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Perception of Students and the Mediating Effect of Acceptance, Interactivity and LMS on Integration of Technology in HEIs

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Abstract: Although the phenomenon of technology is gradually being integrated into tertiary education in Ghana, the perceptions of students to adopt and adapt to learning technologies for smooth integration of technology into academic programmes in public universities is an issue of concern. From the Constructivist and Positivist paradigm, this study adopted the quantitative approach and the purposive and quota sampling technique to solicit data from 1,704 level 400 students in six (6) accredited public universities. Adopting the regression analyses approach with ten hypotheses tested the results were analyzed with PLS-SEM. The study found that the perceptions of students significantly impact the integration of technology. Indirectly, Students' Acceptance and Adjustment (AA) to use technology and Learning Management System (LMS) usage significantly mediates the relationship between the Perception of Students (PS) and the Integration of technology (IG). Furthermore, students' acceptance and adjustment to adopt technology and the use of the LMS, are key predictors of the integration of technology, but Interactivity is a weak predictor of the integration of technology into academic programmes in the topmost public universities in Ghana.

Keywords: perception, acceptance and adjustment, interactivity, learning management systems, integration of technology

1. Introduction

According to Karakose et al. (2021, p.3), 'online distance education is a more complex process and carries more meaning than simply creating, adapting, and uploading digital educational content'. Karakose et al. (2021) further noted that, in certain circumstances, the use of distance education as a crucial instrument has impeded comprehension of its true significance and function in education. For instance, integrating technology into the curriculum is a huge issue in Education Technology and requires urgent attention to ensure a smooth infusion of learning technologies into academic programmes. Integration of technology is an ontological phenomenon that must be carefully studied and understood within the context of higher education students' perspectives. Undoubtedly, developing countries have come a long way in embracing digital platforms for education, especially with the widespread use of e-learning for knowledge transfer (Mishra et al., 2020). The key stakeholders, including students, professors, decision-makers, and IT staff, are

mandated to ensure that technology is seamlessly incorporated into the curriculum to facilitate, enhance, and transform the teaching and learning process. Such a mandate requires a gradual shift from traditional pedagogies to e-learning. But according to Camilleri and Camilleri (2022, p.1312), such a shift to online, synchronous classes do not come naturally. Furthermore, Camilleri and Camilleri (2022) noted that recently, that shift was spurred by COVID-19, which also created different problems for students and lecturers. It is worth examining problems encountered by students as technology is used in the classroom to support, expand, and enhance student learning through computer integration. Our motivation to examine students' perception, acceptance and adjustment, interactivity, learning management systems, and integration of technology issues is in line with Camilleri & Camilleri's assertion that "students' stance toward the use of education technologies can change over time" (p.1327).

Incorporating ICT into education entails more than only instructing students on computer usage. Technology serves as a tool to enhance education, not as its own goal (Omwenga, 2006). In the process of integrating technology to enhance teaching and learning, students encounter numerous issues, which begin with their own beliefs, perceptions, attitudes, and degree of acceptance of the use of technological innovations (Shende & Reddy, 2020) and it is not farfetched to examine students' attitude toward the use of instructional technologies. As cited in Camilleri and Camilleri (2022) all educational institutions should be seen to be regularly evaluating the experiences of their students who are taught employing the remote teaching mode to identify any issues that are affecting their academic output (Camilleri, 2021). This underpinned the present study's purpose; hence our overarching rationale is to examine the perceptions of students and the impact on the integration of technology as well as examine the mediating effect of acceptance, interactivity and LMS usage on the infusion of technology into academic programmers. In addition, this study builds on previous theoretical underpinnings on technology adoption (Camilleri & Camilleri, 2022). The overarching research objective is primarily to investigate whether students' perceptions impact the integration of technology into academic programmes. In achieving this objective, the following research questions are posed and addressed: To what extent do the perceptions of students impact the integration of technology into academic programmes? Secondly, to assess the mediating role of acceptance, interactivity and LMS usage on the integration of technology; 'To what extent do the mediating variables impact the relationship between the perception of students and the infusion of technology? Previous studies in Ghana rarely touched on the impact of students' perception on the integration of technology into academic programmes in Ghanaian public universities. Addressing this gap is necessary for public universities to understand the effect of students' perceptions on the integration of technology.

The problem is that technology is being used in numerous Ghanaian colleges in a variety of ways. Lecturers and students are gradually adjusting to the incorporation of technology through online learning. Previous studies concerning the integration of technology in Higher Educational Institutions (HEIs) in Ghana (Tagoe, 2012; Afari-kuma & Tanye, 2009) have proven that perceptions of students are a potential threat to the success of Integration of Technology. In terms of barriers to ICT integration, Akram et al.'s (2022) meta-analysis of multiple studies showed technological and professional incompetence, inadequate resources, and inadequate infrastructure as key factors among teachers' perceptions of barriers limiting the technology integration in teaching practices. In addition, Ahmed et al. (2017) in an earlier study found that several teachers do not find online teaching socially interactive compared to face-to-face teaching thereby showing a negative attitude toward the online teaching mode. Such negative teacher attitudes will not only affect the status of adopting technologies in instructional practices but may affect the students as well. Even though using technology in the classroom has incalculable advantages, perceived misuse and non-use by students create a crisis for stakeholders (Fox, 2018). No other research contributions that have integrated the same measures in Ghana as those employed in this research exist, as far as we are aware. As a result, this work sets itself apart from other studies within the context of HEI in Ghana by proposing an empirically tested research paradigm. This study, therefore, sought to build on the works of Ahmed et al. (2017) and Akram et al. (2022) to understand students' perceptions, acceptance and adjustment, interactivity, learning management systems, and integration of technology issues.

2. Literature review

The articles reviewed in the study were found in line with the purpose of this study and reviewed thematically. Keeping in view to identify the integration of ICT in student learning practices at the higher educational level, the articles were sorted out across different educational levels and geographical jurisdictions while focusing on students'

perception, acceptance, and interactivity with learning management systems usage. Most of the identified studies were conducted at the university level, with the most commonly used methodological approach being the quantitative method, followed by the qualitative method, while the least applied approach was the mixed-method approach. Previous studies (for example, Camilleri & Camilleri, 2022) have looked at a non-exhaustive list of articles that explored the use of online learning technologies in higher education within the context of the education technology paradigm and associated authors. The present study builds on these works by thematically reviewing perceptions of the integration of technology and related boundary variables which are described below:

2.1 *Positive perceptions and integration of technology*

Students and lecturers are prone to exhibit attitudes and behaviours that may be detrimental to the acceptance, adaption, and integration of technology if their perceptions are clouded by cultural practices like traditional learning pedagogies. According to Venkatesh et al. (2003), technological innovations need to be accepted and used. Byungura (2019), asserts that an individual's decision to accept an innovation at an early stage of the integration process or to ignore it would depend on how valuable they consider it to be. This is consistent with the findings of Teo and Zhou (2014) who concluded that perceived usefulness and attitude toward computer use were significant determinants of the intention to use technology, while perceived ease of use influenced intention to use technology through attitude towards computer use and integration. Meanwhile, before the findings of Teo and Zhou (2014), Lai et al. (2012) discovered that the general ICT literacy skills of students had less predictive power on their technology use and that students perceived technology to be useful for learning. At Majan University College in Oman, Tanveer (2018) stated that students perceived e-learning to foster intrinsic motivation for learning, allow for time management skills, and help introverted students interact better. ICT integration in educational practice helps students to interact with their classmates more in terms of the relationship between learners and other students (Asad et al., 2020). This keeps the students socially engaged and helps them overcome their academic obstacles (Akram et al., 2022). Camilleri & Camilleri's research model demonstrated that students were likely to use synchronous and asynchronous learning technologies in the near future, in a post-COVID-19 context, and further demonstrated that perceived usefulness and perceived interactivity with online technologies had a positive effect on their attitudes toward remote learning.

2.2 *Negative perceptions and integration of technology*

Law et al.'s (2019) study showed that more than 50% of the participants agreed with the perceived benefits and were satisfied with the use of the e-learning platform as a tool to facilitate online learning. Notwithstanding, the benefits and satisfaction outlined by the participants, there were some negative perceptions, such as, the online course being too timely, and the absence of two-way directional discussion which lessened needed interactions (Law et al., 2019). Vasbieva and Saienko (2018) also revealed that a lack of technology literacy impacts students' beliefs and perceptions regarding technology integration into the classroom. More disturbing was the fact that students with negative perceptions were less skilled in technology use and that, integration of technology into the classroom largely depends on students' perceptions, attitudes, and beliefs. The authors of this article, therefore, acknowledge that there are deficiencies in the use of learning support systems due to negative perceptions that tend to affect the integration of technology into academic programmes in HEIs. This gap exists because, even though some universities use learning management systems, these systems do not adequately integrate technology into the teaching and learning process. Tagoe (2012) revealed that the usage of technology at the tertiary level depends on how students perceive using it.

2.3 *Perception and students' learning*

The use of ICT in educational settings such as classrooms enables students to use technology in education in creative and meaningful ways. This view was affirmed by the research of Asif et al. (2020) and Abbasi et al. (2021) where the authors found a strong correlation between the use of technology in educational practices and students' academic achievement. Students can quickly obtain helpful learning resources with the aid of technology-assisted learning, according to Hodgson and Shah (2017) thereby making students' perception of technology integration a critical area of study. Learning management systems (LMS) and management information systems (MIS) have been shown to

help teachers share course outlines, reference materials, lesson plans, assignment submissions, key announcements, and assessment results (Habib et al., 2021). With the new normal (Post COVID-19) era it is worth understanding students' stance toward the acceptance and use of educational technologies as well as their interactivity which can change over time (Camilleri & Camilleri, 2022).

2.4 *Theoretical framework*

Theories underpinning this research are the Constructivist Theories of Perception, the Technology Acceptance Model (TAM), the Technology Integration Matrix (TIM) and the Theory of Online Learning. The Constructivist Theory of Perception is the first theoretical foundation for the study. Helmholtz (1821-94), believed that perception was based on a process of inference. He argued that, based on the sensations we receive, we conclude the nature of the object or event that the sensations are most likely to represent as cited by Rookes and Wilson (2000). Eysenck and Keane (1995) have suggested three shared assumptions about perception: Perception is an active and constructive process involving more than the direct registration of sensations; Perception occurs indirectly as the end-product of the interaction between the stimulus input and the internal hypotheses, expectations, and knowledge of the observer. Motivational and emotional factors can also play a part in this perceptual processing.

The Technology Acceptance Model (TAM) developed by Davis (1989), is an adaptation of the Theory of Reasoned Action (TRA) to the field of Information systems as postulated by Venkatesh et al. (2003). The main objective of the TAM is to express the need for an individual to accept and adjust to innovation and make use of it easily. However, the TAM's core concept is focused on users' motivation to assess their perceptions towards the use of information systems. Due to the TAM's accuracy in forecasting the intention to adopt and use information technology, it has been tested, validated, and expanded throughout time (Liu, 2010; Mohammadi, 2015; Al-Azawei et al., 2017). More specifically the study of Dimoka and Davis (2008) sought to demonstrate the neural processes that underpin perceived usefulness and perceived usability and accurately forecast users' intents to utilize technology. The importance of the TAM to this study is that the perception of students, which is the main variable understudy, was grounded in the assumptions of perceived usefulness and perceived ease of use as originally postulated by the proponents of the TAM. Our position and justification for using the TAM are that we align "students' perceptions", and "acceptance and adjustment" with students having the right mindset and perceiving a particular technology or innovation to be useful, then they would accept it, adjust to it and use it to facilitate academic work (Teo & Zhou, 2014; Lai et al., 2012; Tagoe, 2012). This is a very common practice in several HEIs. But if students do not perceive its usefulness, they tend to reject it (Teo & Zhou, 2014; Lai et al., 2012). In the same breadth, if students do not have the right mindset and do not perceive the technological innovations to be easy to use, probably due to some previous experience or perceived risk as first-time users, then they would reject or abandon that innovation or learning technology (Byungura, 2019; Vasbieva & Saienko, 2018). Much as the "perception of students" is usually inclined towards mindsets and cultural idiosyncrasies, this study investigated the "perception of students" through the lens of the key assumptions of the TAM. The authors acknowledge that TAM 1, TAM 2, and TAM 3, are quite overused and limited in scope. However, our study adopted perceived usefulness and perceived ease of use as the underlying assumption for the perception of students in the public universities under study in Ghana. Moreover, Students' Acceptance and Adjustment (AA) to use technology is one of the three mediating variables under study. Acceptance and Adjustment to use technology is a variable that was operationalised and tested as a paired construct in the survey questionnaire (Almahasees et al., 2021; Teo & Zhou, 2014; Tagoe, 2012). Positive perceptions of students and outright acceptance and adjustment to the use of a particular technology lead to ease of use (Teo & Zhou, 2014; Tagoe, 2012) while the availability of learning technologies for infusion, informs instructors and policymakers on the usefulness of ICTs in the teaching and learning process.

The Technology Integration Matrix (TIM) was introduced by the Florida Center for Instructional Technology (FCIT) at the University of South Florida, as a guide for teachers and administrators in the practice of integrating technology. The TIM is based on the theory of social constructivism in which new learning occurs when students interact with each other to build new knowledge or gain new understanding (Allsopp et al., 2007). This Matrix is relevant to this study in two major delineations; first, it defines and authenticates technology integration as the key dependent variable understudy at the selected public universities and; second, defines the processes involved in the integration and the extent to which students' perceptions are affecting the adoption and adaptation of the five learning domains (entry, adoption, adaptation, infusion, transformation) in the process of infusing technology into the curriculum. It must be

reiterated that an earlier qualitative study conducted by Gyau and Gyan (2023) revealed that public universities in Ghana are at the Adaptation level of deploying the TIM as the main method for integration of technology into academic programmes.

The theory of online learning introduced by Anderson (2004), offered a paradigm of e-learning. He claims three types of Online learning should be considered: Collaborative, Community-of-Inquiry, and Community-of-Learning models. Additionally, the model identifies the two main human actors learners and teachers, as well as how they interact with one another and the content. Interactivity is a major construct and striking characteristic of a web-based learning environment (Chou, 2003; Vrasidas, 2000). In the instructional context, interactivity refers to sustained, two-way communication between students and an instructor. The objective of interaction may be completing a learning task or creating social relationships (Gilbert & Moore, 1998; Liaw & Huang, 2000). A technology-based interactive learning environment incorporates four types of interaction: learner-content, learner-instructor, learner-learner, and learner-interface (Chou, 2003). This interaction can take place within a community of inquiry, using a variety of net-based synchronous and asynchronous (video, audio, computer conferencing, chats, or virtual world) interactions within an interface known as the Learning Management Systems (LMS). According to van Dijk (2006), interacting with and through these media, the superior type of enacting learning is *simulated*, not equal. This theory is relevant to this study because it serves as the underpinning theory for Interactivity (INT) and Learning Management Systems (LMS) usage, which form part of the three mediating variables understudy. A few studies have shown the connections between the user acceptability of a system and some other significant criteria, notwithstanding the paucity of information on the usage of LMS and its levels of acceptance in developing countries. For instance, Claar et al. (2014) investigated how various demographic factors, including age, race, gender, and educational attainment, affect students' acceptance of new learning management systems (LMS), and they discovered that the higher the educational attainment, the more likely it is that new LMS systems will be accepted. Dias and Diniz (2014) also observed that an effective LMS has three characteristics: 1) it allows for a dynamic ecosystem that can integrate a variety of interactive learning activities; 2) it makes it easier for teachers to become familiar with ICT to boost their intrinsic motivation; and 3) it provides training strategies for students to improve their learning performance and level of satisfaction. To what extent, therefore, do Interactivity and LMS usage impact the integration of technology?

Previous studies in Ghana hardly ever discussed the impact of perception on the incorporation of technology into academic programs in Ghanaian public universities. This research sought to fill this knowledge gap to ascertain the impact of perceptions through acceptance, interactivity and LMS usage, on technology integration. It is against this knowledge gap that the authors of this study formulated and tested the following hypotheses based on the empirical review of related works and the research question, to serve as the main constructs for developing a conceptual framework.

2.5 *Hypotheses of the study*
2.5.1 *Perception of Students (PS)*

Perception in this study is defined as the mindset of students about technology integration and how students perceive the usefulness and ease of use of learning technologies in academic work. This study builds on and contributes to the works of Camilleri and Camilleri (2022), Teo and Zhou (2014) and Lai et al. (2012) by formulating hypotheses 1 to 4:

H1: Perception of Students (PS) has a significant positive impact on the Integration of Technology (IG).

H2: Perception of Students (PS) has a significant positive impact on Acceptance and Adjustment (AA) to use technology.

H3: Perception of Students (PS) has a significant positive effect on Interactivity (INT).

H4: Perception of Students (PS) has a significant positive effect on Learning Management Systems (LMS) usage.

2.5.2 *Learning Management System (LMS) usage*

Learning Management System usage in this study is defined as an interactive learning environment embedded with learning technologies that facilitate inter/intra-action, cooperation, training, communication, and exchanging information among students (Dias & Diniz, 2014), and the effect of usage on the integration of technology. The LMS usage is

formulated as a construct based on the works of (Anderson, 2004; Claar et al., 2014; Dias & Diniz, 2014). As such, this study sought to provide additional insight into the influence of LMS usage within the context of PS and IG necessitating the question: 'To what extent does LMS usage mediate the linkage between PS and IG?' as posed in hypotheses 7 and 8:

H7: Learning Management Systems (LMS) usage has a significant positive impact on the Integration of Technology (IG).

H8: Learning Management System (LMS) usage, significantly mediates the relationship between the Perception of Students (PS) and the Integration of technology (IG).

2.5.3 *Interactivity (INT)*

Interactivity in this study refers to sustained, two-way communication between students and an instructor. Interactivity is formulated as a hypothetical construct based on the works of (Anderson, 2004; Liaw & Huang, 2000; Chou, 2003; Vrasidas, 2000). Although studies in interactivity have examined two-way communication between students and an instructor there is the need to provide additional insight on the mediating effect hence the question: To what extent does Interactivity mediate the linkage between PS and IG? This is followed by the hypotheses:

H6: Interactivity (INT) has a significant positive effect on the Integration of Technology (IG).

H9: Interactivity (INT) significantly mediates the relationship between the Perception of Students (PS) and the Integration of Technology (IG).

2.5.4 *Acceptance and Adjustment to Technology (AA)*

Students accepting and adjusting to the introduction of new learning technologies and adopting upgraded versions are dependent on what they perceive that technology to be useful and easy to use. Acceptance and Adjustment to the use of technology is formulated as a hypothetical construct based on the works of (Almahasees et al., 2021; Teo & Zhou, 2014; Lai et al., 2012; Tagoe, 2012; Venkatesh et al., 2003). This study builds on and contributes to works in Acceptance and Adjustment to technology by formulating and examining the mediator-oriented hypotheses:

H5: Acceptance and Adjustment (AA) to use technology have a significant positive impact on the Integration of Technology (IG).

H10: Acceptance and Adjustment (AA) to technology significantly mediate the relationship between the Perception of Students (PS) and Integration of technology (IG).

2.5.5 *Integration of Technology (IG)*

Refers to the use of digital tools and technologically based procedures for routine duties, employment, and educational administration. After making technology accessible and available, the next step is to integrate it. It is a goal-in-process, not an end state. (Schmitt, NCES, 2002)

3. Research methodology

The conceptual model of this study is shown in Figure 1. Accordingly, Technology Integration Matrix (TIM) presents five learning domains and corresponding levels of integration that determine the depth of technology Integration in HEIs. In an earlier study conducted by Gyau and Gyan (2023), it was discovered that the method of technology integration that is predominantly being used by public universities is the Technology Integration Matrix (TIM) and the level of integration is currently at the 'Adaptation level' of the TIM. It is against this background that the TIM became the base model and most ideal definition for Integration of Technology (IG) which is also well positioned as the dependent variable for the study. Perception of Students (PS) is the independent variable being investigated as its impact on the integration of technology in the universities under study. Our proposed conceptual framework, therefore, attempts to investigate the relationship between the two key variables; Integration of technology (IG) and Perception of Students (PS), mediated by the role of students' "Acceptance and Adjustment (AA)" to use technology, "Interactivity (INT)," and "Learning Management Systems (LMS) usage". Figure 1 shows the relationship between the variables. Direct paths are represented by darker lines and indirect paths are indicated by dotted lines.

3.1 *Conceptual framework*
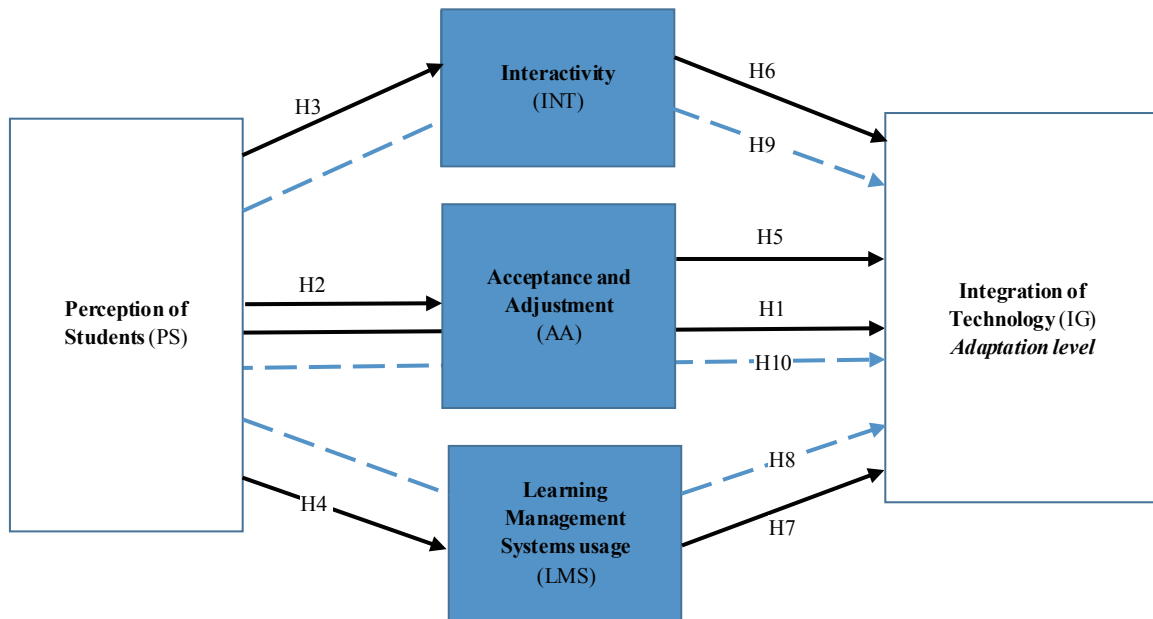
Figure 1. Proposed Conceptual Framework indicating the relationship between PS, AA, INT, LMS and the IG
Source: Researcher, 2022

3.2 *Research approach*

The quantitative approach was used to enable an objective measurement of the variables for this study and further examine the relationship between them numerically and statistically. Primary data was collected through questionnaires from students across six Public Universities in the country. Research Philosophy was based on a Positivist and Constructivist paradigm and therefore quantitative technique was employed (Creswell & Creswell, 2018). The research approach was deductive reasoning through sophisticated statistical tests.

3.3 *Sampling techniques*

Sampling techniques used were purposive sampling, quota sampling and convenience sampling for data collection, based on knowledge of subjects understudy. According to the Ghana Tertiary Education Commission (GTEC), there are 16 public universities in Ghana. The population for this study, therefore, considered sixteen (16) public universities (GTEC, 2023). However, a purposive and convenient sample of six (6) public universities was selected from the Ashanti, Greater Accra and Northern regions for this study respectively. They were selected purposively, based on their status and rank in the adoption and integration of technology into mainstream university education. The overall intent was to identify HEIs that have attained a considerable or reasonable amount of penetration in their integration process, especially after the impact of the COVID-19 pandemic. A situation that forced all HEIs to integrate technology or improve the level of integration. The study, therefore, focused on the public institutions which were known to be conventional universities that had to adopt the dual-mode or blended mode of teaching and learning to ensure some level of integration of technology.

Quota sampling was used to select students based on particular attributes so that the sample size would not be different from the population. Whilst Convenience sampling was used to collect data. A quota of 300 Students was allocated to each of the selected universities irrespective of their large sizes. They are UG, UCC, UEW, UDS, UPSA and KNUST. Additionally, the level 400 students were also purposively selected based on their rank as final-year students and their vast experience in the technology integration process; having adopted and engaged various learning

technologies for various academic activities over their 4-year tenure, pursuing various programmes. According to Taherdoost (2016), quota sampling is a non-probability sampling strategy in which participants were selected based on certain traits or criteria determined by the researchers. Next, based on the proportions of the subgroups (level 400) necessary for the final sample, the researchers allocated a certain number of units (300) to solicit from the level 400 students and conduct the survey. Quota sampling was the best method for this study since it allowed the researchers to select students proportionally from all the universities. A specific number of questionnaires are distributed proportionally with the help of the faculties, to encourage those who will fill out the questionnaires. That makes it possible for a representative sample of universities to take part in the study. Students were, therefore, selected using quota sampling.

3.4 *Data collection methods*

However, the sample size was based on the suggestions of Gay et al. (2009) who recommended that for a population of 5,000 or more, a sample size of 400 is adequate. Factually, this sample size was not practicable for the researchers, because it did not conform to the researcher's resources and it posed a huge financial burden on the researchers. By quota sampling, the researchers targeted 300 students to be drawn from each of the 6 universities, which should culminate into a total of 1,800 students. Therefore, a total of 1,800 students were targeted and reached out to participate in the survey. After a thorough screening of the filled questionnaires, a total of 100 questionnaires were rejected due to inadequacies and incomplete answers. Eventually, a total of 1704 questionnaires were appropriate for data analyses. This formed 94% of the population (1,800) reached.

3.5 *The instrument*

By best practices, quantitative studies of this nature, are best conducted as a survey, deploying questionnaires as the ideal instrument (Creswell & Creswell, 2018). A structured questionnaire with specific scales of measurement, drawn from validated instruments of Kumar and Daniel (2016), Dinc (2019) and Mäkelä et al. (2019) for perception, was modified for this research. Validity and Reliability of the instrument were achieved by pre-testing and piloting the instrument, through the scrutiny of six experts in the Educational and Instructional technology field; therefore, subjecting the structured questionnaire to intense screening led to the validation and invalidation of some of the questions. Pre-testing was further conducted with a cross-section of students (N20) from a sister university, to test the validity and reliability of the questions and refine some questions; to avoid respondent biases and researcher biases. Scales of measurement in the questionnaire, consisting of many definite/close-ended statements as options in a 5-point Likert scale, where (1) = Strongly Disagree and (5) = Strongly Agree.

3.6 *Data analyses*

The data collected through questionnaires were first screened and a total of 100 questionnaires were dropped due to incomplete entries and inadequacies in the information provided by some respondents. Based on the rudiments of PLS-SEM software, which was used for the analyses, each item in the scales of measurement, representing the various constructs was first coded in the Microsoft Excel Software and advanced to the PLS-SEM Software for statistical analyses. This study adopted linear regression analyses and the Partial Least Square-Structural Equation Modelling (PLS-SEM) statistical tool, was ideal because SEM performs more robust and reliable statistical analyses for multiple latent constructs. Notwithstanding, this study implored the need for structural models to be tested via the hypotheses and crystalized for a possible conceptual framework. Considering the proposed conceptual framework and hypothesis of this study, a structural model was, therefore, formulated to guide the various tests relevant to the study.

4. Results and analyses

The main objective that this study sought to achieve was to examine the impact of the perception of students on the integration of technology. To address this objective, the students were asked to respond to pertinent questions. The data gathered from the respondents, were tested by the hypothesis in the regression analyses. Findings indicate that a

38.5% variation in Students' Acceptance and Adjustment to technology can be attributed to the Perception of Students. As indicated in Table 3, by the regression analyses, 27.9% variation in Integration of technology (IG) can be attributed to the Perception of Students. Moreover, an 18% variation in Interactivity (INT) can also be attributed to the Perception of Students. Finally, a 15% variation in the use of Learning Management Systems (LMS), can also be attributed to the Perception of Students in the public universities in Ghana. Although the relationship co-efficient of the IG, INT and LMS, are quite low, they are still above the threshold, and by the regression analyses, there is some impact among the key variables under study. This section presents the categorised results emerging from the analysis of the data.

4.1 *Demographic Analyses of Quantitative Data*

Demographic Profile of students are detailed as follows (Table 1):

Table 1. Demographic Profile of Students sampled from the six universities

Variable	Descriptive	N	(%)
Gender	Male	839	49.6
	Female	861	50.0
Age	18-25	1,347	80.1
	26-35	329	18.2
	36-45	25	1.32
	46-55	2	0.11
Regional Distribution	Greater Accra Region	2	35.3
	Central Region	2	35.3
	Ashanti Region	1	17.6
	Northern Region	1	11.8

Source: Field data, 2022

Table 2. Perception of students

	Perception of Students (PS)	Frequency	%
PS1	Infusion of technology enables me to learn easily	111	18.0
PS2	The infusion of technology makes me an active learner	87	14.1
PS3	Online learning is more difficult	51	8.2
PS4	Infusion of technology is more time-consuming	48	7.7
PS5	Infusion of the technology enables me to construct knowledge	115	18.6
PS6	The infusion of technology makes learning too remote	73	11.8
	Total	485	100%

Source: Field data, 2022

Students-perceptions were solicited and itemized as seen in Table 2. The results indicate the frequencies and percentages as averaged from all the six universities under study.

4.2 *Data analyses*

According to the standards set forth by the Heterotrait-Monorait Ratio (HTMT) recommended by Teo et al. (2015), exploratory analysis such as scale reliability, convergent and discriminant validity, and other factors must be evaluated while measuring the data. To identify the multi-collinearity among the variables, the study first used a preliminary test for the common method bias, and the result of Variance Inflation Factors (VIF) varies from 1.421 to 2.489, which is less than 3.3 recommended by Kock (2015). Secondly, the study examined the convergent validity, discriminant validity and reliability of the structural model by adopting the Hair et al. (2010) criterion. Convergent validity is the degree to which multiple attempts to measure the same concept are in agreement. When the AVE value is greater than or equal to 0.50 convergent validity is established (Fornell & Larcker, 1981). Convergent validity for this study was achieved with all the variables tested. Discriminant validity is established when the square root of AVE for a construct is greater than its correlation with all other constructs. This study used the Heterotrait-Monorait Ratio (Teo et al., 2015) in the PLS-SEM statistical instrument for validity to attain acceptable values for the AVE. Reliability is the extent to which a measuring instrument is stable and consistent. A threshold of 0.70 or above is recommended by Hair et al. (2021). The reliability of the data was tested using the PLS-SEM Cronbach Alpha statistical instrument to determine the reliability coefficient of data collected and analysed. According to (Awang, 2012) the threshold for factor loadings should be 0.6 or higher. Based on that, reliability for this study was achieved with all the variables tested. The table below indicates the confirmatory factor analysis result, outer/inner VIF values, Composite reliability, Cronbach Alpha, AVE, R-squared and the F-squared values attained.

Table 3. Confirmatory factor analysis

Constructs	Indicator	VIF OUT	VIF INN	Loading	AVE	CR	(α)	R^2	F^2
Perception of Students (PS)	PS1	1.701	1.647	0.757	0.512	0.862	0.808		0.057
	PS2	1.518		0.659					
	PS3	2.613		0.756					
	PS4	1.773		0.758					
	PS5	1.641		0.738					
	PS6	1.272		0.611					
Acceptance & Adjustment (AA)	AA1	1.947	2.260	0.755	0.573	0.889	0.849	0.385	0.617
	AA2	2.448		0.811					
	AA3	2.607		0.840					
	AA4	1.602		0.709					
	AA5	1.837		0.765					
	AA6	1.447		0.646					

Constructs	Indicator	VIF OUT	VIF INN	Loading	AVE	CR	(α)	R^2	F^2
Interactivity (INT)	INT1	1.938	1.514	0.712	0.558	0.910	0.887	0.18	0.219
	INT2	2.034		0.735					
	INT3	2.489		0.778					
	INT4	2.178		0.758					
	INT5	2.402		0.758					
	INT6	2.179		0.738					
	INT7	2.104		0.761					
	INT8	1.820		0.733					
Learning Management Systems (LMS) usage	LMS1	1.539	1.421	0.802	0.589	0.850	0.767	0.15	0.177
	LMS2	1.658		0.789					
	LMS3	1.717		0.840					
	LMS4	1.305		0.619					
Integration of Technology (IG) (Itemized by the TIM Variables)	ENTRY	1.841		0.814	0.613	0.888	0.842	0.279	0.022
	ADOPT	2.281		0.828					
	ADAPT	1.959		0.773					
	INFUSION	1.725		0.739					
	TRANS	1.699		0.757					

Source: Field data, 2022

Table 4. Discriminant Validity

	AA	IG	INT	LMS	PS
AA					
IG	0.540				
INT	0.656	0.582			
LMS	0.441	0.504	0.498		
PS	0.534	0.465	0.491	0.482	

Source: Field data, 2022

Discriminant validity is established when the square root of AVE for a construct is greater than its correlation with all other constructs based on the Heterotrait-Monorait Ratio (HTMT) which recommends a threshold value of 0.90 or less (Teo et al., 2015). This is indicated in Table 4.

4.3 *Measurement of model*

The impact of the predictor variable is high at the structural level if (F-squared is ≥ 0.02 is small, ≥ 0.05 is medium, ≥ 0.35 is large: Cohen, 1988). The results revealed (in Table 3) that the model's F-squared effect size ranged from 0.022 for PS to IG to 0.617, 0.177, 0.219 for AA, LMS and INT on IG respectively. In terms of the R-squared statistics, the structural model in this study obtained acceptable R^2 values for the three mediating variables and the dependent variable based on the 0.10 threshold (Falk and Miller, 1992). The analysis reveals an R^2 value of 0.381 for Acceptance and Adjustment to technology and 0.279 for Integration of technology. Interactivity attained an R^2 value of 0.180 and the Learning Management Systems (LMS) usage attained an R^2 value of 0.151, as indicated in Table 3. The R^2 value is illustrated in the structural model below as shown in Figure 2.
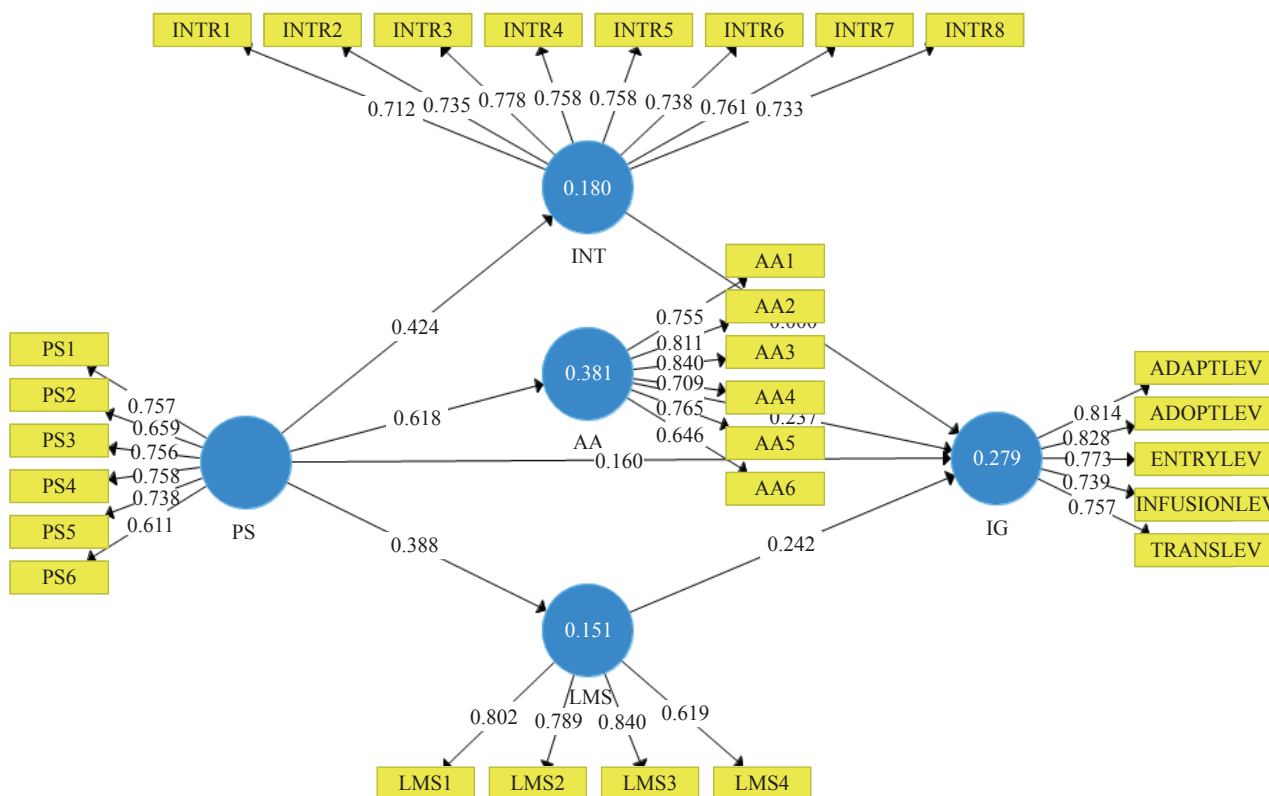
4.4 *Structural model*

Figure 2. Structural model indicating the regression analyses and relationship coefficients among all variables
Source: Researcher, 2022

4.5 *Hypothesis testing-direct effects*

The study tested seven direct hypotheses and three mediating hypotheses. The first hypothesis H1 evaluates whether the Perception of Students (PS) positively and significantly impacts the Integration of Technology (IG). The result shows that PS does not have a direct effect on the integration of Technology (β = 0.159, t = 1.842, p < 0.066).

Hence, Hypothesis 1 was not supported. The second hypothesis H2 evaluates whether the Perception of Students (PS) positively and significantly impacts the Acceptance and Adjustment (AA) to use technology. The result indicates that PS positively and significantly influences AA to use technology ($\beta = 0.618$, t = 16.272, p < 0.000). Hence, the H2 is accepted. The third hypothesis H3 proposed that the Perception of Students positively influences Interactivity (INT). The finding shows that PS positively and significantly influences INT ($\beta = 0.424$, t = 8.744, p = 0.000). Hence hypothesis H3 was accepted.

The fourth hypothesis H4 proposed that the Perception of Students positively influences Learning Management System (LMS) usage. The result is shown in Table 5, revealing that PS positively and significantly influences LMS usage by students ($\beta = 0.388$, t = 7.006, p = 0.000). Hence hypothesis H4 was supported. The fifth hypothesis H5 anticipated that the Students' Acceptance and Adjustment (AA) to the use of technology will have a positive influence on the Integration of Technology (IG). The result, as shown in Table 5, reveals that AA positively and significantly influences the integration of technology into academic programmes ($\beta = 0.275$, t = 2.930, p = 0.004). Hence hypothesis H5 was supported. The sixth hypothesis H6 proposed that Interactivity (INT) will have a positive effect on the Integration of Technology (IG). The result, as shown in Table 5, reveals that INT does not have any positive effect on the integration of technology into academic programmes ($\beta = -0.061$, t = 0.841, p = 0.401). Hence hypothesis H6 was rejected. The seventh hypothesis H7 proposed that Learning Management System (LMS) usage will have a positive effect on the Integration of Technology (IG). The result, as shown in Table 5, reveals that LMS usage positively and significantly influences the integration of technology into academic programmes ($\beta = 0.242$, t = 3.911, p = 0.000). Hence hypothesis H7 was supported.

Table 5. Direct effects of the PS, AA, LMS and INT on IG

H	Direct Paths	Coefficient	Mean	Standard Dev.	T Statistics	P Values	Outcome
H1	PS -> IG	0.159	0.159	0.086	1.842	0.066	Not supported
H2	PS -> AA	0.618	0.624	0.038	16.272	0.000*	Supported
H3	PS -> INT	0.424	0.435	0.049	8.744	0.000*	Supported
H4	PS -> LMS	0.388	0.396	0.055	7.006	0.000*	Supported
H5	AA -> IG	0.275	0.282	0.094	2.930	0.004*	Supported
H6	INT -> IG	-0.061	-0.067	0.073	0.841	0.401	Not supported
H7	LMS -> IG	0.242	0.241	0.062	3.911	0.000*	Supported

Source: Field data, 2022

4.6 *Hypothesis testing-mediation effects*

Mediation analyses were performed to assess the mediating effect of Learning Management Systems (LMS) usage on the linkage between the Perception of Students (PS) and the Integration of Technology (IG). The results, in Table 5, revealed that the direct effect of (PS) on (IG) is insignificant (H1: $\beta = 0.159$, t = 1.842, p = 0.066). However, with the inclusion of the mediating variable LMS usage, the impact of PS on IG became significant (H8: $\beta = 0.094$, t = 3.584, p = 0.000). Hypothesis H8 was therefore supported as shown in Table 6. Notwithstanding, the results (see Table 6) indicate that the total effect of PS on IG was significant (H1: $\beta = 0.396$, t = 6.946, p < 0.000). This shows that PS does not directly influence or impact IG except the linkage is fully mediated by LMS usage.

Table 6. The mediating effect of Learning Management Systems (LMS) on the linkage between PS and IG

Total effect (PS-IG)		Direct effect (PS-IG)			The indirect effect of (PS on IG)				Outcome
Coefficient	P-Value	Coefficient	P-Value	Hypothesis	Coefficient	SD	T Value	P-Value	
0.397	0.000	0.159	0.066	H8: PS > LMS > IG	0.094	0.026	3.584	0.000*	Supported

Source: Field data, 2022

The ninth hypothesis H9 was to assess the mediating effect of Interactivity (INT) on the linkage between the Perception of Students (PS) and the Integration of Technology (IG). The results, in Table 5, revealed that the direct effect of (PS) on (IG) is insignificant. However, with the inclusion of the mediating variable INT, the impact of PS on IG became insignificant (H9: β = -0.026, t = 0.810, p = 0.418). Hypothesis H9 was therefore not supported. Notwithstanding, the total effect of PS on IG was significant (H1: β = 0.397, t = 6.946, p < 0.000) in Table 7.

Table 7. The mediating effect of Interactivity (INT) on the linkage between PS and IG

Total effect (PS-IG)		Direct effect (PS-IG)			The indirect effect of (PS on IG)				Outcome
Coefficient	P-Value	Coefficient	P-Value	Hypothesis	Coefficient	SD	T Value	P-Value	
0.397	0.000	0.159	0.066	H9: PS > INT > IG	-0.026	0.032	0.810	0.418	Supported

Source: Field data, 2022

The tenth hypothesis H10 was to evaluate the mediating effect of Acceptance and Adjustment (AA) to use technology on the linkage between the Perception of Students (PS) and the Integration of Technology (IG). The results revealed the direct effect of (PS) on (IG). However, with the inclusion of the mediating variable AA, the impact of PS on IG became significant (H9: β = 0.170, t = 2.813, p = 0.005*). Hypothesis H10 was therefore supported as shown in Table 8. Notwithstanding, the total effect of PS on IG was significant (H1: β = 0.397, t = 6.946, p < 0.000).

Table 8. The mediating effect of Interactivity (INT) on the linkage between PS and IG

Total effect (PS-IG)		Direct effect (PS-IG)			The indirect effect of (PS on IG)				Outcome
Coefficient	P-Value	Coefficient	P-Value	Hypothesis	Coefficient	SD	T Value	P-Value	
0.397	0.000	0.159	0.066	H10: PS > AA > IG	0.170	0.060	2.813	0.005*	Supported

Source: Field data, 2022

4.7 *Towards a conceptual framework*

Based on the research conducted and the hypothesis tested through regression analyses in the PLS-SEM software, we propose a Conceptual Framework underpinned by the ten hypotheses that indicate the path analyses. Each path is represented by the hypotheses tested and labelled (H1-H10). The darker lines are paths that indicate direct effects whiles the dotted lines indicate indirect effects as shown in Figure 3.
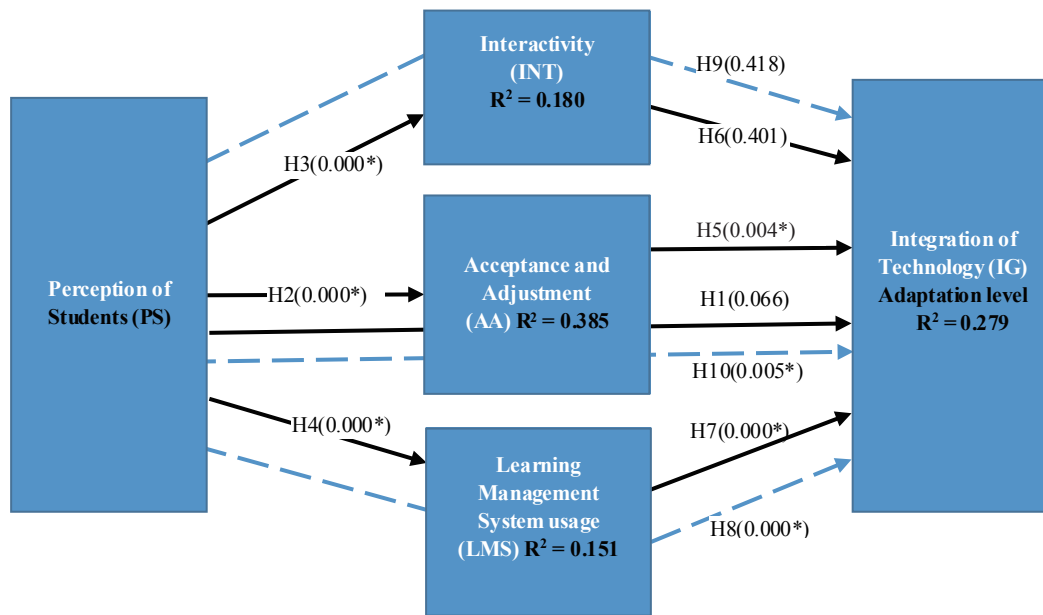
Figure 3. Proposed Conceptual framework

Source: Researcher, 2022

5. Discussions

Implications of the study findings are the key issues to discuss in this segment and these implications, have been categorized into theoretical, practical, policy and major implications. Essentially, best practices require a summary of the findings to crystalize the outcomes of the study. We, therefore, present the findings by summarizing the outcomes of the hypotheses. First, the main objective of this study is to examine the impact of the perception of students on the integration of technology into academic programmes in the topmost public universities in Ghana. Primarily, the perception of students does not have any direct effect on the integration of technology, except it is mediated by students' acceptance and adjustment to the use of technology and also the usage of the Learning Management Systems. The study concludes that the perception of students is negatively related to the integration of technology (Law et al., 2019; Vasbieva & Saienko, 2018).

Amazingly, Interactivity does not significantly mediate the linkage between the perception of students and the integration of technology. Interactivity, again, does not directly impact integration. The study concludes that Interactivity does not have any mediating effect on the Integration of technology into academic programmes. Meanwhile, it is imperative to note that the perception of students has a direct positive and significant impact on the three mediating variables-AA, LMS usage and INT. So, the study affirms that the perception of students positively affects students' acceptance and adjustment to the use of technology, the use of Learning Management Systems and the interactivity that transpires among students and their instructors.

Following that, is the predictive power of students' acceptance and adjustment to the use of technology and the fact that it has a direct positive and significant effect on the integration of technology. The study affirms that students' acceptance and adjustment to the use of technology have a direct effect on the Integration of Technology into academic programmes. Likewise, the use of Learning Management Systems has been found to directly impact the integration of technology into academic programmes. Therefore, LMS usage is a positive predictor of the Integration of Technology into academic programmes of the HEIs under study. We discuss the implications of these findings in the following categories.

5.1 *Implications of the findings*
5.1.1 *Theoretical implications*

The authors discuss the findings in tandem with the theories underpinning the study. Eysenck and Keane's (1995) assumption that perception occurs indirectly as the end-product of the interaction between the stimulus input and the internal hypotheses, expectations and knowledge of the observer has been confirmed in this study because students have demonstrated their mindsets about the integration of technology whiles being exposed to the stimuli of new technologies and their interactions with those technologies as juxtaposed with their innate expectations of the benefits of technology in the process of integration. Some of the perceptions that this study found about the integration of technology among students include the experience that technology in education is *time-consuming, too remote, enables constructive learning* and *requires training*. This study, therefore, confirms the perception assumptions of Eysenck and Keane (1995). Anderson's (2004), theory of Online learning seems to emphasize interactivity among all the key stakeholders in the integration process. Alluding that there is the need for interactivity to be sustained as two-way communication between students, instructors, content, policymakers, and school administrators. Testing the effect of perceptions on integration, through interactivity as a conduit, has proven that, though vital in the integration mix, interactivity is a weak predictor of the integration of technology because it does not have any direct or indirect effect on the Integration of technology into academic programmes. Collaborative, Community-of-Inquiry, and Community-of-Learning models are the three types of online learning as enshrined in the theory of online learning and interactivity is the default construct among these online learning methods. Within the Community-of-Inquiry, a variety of net-based tools are integrated into an interface known as the Learning Management Systems (LMS), to ensure seamless interactivity. That is why this study sought to examine the role of interactivity in the integration mix. However, it has turned out that interactivity has a significant relationship with the perception of students but does not impact integration in any way. This is a major contribution to the theory of online learning and confirms the theory's position on interactivity but contradicts its efficacy in advancing technology integration.

This study has proven that the TAM as a theory, is consistent in the Ghanaian context, as some of its assumptions have been demonstrated in the Ghanaian learning environment, especially after the effects of the COVID-19 pandemic. This is because, the introduction of the mediating variable Acceptance and Adjustment (AA), pre-supposes that, by the assumptions of the TAM, students, to some extent, have accepted and adjusted to the Perceived Use (PU) and Perceived Ease of Use (PEU) of new technologies, among others in the public universities, especially during the COVID19 era. This study has discovered that Students' acceptance to use of technology has a *three-fold effect* on the integration of technology. Because there is a significant positive relationship between the perception of students and the acceptance and adjustment to use new technologies, still based on what they perceive technology to be and how easy it is to use technology. Secondly, Acceptance also has a direct positive impact on integration even without the input of perception. Thirdly, Acceptance and adjustment as a mediator has been proven to have a direct positive impact on integration of technology. These outcomes confirm the assumptions of the TAM in the public universities in Ghana and confirm the study outcomes of Venkatesh et al. (2003), Byungura (2019), Vasbieva and Saienko (2018) and Teo and Zhou (2014). The study concludes that Students' acceptance and adjustment to technology use is critical to the advancement of technology integration in HEIs in Ghana.

5.1.2 *Practical implications*

The practical implications of this study cannot be overlooked. Much as Acceptance and Adjustment to technology impact integration, LMS usage has also been proven to be a strong predictor of Integrating technology as indicated by Hypotheses H7 and H8. Because it has both direct and indirect significant positive effects on integration in the public universities under study. Over time, LMS usage in colleges and universities has increased significantly to support educational activities (Walker et al., 2016). Due to their substantial contribution to the delivery of instruction, students with time have become familiar with the use of the LMS, especially in the COVID era and this may have accounted for the high positive impact of the use of LMS as a strong influence on the integration of technology. Moreover, Fathema et al. (2020) and Walker et al. (2016), assert that LMSs provide a variety of tools such as the Big blue button, chatbots, discussion threads, video conferencing, lecture materials, learning modules, grading, and course assessments, all of which can be tailored to meet educational objectives. Policymakers and management teams in the universities must

therefore begin to consider LMS usage as a strong predictor and critical mediator between the perception of students and the integration of technology into academic programmes.

5.1.3 *Policy implications*

Regarding policy implications, perceptions of students have been found to have no direct effect on technology integration. So, policymakers can overlook it. However, perception can only impact integration when significant consideration is given to acceptance and LMS usage which is consistent with the study outcome of Claar et al. (2014). Pragmatic steps must thus be taken to retune or refine the perceptions of students and encourage them to accept, adjust and patronize the LMS. This is because ideological and cultural idiosyncrasies of students and prospective students can have a significant effect on the integration process if they find the LMSs to be laborious and stale; consistent with the recommendations of Asunka (2008); Ansong et al. (2017). More training sessions for students can neutralise these cultural idiosyncrasies of students. Policymakers, and the management team of the universities under study, must begin to understand the effect of Students' perceptions on the learning technologies that are installed to stimulate and ensure the integration of technology to improve academic performance.

5.1.4 *Major contribution*

One major contribution of this study to the field of educational technology is the introduction of a proposed Conceptual framework-which consists of 10 hypothetical paths that have been tested with the intent to provide an additional conceptual guide to the integration of technology into HEIs at least within the context of perception of students and its effect on the integration of technology. According to (Rallis & Rossman, 2012) a conceptual framework is a summary of various research findings from the literature sources that have been evaluated regarding the study, outlining the study's research agenda for better comprehension of its objectives. By giving an inquiry a structure that organizes the currents of thought that give it focus and direction, understanding is attained. This study adopts the Schematic presentation to present the framework because we used inferential statistics to establish cause and effect between variables based on theories and the research questions of this study (Shikalepo, 2020). We also considered the four characteristics of a good conceptual framework-comparability, verifiability, timeliness and understandability. Figure 3 presents the conceptual framework depicting Perception as the independent variable, integration of technology (incorporating the domains of the TIM) as the dependent variable and acceptance, interactivity and LMS usage as the mediating variables. The validity, reliability and efficacy of their relationships and effects on each other have been duly tested through the confirmed hypotheses as indicated in Tables 3, 5, 6, 7 and 8. We, therefore, proposed this conceptual framework to stakeholders in the educational technology field of study.

5.2 *Limitations and future directions*

Further studies by other researchers could consider the cultural idiosyncrasies of prospective and continuing students and the impact of attitudes and challenges of students on the integration of technology in HEIs through a mixed-method approach.

6. Conclusion and recommendations

The authors of this article wish to conclude by reiterating that, Perception of students is a weak predictor of technology integration and cannot directly affect it. On the other hand, we recommend students' acceptance and adjustment, LMS usage and Interactivity, must be given critical attention, as they have the efficacy to cause perception to impact the integration of technology. Because the perception of students does have significant ramifications on the students' acceptance and adjustment to the use of technology and the usage of the LMS for academic work as well as their interactivity with peers, instructors and content, which in turn impact integration. This implies that when students' perceptions to use technology are positive or negative, they are more likely to incline towards accepting or rejecting the use of that technology. Again, if students' perception towards the use of the LMS is positive or negative, it will directly determine the usage or rejection of the LMS. Although perceptions do not directly impact integration, these

three variables (AA, LMS, INT) have the propensity to cause perceptions to adversely impact technology integration. Policymakers and school administrators in the HEIs, must therefore, give full consideration to the management of the mediating variables(AA, LMS, INT), by charging the IT Directorates to provide more training sessions and Help Desks to stimulate students' acceptance, provide regular notifications and updates about new applications, as well as instructional videos to enable students to learn quickly about new learning technologies; upgrades and software applications that they need for online learning and demonstrate self-efficacy in independent learning.

We also recommend that, even though policymakers and management of the universities have provided the impetus to boost interactivity among students and the learning technologies, they should not expect the perception of students to drive Interactivity as a stimulus for integrating technology into academic programmes. Rather, they should regard Interactivity as one of the numerous digital activities that enable students to share ideas, content, and information to facilitate learning and improve academic work and not necessarily to impact the process of integrating technology tools and applications into the Learning management systems. That notwithstanding, policymakers should continue to boost interactivity by conscientiously directing students to heighten their use of social media (Facebook, YouTube, Instagram, LinkedIn, Twitter and search engines), among others, to improve their search for information, interactivity and research, thus closing the digital divide.

To a very large extent, public universities in Ghana have invested in and installed various forms of LMSs with integrated tools to improve the integration of technology and better engage students in the teaching and learning process, especially during the pandemic. The Kwame Nkrumah University of Science and Technology has already invested a whopping Ghc20 million in technology integration, between 2020 and to present. The mandatory use of the LMS and other learning platforms, during the COVID-19 era, may have accounted for the highly significant impact of the positive perception of LMS usage and the resultant positive effect on the integration of technology in the top public universities in Ghana. We recommend that Policymakers and management teams of public universities must practically invest more in the LMS and other learning platforms to improve technology integration than brick and mortar.

Availability of data and material

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Conflict of interest

The authors declare no competing financial interest.

References

Abbasi, W. T., Ibrahim, A. H., & Ali, F. B. (2021). Perceptions about english as second language teachers' technology based english language teaching in Pakistan: Attitudes, uses of technology and challenges. *International*

Conference on Emerging Technologies and Intelligent Systems (pp. 314-325). Cham: Springer. https://doi.org/10.1007/978-3-030-82616-1_28

Afari-Kumah, E., & Tanye, H. A. (2009). Tertiary students' view on information and communications technology usage in Ghana. *Journal of Information Technology Impact*, *9*(2), 81-90.

Ahmed, S. S., Khan, E., Faisal, M., & Khan, S. (2017). The potential and challenges of MOOCs in Pakistan: A perspective of students and faculty. *Asian Association of Open Universities Journal, 12*(1), 94-105. https://doi.org/10.1108/AAOUJ-01-2017-0011

Akram, H., Abdelrady, A. H., Al-Adwan, A. S., & Ramzan, M. (2022). Teachers' perceptions of technology integration in teaching-learning practices: A systematic review. *Frontiers in Psychology, 13*, 920317. https://doi.org/10.3389/fpsyg.2022.920317

Allsopp, M. M., Hohlfeld, T., & Kemker, K. (2007, November). *The technology integration matrix: The development and field test of an internet-based multi-media assessment tool for the implementation of instructional technology in the classroom*. Paper presented at the annual meeting of the Florida Educational Research Association, Tampa, FL.

Almahasees, Z., Mohsen, K., & Amin, M. O. (2021, May). Facultys' and students' perceptions of online learning during COVID-19. *Frontiers in Education, 6*, 638470. https://doi.org/10.3389/feduc.2021.638470

Al-Azawei, A., Parslow, P., & Lundqvist, K. (2017). Investigating the effect of learning styles in a blended e-learning system: An extension of the technology acceptance model (TAM). *Austral. J. Educ. Technol, 33*, 1-23. https://doi.org/10.14742/ajet.2741

Anderson, T. (2004). Towards a theory of online learning. *Theory and practice of online learning*, *2*, 109-119.

Anderson, T. (2004). Getting the mix right again: An updated and theoretical rationale for interaction. *The International Review of Research in Open and Distributed Learning*, *4*(2). https://doi.org/10.19173/irrodl.v4i2.149

Ansong, E., Boateng, R., Boateng, S. L., & Anderson, A. B. (2017). The nature of E-learning adoption by stakeholders of a university in Africa. *E-learning and Digital Media*, *14*(4), 226-243.

Asad, M. M., Hussain, N., Wadho, M., Khand, Z. H., & Churi, P. P. (2021). Integration of e-learning technologies for interactive teaching and learning process: An empirical study on higher education institutes of Pakistan. *Journal of Applied Research in Higher Education, 13*(3), 649-663. https://doi.org/10.1108/JARHE-04-2020-0103

Asif, M., Edirisingha, P., Ali, R., & Shehzad, S. (2020). Teachers' practices in blended learning environment: Perception of students at secondary education level. *Journal of Education and Educational Development, 7*(2), 286-306. https://doi.org/10.22555/joeed.v7i2.19

Asunka, S. (2008). Online learning in higher education in sub-Saharan Africa: Ghanaian university students' experiences and perceptions. *International Review of Research in Open and Distance Learning, 9*(3), 1492-3831. https://doi.org/10.19173/irrodl.v9i3.586

Awang, Z. (2012). *Research Methodology and Data Analysis Second Edition*. UiTM Press.

Byungura, J. C. (2019). Improving IT integration for higher education institutional institutional performance. *Towards a Contextualised IT-Institutional Alignment Model*. DSV Report Series-No. 19-008. Stockholm University.

Camilleri, M. A. (2021). Using the balanced scorecard as a performance management tool in higher education. *Management in Education, 35*(1), 10-21.

Camilleri, M. A., & Camilleri, A. C. (2022). The acceptance of learning management systems and video conferencing technologies: Lessons learned from COVID-19. *Technology, Knowledge and Learning, 27*, 1311-1333. https://doi.org/10.1007/s10758-021-09561-y

Chou, C. (2003). Interactivity and interactive functions in web-based learning systems: A technical framework for designers. *British Journal of Educational Technology*, *34*(3), 265-279.

Claar, C., Portolese Dias, L., & Shields, R. (2014). Student acceptance of learning management systems: A study on demographics. *Issues in Information Systems*, *15*(1), 409-417. https://doi.org/10.48009/1_iis_2014_409-417

Creswell, J. W., & Creswell, D. (2018). *Research design: Qualitative, quantitative and mixed methods approaches* (5th ed.). Sage edge; Los Angeles.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319-339.

Dias, S. B., & Diniz, J. A. (2014). Towards an enhanced learning management system for blended learning in higher education incorporating distinct learners' profiles. *Educational Technology and Society*, *17*(1), 307-319. https://www.jstor.org/stable/pdf/jeductechsoci.17.1.307.pdf

Dimoka, A., & Davis, F. D. (2008). Where does TAM reside in the brain? The neural mechanisms underlying technology adoption. *ICIS 2008 Proceedings, 169*, 1-18. https://aisel.aisnet.org/icis2008/169

Dinc, E. (2019). Prospective teachers' perceptions of barriers to technology integration in education. *Contemporary*

Educational Technology Journal, 10(4), 381-398. https://doi.org/10.30935/cet.634187

Eysenck, M. W., & Keane, M. T. (1995). Chapter 4: Theories of perception, movement, and action. *Cognitive Psychology: A Student's Handbook.* Lawrence Erlbaum, Hillsdale, USA.

Falk, R. F., & Miller, N. B. (1992). *A Primer for Soft Modeling.* University of Akron Press.

Fathema, N., & Akanda, M. H. (2020). Effects of instructors' academic disciplines and prior experience with learning management systems: A study about the use of Canvas. *Australasian Journal of Educational Technology*, *36*(4), 113-125.

FCIT. (2017). *Technology Integration Matrix (TIM)*. Florida Centre for Instructional Technology.

Fox, C. (2018). *The Misuse of Technology in the Modern Classroom and a Guide for Solutions*. California State University, San Marcos. http://hdl.handle.net/10211.3/207126

Fornell, C., & Larcker, D. F. (1981). Structural equation models with unobservable variables and measurement error: Algebra and statistics. *Journal of Marketing Research, 18*(3), 382-388. https://doi.org/10.1177/002224378101800313

Gay, L. R., Mills, G. E., & Airasian, P. W. (2009). *Educational Research: Competencies for Analysis and Applications*. Merrill/Pearson.

GTEC Accredited Institutions. (2023). GTEC Accredited Institutions. https://gtec.edu.gh/accredited-institutions

Gyau, Y. O., & Gyan, K. E. (2023). Integrating technology into academic programmes in HEIs: The perspectives of policymakers in Covid era. *International Journal of Social Science and Human Research, 6*(1), 90-100. https://doi.org/10.47191/ IJSSHR /v6-i1-13

Gilbert, L., & Moore, D. R. (1998). Building interactivity into Web courses: Tools for social and instructional interactions. *Educational Technology*, *38*(3), 29-35.

Hair, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P., & Ray, S. (2021). An introduction to structural equation modeling. *Partial Least Squares Structural Equation Modelling (PLS-SEM) Using R* (pp. 1-29). Springer, Cham. https://doi.org/10.1007/978-3-030-80519-7_1

Hair Jr JF, Black W. C., Babin, B. J., Anderson, R. E. (2010). *Multivariate Data Analysis: A Global Perspective* (7th ed.). Pearson Education International.

Habib, M. N., Jamal, W., Khalil, U., & Khan, Z. (2021). Transforming universities in interactive digital platform: Case of city university of science and information technology. *Education and Information Technologies, 26*, 517-541. https://doi.org/10.1007/s10639-020-10237-w

Hodgson, V., & Shah, U. (2017). A phenomenographic study of lecturers' conceptions of using learning technology in a Pakistani context. *Learning, Media and Technology, 42*(2), 198-213. https://doi.org/10.1080/17439884.2016.1154074

Karakose, T., Yirci, R., & Papadakis, S. (2021). Exploring the interrelationship between Covid-19 phobia, work-family conflict, family-work conflict, and life satisfaction among school administrators for advancing sustainable management. *Sustainability, 13*(15), 8654. https://doi.org/10.3390/su13158654

Kock, N. (2015). Common method bias in PLS-SEM: A full collinearity assessment approach. *International Journal of e-Collaboration (IJEC)*, *11*(4), 1-10.

Kumar, S., & Daniel, B., K. (2016). Integration of learning technologies into teaching within Fijian Polytechnic Institutions. *Int J Educ Technol High Educ, 13*, 36. https://doi.org/10.1186/s41239-016-0036-8

Lai, C., Wang, Q., & Lei, J. (2012). What factors predict undergraduate students' use of technology for learning? A case from Hong Kong. *Computers & Education*, *59*(2), 569-579.

Law, L., Hafiz, M., Kwong, T., & Wong, E. (2019). Evaluating students' perceptions on the effectiveness of online intercultural learning experience via a SPOC. *Current Issues in Comparative Education*, *21*(1), 69-92.

Law, K. M., Geng, S., & Li, T. (2019). Student enrolment, motivation and learning performance in a blended learning environment: The mediating effects of social, teaching, and cognitive presence. *Computers & Education*, *136*, 1-12.

Liaw, S. S., & Huang, H. M. (2000). Enhancing interactivity in web-based instruction: A review of the literature. *Educational Technology, 40*(3), 41-45.

Liu, B. (2010). Uncertain risk analysis and uncertain reliability analysis. *Journal of Uncertain Systems*, *4*(3), 163-170.

Mäkelä, E., Auvinen, P., & Juuti, T. (2019). The finnish product development teachers' perceptions of their pedagogical content knowledge in higher education. *Proceedings of the 22nd International Conference on Engineering Design (ICED19), 1*(1), 2220-4342. https://doi.org/10.1017/dsi.2019.65

Mishra, L., Gupta, T., & Shree, A. (2020). Online teaching-learning in higher education during lockdown period of the COVID-19 pandemic. *International Journal of Educational Research Open*, *1*, 100012.

Mohammadi, H. (2015). Investigating users' perspectives on e-learning: An integration of TAM and IS success model. *Computers in Human Behaviour*, *45*, 359-374.

Omwenga, E. I. (2006). *Pedagogical issues and e-learning cases: Integrating ICTs into teaching and learning process*.

Nairobi: University of Nairobi Press.

Rallis, S. F., & Rossman, G. B. (2012). *The Research Journey: Introduction to Inquiry*. Guilford: Guilford Publication.

Rooke, P., & Willson, J. (2000). *Perception, Theory, development, and organization*. Routledge Modular Psychology series book.

Shende, M. S., & Reddy, B. M. (2020). Integration of ICT in higher education institutions: Scope and challenges. *Studies in Indian Place Names*, *40*(31), 149-157.

Shikalepo, E. E. (2020). *Defining a conceptual framework in educational research*. Researchgate. https://doi.org/10.13140/RG.2.2.26293.09447

Schmitt, C. (2002). *Technology in schools: Suggestions, tools, and guidelines for assessing technology in elementary and secondary education*. US Department of Education, Office of Educational Research and Improvement, National Center for Education Statistics (NCES).

Tagoe, M. (2012). Students' perceptions on incorporating e-learning into teaching and learning at the university of Ghana. *International Journal of Education and Development using ICT*, *8*(1), 91-103.

Taherdoost, H. (2016). Validity and reliability of the research instrument; How to test the validation of a questionnaire/survey in a research. *International Journal of Academic Research in Management (IJARM), 5*(3), 29-30.

Tanveer, M. (2018). Integrating e-learning in classroom-based language teaching: Perceptions, challenges and strategies. *ICT for Langauge Learning* (5th ed)*.* Majan College (Oman). https://www.researchgate.net/publication/293263940_

Teo, T., & Zhou, M. (2014). Explaining the intention to use technology among university students: A structural equation modelling approach. *Journal of Computing in Higher Education*, *26*, 124-142.

Teo, A. C., Tan, G. W. H., Ooi, K. B., & Lin, B. (2015). Why consumers adopt mobile payment? A partial least squares structural equation modelling (PLS-SEM) approach. *International Journal of Mobile Communications*, *13*(5), 478-497.

Vasbieva, D., G., & Saienko, V. N. (2018). Exploring students' perception and efficiency of technology-mediated ESP teaching. *XLinguae, 11*(1XL), 127-137. https://doi.org/10.18355/XL.2018.11.01XL.11

van Dijk, A. G. M. (2006). *The Network Society* (2nd ed.). SAGE Publications Ltd. London, UK.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 27*(3), 425-478.

Vrasidas, C. (2000). Constructivism versus objectivism: Implications for interaction, course design, and evaluation in distance education. *International Journal of Educational Telecommunications, 6*(4), 339-362.

Walker, D. S., Lindner, J. R., Murphrey, T. P., & Dooley, K. (2016). Learning management system usage. *Quarterly Review of Distance Education*, *17*(2), 41-50.