for predicting indigenised SSs MP (Table 5 and Figure 2), several constructs demonstrate noteworthy importance and

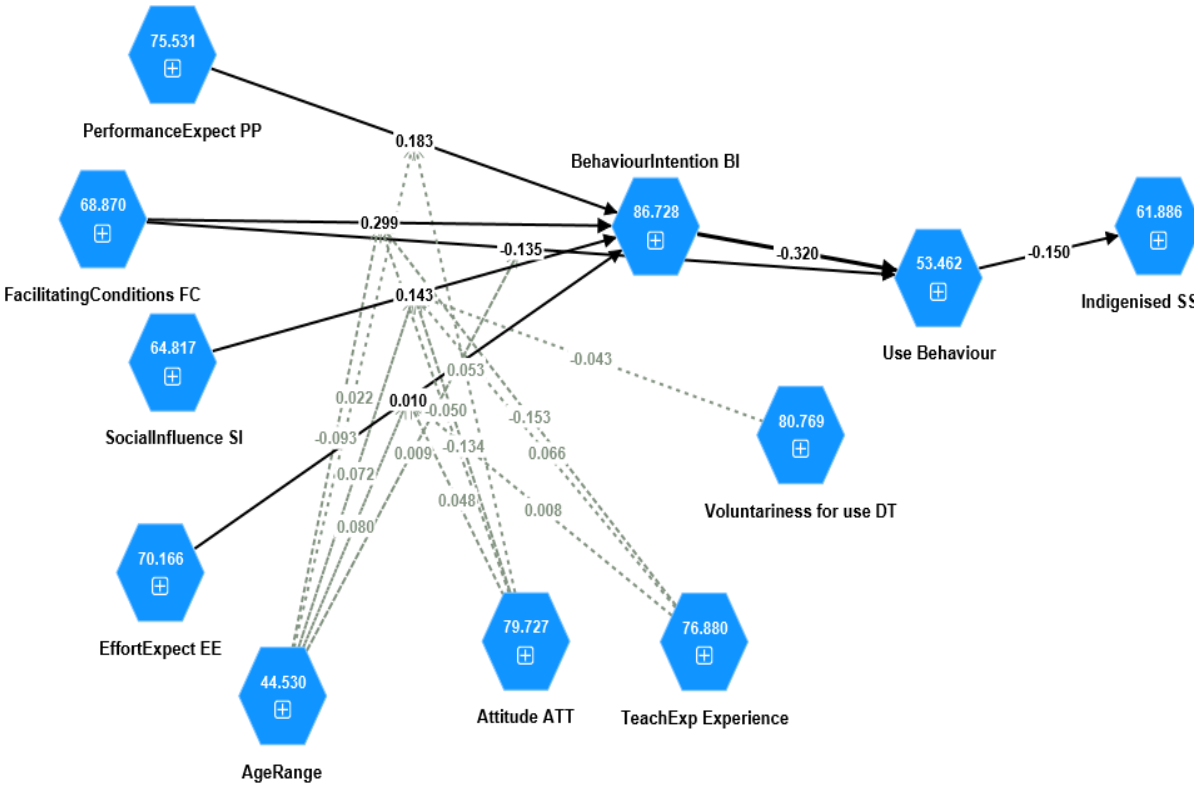

Figure 2: Importance performance map analysis (IPMA) of constructs

performance. Particularly, behaviour intention (BI) exhibits a substantial total effect (β = 0.048), signifying its significance in predicting Indigenised SSs MP, and a commendable

performance score (performance = 86.728), indicating its effectiveness in the model. Similarly, attitude (ATT) also proves influential (β = 0.005) with a high-performance score (performance = 79.727). Conversely, use behavior presents a negative total effect (β = -0.150) and a comparatively lower performance score (performance = 53.462), suggesting a substantial impact but relatively weaker predictive performance.

Table 5: Discriminant validity through Fornell-Larcker criterion Importance-performance map (constructs) -Indigenised SSs MP

Constructs	Total effects (importance)	Performance
Age Range (AR)	-0.004	44.530
Attitude (ATT)	0.005	79.727
BI	0.048	86.728
EE	0.000	70.166
FC	0.035	68.870
PP	0.009	75.531
SI	0.007	64.817
Teach Experience (TE)	0.004	76.880
Use Behaviour (UB)	-0.150	53.462
VU-DT	0.003	80.769

At the indicator level, specific indicators within behavior intention, such as intention to use the system, planning to use the system, predict to use the system, exhibit considerable importance (importance = 0.009) and strong performance (performance = 87.788), emphasising their crucial role in predicting Indigenised SSs MP. Conversely, the indicator use behaviour, representing use behaviour, demonstrates a negative total effect (β = -0.15) and a lower performance score (performance = 53.462), aligning with the construct-level findings.

In summary, these results underscore the pivotal role of constructs like behavior intention (BI) and attitude (ATT) in predicting indigenised SSs MP, while also pinpointing specific indicators contributing significantly to the overall predictive power. The negative total effect for Use Behavior suggests a notable impact that warrants further investigation or potential improvements in predictive performance.

DISCUSSIONS

This section discusses the research hypotheses through the structural model and importance-performance map analysis.

Pathway- PP -> BI: In terms of PP expectancy, this article found PP expectancy to significantly influence BI, with p values < 0.05. This means that PP positively influences the behavioural intention of mathematics teachers to collaborate and use digital technologies in

their day-to-day indigenisation on the SS-MP. Furthermore, H1. Teachers' PP expectancy significantly influences teachers' BI to work collaboratively using DT to indigenize the SSs MP moderated by AR was accepted. The results indicate that teachers' PP on BI to collaborate and adopt digital technologies in their daily teaching activities of indigenising the SS-MP can simplify the process depending on the teachers' age group. Pathway- EE -> BI: Regarding Effort Expectancy (EE), this article found EE not significantly influential on behavioural intention, with p values > 0.05. This means that EE does not positively influence the behavioural intention of maths teachers to collaborate and use digital technologies in their day-to-day indigenisation on the SS-MP. Furthermore, H2. EE of teachers positively affects the BI of teachers to work collaboratively with DT to indigenise the MP SS, moderated by AR, ATT and TE, which was not accepted. Thus, the results indicate that teachers' EE on behavioural intentions to collaborate and adopt digital technologies in their daily teaching activities of indigenising the SS-MP is not proven to simplify the process irrespective of the teachers' Age group, Attitude, and experience. Pathway- SI -> BI: Third, in terms of social influence (SI), this article found that SI influences behavioural intention, with p values < 0.05 significantly. This means SI positively influences the BI of the mathematics teachers to collaborate and use digital technologies in their day-to-day indigenization on the SS-MP. Furthermore, H3. SI factors significantly impact teachers' BI to work collaboratively using DT to indigenise the SS MP moderated by AR, ATT, TE, and VU-DT as accepted. Thus, the results indicate that teachers' SI on behavioural intentions to collaborate and adopt digital technologies in their daily teaching activities of indigenising the SS-MP can make the process easier depending on the teachers' Age group, Attitude, experience, and their voluntary use of DT in the SS MP. Pathway- FC -> BI: Moreover, regarding Facilitating Conditions (FC), this article found FC to be significantly influential on behavioural intention (BI), with p values < 0.01. This means that SI positively influences the mathematics teachers' behavioural intention (BI) to collaborate and use digital technologies in their day-to-day indigenisation on the SS-MP. Indicating that H4. The FCs positively affect the BI of the teachers to work collaboratively using DT (UB) to indigenise the MP of the SSs moderated by AR, ATT and TE was accepted. Thus, the results indicate that FC impacts behavioural intentions to collaborate and adopt digital technologies in their daily teaching activities of indigenising the SS-MP, making the process doable. Pathway- FC -> UB: Furthermore, in terms of facilitating conditions (FC), this article found that FC is significantly influential on behavioural intention (BI), with p values > 0.01. This means that FC does not positively influence behavioural (UB) mathematics teachers' use of digital technologies in their day-to-day indigenisation on the SS-MP. Indicating that H5. FCs positively affect teachers' usage (UB) of DT to indigenize the SSs MP was not accepted. Thus, the results indicate that

FC does not impact mathematics teachers to (UB) and adopt digital technologies in their daily teaching activities of indigenizing the SS-MP. Pathway-ATT x SI -> BI: The article discovered that only one was valid with Attitude (ATT) among the four pathways of moderating factors. Regarding the effect of teachers' ATT and social influence (SI) on teacher's behavioural intention (BI), this article found that ATT x SI is significantly influential on behavioural intention, with p values < 0.05. This means that ATT x SI positively influences the behavioural intention of mathematics teachers to collaborate and use digital technologies in their day-to-day indigenisation on the SS-MP. Thus, the results indicate that teachers' SI on behavioural intentions to collaborate and adopt digital technologies in their daily teaching activities of indigenising the SS-MP can make the process easier. Pathway-BI -> UB: Regarding BI, this article found BI influential on mathematics teachers' use of technology behaviour, with p values < 0.05. This means that BI positively influences the BI of mathematics teachers to collaborate and use digital technologies in their day-to-day indigenisation on the SS-MP. The results indicate that teachers' BI to collaborate and UB to adopt digital technologies in their daily teaching activities of indigenising the SS-MP can simplify the process. Pathway- UB -> ISSs MP: Regarding behavioural intention (UB), this article found UB to be significantly influential on the indigenization of Secondary School Mathematics pedagogy (ISSs MP), with p values < 0.05. This means that UB positively influences the mathematics teacher's day-to-day indigenisation of the SS-MP through digital technologies. In Brief, the results indicate that teachers' UB to adopt digital technologies in their daily teaching activities has the potential to simplify the indigenization of the SS-MP in developing African countries.

Drawn from the results, the literature review underscores the foundational role of the UTAUT in comprehending adoption of technology, particularly in educational fields (Venkatesh et al. 2003). Building on this theoretical framework, our hypotheses development aligns with UTAUT constructs, proposing relationships and moderating factors within the context of teachers collaboratively using digital technology to indigenise SSs MP. The IPMA provides valuable insights into the predictive power of various constructs. BI, a central UTAUT construct, emerges as a crucial predictor, with a substantial total effect ($\beta = 0.048$) and commendable performance (performance = 86.728) (Venkatesh et al. 2003). This underscores the significance of teachers' intentions in shaping the indigenisation of SSs MP. Additionally, attitude (ATT) proves influential ($\beta = 0.005$) with a high-performance score (performance = 79.727), emphasizing its importance in the model. However, use behavior (UB) exhibits a negative total effect ($\beta = -0.150$) and a relatively lower performance score (performance = 53.462). This suggests that while UB has a notable impact, further investigation or enhancements are needed for its predictive performance. Specific indicators within BI, such as

intention to use the technology, planning to use the technology, predict to use the system, play a crucial role in predicting indigenised SSs MP, further highlighting the nuanced contributions of individual components (Venkatesh et al. 2003).

Theoretical, policy and managerial implications

Theoretically, the findings revealed significance of behavioural intention (BI) and attitude (ATT) in predicting the successful indigenisation of mathematics teaching practices. Use behavior (UB) reveals potential for refinement in predictive performance. Policy implications do emphasise tailoring educational technology integration policies, with reference to infrastructure and supportive conditions. For managerial level, targeted professional development initiatives as well as positive social influences are crucial.

CONCLUSION

In conclusion, establishes that technology acceptance in the context of indigenising mathematics teaching practices is imperative. The results underscore the pivotal roles of BI and ATT while pointing to areas for refinement in UB.

REFERENCES

Adedeji, T. 2018. “Revitalizing Mathematics Education Preparation in Nigeria for National Development: An Innovative View.” *International Electronic Journal of Mathematics Education* 13(3): 315–320. https://doi.org/10.12973/iejme/3923.

Ajzen, I. 1991. “The Theory of Planned Behavior.” *Organizational Behavior and Human Decision Processes* 50: 179–211. https://doi.org/10.1016/0749-5978(91)90020-T.

AL-Nuaimi, Maryam Nasser, Omar Said Al Sawafi, Sohail Iqbal Malik, and Rana Al-Maroof. 2022. “Extending the unified theory of acceptance and use of technology to investigate determinants of acceptance and adoption of learning management systems in the post-pandemic era: A structural equation modeling approach.” *Interactive Learning Environments*: 1–27. https://doi.org/10.1080/10494820.2022.2127777.

Amora, J. T. and M. R. Fearnley. 2020. “Learning Management System Adoption in Higher Education using the Extended Technology Acceptance Model.” *Journal of Education* 8(2): 89–106. https://doi.org/10.22492/ije.8.2.05.

Bayaga, A. and A. du Plesssis. 2023. “Ramifications of the Unified Theory of Acceptance and Use of Technology (UTAUT) among Developing Countries’ Higher Education Staffs.” *Education and Information Technologies*: 1–17. https://doi.org/10.1007/s10639-023-12194-6.

Chin, W. W. 1998. “The partial least squares approach for structural equation modeling.” In *Modern methods for business research,* edited by G. A. Marcoulides, 295–336. Lawrence Erlbaum Associates Publishers.

Compeau, D. R. and C. A. Higgins. 1995. “Computer Self-Efficacy: Development of a Measure and Initial Test.” *MIS Quarterly* 19(2): 189–211.

Creswell, J. W. 2014. *Research Design: Qualitative, Quantitative, and Mixed Methods Approach*. Thousand Oaks, California, USA: SAGE Publications, Inc.

Davis, F. 1989. “Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information

Technology." *MIS Quarterly: Management Information Systems* 13(3): 319–339. https://doi.org/10.2307/249008.

Davis, F. D., R. P. Bagozzi, and P. R. Warshaw. 1992. "Extrinsic and Intrinsic Motivation to Use Computers in the Workplace." *Journal of Applied Social Psychology* 22(14): 1111–1132.

Donaldson, R. L. 2011. "Student Acceptance of Mobile Learning." PhD dissertation, Florida State University, Tallahassee.

Fishbein, M. A. and I. Ajzen. 1975. *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research*. Addison-Wesley.

Fornell, C. and D. F. Larcker. 1981. "Evaluating structural equation models with unobservable variables and measurement error." *Journal of Marketing Research* 18(1): 39–50. https://doi.org/10.2307/3151312.

Garson, G. D. 2016. *Partial Least Squares: Regression & Structural Equation Models*. Asheboro, NC: Statistical Publishing Associates.

Goddard, Y., R. Goddard, and M. Tschannen-Moran. 2007. "A Theoretical and Empirical Investigation of Teacher Collaboration for School Improvement and Student Achievement in Public Elementary Schools." *Teachers College Record* 109(4): 877–896

Hailegnaw, T. T. 2022. "Perceived Impact of Collaborative Partnerships on Student Teachers' Core Skills of the 21st Century: A Case of East-Central and Southern Ethiopia." *East African Journal of Education and Social Sciences* 3(4): 158–165. DOI: https://dx.doi.org/10.4314/eajess.v3i4.207.

Hair, J. F., G. T. M. Hult, C. M. Ringle, and M. Sarstedt. 2017. *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. Sage Publications.

Ho, C.-T. B., Y. H. D. Chou, and H. Y. Fang. 2016. "Technology Adoption of Podcast in Language Learning: Using Taiwan and China as Examples." *International Journal of e-Education, e-Business, e-Management, and e-Learning* 6(1): 1–12.

Jojo, Z. 2020. *Mathematics Education System in South Africa*. Intech Open. doi: 10.5772/intechopen.85325.

Khechine, H., P. Ndjambou, and S. Lakhal. 2016. "A Meta-Analysis of the UTAUT Model: 11 Years Later." *Canadian Journal of Administrative Sciences* 33(2): 138–152.

Killion, J. P. 2015. "High-Quality Collaboration Benefits Teachers and Students." *Journal of Staff Development* 36(5): 62–64.

Lavidas, K., V. Komis, and A. Achriani. 2022. "Explaining Faculty Members' Behavioral Intention to Use Learning Management Systems." *Journal of Computers in Education* 9(4): 707–725. https://doi.org/10.1007/s40692-021-00217-5/tables/5.

Munna, A. S. and M. A. Kalam. 2021. "Search Teaching and Search Learning Process to Enhance Search Teaching Effectiveness: A Literature Review." *International Journal of Humanities and Innovation (IJHI)* 4(1): 1–4. https://doi.org/10.33750/ijhi.v4i1.102.

Mutambara, D. and A. Bayaga. 2020. "Determinants of Mobile Learning Acceptance for STEM Education in Rural Areas." *Computers & Education* 28(6): 6485–6513. https://doi.org/10.1016/j.compedu.2020.104010.

Pagán, L. and A. Medina. 2021. "The Acceptance of Moodle's Learning Management System in Higher Institutions during the COVID-19 Pandemic." *INTED2021 Proceedings* 1: 8024–8034. https://doi.org/10.21125/INTED.2021.1620.

Rogers, E. M. 1995. *Diffusion of Innovations*. New York

Saka, A. O. 2021. "Can Teacher Collaboration Improve Students' Academic Achievement in Junior Secondary Mathematics?" *Asian Journal of University Education* 17(1): 33–46. https://doi.org/10.24191/ajue.v17i1.8727.

Sari, M. H. and E. Yüce. 2020. "Problems Experienced in Classrooms with Students from Different Cultures." *Journal on Efficiency and Responsibility in Education and Science* 13(2): 90–100. http://dx.doi.org/10.7160/eriesj.2020.130204.

Stelitano, L. 2018. "Collaborating for Educational Improvement: Exploring Cases of Teacher Collaboration for Policy Implementation from an Organizational Perspective." PhD Thesis, School of Education, University of Pittsburgh.

Sumarni, W. and S. Kadarwati. 2020. "Ethno-Stem Project-Based Learning: Its Impact on Critical and Creative Thinking Skills." *Jurnal Pendidikan IPA Indonesia* 9(1): 11–21.

Taylor, S. and P. A. Todd. 1995. "Understanding Information Technology Usage: A Test of Competing Models." *Information Systems Research* 6(2): 144–176.

Thompson, R. L., C. A. Higgins, and J. M. Howell. 1991. "Personal Computing: Toward a Conceptual Model of Utilization." *MIS Quarterly* 15(1): 124–143.

Vangrieken, K., C. Meredith, T. Packer, and E. Kyndt. 2017. "Teacher Communities as a Context for Professional Development: A Systematic Review." *Teaching and Teacher Education* 61: 47–59. https://doi.org/10.1016/j.tate.2016.10.001.

Venkatesh, V. and F. D. Davis. 2000. "Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies." *Management Science* 46(2): 186–204. https://doi.org/10.1287/MNSC.46.2.186.11926.

Venkatesh, V., J. Y. L. Thong, and X. Xu. 2012. "Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology." *MIS Quarterly* 36(1): 157–178. https://doi.org/10.2307/30036540.

Venkatesh, V., M. G. Morris, G. B. Davis, and F. D. Davis. 2003. "User Acceptance of Information Technology: Toward a Unified View." *MIS Quarterly: Management Information Systems* 27(3): 425–478.