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The Design of an ICT Enabled Active Teaching and Learning Model for Use in Teacher Training Institutions in Uganda

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***Abstract**: In this paper, the author describes the theories behind the model that was designed in a study that was conducted in Eastern Region, Uganda. The paper provides examples of the teaching model based upon the model and illustrates the support systems required to facilitate the implementation of the model. The e-Model for Active Teaching and Learning to enhance the teaching and learning process utilizing technologies as a result of the growing use of technology over the past 10 years has been designed. The e-Model targets the teachers in a bid to improve the learning outcomes. The study design was a mixed method which employed qualitative and quantitative approaches and was conducted in the Eastern Uganda with a total population of 313 participants from the 6 participating teacher training colleges. The findings demonstrated a substantial link between teaching methodologies, ICT tools, and tools for active learning. Using the data collected on the relationship between aspects an e-Model for Active Teaching and Learning (e-MATL), to support teacher educators in effective use of technology to enhance active learning strategies.*

*Keywords**: Active Learning**, Active Teaching**, ICTs Model**, Learner engagement**, Teacher Training Institutions*

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1. Introduction

An instructional strategy that involves the use of technological tools and resources to improve the teaching and learning process is referred to as an ICT (Information and Communication Technology) model of teaching (Sheppard, 2020). It focuses on how different digital tools, like computers, interactive whiteboards, tablets, and online platforms, can be used in the classroom. By utilizing technology to promote and simplify the learning of knowledge and skills, this model encourages student participation, teamwork, and critical thinking. An ICT model of teaching, according (Ghavifekr et al., 2014), gives teachers the ability to create and present dynamic lessons that accommodate various learning styles, give prompt feedback, and extend learning outside of the four walls of the physical classroom.

A study conducted in secondary schools in Mukono district in Uganda showed that despite having few resources, schools are spending a lot on ICT. Accordingly, there are three main reasons for which teachers use ICT in the classroom: administrative (86%), entertaining (45%), and pedagogical (45%). ICT is reportedly used heavily by administrators at some schools to draw pupils and boost revenue (Newby et al., 2013). This implies that the integration of technology in the teaching and learning process in secondary schools in Uganda has not received the attention it deserves. This could probably be due to lack of technical skills by the teachers, a situation that could emanate from the teacher training. This study therefore focused on development of the e-model that could support active teaching and learning in Teacher Training Institutions (TTIs).

A model is a simplified representation or abstraction of a system, concept, or phenomenon, serving as a tool for understanding, analyzing, or predicting the behavior, relationships, or characteristics of the thing being modeled (Bryce et al., 2016). A teaching model is a structured framework that guides teachers in planning, delivering, and assessing instruction by outlining instructional goals, content sequencing, strategies, and assessment methods, thus creating an effective learning environment and promoting student engagement across different subjects and educational contexts (OECD, 2009). Active learning, according to Bonwell and Eison (1991) is a method of instruction that necessitates that learners participate in tasks that encourage their active involvement in the learning process. It is a strategy that emphasis learners' active participation rather than a passive role in acquiring knowledge.

This study aimed at examining the influence of ICT practices on active teaching and learning and designs an ICT-enabled model to enhance active teaching and learning in teacher training institutions in Eastern Uganda and it was guided by the following objectives:

1. To examine the extent to which ICT practices influence active learning strategies in Teacher Training Institutions in Eastern Uganda.
2. To examine the extent to which teaching strategies influence active learning strategies in Teacher Training Institutions in Eastern Uganda.
3. To design an ICT enabled Active Teaching and Learning Model for use in Teacher Training Institutions in Eastern Uganda.
4. To evaluate the usefulness, usability, and sustainability of the designed ICT model to enhance active teaching and learning strategy in Teacher Training Institutions in Uganda.

There is evidence that the use of ICT teaching strategies influences teaching and learning in teacher training institutions in Uganda. Therefore, in this study, the researcher collected data for objective one: to establish the extent to which ICT influences teaching and learning in the TTIs. Based on the findings for this objective, the researcher started working on the process of designing an ICT-enabled model to enhance active teaching and learning in TTIs in Uganda.

2. Literature Review

Several scholars define active teaching and learning differently; This fosters an atmosphere for active teaching and learning, which emphasizes the learner playing a proactive part in acquiring new skills or knowledge (Becker et al., 2015).

The authors; Hackathorn et al., (2011), Konopka et al., (2015b), Andres & Andres (2017) while discussing Active Teaching they emphasized the nature of active teaching other than the strategy a teacher can use to support the process to engage learners while using ICT and this study focused on how this gap can addressed. For any learning approach to improve the quality of education it must have an aspect of Learner-centeredness, this has been evident in this study. Metacognition is an essential component that often goes unnoticed but provides the connection between activity and learning (Brame, 2015)

Information and Communication Technology has also been defined in different always depending on context, time and situation. UNESCO defines ICTs as a combination of different informatics of technologies to actively engage learners. According to Thakur (2016), ICT practices, on the other hand, are a collection of technologies that can be used in a number of ways to enhance teaching and learning. Blogging, Integrated

Learning Modules, podcasts, wikis, browser enhancement, e-learning, M-learning, and U-learning are some of the emerging learning technologies, (Muianga, 2019) are some of the examples of technologies. In the teaching-learning process, these have advanced quickly but still using different pace.

ICT integration, according to Ghavifekr and Rosdy (2015), is the use of ICT by classroom teachers to introduce, reinforce, extend, enhance, assess, and remediate students' comprehension of learning objectives. Effective ICT integration in education requires a teacher, and it won't happen if you just send your students to the computer lab to develop ICT skills while you take care of other things,(Ghavifekr & Rosdy, 2015).The learners of today cannot be taught the way the teachers were teaching yesterday and achieve learning outcomes. ICT does not replace the teacher but facilitates the teaching process and makes teaching interesting.

According to UNESCO (2015), action towards universal access to education and lifelong learning must be taken seriously. The use of ICT to improve active teaching and learning aids the graduate in gaining knowledge and abilities that will help them in the workplace. The teachers must be competent enough to equip the learners with lifelong skills which is the demand of today's market.

Although there has been various studies on the use of technology in education, a big number of teachers are still struggling to use technology effectively in teaching. This study was motivated and benchmarked on three models already existing models: TPACK, SMAR and AIDS models. TPACK, which stands for Technological, Pedagogical, Content and knowledge model was developed by Mishra and Koehler (2006). These authors posited in the preparation process; a teacher should have TPACK model aspects integrated. They also argue that thoughtful pedagogical uses of technology require the development of a complex, situated form of knowledge that we call Technological Pedagogical Content Knowledge (TPCK). They posit that the complex roles of, and interplay among, three main components of learning environments which include content, pedagogy, and technology. They argue that this model has much to offer to the teacher on the discussions of technology integration at multiple levels: theoretical, pedagogical, and methodological.

For the learners to acquire lifelong skills, innovative learning and teaching must provide the room for learner full engagement (Goff, 2012; Istance & Dumont, 2010; Schreurs & Dumbraveanu, 2014). This allows learners active involvement in learning through inquiry pedagogical approaches. An innovative learning context is important for all learners in learning in learner-centred approach. Such context, which accommodates learner-centred approach, should be able to facilitate: Competence-based learning; co- operative learning; service learning; home-school partnerships; personalized, relevant, and contextualized learning; and open-walled learning (Goff, 2012; Istance & Dumont, 2010).

3. Methodology

The study used both cross-sectional survey and explanatory research designs. Cross-sectional studies are characterized by their examination of data at a specific moment in time, without following participants longitudinally.

The selection of participants in these studies is typically based on specific variables of interest. While commonly employed in developmental psychology, cross-sectional studies are also widely utilized in various other fields, such as social science and education. They offer valuable insights into the relationships between variables and allow researchers to capture a snapshot of a population's characteristics or behaviors. The cross-sectional survey design was preferred since it provides a snapshot of how things are at a specific time and allows the use of many variables at once (Kelly & Cordeiro, 2020). In this study, the survey method helped in measuring variables and examining relationships among variables, as recommended by (Orel, 2019).

On the other hand, explanatory research can be defined as a model focused on understanding cause-and-effect relationships and exploring patterns and trends in existing data that have not been previously examined. Due to its emphasis on investigating causality, explanatory research is often categorized as a form of causal research. The researcher used explanatory research in the study on Information and Communication Technology Practices and Active Learning in Selected Teacher Training Institutions in the Eastern Region to gain a deeper understanding of the relationship between ICT practices and active learning approaches. Explanatory research allowed the researcher to analyze patterns and explore the underlying mechanisms behind the integration of ICT in educational practices. By employing this type of research design, the researcher formulated, tested hypotheses, and provided insights into how and why ICT is being utilized in learning. For instance, using the explanatory research design, the researcher explored the underlying mechanisms and reasons behind the integration of the e-MATL in promoting active learning approaches.

The utilization of both cross-sectional survey and explanatory research designs was important for the researcher in conducting the study on ICT Practices and Active Learning in Selected Teacher Training Institutions in the Eastern Region. The cross-sectional survey aided

comprehensive data collection on the characteristics, behaviors, and attitudes of the population involved. Explanatory research design enabled exploration of causal relationships and understanding of the underlying mechanisms of ICT integration and its impact on active learning approaches. The integration of these designs enhanced the validity of the study's findings and provided an evidence base for a need to change the implementation of teaching and learning process.

To develop a thorough knowledge of the efficacy and impact of the ATL, a mixed-methods research technique was used in the study. A mixed-methods strategy that combined quantitative and qualitative data allowed for a more comprehensive understanding of the study question (Creswell, 2007). In the context of designing a technology-enabled ATL model, a quantitative approach was utilized to collect statistical data on the necessary model characteristics and this involved the use of a closed questionnaire (Shannon-Baker, 2016). To complement the quantitative data, qualitative methods such as open-ended interviews and focus group discussions were employed to confirm and provide meaning to the quantitative findings (Shannon-Baker, 2016).

The combination of quantitative and qualitative approaches in a mixed methods design overcomes the limitations of relying solely on quantitative research. While quantitative studies generalize results, qualitative studies focus on specific contexts and aid in interpreting data (Shannon-Baker, 2016; Firmanto et al., 2020). Embracing both epistemological and methodological pluralism is essential for effective research (Firmanto et al., 2020). Qualitative techniques, as recommended by Creswell (2007), were used to explore issues related to the participants' attitudes, perceptions, and views. The study employed Participatory Action Research (PAR) methods, a collaborative approach that bridges the gap between research and practice, to address the research objectives and questions (McIntyre, 2011; Morton & MacArthur, 2002; Guerin, 2011). PAR methods, including interviews, focus group discussions, and observation, facilitated the collection of views and the evaluation of intervention actions aimed at improving the identified problem (McIntyre, 2011).

The qualitative method was employed alongside other quantitative methods for triangulation and to enhance the quality of data (Gyamfi, 2017) . Participatory Action Research (PAR) is distinct from other educational research approaches as it emphasizes reflection, data collection, and action. In this study, the qualitative method helped provide depth to the collected data and involved the active engagement of those taking action to improve the teaching situation (Baum, MacDougall, & Smith, 2006). All the objectives of this study adopted a mixed-methods approach, integrating both qualitative and quantitative elements. The qualitative component involved interviews or focus groups to gather insights from stakeholders regarding their needs, preferences, and expectations for an ICT-enabled Active Teaching and Learning Model. The quantitative component utilized a questionnaire to gather data on specific aspects of the model, such as usability, effectiveness, and potential impact on active teaching and learning strategies.

Only 6 Primary Teachers' Colleges in Eastern Uganda participated in this study. The total population was 1159, out of which only 313 participants were selected. Of these, 297 participated in a quantitative study while 16 participated in a qualitative study. A systematic random and purposive sampling was done to get the respondents. A semi structured questionnaire, interviews, focus group discussion, and document review were used for data collection. For knowledge to be transferred in a complete cycle it requires a network model to facilitate that exchange directly. This at sometimes can be inaccessible through clear knowledge. The connection between people to person calls for the use ICT to exchange knowledge, and information. Therefore, the network model helps when clear knowledge has not been understood by the end of the intended user of knowledge. In such a situation it requires direct communication and social interactions among individuals.

The calculated value for data validity was 0.76 (76%) which implied the validity of instruments employed. Reliability Test value of not less than 0.7 for any Likert scale construct was acceptable. According to Sekeran (2003), any values between 0.5 and 0.8 are adequate to accept internal consistency, while values less than 0.5 are removed. Therefore, this study adopted the lowest alpha as 0.5 upwards.

Mixed-methods approach that involved the integration of both qualitative and quantitative were effected allowing for a comprehensive analysis of the research phenomenon. The qualitative and quantitative findings were compared to identify areas of convergence or divergence, thereby enhancing the overall understanding of the topic under investigation. By comparing the qualitative and quantitative findings, the study aimed to achieve a comprehensive analysis of the research phenomenon. This integration of data allowed for a more nuanced interpretation and a holistic understanding of the relationship between ICT practices and active learning in the context of Teacher Training Institutions. Through the synthesis of results from both qualitative and quantitative sources, the study enhanced the validity and reliability of its conclusions. The connections and implications that emerged from this integration shed light on the complex dynamics and relationships within the research context, providing a solid evidence base and ensuring the overall quality and credibility of the study (Goundar, 2012).

In carrying out this research, ethical clearance from the Directorate of Graduate Studies, then to the ethics committee of TASO Mulago, and the researcher proceeded to the Uganda National Council of Science and Technology. Informed consent was obtained from the respondents.

4. Results and Discussion

This section has been presented and concluded according to the objective it relates to

4.1 Relationship between ICT practices and AT

This sub section introduces the relationship between ICT practices (ICT tools, skills, methods/techniques) and how it facilitates teacher educators through a pedagogical process to achieve active learning in a class. Whereas it is possible to have ICT practices directly influencing Active teaching strategies, it is not sustainable since the teaching will lack teaching methods and techniques to guide in teaching and learning. The illustration in Figure 1. Shows the relationship.

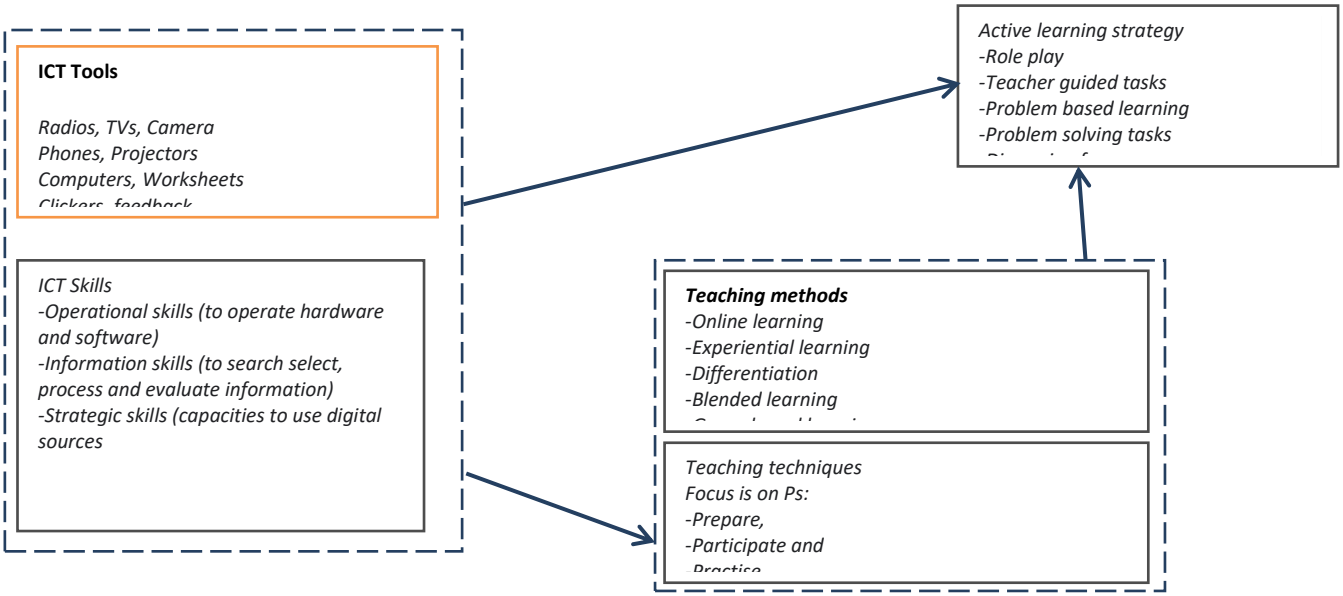


Figure 1: Relationship between ICT practices and ATL

4.2 Structural Equation Modeling (Path Analysis) *To understand the actual relationship between ICT strategies, Active Teaching and Active Learning*

To understand the actual relationship between ICT strategies, Active Teaching and Active Learning, Path analysis was done as shown in Figure 1. This path analysis follows the current study conceptual framework to show the strength in relationship. Findings in Figure 1 & Table 1 show that there is a relationship between ICT tools, ICT skills and Teaching methods / techniques and the results are statistically significant. They also show that there is a significant positive relationship between ICT skills and Teaching techniques. The results further confirm a positive relationship between Teaching methods, Teaching Techniques and ICT tools which result in Active Learning strategies and the results are statistically significant. There is also a very small positive covariance between ICT skills and ICT tools.

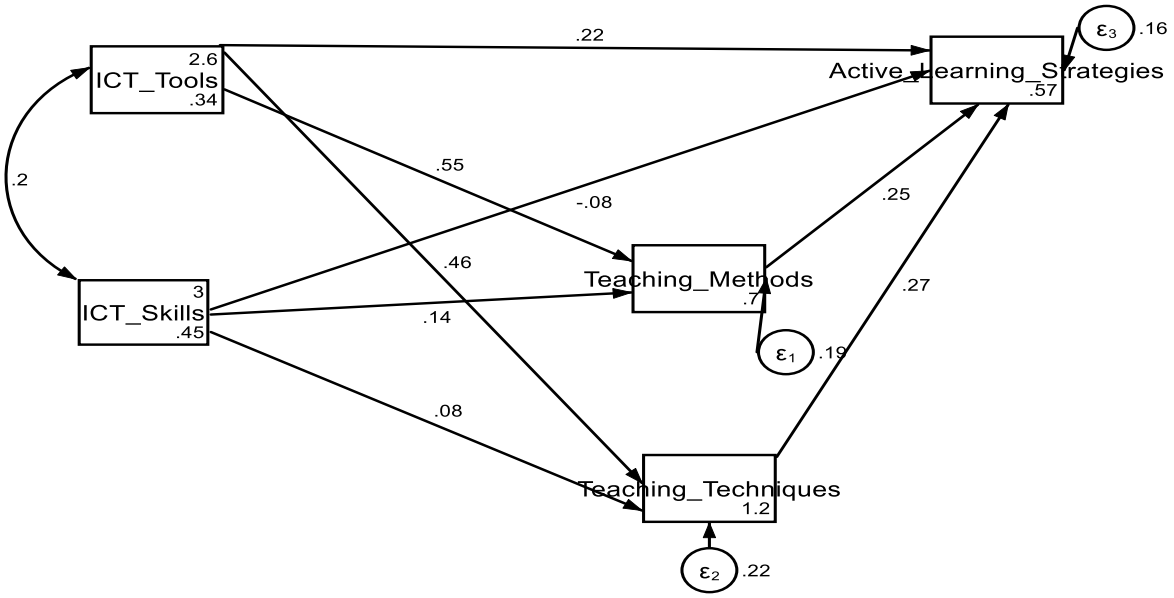


Figure 2: Full model showing the relationship between ICT practices and ATL

Source: Field Data (2022)

Table 1: Full Model Path Coefficients showing the relationship between ICT Practices, Active Teaching and Active Learning.

Fit statistic	Value	Description
Likelihood ratio		
chi2_ms(1)	58.702	model vs. saturated
p > chi2	0.000	
chi2_bs(9)	479.085	baseline vs. saturated
p > chi2	0.000	
Population error		
RMSEA	0.445	Root mean squared error of approximation
90% CI, lower bound	0.352	
upper bound	0.545	
pclose	0.000	Probability RMSEA <= 0.05
Information criteria		
AIC	2092.950	Akaike's information criterion
BIC	2162.809	Bayesian information criterion
Baseline comparison		
CFI	0.877	Comparative fit index
TLI	-0.105	Tucker-Lewis index
Size of residuals		
SRMR	0.077	Standardized root mean squared residual
CD	0.554	Coefficient of determination

Source: Field Data (2022)

4.3 Reduced Model

Findings in Table 2 reveal a diversity of goodness of fit test statistics with result that shows unacceptable fit for the hypothesized SEM based on the Root mean squared error of approximation (RMSEA) (RMSEA = 0.445 > 0.10), Standardized root mean squared residual (SRMSR) (SRMSR = 0.077 > 0.05).

Besides the Comparative Fit Index (CFI) of 0.877<0.9, illustrates unacceptable fit of the model in predicting Active learning since it is less than 0.90. This improved the goodness of fit paths that were not statistically significant therefore were dropped from model as shown in Figures 3 and Table 2.

Table 2: Goodness of fit for the hypothesized reduced model

	OIM Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Structural						
Active_Teaching_~s						
ICT_Teaching_Pra~s	.6120565	.0444643	13.77	0.000	.5249081	.699205
_cons	.8994773	.1253389	7.18	0.000	.6538177	1.145137
Active_Learning_~s						
Active_Teaching_~s	.5788026	.059504	9.73	0.000	.4621769	.6954283
ICT_Teaching_Pra~s	.0935714	.0580559	1.61	0.107	−.020216	.2073589
_cons	.4974465	.1382278	3.60	0.000	.2265251	.768368
var(e.Active_Teach~s)	.1606982	.0132995			.136636	.1889979
var(e.Active_Learn~s)	.1661445	.0137502			.1412668	.1954033

Source: Field Data (2022)

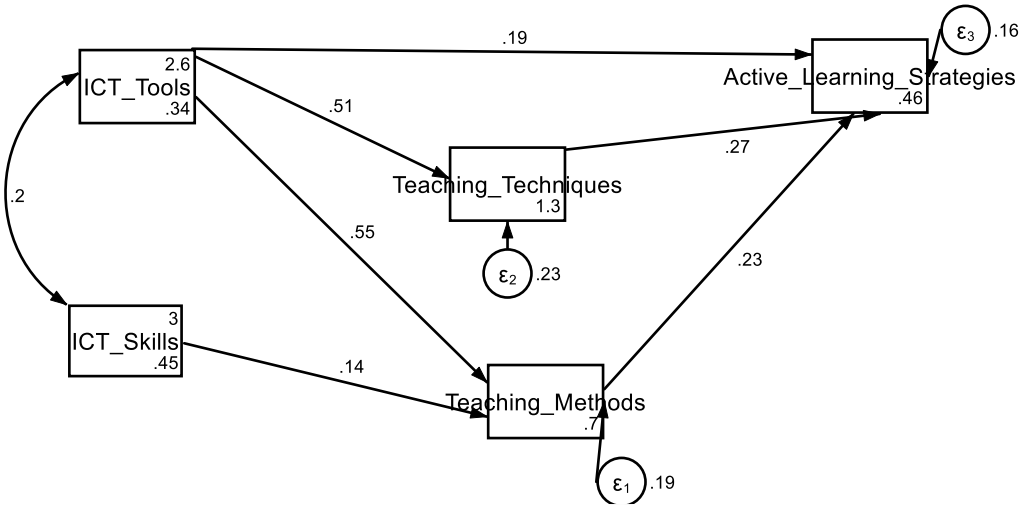


Figure 3: Goodness of fit for the hypothesized reduced model

Table: 3 Goodness of fit for the hypothesized reduced model

	OIM Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Structural						
Active_Teaching_~s						
ICT_Teaching_Pra~s	.6120565	.0444643	13.77	0.000	.5249081	.699205
_cons	.8994773	.1253389	7.18	0.000	.6538177	1.145137
Active_Learning_~s						
Active_Teaching_~s	.5788026	.059504	9.73	0.000	.4621769	.6954283
ICT_Teaching_Pra~s	.0935714	.0580559	1.61	0.107	-.020216	.2073589
_cons	.4974465	.1382278	3.60	0.000	.2265251	.768368
var(e.Active_Teach~s)	.1606982	.0132995			.136636	.1889979
var(e.Active_Learn~s)	.1661445	.0137502			.1412668	.1954033

Source: Field Data (2022)

4.4 Goodness of fit for the reduced model

Generally, the reduced model in Figure 3 is a poor fit. The Root mean squared error of approximation (RMSEA) (RMSEA = 0.266 > 0.10), Standardized root mean squared residual (SRMSR) (SRMSR = 0.08 > 0.05). Besides the Comparative Fit Index (CFI) of 0.868<0.9, illustrates unacceptable fit of the model in predicting Active since it is less than 0.90.

To improve the goodness of fit for the model, the researcher combined the ICT skills and ICT tools to ICT Teaching Practices and Teaching Methods and Teaching Techniques to Active Teaching Practices as shown in Figure 4 and Table 3. The mentioned figure and table show the relationship between ICT Teaching Practices, Active Teaching strategies and Active learning strategies. They further show the direct relationship between ICT teaching practices and Active learning strategies plus the mediating role played by Active teaching strategies.

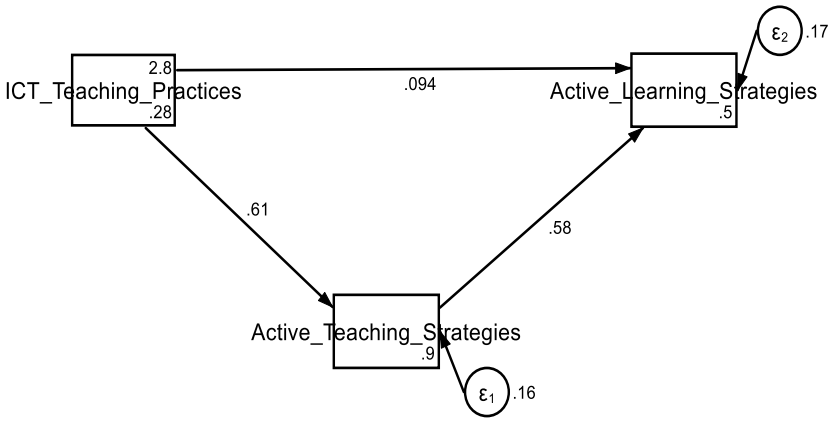


Figure 4: Reduced Model showing the Relationship between ICT Practices, Active Teaching and Active Learning

Source: Field Data (2022)

Table 4: *Reduced Model Path Coefficients showing the Relationship between ICT Practices, Active Teaching and Active Learning*

Fit statistic	Value	Description
Likelihood ratio		
chi2_ms(0)	0.000	model vs. saturated
p > chi2	.	
chi2_bs(3)	294.029	baseline vs. saturated
p > chi2	0.000	
Population error		
RMSEA	0.000	Root mean squared error of approximation
90% CI, lower bound	0.000	
upper bound	0.000	
pclose	1.000	Probability RMSEA <= 0.05
Information criteria		
AIC	1068.605	Akaike's information criterion
BIC	1094.343	Bayesian information criterion
Baseline comparison		
CFI	1.000	Comparative fit index
TLI	1.000	Tucker-Lewis index
Size of residuals		
SRMR	0.000	Standardized root mean squared residual
CD	0.399	Coefficient of determination

Source: Field Data (2022)

Tables 5 and Table 6 results show that ICT practices significantly influence Active Teaching Strategies (β =0.6121, p = 0.000) and ICT practices does not directly influence Active learning (β =0.0936, p = 0.107>0.05). However, the results indicate that Active Teaching has a positive relationship with Active Learning

Table 5: *Final Model showing the Relationship between ICT strategies, Active Teaching and Active Learning*

Fit statistic	Value	Description
Likelihood ratio		
chi2_ms(0)	0.000	model vs. saturated
p > chi2	.	
chi2_bs(3)	294.029	baseline vs. saturated
p > chi2	0.000	
Population error		
RMSEA	0.000	Root mean squared error of approximation
90% CI, lower bound	0.000	
upper bound	0.000	
pclose	1.000	Probability RMSEA <= 0.05
Information criteria		
AIC	1068.605	Akaike's information criterion
BIC	1094.343	Bayesian information criterion
Baseline comparison		
CFI	1.000	Comparative fit index
TLI	1.000	Tucker-Lewis index
Size of residuals		
SRMR	0.000	Standardized root mean squared residual
CD	0.399	Coefficient of determination

Source: Field Data (2022)

Table 6: *Final Model showing the Relationship between ICT strategies, Active Teaching and Active Learning*

	OIM Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Structural						
Active_Teaching_Strategies						
ICT_Teaching_Practices	.6120565	.0444643	13.77	0.000	.5249081	.699205
_cons	.8994773	.1253389	7.18	0.000	.6538177	1.145137
Active_Learning_Strategies						
Active_Teaching_Strategies	.6389663	.0465449	13.73	0.000	.5477399	.7301927
_cons	.6004682	.1231052	4.88	0.000	.3591864	.84175
var(e.Active_Teaching_Strategies)	.1606982	.0132995			.136636	.1889979
var(e.Active_Learning_Strategies)	.1676226	.0138725			.1425235	.1971417

Source: Field Data (2022)

Strategies significantly influence Active Learning (β =0.5788 p = 0.000). Findings in Table 6 reveal a diversity of goodness of fit test statistics. This result shows an acceptable fit for the Reduced SEM based on the Root mean squared error of approximation (RMSEA) (RMSEA = 0.000 <0.10), Standardized root mean squared residual (SRMSR) (SRMSR = 0.000 < 0.05). Besides the Comparative Fit Index (CFI) of 1.0, in addition, illustrates an acceptable fit of the model since it is greater than 0.90.

The study attempted to improve the model by dropping the paths that were not statistically significant in the full SEM model resulting in a final SEM model. The estimates of the full SEM model were presented in Tables 5 & Table 6. These tables show that there is no direct relationship between ICT teaching practices and Active learning strategies and that this relationship is mediated by Active Teaching strategies. To achieve Active Learning strategy, ICT teaching practices must be enhanced to improve Active teaching strategies.

The final model (Figure 5) confirms a path from ICT Teaching Practices to Active teachings strategies and finally Active teaching strategies will help the teacher educators to be able to have an Active Learning class. The statistical data indicates that there is no direct path from ICT strategies to Active Learning Strategies. Table 6 findings reveal a diversity of goodness of fit test statistics which also shows an acceptable fit for the Reduced SEM based on the Root mean squared error of approximation (RMSEA) (RMSEA = 0.074 <0.10),

Standardized root mean squared residual (SRMSR) (SRMSR = 0.000 < 0.05). The Comparative Fit Index (CFI) of 0.995, in addition, illustrates an acceptable fit of the model in predicting Active Learning since it is greater than 0.90.The final model has an acceptable goodness of fit and it shows that the available ICT teaching practices must be enhanced to realize an improvement in Active Teaching Practices which later translates to Active Learning strategies.

4.5 Identification of ICT related issues for model design

To uncover ICT-related concerns that support the model's final design, descriptions and comparisons of different participants' perspectives on existing and needed ICT tools for active teaching and learning were conducted. The issues were categorized through creating code families and grouping them with similar attributes into broad categories as indicated in Figure 6. Participants also identified support systems needed from the exiting ICT tools in TTIs to support ATL.

After Figure 6, the participants listed the expected ICT tools in Teacher Training institutions which mainly included desktop computers, phones, projectors, and radios. Institutions still lacked adequate laptops, tablets, recorders, TV sets, Radio sets, digital cameras, E-books, and printers to enhance active teaching using power point, explaining different phenomenon using videos, build learners' capacity to conduct research, show examples using pictures. These are critical tools in the functioning of the model to enhance active learning practices. Finally, it was observed that an active learning strategy involves sharing of videos, playing games, participating discussions, debates, learning stations, research, and role plays as indicated in Figure 6.

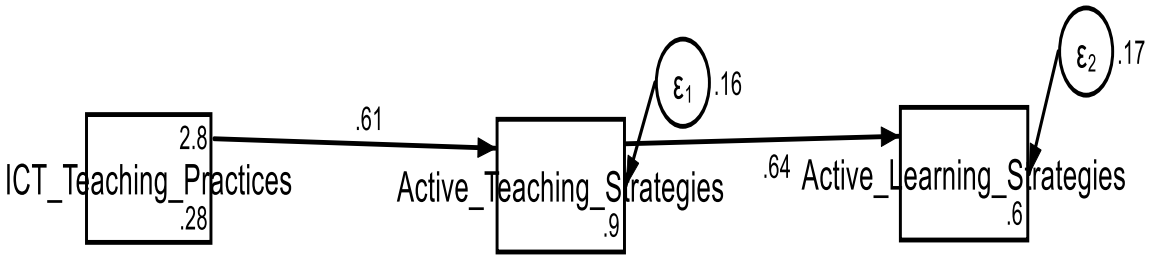
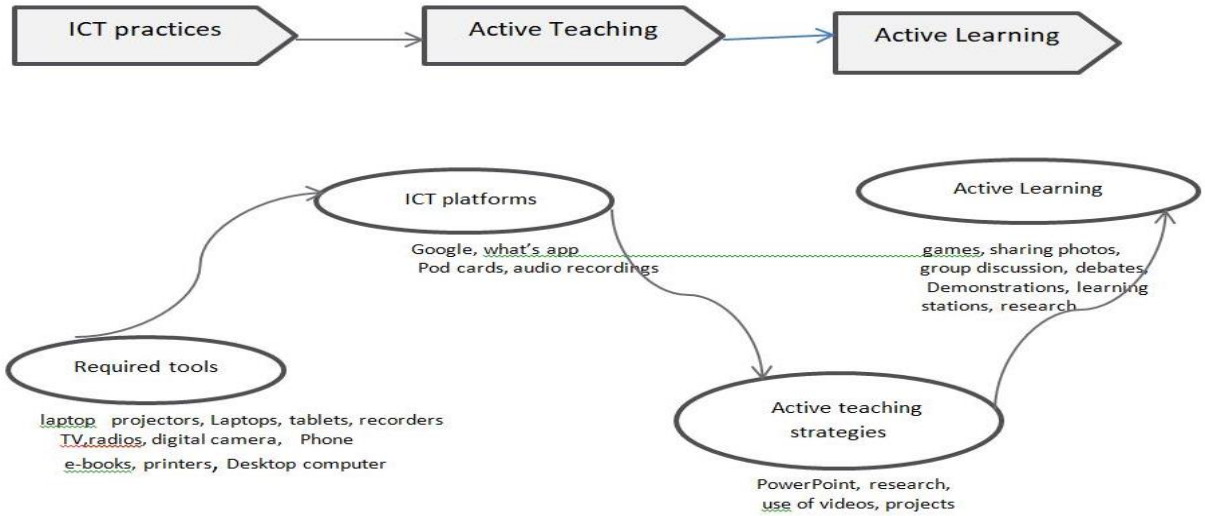


Figure 5: Existing ICT tools and Functionality role in the designed model (ICT priority tools)



Additionally, boosting the existing tools and availing those that are needed would perhaps build functional based learning through games, learner to learner sharing either using photographs or videos. These are the tools that allow ICT practices in teacher training institutions. Learners will be able to visit websites with educational materials and conduct research. However, it was also noted that for active teaching strategies to be successful there must be different platforms to support this approach. The platforms include what's app, Google meet, pod cards, and audio recordings. The use of audio videos, projects, research, and role plays creates active learning practices in the TTIs.

Since ICT based learning triggers group learning, the possibilities of learners engaging in group research is very high when it is used. In Table 8 there is a summary presented to show case the existing and the needed tools to boost functional teaching and hence active learning approach.

4.6 Generation of model principles for Active Teaching Process

During the design process, it was emphasized by the participants that Integrating ICT in teaching should improve pedagogy when there are clear principles or steps. Therefore, the participants identified the main ICT enabled model principles and related each principle to a role it plays in active teaching as indicated in Table 7.

Table 7: ICT enabled Active teaching and learning Model Principles

Principles/Steps	*Role of ICT in Active Learning*
Think pare share Crossword Puzzles Quiz or test questions Jigsaws Flipped classrooms Fish bowel Turn and talk:	Research and generation of relevant information on topics Active sharing of information and motivation to learn beyond classroom Innovativeness and creativity

Source: Field Data (2022)

Qualitative results suggest that Active teaching should follow Principles which link technology tools to active learning.

In this case the first step is to identify the ICT tools suitable for the Learning environment depending on class size and level and concepts needed to be developed in that lesson. If this is done, then research and generation of relevant information using tools looking at concept for a particular lesson is easy. The teacher educator identifies the ICT based teaching methods that lead to learners' participation. S/he prepares a lesson plan with clear objectives. At this point, ICT tools facilitate gathering information with examples about active teaching techniques for tools identified. The third principle rests on teacher educators' practice and rehearsals made in the lesson before the actual lesson using the identified tools and methods where Teacher can record using the ICT materials Store teaching materials. The fourth principle is that teachers must assign active class-based ICT linked exercises such as printing materials for reading or use; give timely Assessments endeavor to Show live examples on screen when teaching. All the above will be made easier if teacher educators envisage collaborative learning by using ICT tools to Generate links and connect students to learn from one another.

4.7 Generation of model principles for Active Learning Process and Supporting ICT tools

To determine the principles of active learning, the participants were asked this question *"What are the key aspects in active learning in your institution? How are these active learning aspects being supported by ICT?* Principles identified were emphasized by the participants as important aspects of support to learners in terms of reading, writing, analysis, synthesis and reflection. These enabled them to talk and express themselves within the classroom.

On active learning, different principles must also apply where learners conduct independent research and generate relevant topics and actively share information beyond classrooms. This enhances creativity and innovation. The following principles must apply, think and pair share, cross word puzzle, quiz or test questions, jigsaws, flipped classrooms, fish bowel and turn talks. These make learning more interesting learners motivation grasp concepts with ease. The respondents further noted that the effectiveness of the principles in supporting ICT enabled Active learning model largely depends on the support system in the TTIs as indicated in the next section.

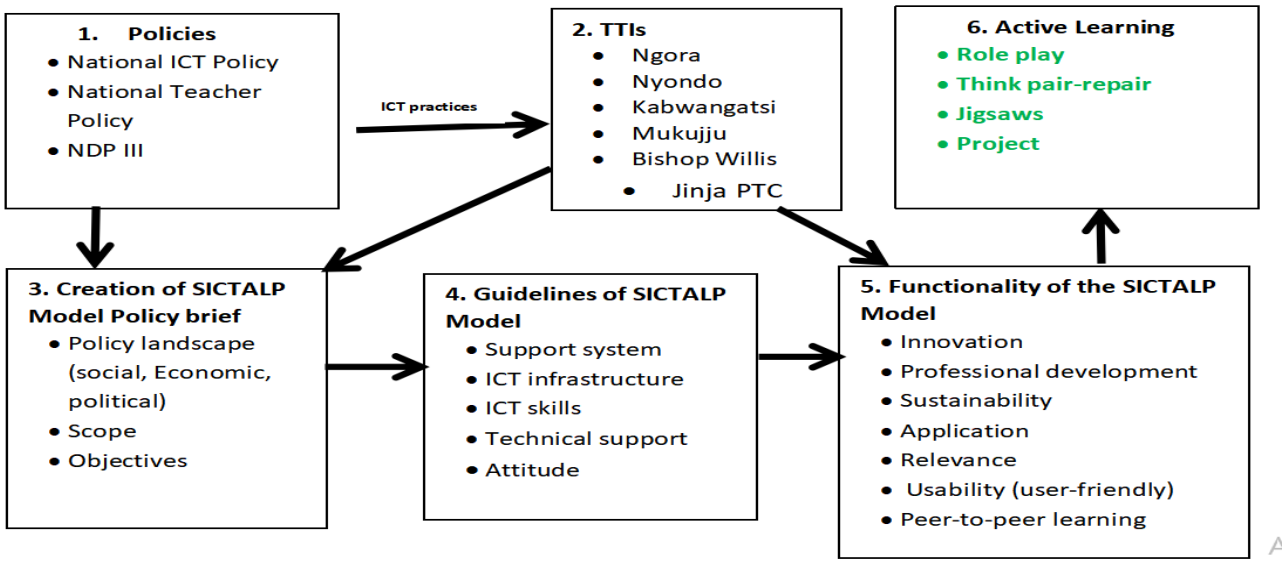


Figure 6: Operationalization process of e-MATL

4.8 Identification of the support system for active teaching and active learning strategies

From the discussions with the respondents, it was noted that for the model to successfully support the learning there will be need for support systems for effective ICT enabled ATL model. The support systems for active teaching and learning were established by asking the following questions: What systems are in place to support ICT enabled active teaching and Learning? What systems should be in place to support ICT enabled active teaching and learning? The responses were then synthesized and presented in Figure 7.

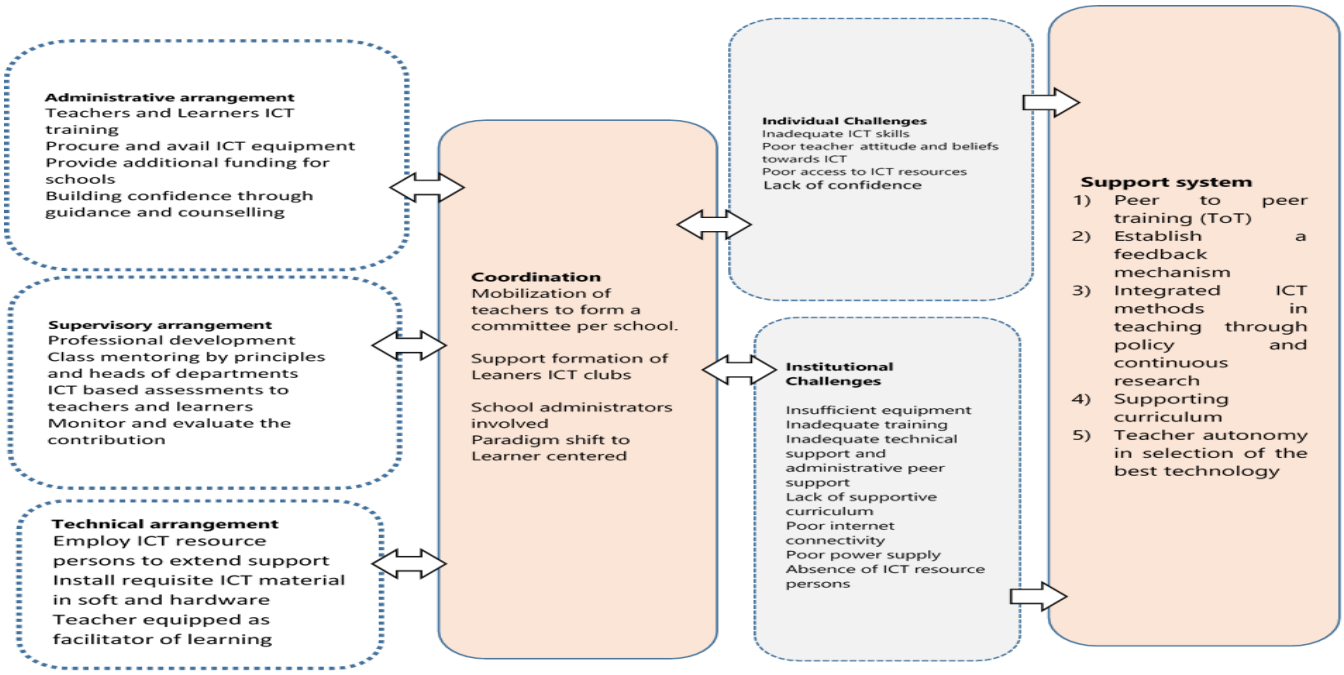


Figure 7: Support system for active teaching and Active Learning strategies

The support system framework presented in Figure 7 provides guidelines that will help to build the foundation for use and integration of ICT. To fully integrate ICT in active teaching and learning, focus was placed on the administrative, supervisory and technical arrangements. According to participants' responses, such arrangements as indicated above are critical because they help to coordinate mechanisms that solve individual and institutional challenges that would hinder full integration of ICT. Hence an aspect that is highly required in the implementation of the model to support active teaching and learning strategies in the TTIs.

The above findings concur with the previous findings from a research study that was carried out at Makerere University to find out the causes of the slow pedagogical integration to suggest interventions to address the situation (Jude et al., 2014). The results revealed that some lecturers lacked confidence in using ICT and the number of the existing tools was far less to the number of learners which combined with less competence in technology hindered the use of ICT in teaching and learning. The recommendations made were emphasizing on interventions that build the lecturers' skills in using ICT to enhance their competence following the SAMR model. The study further reveals that use of ICT would enhance pedagogical integration, an approach that will improve active teaching and learning (Ghavifekr et al., 2014).

Under the ICT enabled model, the teacher needs to be creative based on the ICT tools that are readily available and accessible at the institution. In terms of ranking, the needed tools for active teaching and learning, a projector was ranked number one for active teaching while mobile smart telephones were also ranked number one for facilitating active learning. Hence this requires that both the teacher and the learner follow principles that are clear and easy to understand. This Model leverages between theory and practice as well as constructive learning through enhancing digital literacy and promoting adequate knowledge on information sources.

This belief is aligned with that of Behar-Horenstein & Seabert (2012), who argue that using a teaching model as a platform for instruction gives an opportunity for school-wide practices which lead to self-regulated learning. They however noted that such a model if it experiences inadequate facilitation and teacher competence, learners don't mean learning. Several researchers assert that effective teaching and learning are characterized by the use of a variety of models and styles.

In this process, the participants also suggested that there was need for a supportive Policy that would support growth and development of the ICT infrastructure ranging from classrooms, laboratories, recording studios, internet/network/connectivity and affordable electric power. This is supported by Asabere et al., (2017) where he emphasized that the criteria for designing an ICT

enabled model for either a class or classroom should involve analysis of ICT education Policy, its status, education goal, the use of ICT in education goals, and its integration in the teaching and learning process. Hence, the need for an ICT Policy brief to ensure that the model effectively supports active teaching and learning in TTIs.

5. Conclusion and Recommendations

An ICT-enabled model named e-MATL has been thoroughly designed through a collaborative approach involving learners, teacher educators, and college administrators. The analysis of the finished model shows assistance of teachers and teacher educators in addressing traditional teaching gaps by facilitating a shift from teacher-centered to learner-centered and student-involved learning processes through the use of a variety of ICT tools and platforms. The findings also suggest that the e-MATL strategy can improve active teaching and learning practices in Ugandan teacher training institutions. The model's collaborative development process emphasizes its primary goal of encouraging active learning by engaging and motivating learners throughout the entire learning process thereby improving learning outcomes.

The Ministry of ICT and National Guidance should spearhead the sensitization and motivating of public-private partnerships (PPPs) through the Ministry of Education and Sports. This will improve partnership with tertiary institutions and universities in order to bring extra technical and management experience, as well as financial resources towards the implementation of e-MATL. This will guarantee sustainability and scalability of e-MATL in education learning institutions. The government should encourage educational partnerships that attract private sector investment in ICT education with an emphasis on quality teaching and learning through implementing e-MATL.

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