




The Attitude of Students and the Mediating effect of Acceptance, Interactivity and LMS on Integration of Technology

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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. Using the Constructivist and Positivist paradigm, this study adopted the quantitative approach and the purposive and quota sampling technique to solicit data from 1704 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 attitudes 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 Attitude of Students (AS) 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: *Attitude, Acceptance and Adjustment, Interactivity, Learning Management Systems, Integration of Technology.*

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INTRODUCTION

Integration of 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. 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.¹ According to the Association of African Universities (AAU), the development and application of ICT in African higher education institutions are essential for the region to flourish and remain relevant on a global scale. New flagship research by the World Bank and the African Development Bank, named e-Transform Africa, has been made public with help from the African Union and details the best methods for utilizing ICTs in important African economic sectors.² This indicates that technology is gradually being integrated into all sectors of the educational ecosystem. Within the higher education ecosystem, students are expected to possess some ICT skills before they are admitted or complete tertiary education. Therefore, technology must be integrated into higher education. 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. Technology is used in the classroom to support, expand, and enhance student learning through computer integration. 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.³ In the process of integrating technology to enhance teaching and learning, students encounter numerous issues, which begin with their own beliefs, attitudes, and degree of acceptance of the use of technological innovations.⁴ Quite a considerable amount of these innovations includes the Learning Management Systems (LMS) which also wield numerous tools integrated for teaching and learning. These tools are also endowed and even customized to facilitate interactivity among students and lecturers.⁵

The purpose of this research is to attempt to examine the attitudes of students and the impact on the Integration of technology as well as examine the mediating effect of Acceptance and Adjustment, Interactivity and LMS usage on the integration of technology into academic programmes. The overarching research objective is primarily to investigate whether students' attitudes impact the integration of technology into academic programmes. In achieving this objective, the following research questions were posed and addressed; to what extent do the attitudes of students impact the integration of technology into academic programmes? Secondly, to what extent do the mediating variables impact the relationship between the attitudes of students and the integration of technology? Previous studies in Ghana rarely touched on the impact of students' attitudes 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' attitudes on the integration of technology. The problem is that in most Ghanaian universities, technology is being used in a variety of ways. Public university faculty members and students are gradually adjusting to the incorporation of technology through online learning. Previous studies by Tagoe, Afari-Kumah and Tanye concerning the integration of technology in Higher Educational Institutions (HEIs) in Ghana have proven that the attitudes of students are a potential threat to the success of the Integration of Technology.⁶ In similar studies beyond Ghana, Law et al found that both negative attitudes like - request for a 'face-to-face discussion to encourage more interaction', in an online learning setting were observed in contrast with positive attitudes - where students asserted 'asynchronous discussion was considered the most effective

¹ Lokanath Mishra, Tushar Gupta, and Abha Shree, "Online Teaching-Learning in Higher Education during Lockdown Period of COVID-19 Pandemic," *International Journal of Educational Research Open* 1 (2020): 100012.

² Nicholas E Souter, Kristen A Lindquist, and Elizabeth Jefferies, "Impaired Emotion Perception and Categorization in Semantic Aphasia," *Neuropsychologia* 162 (2021): 108052.

³ Elijah I Omwenga, "Pedagogical Issues and E-Learning Cases: Integrating ICTs into Teaching and Learning Process," *School of Computing and Informatics*, no. 1 (2006): 1-11.

⁴ S N Shende and B M Reddy, "Integration of ICT in Higher Education Institutions: Scope and Challenges," *Studies in Indian Place Names* 40, no. 31 (2020): 149-57.

⁵ Terry Anderson, "Getting the Mix Right Again: An Updated and Theoretical Rationale for Interaction," *The International Review of Research in Open and Distributed Learning* 4, no. 2 (2003).

⁶ Michael Tagoe, "Students' Perceptions on Incorporating e-Learning into Teaching and Learning at the University of Ghana," *International Journal of Education and Development Using ICT* 8, no. 1 (2012): 91-103; Eben Afari-Kumah and Hannah Ayaba Tanye, "Tertiary Students' View on Information and Communications Technology Usage in Ghana," *Journal of Information Technology Impact* 9, no. 2 (2009): 81-90.

feature to engage students in online interaction.⁷ Even though using technology in the classroom has incalculable advantages, perceived misuse and non-use by students create a crisis for stakeholders.⁸ The above statements suggest the need for further examination of students' attitudes to understand the issues and to suggest improvements on the negative attitudes while building on the positive attitudes when it comes to integrating technology into academic programmes. This is the gap that this study addresses.

LITERATURE REVIEW

Understanding students' attitudes toward e-learning and investigating important aspects that influence students' behaviours toward technology integration may aid instructional designers in creating more successful online courses. Alharthi examined university students' attitudes toward technologies used in online courses and how employing these technologies benefit the learning environment and found that students were not satisfied with the technology used in the distance learning courses because many of these technologies did not consider the learning preferences of learners and they were not easy to navigate, nor flexible in their implementation.⁹ According to Smith, Caputi, and Rawstorne, "a person's general evaluation or feeling of favourability or unfavourability toward computer technologies (i.e. attitude towards objects) and specific computer-related activities (i.e. attitude towards behaviours)" is what is meant by "computer attitude."¹⁰ Smith et al., also mention there is frequently a link between students' attitudes and their computer usage experiences, and there are two aspects of the computer experience that have a direct impact on the students' attitudes: (i) Subjective experience, which is related to the student's feelings and thoughts about their computer usage, and (ii) objective experience, which is related to individual computer interaction.¹¹

Notwithstanding, the attitudes of students, whether subjective or objective experience, can be categorized into positive and negative as discovered by other scholars. A few of the positive attitudes have been reviewed beginning with the study outcome of Orgaz, Moral and Domínguez who found that students' attitude toward technology influences their perception of technology and that students' attitude toward social networks has a positive influence on the use of technology.¹² That indicates that there are instances where students' attitudes have positively stimulated the perceptions of students and subsequently impacted social networks towards technology use. Romero et al., in examining preconceived notions of attitudes toward technology affecting the teaching-learning process and the academic-professional performance of students, found that the parameters that relate self-perceived digital competence with attitude were not significant but the parameter that related frequency of use with attitude was significant where high use of technologies produces more positive and developed attitudes toward ICT.¹³ The parameter that related frequency of use with attitude is also confirmed in the work of Mundir and Umiarso because their research indicated that the students' attitudes in the implementation of LMS were positive due to the report of easily accessing learning material and other sources more frequently.¹⁴ In addition, Mundir and Umiarso found that the students'

⁷ Lisa Law et al., "Evaluating Students' Perceptions on the Effectiveness of Online Intercultural Learning Experience via a SPOC," *Current Issues in Comparative Education* 21, no. 1 (2019).

⁸ Kory Knott, "A Cost-Sensitive Model for Revitalizing United Methodist Churches" (George Fox University, 2018).

⁹ Majed Alharthi, "Students' Attitudes toward the Use of Technology in Online Courses.," *International Journal of Technology in Education* 3, no. 1 (2020): 14–23.

¹⁰ B Smith, P Caputi, and P Rawstorne, "Differentiating Computer Experience and Attitudes toward Computers: An Empirical Investigation," *Computers in Human Behavior* 16, no. 1 (2000): 59–81.

¹¹ Smith, Caputi, and Rawstorne, "Differentiating Computer Experience and Attitudes toward Computers: An Empirical Investigation."

¹² Francisco Orgaz, Salvador Moral, and Cándida M Domínguez, "Student's Attitude and Perception with the Use of Technology in the University.," *Journal of Educational Psychology*, 6, no. 2 (2018): 277–99.

¹³ Sonia J Romero Martínez et al., "Attitudes Toward Technology Among Distance Education Students: Validation of an Explanatory Model.," *Online Learning* 24, no. 2 (2020): 59–75.

¹⁴ Mundir Mundir and Umiarso Umiarso, "Students' attitudes Toward Learning Management System (Lms) During Covid-19 Pandemic: A Case Study," *Lentera Pendidikan: Jurnal Ilmu Tarbiyah Dan Keguruan* 25, no. 1 (2022): 68–81.

attitudes toward LMS were influenced by three factors: individual (e-learning self-efficacy), social (subjective norm), and organizational (accessibility system) factors.¹⁵ More intuitively, Mahyiddin and Amin in their study showed that the students have a positive attitude toward technology integration into education, as they were actively involved during discussions and exhibited positive attitudes and responses towards online learning.¹⁶

Positive Attitudes and Integration of Technology

Positive attitudes of students towards technology integration were also assessed in terms of gender in the works of Balta and Duran in an earlier study found interactive whiteboards to be highly rated by both teachers and students with male students having more positive attitudes toward the interactive whiteboards than the female students.¹⁷ However, Balta and Duran showed that as students get older their positive attitudes decrease.¹⁸ Similarly, Al-Emran and Salloum found significant differences in students' attitudes toward the use of mobile technologies for e-Evaluation in terms of gender.¹⁹ However, there was no significant difference in terms of age, degree, and department in which the researchers examined students' attitudes toward the use of mobile technologies for e-Evaluation. In Ghana, Nukpetsi found significant differences among colleges of education when these colleges' attitudes towards ICT education were examined.²⁰ Nukpetsi further observed that there was a significant difference between male and female attitudes toward the use of ICT colleges in Ghana.²¹

In a college of education, Alabdullaziz et al. investigated instructors' and learners' attitudes toward e-learning.²² They revealed the most favourable sentiments regarding e-learning as a setting for multimedia training. The students gave almost identical ratings to animations, movies, and photographs. Performance in an e-learning environment is significantly impacted by learners' attitudes toward self-regulated learning.²³ Even though there was a strong association between some e-learning and learners' technology experience. Additionally, Jan Ardies et al. cautioned instructors to gain a better understanding of the factors influencing attitudes if they want to encourage students' attitudes toward technology.²⁴ Numerous research, have demonstrated the direct correlation between students' attitudes toward technology integration.²⁵ According to Zhwan et al, students showed good attitudes toward IT, and the study of students' attitudes toward IT and how they relate to academic

¹⁵ Mundir and Umiarso, "Students' attitudes Toward Learning Management System (Lms) During Covid-19 Pandemic: A Case Study."

¹⁶ Mahyiddin Mahyiddin and Fakhurrazi M Amin, "Integrating Technology into Education: Students' Attitudes toward Online Learning," *Tadris: Jurnal Keguruan Dan Ilmu Tarbiyah* 7, no. 1 (2022): 79–89.

¹⁷ Nuri Balta and Muharrem Duran, "Attitudes of Students and Teachers towards the Use of Interactive Whiteboards in Elementary and Secondary School Classrooms.," *Turkish Online Journal of Educational Technology-TOJET* 14, no. 2 (2015): 15–21.

¹⁸ Balta and Duran, "Attitudes of Students and Teachers towards the Use of Interactive Whiteboards in Elementary and Secondary School Classrooms."

¹⁹ Mostafa Al-Emran and Said A Salloum, "Students' Attitudes Towards the Use of Mobile Technologies in e-Evaluation.," *Int. J. Interact. Mob. Technol.* 11, no. 5 (2017): 195–202.

²⁰ Gershon Kofi Ladzekpo Alfred Doh Nukpetsi, "Students' Attitude Towards the Use of Information Communication Technology in College of Education, Ghana," 2019.

²¹ Nukpetsi, "Students' Attitude Towards the Use of Information Communication...."

²² Fatma Alabdullaziz et al., "Instructors' and Learners' Attitudes Toward e-Learning within a College of Education," *Department of Educational Technology. University of Northern Colorado. Recuperado de Http://Files. Eric. Ed. Gov/Fulltext/ED528860. Pd*, 2011.

²³ Xianglei Chen, "Students Who Study Science, Technology, Engineering, and Mathematics (STEM) in Postsecondary Education. Stats in Brief. NCES 2009-161.," *National Center for Education Statistics*, 2009.

²⁴ Jan Ardies et al., "Students Attitudes towards Technology," *International Journal of Technology and Design Education* 25 (2015): 43–65.

²⁵ Kenneth S Volk and Wai Ming Yip, "Gender and Technology in Hong Kong: A Study of Pupils' Attitudes toward Technology," *International Journal of Technology and Design Education* 9 (1999): 57–71; M Gail Jones, Ann Howe, and Melissa J Rua, "Gender Differences in Students' Experiences, Interests, and Attitudes toward Science and Scientists," *Science Education* 84, no. 2 (2000): 180–92; Minna Salminen-Karlsson, "Girls' Groups and Boys' Groups at a Municipal Technology Centre," *International Journal of Science Education* 29, no. 8 (2007): 1019–33.

achievement.²⁶ Vasbieva and Saienko discovered that 85% of students have a positive attitude toward a technologically enhanced language learning environment.²⁷ This illustrates that there is no connection between students' chosen learning styles and their attitudes toward the usage of technology.

Negative Attitudes and Integration of Technology

Some negative attitudes of students have been demonstrated in studies by Johansson admitted that young people's enthusiasm for modern things is appreciable, yet they have unfavourable views on technological education.²⁸ Some of the negative attitudes of students were also enumerated by Asunka in his study that students do not respond favourably to online constructivist teaching approaches such as asynchronous discussions and ill-structured project-based learning activities and perceived collaborative online learning within their context as complex, more demanding and time-consuming experience.²⁹ Similarly, Zhwan et al. investigated students' attitudes toward information technology and its link to academic accomplishment and found that students had favourable views toward IT, which facilitated their academic achievement.³⁰ When the underlying dimensions of the attitude toward IT were measured via the PCA method, there appeared to be three dimensions for attitudes toward IT; affection, behaviour, and cognition. The behaviour component recorded the highest score compared with the affection and belief components, also the affection component seemed to be the lowest among all the attitude components. Hence, the need to look at students' attitudes toward information technology and whether they affect the integration of technology into academic programmes.

Theoretical Framework

Theories underpinning this study are discussed at this stage. According to the Theory of Planned Behaviour, the best method to forecast someone's behaviour is to inquire about their intentions.³¹ Here, it is important to highlight that an intention won't manifest itself in behaviour if it is physically impossible to carry it out or if unanticipated obstacles get in the way. If intention can explain behaviour, how can intention be justified? Ajzen claims that three factors help to understand behavioural intention: 1. The attitude (one's perceptions of the behaviour); 2. The subjective norm (others' perceptions of the behaviour); and 3. Perceived behavioural control (self-efficacy regarding the behaviour). Attitudes, subjective standards, and perceived behavioural control are all predicted by the model to influence intention, which in turn influences behaviour. The TPB is relevant to this study because it explains the attitude as the exogenous variable in this study while investigating its role and relationship with perceptions, intentions and the subsequent observable behaviour of tertiary students. Considering all these issues associated with attitude, this study examined the extent to which the attitude of students tends to impact or affect the integration of technology into academic programmes in HEIs in Ghana.

The next is 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

²⁶ Zhwan Dalshad Abdullah et al., "Students' Attitudes towards Information Technology and the Relationship with Their Academic Achievement," *Contemporary Educational Technology* 6, no. 4 (2015): 338–54.

²⁷ D G Vasbieva and N V Saienko, "Exploring Students' Perception and Efficiency of Technology-Mediated ESP Teaching," *XLinguae* 11, no. 1XL (2018): 127–37.

²⁸ L Johansson, "Mathematics, Science & Technology Education Report," *Brussel: European Round Table of Industrials*, 2009.

²⁹ Stephen Asunka, "Online Learning in Higher Education in Sub-Saharan Africa: Ghanaian University Students' Experiences and Perceptions," *International Review of Research in Open and Distributed Learning* 9, no. 3 (2008): 1–23.

³⁰ Abdullah et al., "Students' Attitudes towards Information Technology and the Relationship with Their Academic Achievement."

³¹ Icek Ajzen, "The Theory of Planned Behavior," *Organizational Behavior and Human Decision Processes* 50, no. 2 (1991): 179–211.

knowledge or gain new understanding.³² This Matrix is relevant to this study in two major delineations; first, it defines and authenticates technology integration as the key dependent variable under study at the selected public universities and; second, it defines the processes involved in the integration and the extent to which students' attitudes are affecting the adoption and adaptation of the five learning domains (entry, adoption, adaptation, infusion, transformation). It must be reiterated that an earlier qualitative study conducted by Gyau and Gyan 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.³³

The theory of online learning introduced by Anderson, offered a paradigm of e-learning.³⁴ 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.³⁵ 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.³⁶ A technology-based interactive learning environment incorporates four types of interaction: *learner-content*, *learner-instructor*, *learner-learner*, and *learner-interface*.³⁷ 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). 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 under study. 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. 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.³⁸ 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 the attitude 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 the attitude through acceptance, interactivity and LMS usage, on technology integration. It is against this knowledge gap that the authors of this

³² Margaret M Allsopp, Tina Hohlfeld, and Kate Kemker, "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," *Florida Educational Research Association, Tampa*, 2007.

³³ Yaw Odame Gyau and Ernest Kwabena Gyan, "Exploring Organisational Culture and Challenges towards Integration of Technology: The Perspectives of Policymakers in COVID Era," *International Journal of Social Science And Human Research* 05, no. 12 (December 31, 2022), <https://doi.org/10.47191/ijsshr/v5-i12-90>.

³⁴ Anderson, "Getting the Mix Right Again: An Updated and Theoretical Rationale for Interaction."

³⁵ Qiyun Wang, "A Generic Model for Guiding the Integration of ICT into Teaching and Learning," *Innovations in Education and Teaching International* 45, no. 4 (November 2008): 411–19, <https://doi.org/10.1080/14703290802377307>.

³⁶ Larry Gilbert and David R Moore, "Building Interactivity into Web Courses: Tools for Social and Instructional Interactions," *Educational Technology* 38, no. 3 (1998): 29–35; Shu-sheng Liaw and Hsiu-mei Huang, "Enhancing Interactivity in Web-Based Instruction: A Review of the Literature," *Educational Technology* 40, no. 3 (2000): 41–45.

³⁷ Wang, "A Generic Model for Guiding the Integration of ICT into Teaching and Learning"; Gilbert and Moore, "Building Interactivity into Web Courses: Tools for Social and Instructional Interactions."

³⁸ Chet Claar, Laura Portolese Dias, and Robert Shields, "Student Acceptance Of Learning Management Systems: A Study On Demographics," *Issues in Information Systems* 15, no. 1 (2014).

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.

Attitude of Students (AS)

Although Attitude is a multi-dimensional term, this study examined the attitude of students in the context of how they react and respond to learning technologies that have been introduced by policymakers to facilitate the integration of technology into academic programmes in the HEIs understudy.³⁹ Therefore, the attitudes of students is formulated as the exogenous variable based on the works of some scholars.⁴⁰ As such, this study sought to provide additional insight into the influence of Acceptance and Adjustment, Interactivity and LMS usage within the context of the Attitude of Students (AS) and Integration of Technology (IG) necessitating the question ‘To what extent do the reactions and responses of students affect or impact the integration of technology through the lens of the AA, INT and LMS usage?’ as posed in hypotheses 1 to 4.

H1: Attitude of Students (AS) have a significant positive impact on the Integration of Technology (IG).

H2: Attitude of Students (AS) have a significant positive impact on Acceptance and Adjustment (AA) to use technology.

H3: Attitude of Students (AS) has a significant positive effect on Interactivity (INT).

H4: Attitude of Students (AS) have a significant positive effect on Learning Management Systems (LMS) usage.

Learning Management Systems (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, and the effect of usage on the integration of technology.⁴¹ The LMS usage is formulated as a construct based on the works of some scholars.⁴² As such, this study sought to provide additional insight into the influence of LMS usage within the context of AS and IG necessitating the question: ‘To what extent does LMS usage mediate the linkage between AS 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 Systems (LMS) usage significantly mediates the relationship between the Attitude of Students (AS) and Integration of Technology (IG).

Interactivity (INT)

Interactivity in this study refers to sustained, two-way communication between students and an instructor. A technology-based interactive learning environment incorporates four types of interaction: learner–content, learner–instructor, learner-learner, and learner–interface.⁴³ Interactivity is formulated

³⁹ Jonathan Osborne, Shirley Simon, and Sue Collins, “Attitudes towards Science: A Review of the Literature and Its Implications,” *International Journal of Science Education* 25, no. 9 (2003): 1049–79.

⁴⁰ Mundir and Umiarso, “Students’attitudes Toward Learning Management System (Lms) During Covid-19 Pandemic: A Case Study”; Mahyiddin and Amin, “Integrating Technology into Education: Students’ Attitudes toward Online Learning”; Alharthi, “Students’ Attitudes toward the Use of Technology in Online Courses.”

⁴¹ Sofia Balula Dias and José Alves Diniz, “Towards an Enhanced Learning Management System for Blended Learning in Higher Education Incorporating Distinct Learners’ Profiles,” *Journal of Educational Technology & Society* 17, no. 1 (2014): 307–19.

⁴² Anderson, “Getting the Mix Right Again: An Updated and Theoretical Rationale for Interaction”; Claar, Portolese Dias, and Shields, “Student Acceptance Of Learning Management Systems: A Study On Demographics”; Dias and Diniz, “Towards an Enhanced Learning Management System for Blended Learning in Higher Education Incorporating Distinct Learners’ Profiles.”

⁴³ Wang, “A Generic Model for Guiding the Integration of ICT into Teaching and Learning.”

as a hypothetical construct based on the works of Anderson, Liaw and Huang; Wang.⁴⁴ 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 Attitude of Students (AS) and the Integration of Technology (IG).

Acceptance and Adjustment to Technology (AA)

Students accepting and adjusting to the introduction of new learning technologies and adopting upgraded versions is dependent on whether 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 some scholars.⁴⁵ This study builds on and contributes to works in Acceptance 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 use technology significantly mediates the relationship between the Attitude of Students (AS) and Integration of technology (IG).

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)

CONCEPTUAL FRAMEWORK

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, 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.⁴⁶ It is against this background that the TIM became the base model and most ideal definition for Integration of Technology (IG) which is also better positioned as the dependent variable for the study. The Attitude of Students (AS) is the exogenous variable being investigated and its impact on the integration of technology in the universities under study. The authors proposed conceptual framework, therefore, attempts to investigate the relationship between the two key variables; Integration of technology (IG) and Attitude of Students (AS), 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.

⁴⁴ Anderson, "Getting the Mix Right Again: An Updated and Theoretical Rationale for Interaction"; Liaw and Huang, "Enhancing Interactivity in Web-Based Instruction: A Review of the Literature"; Wang, "A Generic Model for Guiding the Integration of ICT into Teaching and Learning."

⁴⁵ Zakaryia Almahasees, Khaled Mohsen, and Mohammad Omar Amin, "Faculty's and Students' Perceptions of Online Learning during COVID-19," in *Frontiers in Education*, vol. 6 (Frontiers Media SA, 2021), 638470; Timothy Teo and Mingming Zhou, "Explaining the Intention to Use Technology among University Students: A Structural Equation Modeling Approach," *Journal of Computing in Higher Education* 26 (2014): 124–42; Chun Lai, Qiu Wang, and Jing Lei, "What Factors Predict Undergraduate Students' Use of Technology for Learning? A Case from Hong Kong," *Computers & Education* 59, no. 2 (2012): 569–79; Tagoe, "Students' Perceptions on Incorporating e-Learning into Teaching and Learning at the University of Ghana"; Viswanath Venkatesh et al., "User Acceptance of Information Technology: Toward a Unified View," *MIS Quarterly*, 2003, 425–78.

⁴⁶ Gyau and Gyan, "Exploring Organisational Culture and Challenges towards Integration of Technology: The Perspectives of Policymakers in COVID Era."

CONCEPTUAL FRAMEWORK

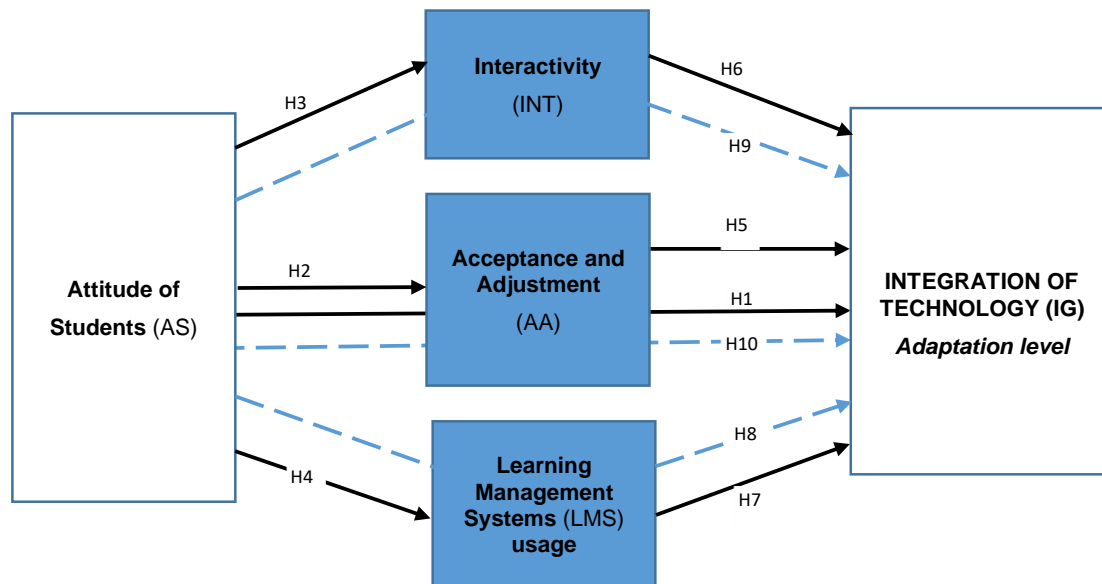


Figure 1: Proposed Conceptual Framework indicating the relationship between AS, AA, INT, LMS and the IG. Source: Researcher, 2022

RESEARCH METHODOLOGY

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. The research approach was deductive reasoning through sophisticated statistical tests.

Sampling techniques

Sampling techniques used were purposive sampling, quota sampling and convenience sampling for data collection, based on knowledge of subjects under study. 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 2021). 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 which 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. 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.⁴⁷ 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. Next, based on the proportions of the subgroups (level 400) necessary for the final sample, the researchers allocated 300 units 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 who took part in the study. Students were, therefore, selected using quota sampling and adopted convenient sampling and snowball methods for data collection.

Data Collection Methods

However, the sample size was based on the criteria of Gay, Mills and Airasian who recommended that for a population of 5000 or more, a sample size of 400 is adequate.⁴⁸ 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 1800 students. Therefore, a total of 1800 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 (1800) reached. In the event that some students declined to fill out the questionnaire, the college/faculty was asked to recommend other level 400 students, within the same group, to fill the questionnaire by consenting: therefore, adopting the Snowball method as an additional method.⁴⁹

The Instrument

By best practices, quantitative studies of this nature, are best conducted as a survey, deploying questionnaires as the ideal instrument.⁵⁰ A structured questionnaire with specific scales of measurement, drawn from validated instruments of Mundir and Umiarso and Mahyiddin and Amin for attitudes, was modified for this research.⁵¹ 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.

⁴⁷ UG – University of Ghana; UCC – University of Cape Coast; UEW – University of Education Winneba; UDS- University of Development Studies; UPSA – University of Professional Studies, Accra; KNUST – Kwame Nkrumah University of Science and Technology.

⁴⁸ L R Gay, G E Mills, and P W Airasian, "Educational Research: Competencies for Analysis and Applications. 9th Editio," *New Jersey*, 2009.

⁴⁹ Chaim Noy, "Sampling Knowledge: The Hermeneutics of Snowball Sampling in Qualitative Research," *International Journal of Social Research Methodology* 11, no. 4 (2008): 327–44.

⁵⁰ John W. Creswell, *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (California: Sage, 2003).

⁵¹ Mundir and Umiarso, "Students' attitudes Toward Learning Management System (Lms) During Covid-19 Pandemic: A Case Study"; Mahyiddin and Amin, "Integrating Technology into Education: Students' Attitudes toward Online Learning."

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.

RESULTS AND ANALYSES

The main objective that this study sought to achieve was to examine the impact of the attitudes 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 51.3% variation in Students' Acceptance and Adjustment to technology can be attributed to the Attitude of Students. As indicated in Table 3, by the regression analyses, 28.4% variation in Integration of technology (IG) can be attributed to the Attitude of Students. Moreover, and 23.3% variation in Interactivity (INT) can also be attributed to the Attitude of Students. Finally, a 22.6% variation in the use of Learning Management Systems (LMS), can also be attributed to the Attitude of Students in the public universities in Ghana. Although the relationship coefficient 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.

Demographic Analyses of Quantitative Data: Demographic profile of students are detailed as shown in 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	1347	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

Students-attitudes 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.

	Attitude of Students (AS)	Frequency	%
AS1	My attitude is positive	555	32.5
AS2	My attitude is negative	132	7.7
AS3	My attitude is indifferent	151	8.8
AS4	My actions towards the infusion of technology has been more positive	500	29.3
AS5	My actions towards the infusion of technology has been more negative	115	6.7
AS6	My responses towards technology have been passive	251	14.7
	Total	1704	100%

Table 2: Attitude of Students. (Source: Field data, 2022)

According to the standards set forth by Fornell and Larcker and the Heterotrait - Monorait Ratio (HTMT) recommended by Teo et al, exploratory analysis such as scale reliability, convergent and discriminant validity, and other factors must be evaluated while measuring the data.⁵² 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.⁵³ Secondly, the study examined the convergent validity, discriminant validity and reliability of the structural model by adopting the Hair et al. criterion.⁵⁴ 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.⁵⁵

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 in the PLS-SEM statistical instrument for validity to attain acceptable values for the AVE.⁵⁶ 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.⁵⁷ 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 Ghazali and Nordin, the threshold for factor loadings should be 0.6 or higher.⁵⁸ Based on that, reliability for this study was achieved with all the variables tested. Table 3 indicates the confirmatory factor analysis result, outer/inner VIF values, Composite reliability, Cronbach Alpha, AVE, R-squared and the F-squared values attained.

⁵² Claes Fornell and David F Larcker, "Evaluating Structural Equation Models with Unobservable Variables and Measurement Error," *Journal of Marketing Research* 18, no. 1 (1981): 39–50; Timothy Teo, Wong Su Luan, and Chai Ching Sing, "A Cross-Cultural Examination of the Intention to Use Technology between Singaporean and Malaysian Pre-Service Teachers: An Application of the Technology Acceptance Model (TAM)," *Journal of Educational Technology & Society* 11, no. 4 (2008): 265–80.

⁵³ Ned Kock, "Common Method Bias in PLS-SEM: A Full Collinearity Assessment Approach," *International Journal of E-Collaboration (Ijec)* 11, no. 4 (2015): 1–10.

⁵⁴ Joseph F Hair Jr et al., "An Introduction to Structural Equation Modeling," *Partial Least Squares Structural Equation Modeling (PLS-SEM) Using R: A Workbook*, 2021, 1–29.

⁵⁵ Fornell and Larcker, "Evaluating Structural Equation Models with Unobservable Variables and Measurement Error."

⁵⁶ Teo, Luan, and Sing, "A Cross-Cultural Examination of the Intention to Use Technology between Singaporean and Malaysian Pre-Service Teachers: An Application of the Technology Acceptance Model (TAM)."

⁵⁷ Hair Jr et al., "An Introduction to Structural Equation Modeling."

⁵⁸ N Ghazali and M S Nordin, "Measuring Meaningful Learning Experience: Confirmatory Factor Analysis," *International Journal of Innovation, Creativity and Change* 9, no. 12 (2019): 283–96.

Constructs	Indicator	VIF OUT	VIF INN	Loading	AVE	CR	(α)	R ²	F ²
Attitude of Students (AS)	AS1	1.701	1.647	0.755	0.634	0.884	0.808		0.057
	AS2	1.518		0.829					
	AS3	2.613		0.831					
	AS4	1.773		0.775					
	AS5	1.641		0.809					
	AS6	1.272		0.776					
Acceptance & Adjustment (AA)	AA1		2.260	0.764	0.573	0.849	0.849	0.513	0.617
	AA2	2.448		0.816					
	AA3	2.607		0.840					
	AA4	1.602		0.706					
	AA5	1.837		0.759					
	AA6	1.447		0.642					
Interactivity (INT)	INT1	1.938	1.514	0.738	0.587	0.86	0.887	0.233	0.219
	INT2	2.034		0.752					
	INT3	2.489		0.765					
	INT4	2.178		0.792					
	INT5	2.402		0.803					
	INT6	2.179		0.744					
Learning Management Systems (LMS) usage	LMS1	1.539	1.421	0.806	0.589	0.767	0.767	0.226	0.177
	LMS2	1.658		0.779					
	LMS3	1.717		0.835					
	LMS4	1.305		0.701					
Integration of Technology (IG) (Itemized by the TIM Variables)	ENTRY	1.841			0.613	0.842	0.842	0.284	0.022
				0.779					
	ADOPT	2.281		0.827					
	ADAPT	1.959		0.816					
	INFUSION	1.725		0.739					
	TRANS	1.699		0.757					

Table 3: Exploratory analysis result and VIF (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-Monotrait Ratio (HTMT) which recommends a threshold value of 0.90 or less.⁵⁹ This is indicated in Table 4.

⁵⁹ Teo, Luan, and Sing, "A Cross-Cultural Examination of the Intention to Use Technology between Singaporean and Malaysian Pre-Service Teachers: An Application of the Technology Acceptance Model (TAM)."

	AA	AS	IG_	INT_	LMS_
AA					
AS	0.823				
IG_	0.54	0.502			
INT_	0.637	0.548	0.557		
LMS_	0.641	0.564	0.504	0.41	

Table 4: Discriminant Validity. (Source: Field data, 2022)

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 AS 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 R² values for the three mediating variables and the dependent variable based on the 0.10 threshold (Falk and Miller, 1992). The analysis reveals an R² value of 0.513 for *Acceptance and Adjustment to technology* and 0.284 for *Integration of technology*. *Interactivity* attained an R² value of 0.233 and the *Learning Management Systems (LMS)* usage attained an R² value of 0.226, as indicated in Table 3. The R² value is illustrated in the structural model below.

Structural Model

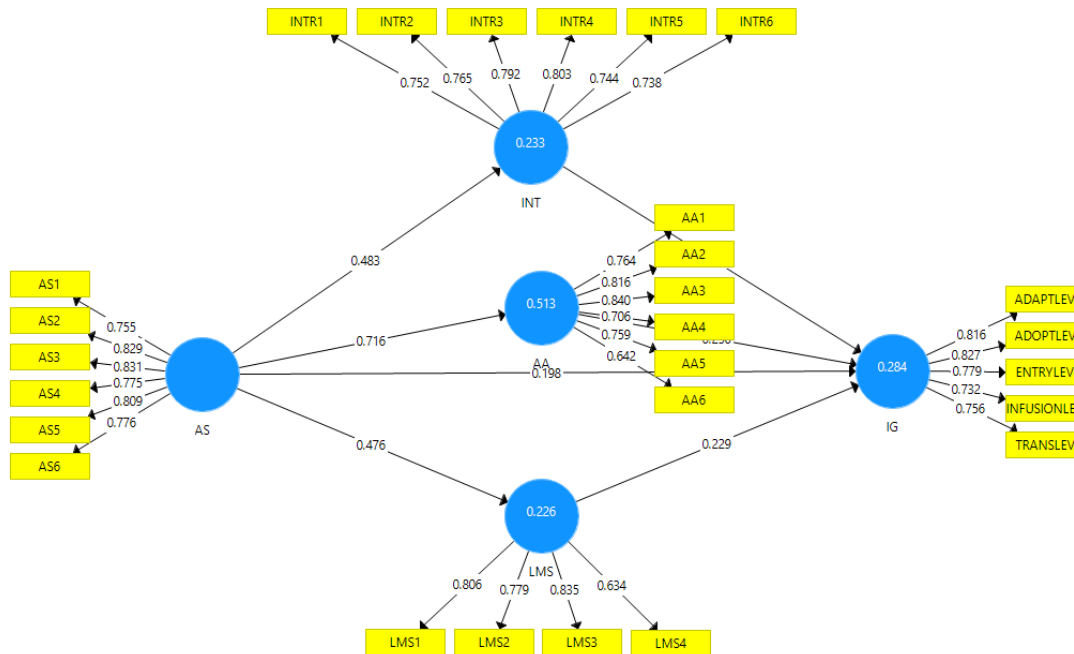


Figure 2: Structural model indicating the regression analyses and relationship coefficients between all variables. Source: Researcher, 2022

Direct Effects

Hypotheses	Constructs	Coefficient(β)	Standard Dev	T Statistics	P Value	Outcome
H1	AS -> IG	0.250	0.105	2.358	0.019*	Supported
H2	AS -> AA	0.716	0.032	22.24	0.000*	Supported
H3	AS -> INT	0.199	0.084	10.027	0.000*	Supported
H4	AS -> LMS	0.483	0.048	10.56	0.000*	Supported
H5	LMS -> IG	0.476	0.061	3.768	0.000*	Supported
H6	INT -> IG	-0.087	0.064	1.368	0.172	Not-supported
H7	AA -> IG	0.229	0.101	2.552	0.018*	Supported

Table 5: Direct effects of the relationship between AS, AA, LMS and INT on IG. (Source: Field data, 2022)

Indirect Effects

Hypotheses	Constructs	Coefficient(β)	Standard Dev.	T-Value	P-Value	Outcome
H8	AS -> LMS -> IG	0.109	0.031	3.565	0.000*	Supported
H9	AS -> INT-> IG	-0.042	0.033	1.288	0.198	Not-Supported
H10	AS -> AA -> IG	0.179	0.075	2.374	0.010*	Supported

Table 6: The mediating effect of LMS, INT and AA on the correlation between AS and Integration of Technology (IG).

Mediation Analyses – Learning Management Systems (LMS), Interactivity (INT), Acceptance and Adjustment (AA).

Mediation analyses were performed to assess the mediating role of Learning Management Systems (LMS) on the linkage between the Attitude of Students (AS) and the Integration of Technology (IG). The results indicate that the indirect effect of AS on IG through LMS usage is found to be significant (H8: $\beta = 0.109$, $t = 3.565$, $p = 0.000$). Hypothesis H8 was therefore supported as shown in Table 6. This shows that the relationship between AS and IG is fully mediated by LMS. Meanwhile, the results, in Table 5, revealed that the direct effect of (LMS) on (IG) is also significant (H5: $\beta = 0.476$, $t = 3.768$, $p = 0.000$). Hypothesis H5 was therefore supported.

Pursuant to these results, mediation analyses were also performed to assess the mediating role of Interactivity (INT) on the linkage between AS and IG and the indirect effect of AS on IG through the INT was found to be not significant (H9: $\beta = -0.042$, $t = 1.288$, $p = 0.198$). Hypothesis H9 was therefore not-supported as indicated in Table 6. This indicates that Interactivity does not have any significant impact on the relationship between AS and IG. Meanwhile, the results, in Table 5, revealed that the direct effect of (INT) on (IG) is also not-significant (H6: $\beta = -0.087$, $t = 1.386$, $p = 0.172$). Hypothesis H6 was therefore not supported.

Finally, mediation analyses were performed to assess the mediating role of Acceptance and Adjustment (AA) to technology, on the correlation between AS and IG. The indirect effect of AS on IG, through the AA was found to be significant (H10: $\beta = 0.179$, $t = 2.374$, $p = 0.010$). Hypothesis H10 was therefore supported as indicated in table 6. Meanwhile, Students' Acceptance and Adjustment to technology had a direct significant impact on the Integration of Technology (H7: $\beta = 0.229$, $t = 2.552$, $p = 0.018$). Therefore, hypothesis H7 was supported as indicated in Table 5. This shows that the Attitude of Students directly impacts on Integration of Technology and the linkage is fully mediated by Students' Acceptance and Adjustment to use technology. Therefore, Acceptance and Adjustment to the use of technology by students is a strong predictor of Integration of technology.

As regards the impact of the Attitude of Students on the Integration of Technology and the mediating variables, it is evidenced in Table 5 that the Attitude of Students has a direct positive impact on the Integration of Technology (H1: $\beta = 0.716$, $t = 22.240$, $p = 0.000$). Hypothesis H1 is therefore supported. This reveals that the Attitude of Students in public universities in Ghana is a strong predictor of the Integration of Technology into academic programmes.

Likewise, the Attitude of Students also has a direct positive effect on Students' Acceptance and Adjustment to the use of technology as indicated in Table 5. (H2: $\beta = 0.716$, $t = 20.702$, $p = 0.000$). Hypothesis H2 is therefore supported. This reveals that the Attitude of students in the public universities in Ghana is a strong predictor of Students' Acceptance and Adjustment to the use of technology in their academic pursuits.

Similarly, the Attitude of Students also has a direct positive effect on Interactivity (INT) in the integration process as indicated in Table 5. (H3: $\beta = 0.199$, $t = 10.027$, $p = 0.000^{**}$). Hypothesis H3 is therefore supported. This discloses the fact that the Attitude of students in the public universities in Ghana is a strong predictor of Students' Interactivity in the entire technology integration process. Finally, the Attitude of Students also had a direct positive effect on the use of Learning Management Systems (LMS) in the integration process, as indicated in Table 5. (H4: $\beta = 0.483$, $t = 10.560$, $p = 0.000$). Hypothesis H4 is therefore supported. The Attitude of Students, therefore, is a strong predictor of Students' patronage of the LMS in the entire technology integration process in the public universities in Ghana.

Proposed Conceptual Framework based on the hypothesis and the Technology Integration Matrix.

The authors of this article, in a quest to determine the variables that will be necessary for developing a new conceptual framework, took into account and tested the relationship between the independent variables (AS) and the dependent variable (IG), vis-a-vis the mediating variables (AA, INT, LMS). Based on the research conducted and the hypothesis tested through regression analyses in the PLS-SEM software, the authors propose a Conceptual Framework underpinned by variables of the Technology Integration Matrix (TIM) and the ten hypotheses that indicates the path analyses. Each path is represented by the hypotheses tested and labelled (H1-H10). The darker lines are paths that indicate direct effects while the dotted lines indicate indirect effects.

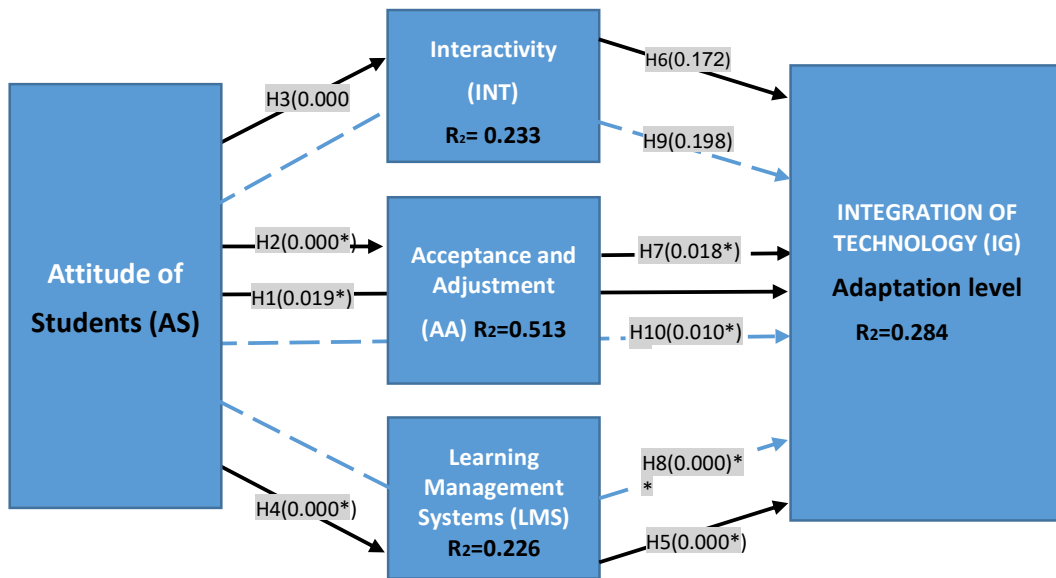


Figure 3: Proposed Conceptual framework. Mediating Effects of AA, INT, LMS on the linkage between AS and Integration of Technology (IG) – Source: Researcher, 2022

FINDINGS AND DISCUSSIONS

This section discusses the findings and implications of the study which have been categorized into theoretical, practical, policy, and major implications. It represents the findings by summarizing the outcomes of the hypotheses. First, the main objective of this study is to examine the impact of the attitude of students on the integration of technology into academic programmes in the topmost public universities in Ghana.

Primarily, the attitude of students has a direct effect on the integration of technology. Again, the acceptance and adjustment to the use of technology and the usage of the Learning Management Systems, are strong predictors to the integration of technology. The study concludes that the attitude of students is positively related to the integration of technology. Amazingly, Interactivity does not significantly mediate the linkage between the attitude of students and the integration of technology. Interactivity, again, does not directly impact integration. The study posits that Interactivity does not have any mediating effect on the Integration of technology into academic programmes. Meanwhile, it is imperative to note that the attitude 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 attitude 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 (AA) to use technology has 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. The study discusses the implications of these findings in the following categories.

Theoretical Implications

Theoretical implications can be explained by discussing the findings in tandem with the theories underpinning the study. Ajzen's assumptions that attitudes, subjective standards, and perceived behavioural control are all predicted by the model to influence intention, which in turn influences behaviour has been confirmed in this study because students have demonstrated their intentions to accept and use learning technologies through attitudes about the integration of technology while being exposed to the stimuli of new technologies and their interactions with those technologies as juxtaposed with their subjective norms and behaviour in the integration process.⁶⁰ Some of the attitudes that this study found about the integration of technology among students include the fact that their attitude towards technology integration is positive, much as their responses to technology integration are also positive. This study, therefore, confirms the assumptions of the Theory of Planned Behaviour.

Anderson's, theory of Online learning seems to emphasize interactivity among all the key stakeholders in the integration process.⁶¹ 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 attitudes 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

⁶⁰ Ajzen, "The Theory of Planned Behavior."

⁶¹ Matthew J. Schultz et al., "Importance and Capability of Teaching Agricultural Mechanics as Perceived by Secondary Agricultural Educators," *Journal of Agricultural Education* 55, no. 2 (June 30, 2014): 48–65, <https://doi.org/10.5032/jae.2014.02048>.

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 attitude 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 technology has a *three-fold effect* on the integration of technology. Because there is a significant positive relationship between the attitude of students and the acceptance and adjustment to the use of 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, AA as a mediator has been proven to have a direct positive impact on the integration of technology. These outcomes confirm the assumptions of the TAM in the public universities in Ghana and confirm the study outcomes of previous studies.⁶² The study concludes that Students' acceptance and adjustment to technology use is critical to the advancement of technology integration in HEIs in Ghana.

Practical Implications

The practical implications of the outcome of this study cannot be overlooked. Much as AA 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. Mundir and Umiarso's study indicated that the students' attitudes toward the implementation of LMS were positive due to the report of easily accessing learning material and other sources more frequently and that students' attitudes toward LMS were influenced by e-learning self-efficacy, subjective norms, and accessibility system.⁶³ In their study, Mahyiddin and Amin, demonstrated that students had a good attitude toward the integration of technology into education since they actively participated in the discussions and showed positive attitudes and reactions to online learning.⁶⁴ Over time, LMS usage in colleges and universities has increased significantly to support educational activities.⁶⁵ 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. Consistent with Zhwan et al's study (2015), students' attitudes toward information technology and its link to academic accomplishment had favourable views toward ICT, which facilitated their academic achievement.⁶⁶ Moreover, Fathema et al. and Walker et al., 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

⁶² Venkatesh et al., "User Acceptance of Information Technology: Toward a Unified View"; Vasbieva and Saienko, "Exploring Students' Perception and Efficiency of Technology-Mediated ESP Teaching"; Teo and Zhou, "Explaining the Intention to Use Technology among University Students: A Structural Equation Modeling Approach."

⁶³ Mundir and Umiarso, "Students' attitudes Toward Learning Management System (Lms) During Covid-19 Pandemic: A Case Study."

⁶⁴ Mahyiddin and Amin, "Integrating Technology into Education: Students' Attitudes toward Online Learning."

⁶⁵ Darrell S Walker et al., "Learning Management System Usage," *Quarterly Review of Distance Education* 17, no. 2 (2016): 41–50.

⁶⁶ Abdullah et al., "Students' Attitudes towards Information Technology and the Relationship with Their Academic Achievement."

assessments, all of which can be tailored to meet educational objectives.⁶⁷ Policymakers and management teams in the universities must therefore begin to consider LMS usage as a strong predictor and critical mediator between the attitude of students and the integration of technology into academic programmes.

Policy Implications

Concerning policy implications, the attitude of students has been found to have a direct effect on technology integration. So, policymakers cannot overlook it because numerous research, including Other authors have demonstrated the direct correlation between students' attitudes towards technology integration.⁶⁸ However, attitude can further impact integration when significant consideration is given to acceptance and LMS usage which is consistent with the study outcome of Claar et al.⁶⁹ Policymakers must take a cue from the study outcomes of their researchers, whose works have been confirmed in this current study. As Chen found, Learners' attitudes toward self-regulated learning have a major influence on performance in an e-learning environment, even though certain e-learning and students' technological experience were strongly associated.⁷⁰ Additionally, if teachers wish to support their students' attitudes toward technology, Jan Ardies et al. advised them to better grasp the elements impacting attitudes.⁷¹ Policymakers must also consider this assertion and empower teachers to practically support students' attitudes toward technology integration. Policymakers and school administrators must, therefore, take pragmatic steps to retune or refine the attitude of students and encourage them to accept, adjust and patronize integration through 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 and Ansong et al.⁷² 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' attitudes on the learning technologies that are installed to stimulate and ensure the integration of technology to improve academic performance.

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 the attitude of students and its effect on the integration of technology. According to Rallis and Rossman, 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.⁷³ This study adopted the Schematic presentation to present the framework because it used inferential statistics to establish cause and effect between variables

⁶⁷ Nafsaniath Fathema and Mohammad H Akanda, "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, no. 4 (2020): 113–25; Walker et al., "Learning Management System Usage."

⁶⁸ Volk and Yip, "Gender and Technology in Hong Kong: A Study of Pupils' Attitudes toward Technology"; Jones, Howe, and Rua, "Gender Differences in Students' Experiences, Interests, and Attitudes toward Science and Scientists"; Salminen-Karlsson, "Girls' Groups and Boys' Groups at a Municipal Technology Centre."

⁶⁹ Claar, Portolese Dias, and Shields, "Student Acceptance Of Learning Management Systems: A Study On Demographics."

⁷⁰ Chen, "Students Who Study Science, Technology, Engineering, and Mathematics (STEM) in Postsecondary Education. Stats in Brief. NCES 2009-161."

⁷¹ Ardies et al., "Students Attitudes towards Technology."

⁷² Asunka, "Online Learning in Higher Education in Sub-Saharan Africa: Ghanaian University Students' Experiences and Perceptions"; Eric Ansong et al., "The Nature of E-Learning Adoption by Stakeholders of a University in Africa," *E-Learning and Digital Media* 14, no. 4 (2017): 226–43.

⁷³ Sharon F Rallis and Gretchen B Rossman, *The Research Journey: Introduction to Inquiry* (Guilford Press, 2012).

based on theories and the research questions of this study.⁷⁴ It also considered the four characteristics of a good conceptual framework – comparability, verifiability, timeliness, and understandability. Figure 4 presents the conceptual framework depicting attitude 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. The authors of this article, therefore, propose this conceptual framework to stakeholders in the educational technology field of study.

LIMITATIONS AND FUTURE DIRECTIONS

Other researchers should conduct more studies that use a mixed method approach to take into account the cultural quirks of prospective and current students as well as the influence of students' attitudes and obstacles on the incorporation of technology in HEIs.

RECOMMENDATIONS

The authors 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 attitude 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 of using technology are positive or negative, they are more likely to incline towards accepting or rejecting the use of that technology. Again, if students' attitude toward the use of the LMS is positive or negative, it will directly determine the usage or rejection of the LMS. Although attitude directly impacts integration, these three variables (AA, LMS, INT) have the propensity to cause attitude to further impact technology integration.

The article also recommends 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 attitude 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 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 to date. 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 attitude of LMS usage and the resultant positive effect on the integration of technology in the top public universities in Ghana. The authors 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.

⁷⁴ Elock Emvula Shikalepo, "Defining a Conceptual Framework in Educational Research," Retrieved from: At: <https://www.researchgate.net/publication/342010918>, 2020.

CONCLUSION

The article has discussed the attitude of students and the mediating effect of acceptance, interactivity and LMS on the integration of technology. The authors of this article wish to reiterate that the perception of students is a weak predictor of technology integration and cannot directly affect it. 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.

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AVAILABILITY OF DATA AND MATERIAL

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