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Article

Students' Technology Preference and Computer Technology Applications in the Teaching and Learning of Physics Modules at the University Undergraduate Level in South Africa during the COVID-19 Pandemic

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Abstract: This research aims to establish students' technology preferences and computer technology applications in the teaching and learning of university physics modules during the COVID-19 pandemic. The proposed objectives were (a) to establish students' technology preferences in physics modules for 2nd and 3rd-year undergraduate level students; (b) to establish students' hardware technology preferences and hardware technology they own; (c) to determine relationships between technology preferences using Pearson's correlation coefficient and (d) to determine the effectiveness of the integration of computer technology applications in the lecturer's teaching and learning of physics modules. Forty-one students (58.5% male and 41.5% female) participated. The questionnaire data was examined utilising descriptive and inferential statistics. Based on the findings of this study, integrating technology in tertiary physics education is recommended as it may enhance the comprehension of abstract and difficult physics concepts.

Keywords: COVID-19; Technology Enhanced Learning; physics; technology preference; web technologies; online learning

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1. Introduction

The usage of Technology Enhanced Learning (TeL) is breaking down barriers in all education advances by speeding up the transfer of knowledge from a teacher to students [1]. TeL refers to any type of technology-supported learning and is increasingly popular in tertiary education as universities worldwide continue to invest in its use to transform traditional education [2,3]. However, this has pressured lecturers to adapt to this exponential growth of technology integration in universities. In addition, the coronavirus disease (COVID-19) that was declared a pandemic, infecting millions of people and causing whole nations' lockdowns in at least one hundred and eighty countries, has also acted as a catalyst in the introduction of TeL. Mobile learning, blended learning, and open online courses are examples of TeL, which are supported by current technologies such as learning analytics, intelligent learning systems, and many learning applications [4]. The COVID-19 pandemic came to South Africa when students from many public universities in the country protested against registration fees, rising tuition fees, and lack of accommodation [5,6]. In some universities, the protest led to the destruction of university properties, prompting university management to close the universities temporarily [5,6]. The students' protest was also experienced at the university under this study, as most of its rural student population could not afford the fee hikes [5,6]. On 26 March 2020, the COVID-19 pandemic halted all protests and university activities as an announcement was made to close all universities leading to national lockdowns [5]. The university under study was not spared from the sudden shift from traditional methods of instruction, face-to-face approaches, to online instruction [7]. However, this shift to online needed to be supported by radical changes by students and lecturers concerning their communication style, online assessments and content delivery [8]. Many research studies in South Africa reveal that socio-economic factors such as race, gender, social class, age, education and geographical area have caused a digital divide [9]. As a result, universities, including those under study, still struggle to provide internet, computers and related software to their students [6,7,10]. Its rural location aggravates the situation as the communities do not have adequate information and communications technology (IcT) infrastructure to support online learning, unreliable electricity, and network connectivity challenges [11]. Despite all these challenges before the COVID-19 outbreak, the university had online learning platforms but mainly used for sharing learning materials whilst teaching and learning physics modules was done using the traditional face-to-face method [5]. Physics is a natural science subject based on theories, experiments, observations, measurements, and mathematical analysis. In their study, Tenzin et al. noted the need to use TeL to demystify its abstractness among students [12]. Students at the undergraduate level find it difficult to understand some physics modules. This is evident through students' failure to apply taught knowledge to transform their community's living standards, including negative perceptions such as 'physics is difficult' [12–14]. It is envisioned that the introduction of TeL in Physics will promote students' achievement [1]. In addition, integrating technology in the teaching and learning of Physics supports teaching methodologies that embrace the active participation of students [15]. During the COVID-19 outbreak, it was noted that most lecturers were struggling with online teaching. The lecture preparations were hectic and overwhelming for most of them. Online assessment challenges were also a significant issue as the lecturers could not type an assessment that required the length of physics equations and formulae; hence resorted to multiple-choice questions [5]. On the other hand, students could not answer the exam/test questions because of poor computer typing skills of equations using the online blackboard platform offered by the university [5].

Against this background, this present study aims to understand the technological preferences of students and the applications of computer technology used in the teaching and learning of physics modules. The study also aims to establish students' hardware technology preferences and state of ownership of hardware computer technology they will use during their physics lectures. In addition, the study aims to determine the relationships between technology preferences using Pearson's correlation coefficient and examine whether lecturers effectively integrate computer technology applications while teaching physics modules.

The following research questions guide this research:

(a) What are students' technology preferences in physics modules for 2nd and 3rd-year undergraduate level students?
(b) Which hardware technology do students prefer and own?
(c) Is there any relationship between technology preferences?
(d) How effectively do lecturers incorporate computer technology applications in teaching and learning of physics modules?

2. Literature Review

2.1. Theoretical Framework

This study will utilise constructivism theory and the cognitive theory of multimedia learning. Constructivism theory emphasises more on active student participation. The student is an active constructor of knowledge [16], whilst the cognitive theory of multimedia learning positively claims that the use of multimedia in teaching and learning of physics will result in a more profound comprehension of physics concepts. The cognitive theory of multimedia learning suggests that students effectively comprehend a concept through a combination of both verbal and pictorial explanations and, therefore, should not merely depend on verbal explanations [17–20]. The first stage in this theory is to choose the correct verbal and visual information. Secondly, to choose accurate verbal and visual information to arrange separately into vivid mental models. Thirdly, to link connections between verbal and mental models and integrate these models with knowledge already known [17,21]. The two theories support each other as multimedia usage will promote a learning environment that will put the student at the centre of all learning activities and allow them to construct meaning from their own experiences [21].

2.2. Students' Technology Preferences in Physics Instruction

It is widely acknowledged in many research studies that considering the students' technology preferences and perceptions will be critical to successfully integrating technology in physics instruction and learning [22]. In support of this notion, Mirriahi et al. asserted that designing learning environments taking into account students' technology preferences would lead to high levels of acceptance of the technologies by students [23]. Similarly, Saeed et al. believe students' different learning styles deeply influence their technology preferences, and technology positively impacts achieving balanced academic performance [24]. Conole et al. conducted research to find out students' technology preferences and why they prefer them. The results showed that students are utilising technologies to support their learning. They indicated that Google, Wikipedia, word, instant messaging (IM), and podcasts were being utilised for information searching and handling. They also stated that students used technologies like e-mail, MSN messenger, skype and blogs for communication, especially with their friends, when discussing their learning materials. Lastly, for assignments and homework, the students indicated that they were using Microsoft Office (Word, Powerpoint and Excel) [22,25].

The introduction of TeL into physics instruction affects the lecturer's ability to quickly adjust to multiple modalities of content delivery based on e-learning and online learning [26]. Researchers have noted that lecturers must prioritise improving the teaching and learning of physics because, at present, physics education mainly utilises traditional lecture-based approaches, making students passive recipients of information [27]. In addition, according to academic research, incorporating technology into physics instruction and learning has the advantage of students becoming the centre of the learning process and, therefore, having control over the pace of learning and freedom to consider any educational information of their choice [18,28].

It is also worth noting that in surveys conducted at the time of the COVID-19 outbreak on online learning, above sixty percent of participants acknowledged using online learning. Fifty percent of those surveyed said the system was user-friendly [26,29]. On the other hand, Coman et al. noted that students do not actively participate in online learning, especially in activities requiring critical thinking [30]. If the lecturer requests their contributions, they will give an excuse for network connection challenges or can not hear the lecturer because of the poor sound quality of their device [30]. Costado Dios [7] noted that 49% of students who participated in a survey preferred face-to-face learning, and 7% favoured online learning. However, 44% chose both online learning and face-to-face learning. The students suggested that they should carry out practical work through face–to–face learning, whilst theoretical classes were handled through online learning. Gherhes et al. conducted research at the Politehnica University of Timisoara to find out about students' perceptions of face-to-face and e-learning. Their findings showed that the students preferred face-to-face learning more than e-learning [25].

Similarly, in the studies by Mahfouz et al. at the university of Jordan, most students preferred face-to-face learning over online learning. The reason for their choice was that face-to-face offered direct contact with lecturers as compared to online learning. It is noteworthy that Mahfouz et al. concluded that students' lack of technological devices and tools required for online learning due to socio-economic factors might have contributed to their negative responses regarding online learning.

Gocsal and Marusenko researched on the use of Praat free software in teaching physics topics on waves and sound [10]. The main focus was to demonstrate various sound waves using Praat, an Information communication technology instrument capable of depicting visual differences of sound waves more accurately than textbook illustrations.

Gocsal and Marusenko [16] asserted that using technology in physics classes will help students understand physical laws. The use of technology brings varied representations, for example, pictures, animations and graphs. Students can understand fundamental concepts, relationships, and processes, particularly when it is challenging to experience a phenomenon in the laboratory [16]. The research further revealed that time-consuming and costly experiments would be made possible by integrating technology into physics modules. Oyelaki et al. [31] found that undergraduate-level students doing a Physics course believed that a combination of computer-assisted instruction (a student-centred approach) and a traditional classroom teaching approach would nurture their interest. This suggests that technology integration in physics teaches better ways of visualising complex concepts [32]. Azar and Şengüleç [33] posited that computer technology applications effectively capture interest in studying physics modules.

Zosia [34] assessed three emerging technologies in physics. Physlets, according to Zosia [34], increased pupils' conceptual comprehension of physics. The second technology, the Andes intelligent tutoring system, helped students better know how to solve physics problems procedurally. The third technology, microcomputer-based laboratory instruments, assisted students in making links between concrete events and abstract representations.

Tugirinshuti et al. [20] carried out a survey to determine the obstacles to video-based multimedia integration in Physics. The survey results revealed that multimedia technology is under-utilised in physics instruction. Poor infrastructure, lack of time to design and prepare for video lectures, and lecturers focusing on preparing students for final examinations are all obstacles to effectively integrating multimedia technology into physics.

2.3. Web-Based Applications

Lecturers and students can use emerging web technologies such as podcasts, vodcasts, course blogs, course wikis, and instant messaging to teach and learn physics modules. Podcast technology is when audio is recorded and then distributed to students through the internet. It then permits student users to access the feed of new files [35], while vodcast is simply the distribution of video files. A course blog is an online website that looks like a journal or diary and is free to use, manipulate, and personalise. Blogs are simple websites that allow a blogger to write, modify, and publish blog posts in the blogosphere [36]. Course Wiki is a collection of interconnected web pages reflecting multiple authors' collaborative efforts [37]. It makes it easier to create common knowledge, disseminate information, and engage with others [38]. Lecturers can evaluate the students' contributions to the wiki. As a result, it can be quite beneficial when used as a tool for connecting with peers [39,40]. Instant messaging is a method of Internet-based real-time communication among more than two individuals using written text. Instant messaging enhances student engagement and collaboration, as well as interaction and communication abilities [41]. Latifah et al. [42] found that mobile instant messaging can help students strengthen their critical thinking abilities. Therefore, the current study seeks to establish students' preferences for these new emerging web technologies in teaching physics modules, which have grown in popularity following the COVID-19 outbreak. The study will include two traditional technologies the university has been utilising even before the pandemic: e-mails and blackboard.

2.4. Computer Technology Applications

Onasanya et al. [43] posited that integrating technology into education creates a conducive environment for learning that will lead to students performing well in their physics modules since they become active learners rather than passive ones. Computer technology applications are hampered by perceived technological hurdles, time restrictions, lecturer complacency, self-efficacy deficiencies, and lecturer views and values regarding integrating technology into physics module teaching [44]. Lowerison et al. [45] asserted that integrating technology in physics must lead students to competently carry out learning tasks and implement their taught knowledge to solve society's everyday needs. Furthermore, students will be motivated if technology is not only used as a tool for simple presentations of physics lectures. In addition, [46] in their study reported that computer-aided instruction was very effective regarding students' cognitive achievement when they were doing a physics topic, for example, current electricity [31].

Various examples of computer technology applications are mentioned in the literature [31]. The use of interactive computer simulations in physics modules has been widely embraced [47]. This is because physics simulation creates animated, highly engaging and game-like environments, which promotes student-centred approaches that will allow students to connect real-life situations to underlying physics concepts. However, implementing physics simulations in physics teaching largely depends on the lecturer's ability to find suitable simulations that will directly address physics lessons' technical and academic requirements [48,49].

3. Materials and Methods

3.1. Context and Methodology of Research

This study utilised a survey method, and participants were 2nd and 3rd-year Physics undergraduate students from a university in South Africa. Quantitative data were collected as primary data from the questionnaire to measure the respondents' preferences and opinions using deductive and logical thinking. The questionnaire was developed based on the ones used in earlier research investigations by Saeed et al. [24] and Lowerison et al. [45]. As a tool to collect the data, the questionnaire provided no opportunity for interviewers' bias [50]. The questionnaire, an online tool, was created using Google forms. The researchers sent the respondents the questionnaire's web link via e-mail and Whatsapp platform, respectively, to complete the questionnaire and submit it back [51]. Since it was an online form when respondents submitted their responses, they were all received in real-time, and this minimised physical contact between the researchers and respondents. The practice resonated well with the COVID-19 prevention protocol in South Africa. The students were requested to take part anonymously for one week. The responses were extracted from Google forms as an excel file and then coded in SPSS (Statistical Package for the Social Sciences) software version 26 for windows for analysis.

3.2. Participants

Voluntary and convenience sampling approaches were used in this study. The researchers chose these strategies because of their simplicity, cheap cost, and time-consuming nature [8]. A sample size representative of 34% (n = 41) of the total physics student enrolment (N = 119) in the 2nd and the 3rd-year undergraduate level was utilised in this research study. This study's participants comprised registered university students. Table 1 shows the demographic profiles of the students.

Table 1. Demographic Characteristics of Participants.

Category	Sample Total	Percentage (%)	Population Total
Gender			
Male	24	58.5	69
Female	17	41.5	50
Undergraduate Level			
2nd-year Physics	32	78	88
3rd-year Physics	9	22	31
Age			
16–20 years	26	63.4	
21–25 years	11	26.8	
25 years and above	4	9.8	

Table 1 shows that the demography is adequate and reflective of the whole variety of views held by students studying physics, with 41 undergraduate students participating in the study. Of the respondents, 41.5% (N = 17) were female, and 58.5% (N = 24) were male. The majority of the students (63.4%) were between the ages of 16 and 20 years.

3.3. Research Instrument

The instrument for data collection was a 64-item questionnaire designed by the researchers and tagged "Physics student questionnaire'. The instrument was divided into four sections as follows:

1. Section 1 consisted of 5 items that captured the participants' demographics (gender, undergraduate level, age, number of hours spent on the internet and their purpose of using the internet).
2. Section 2 included 31 items about the technology preference of the 2nd and 3rd-year undergraduate physics students. Each item was structured on a five-point Likert scale of least preferred (LP), slightly preferred (SP), preferred (P), strongly preferred (SP) and most preferred (MP). The higher the number on the scale, the more firmly the participants agreed (item) [8].
3. Section 3 included 16 items on students' preferred hardware technology and the hardware technology they own. The responses to items in Section 3 used multiple-choice with Yes or No options to choose.
4. Section 4 had 12 items on students' experiences and opinions on the effectiveness of computer technology applications in the teaching and learning of their previous and current physics modules. The responses to items in Section 4 used a six-point Likert scale of very ineffective (VI), ineffective (I), neutral (N), effective (E), very effective (VE) and not applicable (NA). The higher the number on the scale, the more firmly the participants agreed (item) [8]

3.4. Data Analysis

The researchers used a five-dimensional Likert scale. As indicated in Table 2, all responses were coded as follows: 1 = Least preferred, 2 = Slightly preferred, 3 = Neutral, 4 = Preferred, and 5 = Most preferred, with the responses used to evaluate counting times.

Table 2. Evaluation of scale data based on the responses of scale and category intervals [52].

Category	Responses	Category Interval
1	Least preferred	1–1.80
2	Slightly preferred	1.81–2.60
3	Neutral	2.61–3.40
4	Preferred	3.41–4.20
5	Most preferred	4.21–5.00

1–1.80 represents "Least preferred," 1.81–2.60 represents "Slightly preferred," 2.61–3.40 represents "Neutral," 3.41–4.20 represents "Preferred," and 4.21–5.00 represents "Most preferred" [51–53].

The minimum and the maximum length of the 5-point Likert scale is calculated by first obtaining the range of the response level ($5 - 1 = 4$) and then dividing it by the number of levels, which is equal to 5, that is ($4/5 = 0.80$). 0.8 represents the length of the category. Afterwards, 1, which is the lowest scale value, was added to identify this category's maximum. The lengths of the categories were then determined, as shown in Table 2.

The quantitative descriptive statistical analysis (which includes percentages, mean, and standard deviation) was performed using SPSS to answer the research questions. At the same time, the relationships between technologies were evaluated by using the Pearson correlation coefficient.

To acquire the overall category of students' experiences and opinions on the effectiveness of computer technology applications in teaching and learning of their previous and current physics modules, the presentation criteria in Table 3 were employed.

Table 3. Interval of the effectiveness of computer technology applications in the teaching and learning of their previous and current physics modules.

Score Interval (%)	Category
75–100	Strongly Agree
50–74.99	Agree
25–49.99	Disagree
0–24.99	Strongly Disagree

Source [54,55].

4. Results

4.1. Tests of Instrument Reliability

The reliability test checked the internal consistency of items on the questionnaire used in the study. The reliability test was conducted using SPSS. The researchers tested the reliability of sections 2 to 4. Table 4 shows the reliability test results for sections 2 to 4 of the questionnaire. It covers three metrics: the coefficient of Cronbach's alpha (Ca), Cronbach's alpha based on standardised items (CASI) and the smallest Cronbach's Alpha if Item Deleted (SCAID). The Ca is a value number from 0 to 1, with higher numbers suggesting stronger internal consistency. The Cronbach's alpha values of sections 2, 3, and 4 ranged from 0.614 to 0.962. The overall reliability value was 0.862, suggesting acceptable reliability for the survey tool. Cronbach's alpha values above 0.7 are considered reliable [56]. The results also depict that the participants responded well to the items given in the questionnaire.

Table 4. Reliability tests of the Physics student questionnaire.

Section	Ca	CASI	SCAID	Conclusion
2	0.927	0.917	0.921	Very Reliable
3	0.614	0.580	0.559	Reliable
4	0.962	0.963	0.958	Very Reliable
Overall reliability	0.862	0.802	0.855	Very reliable

The data shown in Table 5 indicates that 6 (14.6%) and 9 (22.0%) of the students spent between 5–10 h and 10–15 h, respectively, using the internet per week. Furthermore, 9 (22.0%) of the students spent between 15–20 h whilst most of the students, 17 (41.5%), spent above 20 h on the internet per week. It is interesting to note that 36 (87.8%) of the students spent many hours studying using the internet, with the majority of students, 13 (31.7%), studying above 20 h per week using internet. This clearly indicates that students are aware of technology-enhanced learning, primarily web-based e-learning applications. Meanwhile, 3 (7.3%) of the students spent time using the internet for entertainment activities.

Table 5. Hours students spend on the internet per week and purpose of use.

<table>
<tr><th colspan="3" rowspan="2"></th><th colspan="4">Hours Students Spend on the Internet per Week</th><th rowspan="2">Total</th></tr>
<tr><th>5–10 h</th><th>10–15 h</th><th>15–20 h</th><th>Above 20 h</th></tr>
<tr><td rowspan="6">Purpose</td><td rowspan="2">Study</td><td>Frequency</td><td>6</td><td>8</td><td>9</td><td>13</td><td>36</td></tr>
<tr><td>% of total</td><td>14.6%</td><td>19.5%</td><td>22.0%</td><td>31.7%</td><td>87.8%</td></tr>
<tr><td rowspan="2">Entertainment</td><td>Count</td><td>0</td><td>1</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td>% of total</td><td>0.0%</td><td>2.4%</td><td>0.0%</td><td>4.9%</td><td>7.3%</td></tr>
<tr><td rowspan="2">Others</td><td>Frequency</td><td>0</td><td>0</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td>% of total</td><td>0.0%</td><td>0.0%</td><td>0.0%</td><td>4.9%</td><td>4.9%</td></tr>
<tr><td colspan="2" rowspan="2">Total</td><td>Frequency</td><td>6</td><td>9</td><td>9</td><td>17</td><td>41</td></tr>
<tr><td>% of total</td><td>14.6%</td><td>22.0%</td><td>22.0%</td><td>41.5%</td><td>100.0%</td></tr>
</table>

4.2. Students' Technology Preferences

Figures 1–3 show that most students (63.4%) preferred lectures to be taught online, 29.3% preferred lectures to be taught using the traditional approach (face–to–face), and 39% of the students preferred both online and face-to-face lectures. Therefore, it is evident that students can adapt to the technology-enhanced teaching and learning strategies that fit well with the present scenario of the COVID-19 pandemic, making it difficult for face-to-face teaching and learning.

Table 6 further analyses students' preferences on how lectures are taught. In Table 6, the mean for online lectures is 4.20. This means that most of the students preferred lectures to be taught online. The mean for face-to-face is 3.29. Accordingly, most students were neutral as to whether they needed their lectures to be taught face-to-face or not. The majority of the students preferred to be taught face-to-face and online lectures. The calculated mean is 3.71. This is quite interesting, considering that most students indicated neutrality when it was only for face-to-face lectures.

Table 6. Students' preference on how Lectures should be taught.

I Prefer Lectures to Be Taught	Mean	Standard Deviation	Decision
online	4.20	1.269	Most preferred
face to face	3.29	1.453	Neutral
both online and face to face	3.71	1.327	Preferred

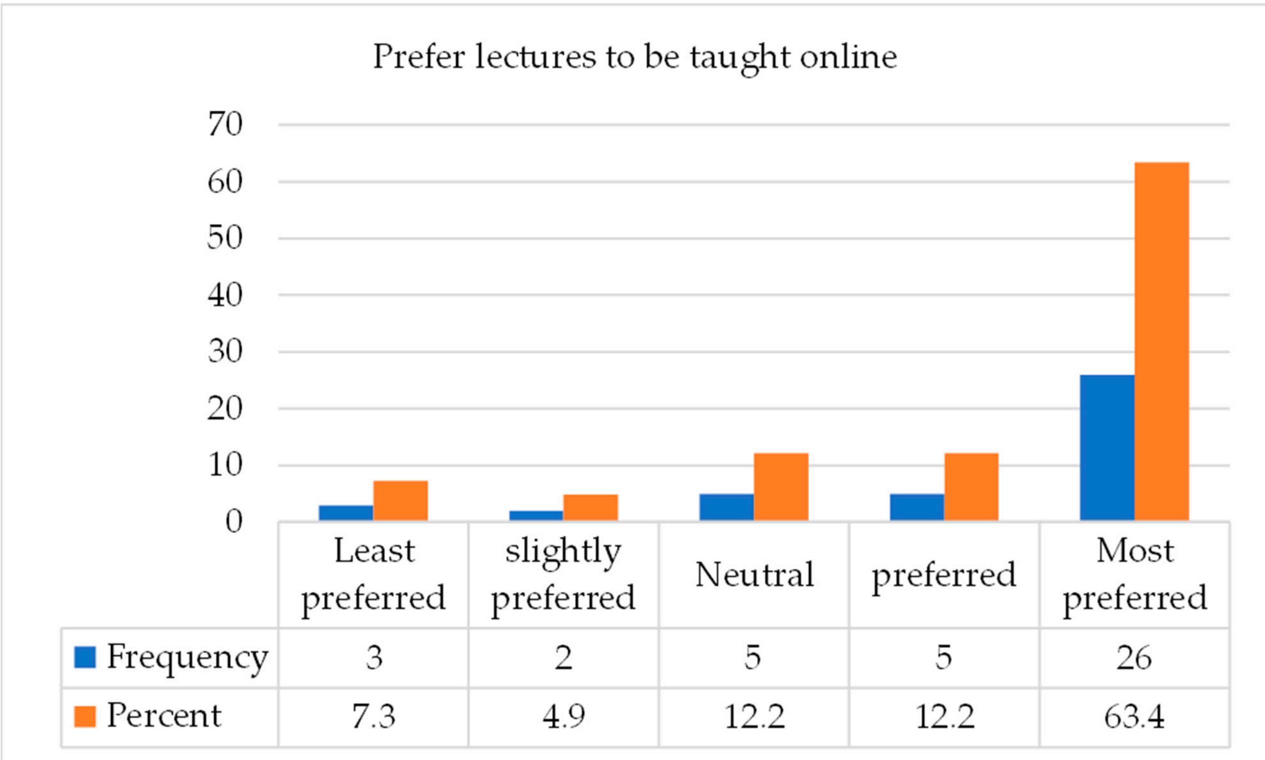

Figure 1. Students' preferences on online lectures.

The findings of students' technology preferences for online lectures when submitting/receiving their tasks to lecturers and carrying out online study discussions with their classmates are shown in Tables 7–10. In Table 7, findings show that the majority of the students were neutral about submitting task/assignments to their lecturers through podcast (mean = 2.9), course blog (mean = 3.0), course wiki (mean = 2.9) and email (mean = 3.4). The students slightly preferred vodcast (mean = 2.5) and IM (mean = 2.6) to submit their tasks/assignments to their lecturers. However, most students preferred submitting their tasks/assignments to the lecturer through the blackboard (mean = 4.7).

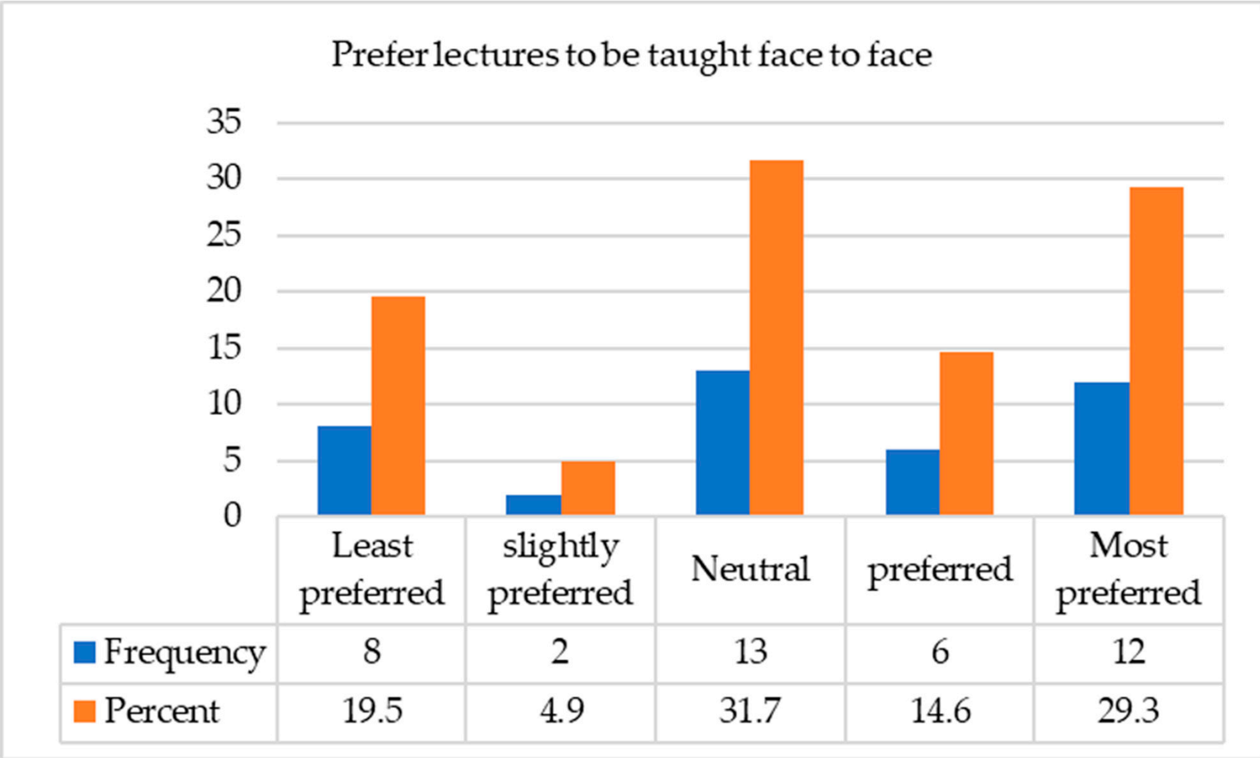

Figure 2. Students' preferences on face-to-face lectures.

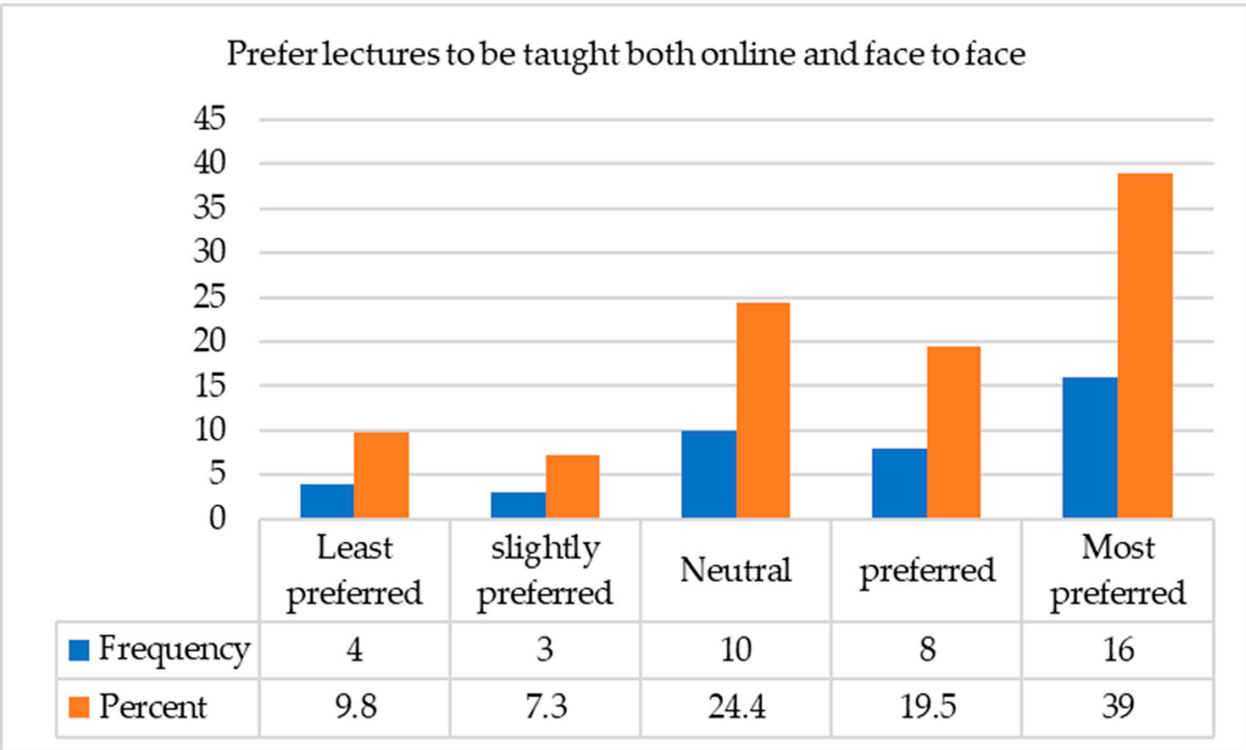

Figure 3. Students' preferences in both online lectures and face-to-face lectures.

Table 7. Students' Technology Preference for Online Lectures.

I Prefer Online Lectures through	Mean	Standard Deviation	Decision
podcast	2.9	1.5	Neutral
vodcast	2.5	1.3	Slightly Preferred
course blog	3.0	1.5	Neutral
course wiki	2.9	1.5	Neutral
IM	2.6	1.3	Slightly Preferred
e-mail	3.4	1.6	Neutral
blackboard	4.7	0.8	Most preferred

Table 8. Shows students' preferences on tasks/assignment submission.

I Prefer to Submit Online All My Tasks as	Mean	Standard Deviation	Decision
podcast	3.1	1.7	Neutral
vodcast	2.6	1.5	Slightly Preferred
course blog	2.7	1.4	Neutral
course wiki	2.7	1.5	Neutral
IM	2.6	1.5	Slightly Preferred
e-mail	4.3	1.1	Most preferred
blackboard	4.7	0.6	Most preferred

Table 9. Students' preferences for tasks/assignments received.

I Prefer to Receive All My Tasks through	Mean	Standard Deviation	Decision
podcast	2.7	1.6	Neutral
vodcast	2.7	1.5	Neutral
course blog	2.7	1.6	Neutral
course wiki	2.6	1.6	Slightly Preferred
IM	2.7	1.5	Neutral
e-mail	4.3	0.9	Most preferred
blackboard	4.7	0.7	Most preferred

Table 10. Students' preference on how they would want to carry out an online study discussion with colleagues.

I Prefer an Online Study Discussion with a Colleague through	Mean	Standard Deviation	Decision
podcast	2.8	1.5	Neutral
vodcast	2.7	1.4	Neutral
course blog	2.6	1.3	Slightly Preferred
course wiki	2.4	1.4	Slightly Preferred
IM	2.5	1.4	Slightly Preferred
e-mail	3.6	1.4	Preferred
blackboard	4.4	0.9	Most preferred

Table 8 shows that most students preferred their tasks/assignments submitted through e-mails (mean = 4.3) and Blackboard (mean = 4.7). Traditional technologies like e-mail and blackboard might have influenced this preference since these two technologies are presently being used in teaching and learning modules at the university. Neutrality in emerging web technologies such as course wikis, blogs and podcasts indicate these technologies are not popular with students.

Table 9 depicts the same trend as observed in Table 8. Most students preferred their task/assignments to be received through e-mails (mean = 4.3) and blackboard (mean = 4.7) and chose to be neutral in most of the emerging web technologies such as podcasts, vodcast, course blogs and instant messaging (IM).

Lastly, in Table 10, most students preferred e-mails (mean = 3.6) and blackboard (mean = 4.4) for online group discussions with colleagues. on the other hand, the results indicated that students were willing to carry out their online studies using course blogs, course wiki and instant messaging (IM).

4.3. Relationships within Technology Preferences

The relationship between technological preferences was established using Pearson correlation analysis. The Pearson correlation coefficients (r) can be classified as shown in Table 11 below.

Table 11. Pearson correlation classification.

Pearson Correlation Coefficients (r)	Classification of the Relationship
0	No relation
$0 < r < 0.3$	Weak relation
$0.3 \leq r < 0.7$	Moderate relation
$0.7 \leq r \leq 1.0$	Strong relation

Table 12 shows the correlation between technology preferences of how lectures are taught. The technologies correlated consist of emerging web technologies, namely podcast, vodcast, course blog, course wiki and instant messaging (IM) and conventional technologies, namely e-mail and blackboard. The correlation coefficients between these technologies varied between 0.448 and 0.806. All correlations between technologies were positive. This suggests that having a stronger preference for one technology led to a stronger preference for the other [24]. There was a strong positive correlation and statistical significance ($r = 0.727$, $p < 0.01$) between course blogs and wiki technology. Furthermore, a very strong positive correlation and statistically significance ($r = 0.806$, $p < 0.01$) between course wiki and instant messaging (IM) technologies. The results obtained also support the findings by [24]. They found no correlation between emerging web technologies (podcast, vodcast, course blog, course Wiki, and instant messaging (IM) and traditional online technologies (e-mail and blackboard)). However, an exceptional case in this present study is that, between e-mail and instant messaging (IM) technologies, there was a positive correlation ($r = 0.447$, $p < 0.01$).

Table 12. Correlation between technology preferences on how lectures are taught.

	P	V	B	W	IM.	E	BB.
Podcast (P)	1						
Vodcast (V)	0.547 **	1					
Course blog (B)	0.448 **	0.694 **	1				
Course wiki (W)	0.471 **	0.586 **	0.727 **	1			
IM	0.557 **	0.566 **	0.567 **	0.806 **	1		
E-mail (E)	0.393 *				0.447 **	1	
Blackboard (BB.)							1

Note: ** correlation is significant at the 0.01 level (2-tailed). * correlation is significant at the 0.05 level (2-tailed).

In Table 13, the correlational tests between technology preferences on how tasks are submitted revealed that, in most cases, there are moderate to strong positive correlations ($0.523 < r < 0.0.828$, $p < 0.01$). However, an exceptional case of a weak positive correlation and statistically significant between e-mail and Course wiki (W) technologies ($r = 0.366$, $p < 0.05$) was observed. The emerging findings also align with earlier research that the blackboard and e-mail did not correlate with emerging web technologies (podcast, vodcast, course blog, course Wiki, and instant messaging (IM)) [24]. Course blog (B) and vodcast (V) technologies showed a very strong positive correlation ($r = 0.828$), with a significance level of 0.000 < 0.01. The findings also revealed that course wiki and instant messaging (IM) technologies had moderate to strong relationships with most of the technologies; however, their correlation was the strongest (r = 0.751, $p < 0.01$).

Table 13. Correlation between technology preferences on how tasks are submitted.

	P	V	B	W	IM.	E	BB.
Podcast (P)	1						
Vodcast (V)	0.523 **	1					
Course blog (B)	0.571 **	0.828 **	1				
Course wiki (W)	0.620 **	0.622 **	0.667 **	1			
IM	0.687 **	0.639 **	0.692 **	0.751 **	1		
E-mail (E)				0.366 *		1	
Blackboard (BB.)							1

Note: ** correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

As can be seen in Table 14, the results show that there is a significant strong positive correlation between technology preferences (0.745 < r < 0.928, $p < 0.01$). This means that students prefer to receive their assignments/tasks using different technologies instead of depending on one particular type of technology. A similar trend in Table 14 shows course, wiki and instant messaging (IM) technologies having very strong positive correlations with most technologies. The highest recorded is between course blog (B) and course Wiki technologies (r = 0.928, $p < 0.01$). As previously observed in this study, the two traditional technologies, blackboard and e-mail, did not have any relationship with other emerging web technologies (podcast, vodcast, course blog, course wiki and instant messaging (IM)).

Table 14. Correlation between technology preferences on how tasks are received.

	P	V	B	W	IM.	E	BB.
Podcast (P)	1						
Vodcast (V)	0.745 **	1					
Course blog (B)	0.825 **	0.830 **	1				
Course wiki (W)	0.847 **	0.829 **	0.928 **	1			
IM	0.857 **	0.850 **	0.920 **	0.919 **	1		
E-mail (E)						1	
Blackboard (BB.)							1

Note: ** correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

The findings in Table 15 showed that there is a moderate to strong positive correlation between technology preferences for online study discussions with a colleague (0.560 < r < 0.880, $p < 0.01$). The blackboard had a positive moderate correlation with use of emails (r = 0.318, $p < 0.05$). Both are traditional technologies; therefore, the study also sought to assert if blackboard would likely correlate with other traditional technologies rather than emerging web technologies.

Table 15. Correlation between technology preferences on online study discussions.

	P	V	B	W	IM.	E	BB.
Podcast (P)	1						
Vodcast (V)	0.716 **	1					
Course blog (B)	0.700 **	0.880 **	1				
Course wiki (W)	0.560 **	0.816 **	0.796 **	1			
IM	0.569 **	0.758 **	0.686 **	0.808 **	1		
E-mail (E)						1	
Blackboard (BB.)						0.318 *	1

Note: ** correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

4.4. Hardware Technology Preferences and Ownership

In Figure 4, the most prefered hardware technology by students was a laptop (97.6%), whiteboard (97.6%) and books (85.4%). Furthermore, students showed preferences in the use of smartphones (68.3%), tablets (58.5%) and desktop computers (58.5%). However, 12.2% and 17.1% of the students preferred to use videos/games and television to learn physics modules, respectively. The results showed that students prefered hardware technology that they are familiar with, usually the hardware that most universities provide for teaching and learning of modules.

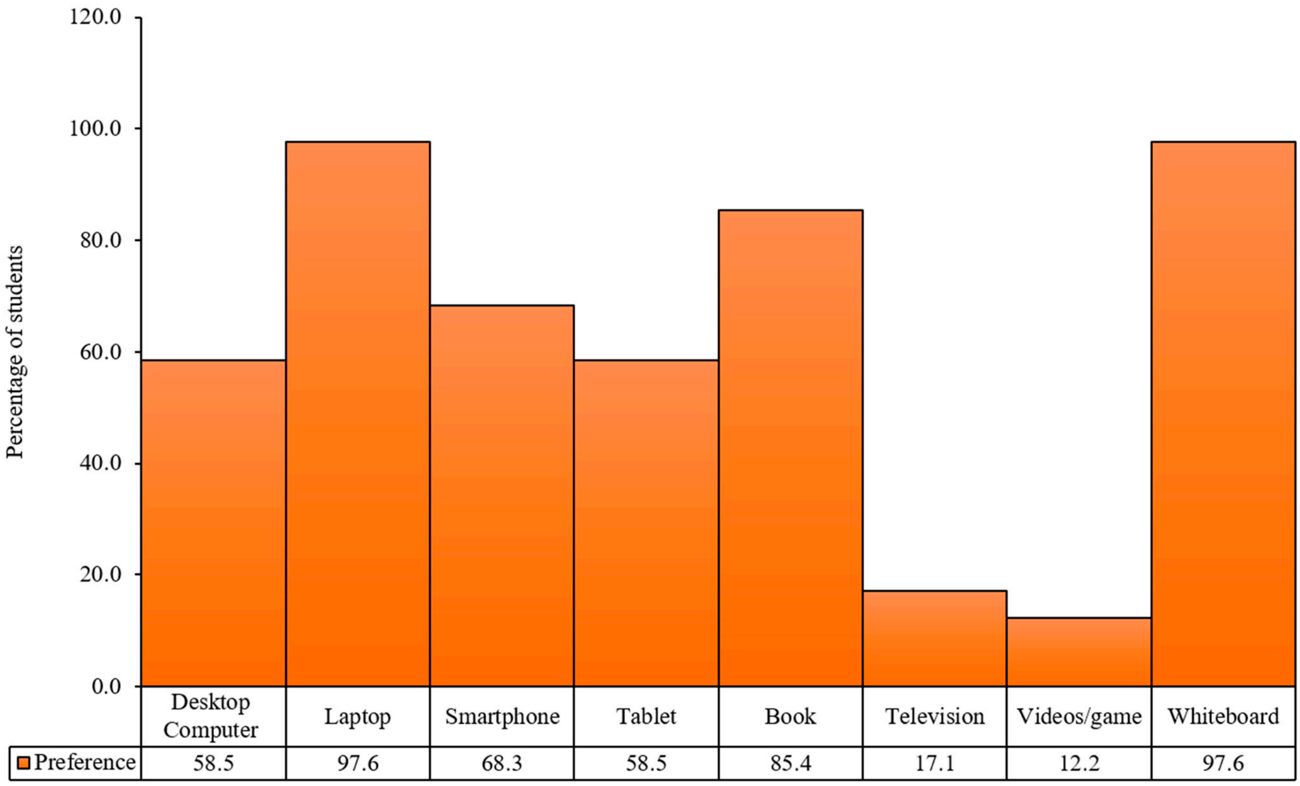

Figure 4. Hardware technology students prefer to use when learning.

In this study, 97.6% of the students owned laptops, 95.1% owned smartphones, and 78% owned whiteboards as hardware technology for teaching and learning physics. Very few students indicated that they own television (4.9%) and (videos/games) hardware technology. Furthermore, 65.9% of the students owned books as a hardware technology for learning physics modules. See (Figure 5).

4.5. Students' Preferences on the Effectiveness of Computer Technology Applications in the Teaching and Learning of Physics Modules

In Table 16, the data related to integrating computer technology applications in instructional supplements such as drill and practice exercises and tutorials by lecturers shows that 14.6% of the respondents rated its use as effective, whilst 51.2% as very effective. This means that 65.8% of the respondents agree that the lecturers implement technology-enhanced teaching and learning when teaching physics modules. Using computer technology based on drill and practice and tutorials in the teaching and learning of physics modules increases learning motivation and learning activities by giving a variety of practice questions that students can do and trigger student feedback [57,58]. This implies that computer technology applications are being implemented by lecturers teaching Physics modules. This is clearly depicted in Table 16, as 65.9% of students indicated that using communication such as e-mail, mailing lists, and conferencing by lecturers in their physics modules was effective. This is important, especially during the COVID-19 pandemic, as students can build and maintain communication and interaction with lecturers. This also facilitates students' access to study material and study, therefore deepening their conceptual comprehension of physics concepts. Similarly, 51.2% of the students stated that integrating computer technology applications in organisational applications, such as databases and spreadsheets, by the lecturer when teaching physics modules is effective. This means students support that lecturers utilise computer technology applications in Physics modules when teaching.

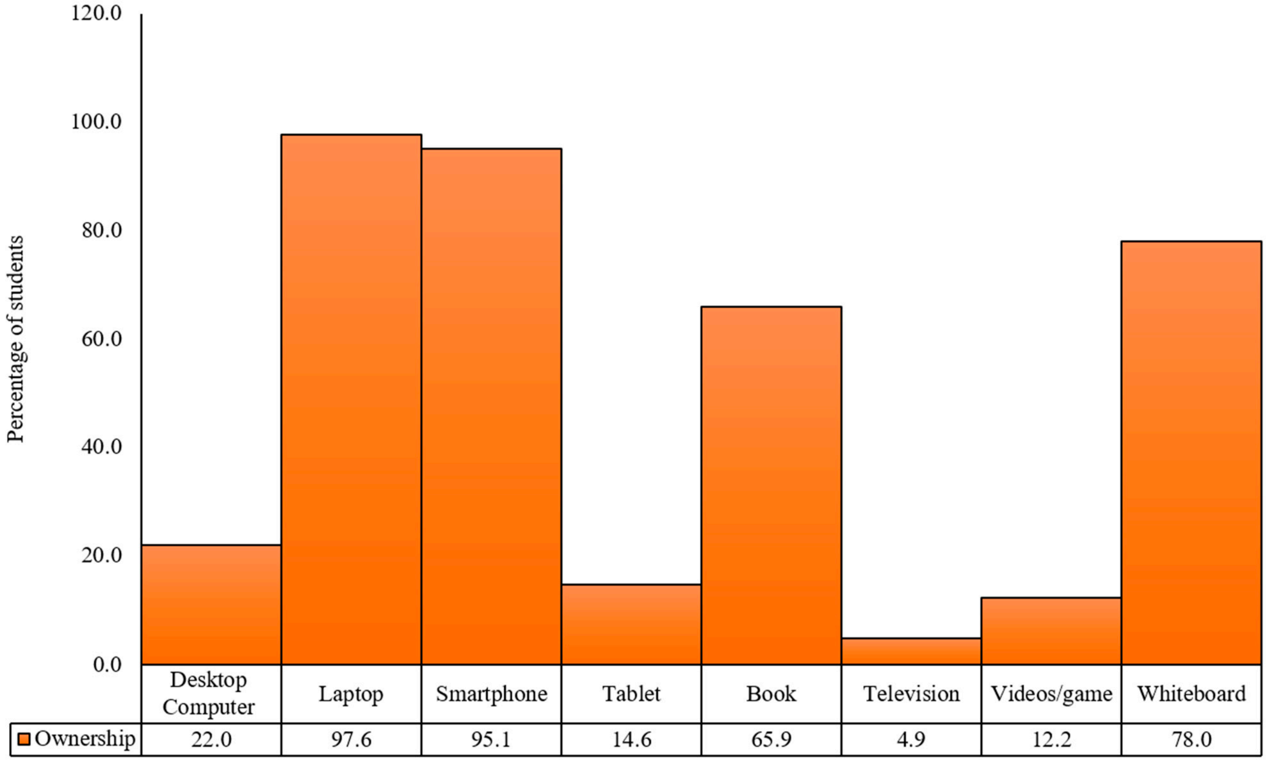

Figure 5. Hardware technology students own.

Only 46.3 students responded that using Analytical or Programming applications such as statistics, charting, graphing, drafting or robotics by the lecturer in physics modules is effective. According to the categorisation in Table 3, students disagree with the notion that the lecturers are effectively using computer technology applications when teaching the physics modules. Lecturers might lack the skills to fully incorporate computer applications or software, such as MatLab, when teaching complex physics concepts that require solving high-order mathematical operations such as differentiation, integration, and optimisations. In addition, software like MatLab is expensive to buy and requires computers with large free space on the disk and a high-performance processor [59]. However, participants' responses did indicate that lecturers are integrating computer applications or software in their instruction of physics modules.

Findings also showed that a total of 65.9% of students expressed that computer technology applications like expansive uses such as simulations or experiments are being effectively used in the lecturer's teaching and learning of physics. Meanwhile, 53.7% of the students indicated that there was an effective use of computer technology applications in creative uses such as desktops, publishing, digital videos, digital cameras, scanners or graphics. In both cases, students agreed that the lecturers were using computer applications in their teaching. Most experiments that assist students in learning physics concepts cannot be done in real laboratories because they are not safe, complicated, time-consuming, and expensive to run. With the use of these simulations in a short time, students can learn various scientific phenomena using pictures, graphs, and vectors. PhET simulations are controlled so that they provide certain phenomena and structures with which the user can interact by changing some parameters. The simulation-based virtual laboratories also helped students conduct experiments during the COVID-19 pandemic [14,60]. It is important to note that 58.6% of students clearly stated that both the use of expressive uses such as word processing or online journals and the use of presentation applications such as PowerPoint in Physics modules was effective. According to Table 3, this means students agree that the lecturers employed computer technology applications effectively during teaching and learning. Although preparing an exciting PowerPoint presentation (including animation, photos and illustrations) is time-consuming, students are kept focused and motivated to learn [12]. Thus, 48.8% of the students responded that using computer technology applications in evaluative uses, such as electronic portfolios in physics modules, was effective. However, according to the categorisation in Table 3, most students disagreed that it was effective because the positive responses on its effectiveness fell below 50%. On the effectiveness of computer technology applications for informative uses such as the internet in the Physics modules. Only 36.6% of students stated that the integration of computer technology applications in the teaching and learning of physics modules was effective. The emerging findings could be related to the fact that students had trouble connecting to the internet and had power outages such as load shedding. Students may have disagreed as a result of this problem [61,62]. 61% of the students, through their responses, agreed that using access applications such as a class folder in physics modules was effective. Overall, 65.9% of the students agreed in this study that using computer technology applications in teaching Physics modules by lecturers at the university is effective.

Table 16. Students' responses on the effectiveness of computer technology applications in teaching and learning physics modules.

	Students' Responses (%)					
Aspect	**Very Ineffective**	**Ineffective**	**Neutral**	**Effective**	**Very Effective**	**NA.**
Instructional Supplements (drill and practice)	22	2.4	7.3	14.6	51.2	2.4
Communication (e-mail, conferencing)	22	7.3	17.1	17.1	48.8	4.9
Organisational applications (databases/spreadsheets)	17.1	4.9	17.1	19.5	31.7	9.8
Analytical/Programming applications (statistics, graphing)	19.5	2.4	14.6	14.6	31.7	17.1
Expansive uses (simulations)	12.2	9.8	9.8	29.3	36.6	2.4
Creative uses (desktop publishing)	19.5	7.3	9.8	17.1	36.6	9.8
Expressive uses (word processing)	14.6	4.9	12.2	22.0	36.6	9.8
Evaluative uses (electronic portfolios)	17.1	2.4	12.2	26.8	22.0	19.5
Informative uses (Internet or DVDs)	14.6	7.3	19.5	12.2	24.4	22.0
Presentation applications (PowerPoint)	9.8	9.8	12.2	9.8	48.8	9.8
Access applications (class website/folder)	17.1	4.9	7.3	22.0	39.0	9.8
Overall use	17.1	4.9	9.8	12.2	53.7	2.4

5. Discussion

The majority of the students preferred online learning of Physics lectures, similar to the findings in [63]. This might be because online learning overcomes the physical distance barrier between the lecturer and the students brought about by the COVID-19 pandemic, which stopped face-to-face lectures. Online learning promotes versatility and flexibility. Face-to-face, which heavily depends on time and space, was not much preferred [64]. Many academics also believe that online learning allows lecturers to use more effective pedagogical and instructional tools, such as games, interactive models, computer simulations and animations, and audio and video clips, to involve learners in meaningful knowledge production [64,65]. However, in cases where the lecturer is not comfortable with an abrupt transition to only online learning, the use of both face-to-face and online learning can be recommended. The present study shows that students generally preferred a combination of face-to-face and online learning. The findings are contrary to that of Gherhes et al., who found that students prefered face-to-face learning as compared to online learning [66]. The preference for face-to-face learning may have been motivated by the need to interact with fellow students as they were doing before the COVID-19 pandemic [66]. Interaction is evident in physics classes as students usually consult their peers on complex physics concepts they fail to comprehend during lectures. It is also interesting to note that students strongly preferred online learning regardless of issues of unreliable electricity and network connectivity challenges experienced in the university's area [6].

In Tables 7–10, it can be deduced that the blackboard and the e-mail, considered traditional technologies, were the most preferred technologies for online lectures, submission, and receiving of tasks or assignments. Similar trends were also observed by Saeed et al. [34]. This preference may be attributed to the fact that students at the university were familiar with blackboard and e-mail technologies as they utilised them in learning physics modules [5]. It is important to note that the use of the blackboard had a lot of challenges. As Landa et al. pointed out, lecturers avoided using the blackboard because they were not competent.

On the other hand, it is interesting to note that students were prepared to try out these new emerging web technologies, such as vodcast, course wiki and blogs and instant messaging (IM), as they slightly prefer them. These results also suggest that physics students are eager to collaborate using multiple communication channels, similar to Saeed et al. findings [24]. Therefore, these results can be used to incorporate emerging web technologies (vodcast, course wiki, blogs, and instant messaging (IM) in the teaching and learning physics modules as the students prefer them.

Tables 12–15 depict strong positive correlations between technology preferences. The results showed that students preferred to utilise the technological tools such as podcasts, vodcast, course wiki, blackboard and instant messaging in their online learning, Different learning styles might have influenced the students' preferences for these technological tools [22,24]. In addition the relationship between these technologies shows that students are aware of existing new technologies and are more than prepared to utilise them when studying physics modules. This could be an advantage to the lecturer as many options for bringing clarity to complex physics concepts through different instructional and technological communication tools are made available.

In Figures 4 and 5, students owned the hardware technology that they preferred to use. These results suggest that technology integration is possible because most students have the necessary technological tools like laptops and smartphones. As noted in [67], lack of access to appropriate hardware technology leads to demotivation among students. It is also evident from this study that most students did not prefer television and videos/games or owning them, so the lecturer should not design instructional material based on these technologies. Their use will not motivate students and instil interest in physics lessons.

In Table 16, students' responses on the effectiveness of computer technology applications in teaching and learning revealed that the technology is being used for instructional supplements which promote drill and practice associated with rote learning. Therefore, constructivists' approaches which are student-centred, are ignored. This leads to students learning physics without comprehending the key concepts. In this case, researchers can assert that technology is used to deliver the physics content rather than as a means to promote deep and meaningful learning. Other uses like communication and expressive use, presentations and access applications indicate that lecturers value integrating computer technology applications in the teaching and learning of physics modules. The students' responses in this study revealed that lecturers effectively utilised digital videos in teaching physics modules. This is supported by Mayer's cognitive theory of multimedia learning, as digital videos are capable of visual representations of physics concepts and are accessible at any time [18,68]. Consistent with this study, Tugirinshuti et al. [19] reported that video-based multimedia is being utilised in teaching physics in Rwandan secondary schools, but the degree of utilisation is below expectations. Many research studies opined that the effective use of multimedia would lead students to acquire the necessary dynamic skills, values and physics content that maybe be applied to solve everyday societal problems [18,21,69]. However, contrary to expectations, research has also shown that students passively watch instructional videos, becoming passive recipients of physics concepts. To remedy this challenge, tasks, quizzes, and questions must be added to online videos that might encourage active processing [68].

The use of simulations by lecturers was very effective. Dantic and Fularon also reported this finding. They noted that the use of simulations positively affected academic performance in the field of physics and, at the same time, developed students' critical thinking skills. Overally, students asserted that computer technology applications are effective in their teaching and learning of physics modules. Therefore, researchers need to establish the technologies that are more effective in teaching and learning each physics module.

6. Limitations and Future Research

The research was conducted in one university with a relatively small sample that was non-probabilistic. Therefore, findings can not be generalised to represent the other universities in the country. It would therefore be proper to carry out a similar study to other universities so that the findings can represent all universities. The other limitation of the study was that it only utilised student questionnaires as a research instrument and did not conduct interviews to seek clarity on some of the student responses. On the other hand, lecturers' preferences were not investigated in this study and could be future work.

7. Conclusions

The feedback showed that 53.7% of the students spent over 15 h on the internet per week studying. This clearly indicates that most students are well versed with e-learning usage of the internet and informed about emerging web technologies. The information gathered in this study on students' technology preferences revealed that most students preferred online learning of Physics lectures or a combination of online and face-to-face learning. One of the reasons could be that the COVID-19 pandemic changed how universities were expected to conduct teaching and learning. In addition, most physics students preferred traditional technologies (blackboard and e-mail) for online lectures, submission and receiving of tasks or assignments over new emerging web technologies.

On the other hand, students in this study showed a willingness to test out new web technologies that promote student involvement and interaction in general [70]. In light of this, it is envisioned that for the effective teaching and learning of the physics modules, the lecturers should utilise students' preferences for designing instructional strategies and materials for the physics modules. Further to this, research findings illuminated that technology integration that bears the students' preferences will promote students' interest and learning independence and simplify physics concepts considered abstract and complex. The research has also shown that students' technology preferences were related to the hardware technology they owned.

The study's results revealed that the lecturer used computer applications to teach physics modules effectively. Therefore, according to these findings, we can conclude that students are able to comprehend the physics content material [71]. Interestingly, the students indicated that lecturers did not effectively use analytical or programming applications to teach physics modules. Therefore, to be able to integrate computer technology applications effectively when teaching physics modules, lecturers need to be professionally trained with the necessary knowledge and skills [12,72]. In addition, the universities' administration must ensure lecturers are supported and encouraged to develop technology-based instructional physics content and experiments that are informed by students' preferences.

In summary, the COVID-19 pandemic has positively intensified the drive for the integration of technology in the teaching and learning of physics modules and the benefits of online learning. However, it is essential to note that both online and face-to-face learning, as reflected by students' preferences, must be utilised in the teaching and learning of physics modules. The results obtained from this research might be a vital resource for studies into factors that affect students' achievement in physics and the effects of specific technological integrations.

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