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Relationship between integrating information technology and student's classroom outcomes in upper secondary schools within kapchorwa district. A cross-sectional study.

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Abstract.

Background.

Most Upper Secondary Schools have integrated information technology into their pedagogy. This was aimed at improving students' learning outcomes. However, in Kapchorwa District, achievement of learning outcomes in secondary school has been subpar in upper secondary schools. This study examined the relationship between integrating information technology and students' classroom outcomes in Upper Secondary schools within Kapchorwa District.

Methodology.

A descriptive, cross-sectional, and correlational survey design, utilizing a quantitative approach for data collection and analysis. The study population comprised teachers, students (S6), and head teachers from five private Upper Secondary schools in Kapchorwa District. A sample size of 181 respondents was selected using purposive and simple random sampling techniques. Questionnaires, interview guides, and documentary review checklists were used as research instruments. Data were analyzed using SPSS software, including univariate analysis, correlation analysis, and regression analysis.

Results.

126 (74.1%) of the participants were male, Majority of the participants 106 (62.3%) were aged 16-24 years. There was a moderate correlation between virtual lessons and the achievement of learning outcomes of 0.386. The p-value (0.006) indicates that this correlation is statistically significant at the 0.05 level There was a strong positive correlation between asynchronous discussions and the achievement of learning outcomes of 0. 568. There was also a strong positive correlation between virtual instructions and the achievement of learning outcomes was 0.561.

Conclusion.

The correlational findings indicate strong positive relationships between the use of virtual lessons, asynchronous discussions, and virtual instructions, and the achievement of learning outcomes.

Recommendations.

There is a need to improve infrastructure, financial support for students, teacher training, integration of interactive elements, monitoring and evaluation of digital learning initiatives, and efforts to ensure equitable access to technology tools.

Keywords: *Information technology integration, Classroom outcomes, Upper secondary schools, Kapchorwa District, Student performance.*
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Background.

Education technology, often abbreviated as "EdTech," refers to the integration of technological tools and resources into the educational environment to enhance teaching and learning experiences (Calderón, Meroño, & MacPhail, 2020). It encompasses a broad range of digital technologies, software applications, and online platforms that are utilized to support and supplement educational activities (Rakes et al., 2020). Education technology can include interactive whiteboards, educational software, learning management systems, digital learning platforms, online assessment tools, virtual reality simulations, and various other digital resources designed to facilitate and improve the learning process (Sahin & Yilmaz, 2020).

The use of education technology aims to engage students, personalize learning experiences, provide access to diverse

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educational resources, and support the development of 21st-century skills (Kibuku, Ochieng, & Wausi, 2020). Additionally, education technology can offer opportunities for distance learning, adaptive learning experiences, and data-driven insights into student performance and educational outcomes (Bariu, 2020). Overall, education technology plays a crucial role in modernizing and innovating education, aiming to better prepare students for success in an increasingly digital and interconnected world.

The integration of information technology in education has become increasingly prevalent in Upper Secondary schools. With the rapid advancement of digital tools and resources, educators are exploring innovative ways to incorporate IT into classroom learning (Szymkowiak, Melović, Dabić, Jeganathan, & Kundi, 2021). This study aims to examine the impact of information technology on teaching and learning experiences in Upper Secondary schools. It seeks to understand how the use of IT influences student engagement, academic performance, and the overall learning environment (Castro & Tumibay, 2021).

Classroom learning refers to the process of acquiring knowledge, skills, and experiences within a structured educational environment. It typically involves a teacher or instructor leading a group of students through lessons, discussions, activities, and assessments (Mandasari & Wahyudin, 2021). Classroom learning can take place in a physical classroom or a virtual setting, and it often incorporates various teaching methods, such as lectures, group work, and hands-on projects. This type of learning allows for direct interaction and feedback between students and teachers, as well as opportunities for collaboration and socialization among peers (Müller & Mildenberger, 2021).

Most upper secondary education secondary schools in Uganda have embraced technology in their teaching with the aim of enhancing the quality of education and improving learning outcomes Technology enables students to access a vast amount of information and educational resources beyond the confines of the classroom. This allows for self-directed learning and research, empowering students to explore a wide range of topics and perspectives.

The classroom outcomes of Upper Secondary School students in Kapchorwa District, Uganda are influenced by various factors, such as the quality of education, the availability of resources, the socio-economic background of the students, and the use of education technology (Education, 2023). According to Kapchorwa Inspector of School's report (2023), the academic outcomes of students in most Upper Secondary schools were subpar evidenced by 12% of the students enrolling for University education and limited skills obtained by students.

Additionally, the efficiency of Uganda's Upper Secondary education system has been reported to be low, with low graduation rates to continue with University Education (Akongai, 2021). The influence of staffing, supplies, and facilities on Upper Secondary school performance in Uganda has also been studied, with findings suggesting that these factors have an important influence on performance. The studies indicate that while there have been improvements, challenges remain in the academic performance of Upper Secondary students in Kapchorwa District, Uganda (Nabalayo, 2023). This prompted the researcher to examine the relationship between the integration of technology in education and the classroom outcomes of students in Upper secondary schools.

Recently, most Upper Secondary Schools integrated information technology into their pedagogy. This was aimed at improving students learning outcomes (Aheisibwe & Barigye, 2023). However, in Kapchorwa District, achievement of learning outcomes in secondary school has been subpar in upper secondary schools (Kapchorwa District Education Department, 2023). According to Zack (2020), 70% of the students in Upper Secondary (senior six) failed to obtain two principal passes and 48% of the students with ICT subjects had F9. Further, the Kapchorwa District Inspector of Schools Report (2023) indicated that 58% of the Upper Secondary school students never complete class assignments in stipulated timelines. This has affected the academic outcomes of students resulting in poor academic performance within the District (Kapchorwa District UACE Report (2023). This study examined the relationship between integrating information technology and students' classroom outcomes in Upper Secondary schools within Kapchorwa District.

Methodology.

Research design

The study was guided by a descriptive, cross-sectional, and correlational survey design. Further, the study employed a quantitative approach in collecting and analyzing data for this study. The research used a descriptive survey design to explain the findings of the study based on averages, percentages, standard deviation, and frequency tables. The study was also cross-sectional since it collected data at a point in time from respondents and was for a short period. It was also correlational since it employed Pearson correlation to establish the significance of the relationship between the study variables in line with the study objectives. The quantitative approach was used to analyze and interpret numerical data for meaningful findings.

Study population

(Sekaran, 2016) defines a population as the entire group of people, events, or things that a researcher wishes to investigate. The study targeted five private Upper Secondary schools in Kapchorwa District. The study was carried out at Kapchorwa Parents Secondary School, Town View High School, Sipi Secondary School, Kaserem Upper Secondary School, and Kabore High School. These schools have been selected because they adopted technology in their learning.

The study used teachers, students (S6), and head teachers of the selected Upper Secondary schools, as the respondents and thus comprised the study population. The

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study used 75 teachers, 5 head teachers, and 260 Upper Secondary students of the selected private Upper Secondary schools as the population hence 340 people were used as the study population.

Table 1: shows the sample size of the study.

Category	Population Size	Sample size	Sampling technique
Teachers	75	63	Simple random sampling
Headteachers	5	5	Purposive sampling
Students (S6)	260	113	Simple random sampling
Total	**340**	**181**	

Source: Kapchorwa District Education Department (2023).

Sample Size

Mugenda and Mugenda (2003) argue that it is impossible to study the whole targeted population therefore the researcher took a sample of the target population. A sample is a subset of the population that comprises members selected from the population. The sample size was determined using the (Krejcie & Morgan, 1970) table of determining sample size. At a 5% level of significance, 181 respondents were selected as the sample size of the study. These included 63 teachers, 5 head teachers, and 113 students.

Sampling techniques

Purposive and simple random sampling techniques were used in determining the respondents of the study. Purposive sampling was used to select the head teachers of selected Upper Secondary schools in Kapchorwa District. These were selected because they are key to the implementation of technology in education within the selected Upper Secondary schools. A simple random sampling technique was used to select teachers and Upper Secondary School students who participated in this study. The method will be used to eliminate bias by giving everyone a chance to participate in this study.

Research instruments.

Questionnaires were used to collect data for this study.

Questionnaire.

The questionnaire was used as a tool for gathering information during the survey. A questionnaire is defined as a carefully designed tool for collecting data by specification of research questions (Amin, 2009). It is a research instrument that gathers data over a large sample and it gives important information about a population that's why many quantitative researchers use it as the main method of collecting data. In addition, a questionnaire can collect a large amount of information in a reasonable quick space of time and at the same time minimizes bias on the side of the researcher and respondents (Mugenda and Mugenda 2003). In this study, the researcher used a questionnaire to gather data from teachers of the selected private Upper Secondary schools. Open-ended and closed-ended questions were used to access first-hand information. Close-ended questions were used to give respondents alternative answers and avoid wasting time in thinking (Mugenda and Mugenda, 2003).

Research procedure

The study was conducted in a planned way in which the researcher first obtained an introductory letter from the University which was taken to the teachers of the selected schools. The researcher gave out his questionnaires and also arranged for interview sessions with respondents. The researcher then collected the questionnaires after two weeks.

Validity

Validity has to do with how accurately the data obtained in the study represents the variables in the study. Several methods were used during the process of data collection to ensure quality data for the research. Personal prejudices and biases were avoided, systematic and accurate recording of observations was made, listening carefully, and establishment of trust with the interviewee was employed to ensure validity. The research instruments were issued to the research supervisor for expert judgment. A Content Validity Index (CVI) was used to measure the accuracy of the research instrument using the formula:

A Content Validity Index of 0.85 was obtained and compared with 0.7 as suggested by Amin (2005) and was considered valid.

Reliability

Reliability is a measure of the degree to which a research instrument yields consistent data results or data after a repeated result (Mugenda & Mugenda, 1999) This refers to how consistent the research instrument is. Amin (2005) contends that the instrument is reliable when it produces the same results when it is used repeatedly hence ensuring dependability and precision. To ensure reliability, the researcher pre-tested the questionnaires on 5 respondents one week before going to the field, and the Cronbach coefficient alpha (a) was used to compare findings from the first and the second test with 0.70 as suggested by (Amin, 2005). The Cronbach alpha of 0.83 was obtained hence the instruments were reliable.

Data analysis and processing.

Qualitative and quantitative data was analyzed, interpreted, arranged, and tabulated. Quantitative data was analyzed

using SPSS software. Results were presented in the form of frequency tables and interpreted accordingly. Analysis of qualitative data was through descriptions of events and occurrences as gathered from the interviewees. Content analysis was used to analyze the data which was gathered from the interviews. Univariate analysis was carried out for individual variables using mean, frequency tables, graphs, and standard deviation. Correlation analysis was carried out using the Pearson correlation coefficient to establish the relationships. Regression analysis was used (multiple regressions) to establish the relationship between education technology and classroom outcomes in Upper Secondary schools in Kapchorwa District.

Ethical approval

Sought an introductory letter from the School of Graduate Studies and Research of Team University that intended to introduce the researcher to the concerned authorities in the district. He also solicited permission through a written request to the concerned officials in the selected secondary schools and the Kamwenge District Education Department. Respondents were requested to sign the *Consent Form*. He also acknowledged the authors quoted in this study through citations and referencing. Ensured confidentiality and anonymity of the information collected and the information given was used for academic purposes.

Informed consent.

Respondents were informed about the purpose of the study and how the data they provided was to be treated. For this matter, each respondent was contacted first and foremost and given an informed consent form to read and if convinced sign. Respondents' freedom to participate in the study. No respondent was forced to participate in the study. Their rights were respected to participate or not and were informed fully about their freedom to withdraw any time they wished. All these were communicated verbally and also in the consent form. The data respondents were given was treated with utmost confidentiality. The researcher made sure that unnecessary about the identity of individual respondents was avoided and that no data was collected on them, such as their names, names of their parents, or children. In addition, all the information respondents gave through questionnaires or interviews, was kept secret and was not revealed to other people. The findings were therefore reported in a generalized manner and the raw data will be protected from being accessed by other people.

Discussion of results.

Table 2: Demographic characteristics of the respondents

Gender	**Frequency**	**Percent**
Male	126	74.1%
Female	44	25.9%
Total	**170**	**100%**
Age (year)		
16-24	106	62.3%
25-34	37	21.8%
35-60	27	15.9%
Total	**170**	**100%**
Marital status		
Single	110	64.7%
Married	58	34.1%
Divorced	2	1.2%
Total	**170**	**100%**
Education level		
Secondary	106	62.4%
Diploma	26	15.3%
Bachelors	32	18.8%
Masters	6	3.5%
Total	**170**	**100%**
Total	**38**	**100%**
Education technologies		
Virtual lessons	15	14.1%
Asynchronous discussions	29	27.4%
Virtual instructions	62	58.5%
Total	**106**	**100%**

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Table 2: shows that male respondents were 126 (74.1%) and female respondents were 44 (25.9%). Therefore, the majority of respondents were males. This gender disparity in the sample could potentially influence the perspectives and experiences reported in the study, as different genders may have varying experiences with education technology and learning outcomes. Findings on the age of the respondents indicated that respondents aged 16-24 years were 106 (62.3%), followed by those aged 25-34 years at 37 (21.8%) and 35-60 years were 27 (15.9%). The largest age group represented was 16-24 years old, indicating that the majority of respondents are relatively young. This age distribution suggests that the study's findings were more reflective of the experiences and perspectives of students in the education system. Findings on marital status showed that singles were 110 (64.7%), the married were 58 (34.1%) and the divorced were 2 (1.2%). The majority of respondents were single, which is expected given the younger age demographic. The relatively low percentage of married respondents might suggest that marital status has less influence on the use and perception of education technology in this context. On the education level of the respondents, 106 (62.4%) respondents had secondary education (students), 26 (15.3%) had a diploma level, 32 (18.8%) had a bachelor's level of education and 6 (3.5%) had master's level of education. The majority of respondents have secondary education, indicating that they likely have first-hand experience with the education system being studied.

However, a notable proportion also holds higher education qualifications, which could provide diverse perspectives on the impact of education technology. Regarding familiarity with Education Technologies, 15 (14.1%) of the respondents were familiar with virtual lessons, 29 (27.4%) of the respondents were familiar with asynchronous discussions and 62 (58.5%) of the respondents were familiar with virtual instructions. Virtual instructions were the most commonly familiar education technology among respondents. This suggests that virtual instructions may be more prevalent or accessible in the education system studied, potentially influencing the overall perception of education technology's effectiveness in achieving learning outcomes. In conclusion, the demographic characteristics of the respondents in the study provide an important context for understanding their perspectives and experiences with education technology and learning outcomes. While the majority of respondents are male, young, single, with secondary education, and familiar with virtual instructions, the diversity in age, marital status, education level, and familiarity with different education technologies enriches the insights gathered from the study, allowing for a more comprehensive understanding of the topic.

Virtual lessons and achievement of learning outcomes in Upper Secondary schools in Kapchorwa District

Likert scale where the answers were on a scale of 1 to 5. Where 5= Strongly Agree, 4= Agree, 3 = Neutral, 2 = Disagree and 1 = Strongly Disagree. The table also includes the summary of the participant's responses based on percentages (%), frequency (F), standard deviation (Std), and mean. Tick the most appropriate answer using codes

Table 3: Virtual lessons and achievement of learning outcomes in Upper Secondary schools in Kapchorwa District.

Statement	Mean	Standard deviation
There are virtual lessons conducted by external teachers	3.7	0.5
Virtual lessons are expensive for students	4.6	0.2
Virtual lessons are affected by poor network	4.8	0.1
Virtual lessons save time as notes are already generated	4.1	0.8
Virtual lessons provide students with access to a wide range of resources	4.2	0.3
Virtual lessons allow for more personalized learning experiences.	3.1	0.1
Virtual lessons offer greater flexibility in terms of when and where students access learning materials.	4.2	0.3
Not all students have access to the necessary technology tools to participate fully.	4.3	0.4
Virtual lessons lack social interaction and peer-to-peer learning opportunities	4.1	0.8

Source: *Primary data (2024)*

Table 3: indicates that in the statement "There are virtual lessons conducted by external teachers", the mean score was 3.7 and the standard deviation was 0.5. Respondents were neutral regarding the existence of virtual lessons conducted by external teachers. This suggests that while virtual lessons conducted by external teachers exist, there might be some uncertainty or variability in their availability or effectiveness. The statement "Virtual lessons

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are expensive for students" had a mean score of 4.6 and a standard deviation of 0.2. Respondents strongly agree that virtual lessons are expensive for students. This indicates a widespread perception among respondents that accessing virtual lessons carries a financial burden for students, potentially limiting their access or participation.

The statement "Virtual lessons are affected by poor network" had a mean score of 4.8 with a standard deviation of 0.1. Respondents strongly agree that virtual lessons are affected by poor network conditions. This suggests that unreliable internet connectivity is a significant challenge faced in the implementation of virtual lessons, potentially hindering their effectiveness and accessibility.

The statement "Virtual lessons save time as notes are already generated" had a mean score of 4.1 and a standard deviation of 0.8. Respondents are somewhat positive about virtual lessons saving time as notes are already generated. However, the higher standard deviation indicates some variability in perceptions, suggesting that not all respondents are equally convinced about this aspect. The statement "Virtual lessons provide students with access to a wide range of resources" had a mean score of 4.2 and a standard deviation of 0.3. Respondents generally agree that virtual lessons provide students with access to a wide range of resources. This indicates a positive perception of the potential benefits of virtual lessons in enriching learning experiences through diverse resources.

The statement "Virtual lessons allow for more personalized learning experiences" had a mean of 3.1 and a standard deviation of 0.1. Respondents are somewhat neutral regarding virtual lessons allowing for more personalized learning experiences. This suggests that there may be room for improvement in tailoring virtual lessons to individual student needs and preferences.

The statement "Virtual lessons offer greater flexibility in terms of when and where students access learning materials" had a mean of 4.2 and a standard deviation of 0.3. Respondents generally agree that virtual lessons offer greater flexibility in accessing learning materials. This highlights the perceived advantage of virtual lessons in providing flexibility in learning schedules and locations.

The statement "Not all students have access to the necessary technology tools to participate fully" had a mean of 4.3 with a standard deviation of 0.4. Respondents strongly agree that not all students have access to the necessary technology tools to fully participate in virtual lessons. This underscores the equity issues associated with technology access and its implications for inclusive education. The statement "Virtual lessons lack social interaction and peer-to-peer learning opportunities" had a mean score of 4.1 with a standard deviation of 0.8. Respondents agree that virtual lessons lack social interaction and peer-to-peer learning opportunities. This highlights a perceived limitation of virtual learning environments in fostering social connections and collaborative learning experiences.

In conclusion, the findings reveal a mix of perceptions regarding virtual lessons and their impact on learning outcomes. While respondents acknowledge the potential benefits such as access to resources and flexibility, they also recognize challenges such as cost, connectivity issues, and limitations in social interaction. These insights can inform strategies to optimize the implementation of virtual lessons and address the identified challenges to enhance their effectiveness in achieving learning outcomes in Upper Secondary schools in Kapchorwa District.

Asynchronous discussions and achievement of learning outcomes in Upper Secondary schools in Kapchorwa District.

Likert scale for this particular section of the study where the responses were on a scale of 1-5. Where 5 = Strongly Agree, 4 = Agree, 3 = Neutral, 2 = Disagree and 1 = Strongly Disagree. The table below shows a summary of the participant's responses based on percentages (%), frequency (F), standard deviation (Std), and mean;

Table 4: Asynchronous discussions and achievement of learning outcomes in Upper Secondary schools in Kapchorwa District.

Statement	Mean	Standard deviation
Students hold asynchronous discussions with students from other schools	**1.4**	**0.5**
Asynchronous discussions are cheap to conduct by students	**2.3**	**0.4**
Asynchronous discussions give students the flexibility to learn from various locations	**3.9**	**0.6**
Asynchronous discussions are affected by poor network	**4.7**	**0.3**
Asynchronous discussions provide students with the opportunity to reflect on the course material	4.5	0.1
A synchronous discussion enables students to formulate thoughtful responses and engage in deeper critical thinking.	4.1	0.3
Asynchronous discussions enable students to collaborate with their peers	4.4	0.2
Asynchronous discussions allow students to participate at their own pace and convenience	2.6	0.6
Participating in asynchronous discussions helps students gain communication skills	4.1	0.4

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Asynchronous discussions allow students to reflect on their learning	4.4	0.3
Asynchronous discussions cater to different learning preferences and styles	2.4	0.4
Asynchronous discussions provide students with the opportunity to reflect on the course material	4.7	0.2

Source: Primary (2024).

Table 4: shows that the statement "Students hold asynchronous discussions with students from other schools" had a mean score of 1.4 and a standard deviation of 0.5. Respondents strongly disagree that students hold asynchronous discussions with students from other schools. This suggests a perception that cross-school asynchronous discussions are not common or actively practiced. The lack of cross-school asynchronous discussions may indicate limited opportunities for students to engage with peers from different schools, potentially limiting the diversity of perspectives and collaborative learning experiences. The statement "Asynchronous discussions are cheap to conduct by students" had a mean score of 2.3 with a standard deviation of 0.4. Respondents somewhat disagree that asynchronous discussions are cheap to conduct by students. Although the mean is relatively low, there is some variability in perceptions. While asynchronous discussions may not be perceived as prohibitively expensive, there may still be concerns about the cost associated with participating in or facilitating these discussions, which could impact their accessibility.

The statement "Asynchronous discussions give students the flexibility to learn from various locations" had a mean score of 3.9 and a standard deviation of 0.6. Respondents agree that asynchronous discussions provide flexibility for learning from various locations. The relatively high mean suggests a widespread perception of the benefits of asynchronous discussions in accommodating diverse learning environments. The flexibility offered by asynchronous discussions aligns with the needs of students who may have varying schedules or limited access to traditional classroom settings, enhancing opportunities for remote learning and engagement. The statement "Asynchronous discussions are affected by poor network" had a mean score of 4.7 and a standard deviation of 0.3. Respondents strongly agree that asynchronous discussions are affected by poor network conditions. The high mean indicates a widespread recognition of the impact of connectivity issues on the effectiveness of asynchronous discussions. Poor network connectivity poses a significant barrier to the successful implementation of asynchronous discussions, highlighting the need for infrastructure improvements to support digital learning initiatives.

The statement "Asynchronous discussions provide students with the opportunity to reflect on the course material" had a mean score of 4.5 with a standard deviation of 0.1. Respondents strongly agree that asynchronous discussions provide students with the opportunity to reflect on the course material. The high mean and low standard deviation indicate a consistent perception among respondents. Asynchronous discussions are perceived as effective platforms for promoting critical reflection and deeper engagement with course content, fostering metacognitive skills, and enhancing learning outcomes.

The statement "Asynchronous discussions enable students to collaborate with their peers" had a mean score of 4.4 and a standard deviation of 0.2. Respondents strongly agree that asynchronous discussions enable students to collaborate with their peers. The high mean suggests widespread recognition of the collaborative nature of asynchronous discussions. Asynchronous discussions facilitate peer interaction and knowledge sharing, promoting collaborative learning experiences that contribute to the achievement of learning outcomes.

The statement "Asynchronous discussions allow students to participate at their own pace and convenience" had a mean score of 2.6 with a standard deviation of 0.6. Respondents somewhat disagree that asynchronous discussions allow students to participate at their own pace and convenience. The relatively low mean and high standard deviation indicate variability in perceptions. While asynchronous discussions may offer some degree of flexibility, there may be limitations or challenges in accommodating individual learning preferences and schedules, impacting their effectiveness in promoting self-paced learning. The statement "Participating in asynchronous discussions helps students to gain communication skills" had a mean score of 4.1 and a standard deviation of 0.4. Respondents agree that participating in asynchronous discussions helps students gain communication skills. The moderate mean suggests a generally positive perception of the communicative benefits of asynchronous discussions. Asynchronous discussions serve as valuable platforms for developing communication competencies and fostering effective communication and collaboration among students.

The statement "Asynchronous discussions allow students to reflect on their learning" had a mean response of 4.4 and a standard deviation of 0.3. Respondents strongly agree that asynchronous discussions allow students to reflect on their learning. The high mean and low standard deviation indicate a consistent perception among respondents. Asynchronous discussions promote metacognitive awareness and self-directed learning by providing students with opportunities to reflect on their learning process and outcomes. The statement "Asynchronous discussions cater to different learning preferences and styles" had a mean score of 2.4 with a standard deviation of 0.4. Respondents somewhat disagree that asynchronous discussions cater to different learning preferences and styles. The relatively

low mean and high standard deviation suggest variability in perceptions. There may be concerns about the suitability of asynchronous discussions for accommodating diverse learning preferences and styles, indicating potential limitations in their ability to meet the needs of all students effectively.

In conclusion, the findings highlight the perceived benefits and challenges associated with asynchronous discussions in the context of Upper Secondary schools in Kapchorwa District. While asynchronous discussions are recognized for their flexibility, collaborative nature, and facilitation of reflection and communication skills development, challenges such as poor network connectivity and limitations in accommodating diverse learning preferences may need to be addressed to optimize their effectiveness in achieving learning outcomes.

Virtual instructions and achievement of learning outcomes in Upper Secondary schools in Kapchorwa District.

Likert scale for this particular section of the study where the responses were on a scale of 1-5. Where 5 = Strongly Agree, 4= Agree, 3 = Neutral, 2 = Disagree and 1 = Strongly Disagree. The table below shows a summary of the participant's responses based on percentages (%), frequency (F), standard deviation (Std), and mean;

Table 5: Virtual instructions and achievement of learning outcomes in Upper Secondary schools in Kapchorwa District.

Statement	mean	Standard deviation
Teachers send virtual instructions	**2.1**	**0.3**
Students access computers and phones for virtual instructions	**2.6**	**0.6**
Virtual instruction limits interactions with instructors	**2.5**	**0.4**
Students encounter technical issues like poor network	**4.7**	**0.2**
Virtual instructions offer less personalized support	**4.3**	**0.2**
Virtual instructions lack hands-on learning	**4.4**	**0.7**
Virtual instructions limit building relationships with tutors	**2.0**	**0.2**
Virtual instructions provide students with access to a wide range of resources	**2.7**	**0.3**
Virtual instructions allow for more flexibility in tailoring instruction to meet the individual needs of students	**4.8**	**0.3**
Virtual instruction platforms enable students to collaborate with peers	**4.2**	**0.2**

Source: Primary (2024).

Table 5: shows that the statement "Teachers send virtual instructions" had a mean score of 2.1 and a standard deviation of 0.3. Respondents disagree that teachers send virtual instructions. The relatively low mean suggests a perception that virtual instructions from teachers are not commonly utilized. There may be limited adoption or implementation of virtual instructions by teachers, potentially impacting the availability and effectiveness of virtual instructional materials. The statement "Student's access computers and phones for virtual instructions" had a mean score of 2.6 with a standard deviation of 0.6. Respondents somewhat disagree that students access computers and phones for virtual instructions. The relatively low mean and high standard deviation indicate variability in perceptions. While some students may access virtual instructions through computers and phones, there may be challenges or limitations in technology access or utilization among the student population.

The statement "Virtual instructions limit interactions with instructors" had a mean score of 2.5 and a standard deviation of 0.4. Respondents somewhat disagree that virtual instructions limit interactions with instructors. The relatively low mean suggests a perception that virtual instructions do not significantly hinder interactions with instructors. While virtual instructions may not completely replace face-to-face interactions with instructors, they may still provide opportunities for communication and support.

The statement "Students encounter technical issues like a poor network" had a mean score of 4.7 with a standard deviation of 0.2. Respondents strongly agree that students encounter technical issues like poor networks. The high mean indicates a widespread recognition of the challenges posed by technical issues in accessing virtual instructions. Technical issues such as poor network connectivity significantly impact the effectiveness of virtual instructions, highlighting the need for infrastructure improvements to support digital learning initiatives.

The statement "Virtual instructions offer less personalized support" had a mean score of 4.3 and a standard deviation of 0.2. Respondents strongly agree that virtual instructions offer less personalized support. The high mean suggests a widespread perception that virtual instructions may not adequately address individual learning needs. Virtual instructions may lack the personalization and individualized support provided in traditional classroom settings, potentially impacting student engagement and learning outcomes.

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The statement "Virtual instructions lack hands-on learning" had mean score of 4.4 and standard deviation of 0.7. Respondents strongly agree that virtual instructions lack hands-on learning. The high mean and high standard deviation indicate consistent perception among respondents. The absence of hands-on learning opportunities in virtual instructions may limit students' practical skills development and application, affecting the comprehensiveness of their learning experiences.

The statement "Virtual instructions limit building relationships with tutors" had a mean score of 2.0 and a standard deviation of 0.2. Respondents strongly disagree that virtual instructions limit building relationships with tutors. The low mean suggests a perception that virtual instructions do not significantly hinder relationship-building with tutors. Despite the virtual nature of instructions, there may still be opportunities for students to build relationships and connect with tutors, potentially through alternative communication channels.

The statement "Virtual instructions provide students with access to a wide range of resources" had a mean score of 2.7 and a standard deviation of 0.3. Respondents somewhat disagree that virtual instructions provide students with access to a wide range of resources. The relatively low mean suggests a perception that virtual instructions may not fully leverage available resources. There may be limitations or gaps in the diversity and accessibility of resources provided through virtual instructions, potentially impacting the richness of students' learning experiences.

The statement "Virtual instructions allow for more flexibility in tailoring instruction to meet the individual needs of students" had a mean score of 4.8 and a standard deviation of 0.3. Respondents strongly agree that virtual instructions allow for more flexibility in tailoring instruction to meet the individual needs of students. The high mean indicates a widespread recognition of the flexibility offered by virtual instructions. Virtual instructions are perceived as effective platforms for adapting instruction to accommodate diverse learning needs and preferences, enhancing the customization of learning experiences.

The statement "Virtual instruction platforms enable students to collaborate with peers" had a mean score of 4.2 and a standard deviation of 0.2. Respondents strongly agree that virtual instruction platforms enable students to collaborate with peers. The high mean suggests a widespread perception that virtual instruction platforms facilitate peer collaboration. Despite the virtual nature of instructions, students can still engage in collaborative learning experiences and interact with peers, potentially fostering peer support and knowledge sharing.

In conclusion, the findings highlight both challenges and opportunities associated with virtual instruction in Upper Secondary schools in Kapchorwa District. While technical issues and limitations in personalization and hands-on learning may pose challenges, virtual instructions also offer flexibility and opportunities for collaboration, contributing to the achievement of learning outcomes. Addressing challenges while leveraging the strengths of virtual instructions can optimize their effectiveness in enhancing learning experiences and outcomes.

Correlational findings

Table 6: Correlational findings

		Achievement of learning outcomes in Upper Secondary schools in Kapchorwa District
Virtual lessons	Correlation Coefficient	0.386*
	Sig. (2-tailed)	.006
	N	170
Asynchronous discussions	Correlation Coefficient	0.568*
	Sig. (2-tailed)	.002
	N	170
Virtual instructions	Correlation Coefficient	0.561*
	Sig. (2-tailed)	.001
	N	170

Source: Primary (2024)

Table 6: shows that the correlation between virtual lessons and the achievement of learning outcomes was 0.386. This suggests a moderate positive correlation between virtual lessons and the achievement of learning outcomes. The p-value (0.006) indicates that this correlation is statistically significant at the 0.05 level (since it is less than 0.05). The findings suggest that there is a significant, albeit moderate, positive relationship between the use of virtual lessons and the achievement of learning outcomes in Upper Secondary schools in Kapchorwa District. This indicates that schools

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that utilize virtual lessons tend to have better learning outcomes. The correlation between asynchronous discussions and the achievement of learning outcomes was 0.568. This indicates a strong positive correlation between asynchronous discussions and the achievement of learning outcomes. The p-value (0.002) suggests that this correlation is statistically significant at the 0.05 level. The findings indicate a strong and significant positive relationship between the use of asynchronous discussions and the achievement of learning outcomes. This suggests that schools where asynchronous discussions are utilized tend to see better learning outcomes among students.

The correlation between virtual instructions and the achievement of learning outcomes was 0.561. This indicates a strong positive correlation between virtual instructions and the achievement of learning outcomes. The p-value (0.001) suggests that this correlation is statistically significant at the 0.05 level. The findings reveal a strong and significant positive relationship between the use of virtual instructions and the achievement of learning outcomes. This implies that schools that implement virtual instructions tend to have better learning outcomes among students. Overall, the correlational findings suggest that all three factors - virtual lessons, asynchronous discussions, and virtual instructions - are positively associated with the achievement of learning outcomes in Upper Secondary schools in Kapchorwa District. Schools that utilize these digital learning methods may experience improved academic performance among their students. However, it's important to note that correlation does not imply causation, and other factors not accounted for in this study could also contribute to the observed relationships.

Discussion of key results.

Virtual lessons and achievement of learning outcomes in Upper Secondary schools in Kapchorwa District

The findings from the survey on virtual lessons in Upper Secondary schools in Kapchorwa District reveal a nuanced perspective among respondents:

Respondents were neutral about the existence of virtual lessons conducted by external teachers, indicating some uncertainty or variability in their availability or effectiveness.

There was a strong agreement among respondents that virtual lessons are expensive for students, suggesting a widespread perception of financial burden associated with accessing virtual education. Respondents strongly agreed that virtual lessons are affected by poor network conditions, highlighting a significant challenge that hinders their effectiveness and accessibility.

While respondents were somewhat positive about virtual lessons saving time as notes are already generated, there was variability in perceptions, suggesting not all respondents were equally convinced about this aspect. Respondents generally agreed that virtual lessons provide students with access to a wide range of resources, indicating a positive perception of the potential benefits of enriching learning experiences.

There was neutrality regarding virtual lessons allowing for more personalized learning experiences, indicating room for improvement in tailoring lessons to individual student needs.

Respondents generally agreed that virtual lessons offer greater flexibility in accessing learning materials, highlighting the advantage of virtual education in providing flexible learning schedules and locations. There was strong agreement that not all students have access to the necessary technology tools to fully participate in virtual lessons, indicating equity issues in technology access and implications for inclusive education. Respondents agreed that virtual lessons lack social interaction and peer-to-peer learning opportunities, indicating a perceived limitation in fostering social connections and collaborative learning experiences. The correlation between virtual lessons and the achievement of learning outcomes was 0.386. This suggests a moderate positive correlation between virtual lessons and the achievement of learning outcomes. The p-value (0.006) indicates that this correlation is statistically significant at the 0.05 level (since it is less than 0.05).

The findings suggest that there is a significant, albeit moderate, positive relationship between the use of virtual lessons and the achievement of learning outcomes in Upper Secondary schools in Kapchorwa District. This indicates that schools that utilize virtual lessons tend to have better learning outcomes. Overall, the findings suggest a mixed perception of virtual lessons, recognizing both their potential benefits and challenges. These insights can inform strategies to optimize the implementation of virtual lessons and address identified challenges to enhance their effectiveness in achieving learning outcomes in Upper Secondary schools in Kapchorwa District.

The literature discussed provides valuable insights into the broader context of virtual learning environments, which can help contextualize the findings of the study regarding virtual lessons and their impact on learning outcomes in Upper Secondary schools in Kapchorwa District.

Müller (2021) emphasizes the importance of authentic and high-quality virtual learning environments, particularly focusing on communication between students and teachers, as well as peer-to-peer interactions. This aligns with the findings of the study, where respondents acknowledged the limitations of virtual lessons in providing social interaction and peer-to-peer learning opportunities. Dung (2020) highlights the potential benefits of digital resources in providing students with more time for active learning and self-directed spaces. While the study did not directly investigate the use of self-directed spaces like blogs and forums, it suggests that such resources could enhance the effectiveness of virtual learning environments, complementing the findings regarding access to a wide range of resources in virtual lessons.

Torres Martín et al. (2021) found that immersive virtual reality can be an effective pedagogical tool, which echoes the potential benefits of virtual lessons identified in the study, particularly in providing engaging and interactive learning experiences. Kaufmann (2022) outlines key learning outcomes for Upper Secondary school students related to digital age skills and effective learning environments. These outcomes underscore the importance of incorporating virtual learning experiences, such as virtual lessons, to develop students' digital literacy and prepare them for the demands of the digital age. Wang et al. (2020) and Jones et al. (2019) both demonstrate the positive impact of virtual lessons on student engagement, motivation, and learning outcomes, which aligns with the moderate positive correlation found in the study between virtual lessons and achievement of learning outcomes.

Smith et al. (2018) and Brown et al. (2021) provide further evidence of the potential effectiveness of virtual lessons in improving student learning outcomes, particularly in subjects like science and social studies. These findings support the positive perceptions of virtual lessons identified in the study, despite acknowledging challenges such as connectivity issues and limitations in social interaction. Overall, the literature corroborates the findings of the study regarding the potential benefits of virtual lessons in enhancing learning outcomes in Upper Secondary schools. While challenges and limitations exist, such as cost, connectivity issues, and the need for more personalized learning experiences, the literature suggests that virtual learning environments can be valuable tools for promoting student engagement, motivation, and achievement. Integrating insights from both the study findings and the literature can inform strategies to optimize the implementation of virtual lessons and address the identified challenges, ultimately enhancing their effectiveness in achieving learning outcomes in Upper Secondary schools in Kapchorwa District.

Asynchronous discussions and achievement of learning outcomes in Upper Secondary schools in Kapchorwa District.

Respondents strongly disagree that students engage in asynchronous discussions with peers from other schools, indicating a perceived lack of cross-school interaction and potentially limiting diversity of perspectives. There is some disagreement about the affordability of asynchronous discussions for students, suggesting concerns about associated costs despite not being perceived as prohibitively expensive. Respondents widely agree that asynchronous discussions offer flexibility in learning from various locations, aligning with the needs of students with diverse schedules and environments. There is strong agreement that poor network connectivity affects the effectiveness of asynchronous discussions, indicating significant barriers to implementation. Respondents strongly agree that asynchronous discussions provide opportunities for students to reflect on course material, fostering critical thinking and metacognitive skills. There is widespread recognition that asynchronous discussions enable collaboration among students, enhancing learning experiences through peer interaction and knowledge sharing.

There is some disagreement about asynchronous discussions allowing students to participate at their own pace and convenience, suggesting limitations in accommodating individual learning preferences and schedules. Respondents agree that participating in asynchronous discussions helps students gain communication skills, acknowledging the communicative benefits of these platforms. There is strong agreement that asynchronous discussions facilitate students' reflection on their learning, promoting metacognitive awareness and self-directed learning. There is some disagreement about asynchronous discussions catering to different learning preferences and styles, indicating potential limitations in meeting the diverse needs of all students effectively. In conclusion, while asynchronous discussions are recognized for their flexibility, collaborative nature, and facilitation of reflection and communication skills development, challenges such as poor network connectivity and limitations in accommodating diverse learning preferences may need to be addressed to optimize their effectiveness in achieving learning outcomes in Upper Secondary schools in Kapchorwa District.

The literature discussed provides a comprehensive understanding of the potential impact of asynchronous discussions on achieving learning outcomes in Upper Secondary schools, which aligns well with the findings of the study. Rindaningsih et al. (2021) and Moorhouse & Wong (2022) emphasize the benefits of asynchronous discussions in promoting deeper understanding, critical thinking skills, and inclusivity in learning environments. These findings align with the strong positive correlation found in the study between asynchronous discussions and the achievement of learning outcomes. The ability of asynchronous discussions to foster reflective interaction among peers and provide opportunities for shy or introverted students to participate comfortably contributes to their effectiveness in enhancing learning outcomes. Farros et al. (2020) and Xu (2020) highlight the practicality and advantages of asynchronous discussions in engaging students in online classes, promoting active learning, and accommodating diverse learning preferences and styles. The study findings reflect these perceptions, with respondents generally acknowledging the flexibility and collaborative nature of asynchronous discussions, as well as their potential to cater to different learning needs.

Al-Husban (2020) discusses the importance of assessing asynchronous discussions to ensure that they effectively contribute to achieving learning outcomes. This aligns with the study findings, which suggest a strong and significant positive relationship between asynchronous discussions and learning outcomes. Effective assessment strategies are

crucial for measuring students' critical thinking skills, application of course concepts, and communication abilities, all of which are fostered through asynchronous discussions. Dahlstrom-Hakki (2020) raises concerns about the timing and meaningfulness of asynchronous engagement, emphasizing the need for deliberate and thoughtful participation in asynchronous discussions. While the study findings indicate a strong positive correlation between asynchronous discussions and learning outcomes, it is essential to consider the quality and depth of student engagement in these discussions to optimize their impact on achieving learning outcomes.

Overall, the literature supports the positive role of asynchronous discussions in enhancing learning outcomes in Upper Secondary schools. The findings of the study complement existing research by providing empirical evidence of the strong positive correlation between asynchronous discussions and learning outcomes. By integrating insights from both the study findings and the literature, educators, and policymakers can develop strategies to effectively leverage asynchronous discussions to promote deeper learning and improve student achievement in Upper Secondary schools.

Virtual instructions and achievement of learning outcomes in Upper Secondary schools in Kapchorwa District.

Respondents generally disagree that teachers commonly send virtual instructions, indicating a perception of limited utilization of virtual instructional materials. While some students may access virtual instructions through computers and phones, there are perceived challenges or limitations in technology access or utilization among the student population. There is widespread agreement that students encounter technical issues like poor network connectivity, significantly impacting the effectiveness of virtual instructions. Respondents strongly agree that virtual instructions offer less personalized support, potentially impacting student engagement and learning outcomes.

Virtual instructions are perceived to lack hands-on learning opportunities, potentially limiting students' practical skills development and application.

Despite being virtual, there is a perception that virtual instructions do not significantly hinder relationship-building with tutors, providing opportunities for connection through alternative communication channels.

There is disagreement about the extent to which virtual instructions provide access to a wide range of resources, suggesting potential gaps in resource diversity and accessibility.

Respondents strongly agree that virtual instructions allow for more flexibility in tailoring instruction to meet individual student needs, highlighting their adaptability and customization potential.

There is widespread agreement that virtual instruction platforms enable students to collaborate with peers, fostering peer support and knowledge sharing despite the virtual nature of instructions.

The correlation between asynchronous discussions and the achievement of learning outcomes was 0.568. This indicates a strong positive correlation between asynchronous discussions and the achievement of learning outcomes. The p-value (0.002) suggests that this correlation is statistically significant at the 0.05 level. The findings indicate a strong and significant positive relationship between the use of asynchronous discussions and the achievement of learning outcomes. This suggests that schools where asynchronous discussions are utilized tend to see better learning outcomes among students. The correlation between virtual instructions and the achievement of learning outcomes was 0.561. This indicates a strong positive correlation between virtual instructions and the achievement of learning outcomes. The p-value (0.001) suggests that this correlation is statistically significant at the 0.05 level.

The findings reveal a strong and significant positive relationship between the use of virtual instructions and the achievement of learning outcomes. This implies that schools that implement virtual instructions tend to have better learning outcomes among students. Overall, while challenges such as technical issues and limitations in personalization and hands-on learning exist, virtual instructions offer opportunities for flexibility and collaboration, contributing to the achievement of learning outcomes in Upper Secondary schools in Kapchorwa District.

Acquah & Katz (2020) and Liu et al. (2020) highlight the diverse nature of virtual instructions, encompassing various forms of digital education that leverage technology to facilitate teaching and learning. This aligns with the findings of the study, which suggest a mix of perceptions regarding the utilization and effectiveness of virtual instructions in Upper Secondary schools.

Szymkowiak (2021) emphasizes the potential of virtual instructions to provide access to a wider range of learning resources and personalized learning experiences, contributing to improved learning outcomes. Mukhtasar (2021) further underscores the flexibility and customization offered by virtual instructions, which can enhance students' engagement and achievement.

Farros et al. (2020) discuss the collaborative and interactive nature of virtual instructions, which can foster engagement, critical thinking, and teamwork among students. These findings align with the study's results, which suggest a widespread perception among respondents that virtual instruction platforms enable collaboration and peer interaction. However, challenges such as technical issues, limited personalization, and lack of hands-on learning opportunities associated with virtual instructions are also evident in the literature and reflected in the study findings. Pisoni & Hoogeboom (2019) discuss the disparities in access to technology and resources, which

can pose barriers to effective virtual instruction and impact learning outcomes.

Clark (2003) and Salerno (2021) highlight the need for further research into the factors influencing student success in virtual learning environments, particularly in Upper-secondary settings. Rice (2006) underscores the importance of teacher readiness and facilitation in maximizing the effectiveness of virtual learning environments. Overall, the literature and study findings suggest that while virtual instructions hold promise in enhancing learning outcomes, addressing challenges such as technology access, personalization, and teacher facilitation is essential to realizing their full potential in Upper Secondary schools. By leveraging the strengths of virtual instructions and addressing potential barriers, educators and policymakers can optimize their effectiveness in promoting student engagement, achievement, and holistic development.

Conclusion.

The study highlights a mix of perceptions regarding the benefits and challenges associated with virtual lessons, asynchronous discussions, and virtual instructions. While these digital learning methods offer advantages such as flexibility, access to resources, and opportunities for collaboration, they also face challenges related to cost, connectivity issues, limitations in personalization, and hands-on learning experiences. The correlational findings indicate strong positive relationships between the use of virtual lessons, asynchronous discussions, and virtual instructions, and the achievement of learning outcomes. Schools that implement these digital learning methods tend to see better academic performance among students. This suggests the potential of digital learning technologies to positively impact learning outcomes in Upper Secondary schools.

Recommendations.

Addressing technical challenges such as poor network connectivity is crucial for optimizing the effectiveness of digital learning methods. Schools and education authorities should prioritize investment in reliable internet infrastructure and technology tools to ensure seamless access to virtual lessons and asynchronous discussions for all students.

Given the perceived costliness of accessing virtual lessons, financial support mechanisms such as subsidies or scholarships could be implemented to alleviate the financial burden on students. This would help ensure equitable access to digital learning resources and mitigate disparities in access based on socioeconomic status.

Providing teachers with training and professional development opportunities in digital pedagogy is essential for enhancing the quality of virtual instruction. Teachers should be equipped with the skills and knowledge necessary to effectively leverage digital learning platforms, personalize instruction, and facilitate engaging asynchronous discussions.

To address the perceived limitations in hands-on learning experiences, virtual lessons, and asynchronous discussions should incorporate interactive and practical elements. This could include virtual simulations, hands-on experiments, group projects, and real-world applications to enhance student engagement and deepen understanding.

Strategies should be implemented to promote social interaction and peer-to-peer learning opportunities within digital learning environments. This could involve structured collaborative activities, discussion forums, group projects, and peer feedback mechanisms to foster meaningful interactions and collaborative learning experiences.

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List of abbreviations.

CVI	Content Validity Index
ICT	Information and communication technologies
SPPS	Special Package for Social Sciences
TAM	Technology Acceptance Model.

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The authors declare no conflict of interest.

Availability of data.

Data used in this study is available upon request from the corresponding author.

Authors contribution.

KKN designed the study, conducted data collection, cleaned and analyzed data and draft the manuscript and SM supervised all stages of the study from conceptualization of the topic to manuscript writing.

Authors biography

Kenneth Kennedy Nakitari is a student with a master's degree in education planning and management at the School of Graduate Studies and Research, Team University. Sendagi Muhammad is a research supervisor at the School of Graduate Studies and Research, Team University.

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