

An Assessment of Student Teacher's Attitudes Towards Incorporation of ICT in Mathematics Instruction

¹Denis Katakara Kagyera, ²Banzi Wellars, ³Danny Kamuhanda

¹*African Centre of Excellence for Innovative Teaching and Learning Mathematics and Science-University of Rwanda - College of Education*

²*University of Rwanda - College of Science and Technology*

³*University of Rwanda - College of Education*

Abstract

This study points to assess the attitude of student teachers regarding the incorporation of ICT as a classroom instrument for mathematics instruction. A study was conducted using a sample of one hundred thirty-two (132) mathematics student teachers at two selected teacher training institutions in central Uganda during the Covid-19 pandemic lockdown of the Education sector. The study was conducted using the descriptive survey research design. Data was collected with the aid of an online questionnaire and it was analyzed using SPSS edition 23.0. It had Cronbach's alpha constant (α) of 0.714 determined using SPSS. The results demonstrate that student teachers, despite gender, have a positive attitude toward ICT as a pedagogical instrument. Based on the analysis, it is suggested that lecturers within the departments of mathematics should incorporate ICT tools in their instruction so that student teachers can benefit from them.

Keywords: Assessment; attitudes, ICT, incorporation, mathematics, student teachers.

INTRODUCTION

Information and communication technology (ICT) has a wide range of applications in all areas of today's life, ranging from commerce and trade (e-trade) to household and Education. The incorporation of ICT in Education means that, combining technologies that provide information for the functions of academic development (Mooij, 2007). For this study, the ICT facilities referred to include, desktop computers, laptops, smartphones, tablets, radios, television, satellite systems, computer disc (writer or re-writable), the internet, network hardware, and software (Mahmood et al., 2021).

Uganda's education Ministry has been experiencing different reforms, and mathematics instruction has not been exempted. Previous secondary school mathematics education reforms have focused on the incorporation of ICT in the instruction process (Farrell, 2007). However, while still in teacher

education institutes, the obstacles that student teachers face, as well as their attitudes toward ICTs, have attracted scant consideration (Tusiime et al., 2020). The Ministry of Education of Uganda and curriculum developers must appreciate student teachers' attitudes on classroom instruction and constructively involve their instructors in discussions, planning, adoption, and execution of technology policies. If instructors are not valued for their competence in the instruction-learning environment, ICTs will have little or no impact on student teachers' attitudes in incorporating them into instruction in their future careers.

The incorporation of ICT in the instruction of mathematics offers opportunities in terms of the quality of learning and instruction. It has a novel place within the classroom as an academic innovation and preparing student teachers to utilize and incorporate ICT in the instruction of mathematics, has proved challenging for many

teacher education establishments in Uganda (Polly et al., 2010). Research studies by Agyei & Voogt (2011), showed that student teachers build very little or no incorporation of ICT in their learning practice. Thus, teacher trainers are presented with the demand to improve their pedagogical practices in the utilization of ICT to empower student teachers with skills necessary for ICT utilization (Nelson et al., 2019). However, the effectiveness of these pedagogical practices is based on several factors, including student teachers' attitudes towards ICT incorporation in mathematics instruction.

Attitudes are characterized as persistent patterns of beliefs (Hogg & Vaughan, 2010) with three constructs: cognition, affect, and behavior. The cognitive construct is the student teachers' thoughts on the benefits of incorporating ICT into their future classroom instruction. The feeling or affect construct is student teachers' emotions that are sparked by their use of technologies. Finally, behavior is an element of intent that student teachers are willing to take any action to incorporate technologies into their subsequent classroom practices (Fazio & Roskos-Ewoldsen, 2005).

The incorporation of ICT in the future mathematics classrooms is linked to student teachers' training programs they undergo while in colleges and universities. It is believed that ICT-related training programs improve student teachers' technology skills and attitudes toward technology. Student teachers should be trained in the practical application of ICT tools to realize their potential in their future use, and in particular, they should be trained to integrate it into the instruction of mathematics. Teachers' attitudes on incorporating ICT into their instruction practice are based on their perceptions of ICT incorporation in the classroom (Chukwudi et al., 2020). In this regard, it's possible to suggest that when student teachers develop positive attitudes toward incorporating ICTs in mathematics classrooms, their attitudes toward ICT incorporation in their eventual instructional practices will as well be positive. The key driver in the future approaches to ICT incorporation in mathematics instruction is student teachers' favorable attitudes toward ICT. Furthermore, changing student teachers' attitudes could help them overcome some of the challenges to effective ICT incorporation in their classrooms (Goktas et al., 2009).

Today's learning environments in higher education are being transformed by the use of ICT as a pedagogical instrument in instruction. The acceptance of the benefits of ICT in the classroom is demonstrated by student teachers' favorable attitudes, with numerous researches suggesting that the majority of mathematics student teachers appreciate the use of ICT as a pedagogical tool. The purpose of the study is to find out how student teachers feel about incorporating ICT into mathematics classes.

Research questions

The following research questions served as the basis for the investigation.

1. What are the attitudes of mathematics student teachers' towards the incorporation of ICT in mathematics instruction?
2. What is the difference in attitudes about incorporating ICT as a pedagogical tool in mathematics instruction between male and female student teachers?
3. What are the barriers that student teachers encounter when incorporating ICT into mathematics learning?

Hypothesis

Ho1: Student teachers' attitudes regarding incorporating ICT in the instruction of mathematics do not differ significantly by gender.

Literature review

Literature that reveals influential determinants of student teachers' attitudes about ICT incorporation already done by other researchers was reviewed. Ndawula et al., (2020), revealed that positive attitudes of student teachers at Kyambogo University toward the Internet related to increased computer use. End users with longer computer exposure time and more opportunities to use the computer on campus had favorable attitudes toward the use ICTs. Students with differing levels of computer experience tend to differ significantly in their preferences for Internet services. Students with more computer experience are in better control while online, compared to those with less experience. The experienced students appear more independent while online. Such

participants will in general be sure of what they are searching for and can explore the web easily. Based on the outcomes of this study, students were urged to be encouraged to develop good mindsets about the incorporation of ICTs in instruction.

Furthermore, Chukwudi et al., (2020), investigated the attitudes of mathematics student teachers' towards the incorporation of ICT in mathematics instruction. The study employed a stratified random sampling technique. The data generated were analyzed using descriptive statistics to answer research questions. The study analysis revealed that student teachers exhibited strongly favorable attitudes about the incorporation of ICT in their instruction, with little influence from student teachers' pedagogical perspectives toward ICT use in their future instructional practices. Another study by Justina Stella et al., (2017) investigated the attitudes of student teachers' towards the incorporation of ICT in instruction. Data generated was analyzed using descriptive statistics. The study's findings also reported that student teachers had a favorable attitude towards ICT as a medium of instruction. Based on the research outcome the authors suggest that teacher institutions of higher learning should incorporate ICT in mathematics instruction of pre-service teacher education to make it possible for them to practice it in their careers.

In another study, Bower & Wittmann, (2009) assessed student teachers about their attitudes toward the incorporation of ICTs and their desire to employ them in their future professional careers. The results show that student teachers intend to employ ICTs in their subsequent classroom instruction. The authors further argue that these were directed by the instruction conditions, technological development in the lessons, and the student's commitment, which leads to meaningful learning. Based on the research findings, the authors recommend that studies are needed to analyze the readiness of pre-service teachers to use ICT in teaching and learning mathematics.

The study by Fook et al., (2011) examined student teachers' attitudes towards their future practice regarding technology incorporation and the factors leading to such attitudes. Data was collected from seventy participants for practical attitude change measures. The findings showed that the student teachers have a favorable

attitude, a moderate level of competency, and are adequately prepared in incorporating ICT in the classroom thereby improving the quality of education. These findings suggest that it is important that the incorporation of ICT into instruction be initially modeled by teachers in educational establishments, to inspire student teachers to incorporate it in their future ICT-based instruction. By modeling, the level of anxiety of student teachers in using ICT can be lowered.

With the same objective, Lei, (2009) examined the experience, abilities, and knowledge of student teachers in ICT as well as their attitude toward the incorporation of ICT in instruction. The findings showed positive attitudes towards ICT incorporation in instruction among the respondents. Student teachers considered ICT to be a tool for improving their instructional practice and improving learning results. The author recommends that student teachers' education programs, should include the use of particular ICTs, the provision of knowledge and skills for student teachers to establish effective links between ICT and their instructional practices; and the exposure to the various ICT instruments which can be used in their instruction.

The above finding is consistent with the study by Teo, (2008). The author examined several factors, including age, computer skills and competence, and student teachers' perceptions toward ICT incorporation into future instructional practice. The study was conducted using a five (5) point Likert scale to evaluate the population characteristics, ICT incorporation attitude, computer literacy, and confidence in the usage of digital education technologies. The study revealed a positive position for the participating student teachers about technology use in teacher education. They preferred to incorporate ICT in their courses because ICT made learning fun, and comprehensible and improved their performance.

Furthermore, Joy Egede, (2021) carried out a study by assessing student teachers' readiness to use ICT to teach. It also investigated the influence on attitudes towards ICT incorporation by student teachers' intentions, computer competency and expertise, and content knowledge. A questionnaire was issued to student teachers, in their last year at University, while they also finished the

internship and the course. The findings of the study revealed that the student teachers had a positive attitude and were willing to use ICT to teach in terms of awareness and motivation.

A research finding by Aslan and Zhu, (2015), also points toward student teachers' attitudes toward the incorporation of ICT in their practice. Their study was focused on the expected impact of ICT incorporation on student teachers' attitudes and learning abilities; student teachers' attitudes toward ICT incorporation and ICT incorporation conditions. The study found that the previous ICT experience of student teachers and their beliefs in the utilization of ICT for mathematical education had an impact on their attitudes on incorporating ICT into their future professions.

In summary, many governments across the world, including Uganda, should appreciate the need for digital technologies in strengthening classroom mathematics instruction and especially during the covid-19 pandemic lockdown of the education sector. According to Mulenga and Marban Prieto (2018), school reform focuses on altering mindsets, such as pedagogical assumptions, attitudes, and beliefs, which is an essential component of any educational transformation effort. Several factors determine the way teachers integrate ICT into the instruction of mathematics in the classroom, including perceptions of the nature of mathematical knowledge and how it should be learned, as well as beliefs, attitudes, and confidence. Little research has been done at the selected institutions in central Uganda to assess how student teachers perceive the incorporation of ICT in the instruction of mathematics. As a result, this study aims to assess student teachers' attitudes towards incorporating ICT in mathematics instruction at these selected Ugandan teacher training institutions.

Methods and Techniques

Research design

The descriptive survey study design was used to investigate the attitudes of mathematics student teachers about the incorporation of ICT as an instructional instrument in mathematics instruction. This design was deemed ideal since it allowed data collection from respondents during a lockdown caused by the covid-19

outbreak, resulting in data that was representative enough to provide the genuine situation on the ground.

Study population

Given the unavailability of year three students who had completed their course by the time of data collection, the population frame constituted the first and second years of a three-year degree and a two-year diploma program in Mathematics Education at the selected teaching training institutions in Central Uganda

Table 1: *Demographic characteristics of respondents*

Age	Frequency	Percentage (%)
20 or less	3	2.3
21-25	129	97.7
Total	132	100
Gender		
Female	20	15.2
Male	112	84.8
Total	132	100
Institution		
A (University)	65	49.2
B (National Teachers College)	67	50.8
Total	132	100

Table 1 shows a summary of the demographic characteristics of the participants. In terms of gender, 112(84.8%) were male, while 20 (15.2%) were female. The majority (97.7%) of the respondents' ages ranged between 21 and 25 years with 2.3% below 20 years.

Instrumentation

The questionnaire was the only data collection tool employed and it was administered online since it was deemed adequate for avoiding researchers' close contact with respondents to strictly comply with the COVID-19 preventive precaution of social distancing. The questionnaire items were developed following the available literature on student teachers'

attitudes regarding ICT incorporation in the instruction of mathematics. To ensure the scientific validity of the study, SPSS edition 23 was used to examine the tool for coherence. It provided a detailed analysis of how to enhance each of the items. Some items in the survey instruments that were almost double in design were altered based on the SPSS analysis. A Reliability Coefficient of 0.714 was produced and deemed adequate (Matheson, 2019).

Data Analysis

The data collected from the questionnaire was analyzed using SPSS 23.0 edition. Descriptive statistics was used to measure student teachers' attitudes regarding ICT as a pedagogical practice in mathematics instruction at the selected teacher training institutions.

Ethical considerations

The study's research ethics were upheld at all levels. Permission was sought and obtained from the Ministry of Education and Sports in Uganda. To comply with COVID-19 safety precautions, it was suggested that I distribute the questionnaires to the students as an online survey. The study's objectives were presented to students, and they were given the option of participating by registering their e-mail addresses or not. Save that, no participant's identity has indeed been revealed in this piece of work

Research results

Table 2: *Summary of student teachers' responses*

The attitude of student teachers towards ICT incorporation in mathematics instruction	M ea n	Std. devi atio n	R e s p o n s e
I feel comfortable with the idea of ICT use in the instruction of mathematics.	1.9091	0.6706	A c c e p t

The use of ICT as a learning tool excites me.	1.7879	0.6993	„
ICT incorporation helps instructors teach in more effective ways.	2.0606	0.9943	„
ICT use in the instruction of mathematics hinders the completion of learning materials.	2.3636	0.7938	„
ICT use helps in understanding concepts in more effective ways.	1.8258	0.6239	„
ICT does not lead to good instruction as it causes technical challenges.	3.7652	1.1111	„
ICT incorporation in the instruction of mathematics speeds up the learning process.	1.8636	0.7792	„
I can use ICT to solve mathematical problems by browsing the internet more than any other source.	1.8636	0.5817	„
Grand Mean	2.1799	2.2643	

Table 2 illustrates that each of the items was accepted since their respondent mean was above the instrument's threshold mean of 1.50, indicating that mathematics student teachers have a positive attitude toward ICT integration in the classroom. Student teachers answered positively to all the statements about the use of ICT attitudes, with the majority of the student teachers finding ICT to be a helpful instrument for mathematics instruction (Mean = 2.1799 and SD = 2.2643). The research findings show that student teachers' attitudes about the incorporation of ICT in mathematics instruction were generally positive.

Table 3: *Gender-based summary of student mathematics teachers' responses*

Gender	N	Mean	Std. deviation	Difference in mean	Df	t _{cal}	t _{0.05}	Remark
Male	112	2.1496	2.1271	0.1754	131	0.1281	1.660	Accepted
Female	20	2.3250	2.7663					

Table 3 shows that male mathematics student teachers responded with an average mean of 2.1496 and a standard deviation of 2.1271, while female mathematics student teachers responded with an average mean of 2.325 and a standard deviation of 2.7663. This resulted in a mean difference of 0.1754 in favor of the females, indicating that they have a favorable attitude towards the incorporation of ICT in mathematics instruction more than their male student teachers.

Hypothesis

Ho1: There is no statistically significant difference in attitudes toward the use of ICT in mathematics instruction between male and female student teachers.

Table 3 reveals that at a 0.05 level of significance and 131 degrees of freedom, the calculated t-value of 0.1281 is less than the critical table value of 1.660. At the 0.05 level of significance, the null hypothesis is supported.

Table 4: *Factors affecting student teachers' use of ICT in mathematics education.*

Factors	Major	Minor	Not a challenge
Lack of electricity	40 (30.3%)	21 (15.9%)	71 (53.8%)
Irregular supply of electricity	40 (30.3%)	0	92 (69.7%)
Lack of ICT gadgets like laptops, smartphones, etc	72 (54.5%)	12 (9.1%)	48 (36.4%)
Lack of internet access.	33 (25.0%)	8 (6.1%)	91 (68.9%)
Limited access to internet	83 (62.9%)	21(15.9%)	28(21.2%)
Lack of commitment among students to use the eLearning platform	97 (73.5%)	17(12.9%)	18 (13.6%)
Resistance of some students to adopt change and new technology	19 (14.4%)	72 (54.5%)	41 (31.1%)
Lack of training opportunities for Student teachers in the use of ICT in teaching and learning Mathematics	132 (100%)	0	0
Dependence on the internet for solutions.	24 (18.2%)	82 (62.1%)	26(19.7%)
Lack of technical support regarding ICT integration	92 (69.7%)	40 (30.3%)	0
Limited competencies in using ICT technologies by student teachers	99 (75%)	33 (25%)	0

Table 4 shows that the majority of student teachers (100%) did not have access to training in the use of ICT in mathematics teaching and

learning. These findings back up the claim that ICT skills and knowledge are developed through ongoing professional development and that this

determines ICT integration in the mathematics classroom (Ndawula et al., 2020). Other obstacles were limited competencies in using ICT in mathematics teaching and learning (75%), a lack of technical support (69.7%), a lack of commitment by student teachers to use the eLearning platform (73.5%), a lack of internet connection (62.9%), and a shortage of ICT devices (54.5%).

Discussion

According to the findings, student mathematics teachers' have a favorable attitude toward the incorporation of ICT in the instruction of mathematics. All of the items in Table 1 were allowed since the respondent mean was more than the threshold of the instrument mean, and the mean average was also greater than the instrument threshold mean. This was evidence of favorable attitudes possessed by student teachers' regarding the incorporation of ICT in the instruction of mathematics. The findings are consistent with those of Justina Stella et al., (2017) and many other authors in the literature review who revealed that student teachers have a favorable attitude toward the incorporation of ICT in mathematics instruction.

Gender did not play a role in student teachers' attitudes toward incorporating ICT into mathematics instruction. This showed that both male and female student teachers appreciated using ICT in mathematics classes. Furthermore, the results of this study revealed that student teachers' attitudes toward the use of ICT in mathematics instruction were not significantly different by gender. These findings contradict those of Chukwudi et al. (2020), who found that gender was a key determinant in the use of ICT in mathematics education.

Limitations of the study

This research adds to our understanding of student teachers' attitudes regarding incorporating ICT in mathematics instruction in Ugandan teacher training institutions and other countries with similar educational systems. However, because of a limitation in the research methodology, the findings should be regarded with caution. In the literature, it has been suggested that survey research rely on self-

reported data with no evidence of the truth of respondents' claims. The participants personally explain their own experiences and perspective based on their interpretations. Given that they are expected to be certified teachers, their status as university and college students may have impacted them to demonstrate higher confidence and capacity to use ICT in instruction and studying mathematics. Another drawback of this study is that it relied solely on a questionnaire as a research tool. While an explanation for this methodological constraint has been provided, it is sufficient to state that not all of the essential information was acquired, as certain responses required follow-up questions via interviews or other kinds of data collection.

Conclusion

The purpose of the study was to find out how student teachers felt about incorporating ICT into mathematics classes. The outcomes of the study demonstrated that student teachers had a positive strong attitude regarding the use of ICT in mathematics instruction, and gender was not a factor in it. Positive attitudes in incorporating ICT into instruction empower student teachers to engage in the learning process and give them an interest in their education. By incorporating ICT into the mathematics classroom, student teachers can learn more effectively, collaborate, and explore the world around them (Oden, 2018).

Recommendations

Incorporating ICT into mathematics instruction remains a challenge to many educators in developing countries like Uganda. Thus, there is a need to strengthen lecturers' professional development programs towards ICT use in the instruction of teacher training colleges and Universities to enable both instructors and student teachers to implement it in their profession. In this regard, we recommend that ICT training programs should strengthen the awareness about the use of ICT tools used in mathematics instruction with a lot of emphasis on the importance of using ICT in the instruction of mathematics. In addition, for effective ICT incorporation to be used in mathematics classrooms, there should be a constant power supply and technical personnel should be

employed in teacher education establishments to handle the upkeep of technological pedagogical equipment. Teacher education establishments should have good internet connectivity so that student teachers and their lecturers can integrate ICT in the classroom. To improve the incorporation of ICT in mathematics instruction, the government and college or University administrators should provide technology facilities in teacher training establishments.

Acknowledgments

This research was funded by the African Centre of Excellence for Teaching and Learning Mathematics and Science (ACEITLMS), University of Rwanda- College of Education

Reference

- [1] Agyei, D. D., & Voogt, J. (2011). ICT Use in the Teaching of Mathematics: Implications for Professional Development of Pre-service Teachers in Ghana. *Education and Information Technologies*, 16(4), 423–439. <https://doi.org/10.1007/s10639-010-9141-9>
- [2] Aslan, A., & Zhu, C. (2015). Pre-service Teachers' Perceptions of ICT Integration in Teacher Education in Turkey. *Turkish Online Journal of Educational Technology*, 2015(July), 462–466.
- [3] Bower, M., & Wittmann, M. (2009). Pre-service Teachers' Perceptions of LAMS and Moodle as Learning Design Technologies. *The 4th International LAMS and Learning Design Conference*, Sydney, Australia, 28–39.
- [4] Chukwudi, A., Ihechukwu, B., & Humphrey, O. (2020). Attitude of Pre-service Teachers Towards Application of Techno-pedagogy in Mathematics Classroom. *VII(Viii)*, 253–257.
- [5] Farrell, G. (2007). ICT in Education in Uganda. *Policy*, April, 1–14.
- [6] Fazio, R. H., & Roskos-Ewoldsen, D. R. (2005). Acting as Well as We Feel. *Persuasion: Psychological Insights and Perspectives*, 1934, 71–93.
- [7] Fook, C. Y., Sidhu, G. K., Shah, N. K. M., & Aziz, N. A. (2011). Pre-service Teachers' Training in Information Communication and Technology for the ESL Classrooms in Malaysia. *Turkish Online Journal of Distance Education*, 12(3), 97–108. <https://doi.org/10.17718/tojde.56165>
- [8] Goktas, Y., Yildirim, S., & Yildirim, Z. (2009). Main Barriers and Possible Enablers of ICTs Integration into Pre-service Teacher Education Programs. *Educational Technology and Society*, 12(1), 193–204.
- [9] Hogg, M. A., & Vaughan, G. M. (2010). *Essentials of Social Psychology*. In *Psychological Bulletin* (Vol. 16, Issue 3). <https://doi.org/10.1037/h0064341>
- [10] Joy Egede, B. A. (2021). An Assessment of Final Year Pre-Service Teachers' Readiness to Use ICT to Teach Implication for COVID-19 Education Response. *Frontiers in Education Technology*, 4(1), p66. <https://doi.org/10.22158/fet.v4n1p66>
- [11] Justina Stella, O., Bright Ihechukwu, N., Anayochi Nwakaego, N., & Donatus Uchechukwu, U. (2017). Pre-Service Teachers' Attitude Towards Application of Information and Communication Technology (ICT) As a Pedagogical Tool in Teacher Education. *British Journal of Education*, 5(11), 50–57. www.eajournals.org
- [12] Lei, J. (2009). Digital Natives as Preservice Teachers: What Technology Preparation is Needed? *Journal of Computing in Teacher Education*, 25(3), 87–97. <http://web.b.ebscohost.com.ezproxylocal.library.nova.edu/ehost/detail?vid=3&sid=f5a23215-aad8-436b-8c4c-9e62d71bc989@sessionmgr111&hid=112&bdata=JnNpdGU9ZWZWhvc3QtbGl2ZQ==#db=eue&AN=37291241>
- [13] Mahmood, H., Lodhi, F. A., & Rahat, A. (2021). An Analysis Towards Implication Of Information and Communication Technology at University Level. *4(1)*, 143–161.
- [14] Matheson, G. J. (2019). We Need to Talk About Reliability: Making Better use of Test-Retest Studies for Study Design and Interpretation. *PeerJ*, 2019(5), 1–25. <https://doi.org/10.7717/peerj.6918>
- [15] Mooij, T. (2007). Design of Educational and ICT Conditions to Integrate Differences in Learning: Contextual Learning Theory and a First Transformation Step in Early Education.

- Computers in Human Behavior, 23(3), 1499–1530.
<https://doi.org/10.1016/j.chb.2005.07.004>
- [16] Ndawula, S., Namatende-Sakwa, L., & Patrick Bigirwa, J. (2020). Is Previous Student Computer Experience Related to their Attitudes Towards Internet Use? *European Journal of Education Studies*, 234–249.
<https://doi.org/10.46827/ejes.v7i8.3210>
- [17] Nelson, M. J., Voithofer, R., & Cheng, S. L. (2019). Mediating Factors that Influence the Technology Integration Practices of Teacher Educators. *Computers and Education*, 128, 330–344.
<https://doi.org/10.1016/j.compedu.2018.09.023>
- [18] Oden, C. (2018). Impact of ICT on Teaching and Learning in the 21st Century. Chrisantus Oden.
- [19] Polly, D., Mims, C., Shepherd, C. E., & Inan, F. (2010). Evidence of Impact: Transforming Teacher Education with Preparing Tomorrow's Teachers to Teach with Technology (PT3) Grants. *Teaching and Teacher Education*, 26(4), 863–870.
<https://doi.org/10.1016/j.tate.2009.10.024>
- [20] Teo, T. (2008). Pre-service Teachers' Attitudes Towards Computer Use: A Singapore Survey. *Australasian Journal of Educational Technology*, 24(4), 413–424.
<https://doi.org/10.14742/ajet.1201>
- [21] Tusiime, W. E., Johannesen, M., & Gudmundsdottir, G. B. (2020). Teaching Art and Design in a Digital Age: Challenges Facing Ugandan Teacher Educators. *Journal of Vocational Education and Training*, 00(00), 1–21.
<https://doi.org/10.1080/13636820.2020.1786439>