The Role of Academic Library Resources and Teacher Competency in Student Learning Engagement in the Digital Era

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Abstract

Effective use of high-quality digital resources and digital technologies has become essential in the present modern academic environment. The main aim of this research was to explore the way new media resource quality, teacher digital competency, and digital technology innovation (with support of digital technology) can enhance knowledge retention and learning engagement. The present study also examined the mediating effect of student learning engagement. For this purpose, this research used quantitative research methodology. A questionnaire was developed on a Likert scale to distribute among students at different institutes in China. This research used simple random samplings to reach respondents. The usable response rate of the study was 65%. Smart PLS 4 was used for the analysis of data. Findings show that new media resource quality, teacher digital competence, and digital technology innovation have a positive effect on engagement. Moreover, student learning engagement has a positive influence on knowledge retention. The mediating effect of student learning engagement was also statistically confirmed. This research adds to the body of knowledge by discussing the mediating role of student learning engagement. Scholars can use these findings in future research.

Introduction

The basic goal of every education institute is to provide education and knowledge to students with the purpose of passing the registered subject, but also to make sure that students can easily understand and internalize the knowledge. It means that whatever is being taught in the university institute will remain for a long time in the memory of the students. This concept in literature is known as knowledge retention which is important for the application of knowledge in the practical field (Maceiras et al., 2025). From the perspective of modern education, knowledge retention is significantly affected through modern digital tools. Among these, digital library resources act as an important component for delivering information. Digital library resources also provide students with access to multimedia materials, databases, journals, e-books, and international magazines. Students can use these resources of digital libraries to get engaged with academic content according to their own pace. Students can strengthen their memory and revisit academic information whenever needed. Furthermore, well-organized and interactive digital platforms help students in deeper comprehension through the integration of digital elements like visualizations, simulations, and videos. These elements help students to cater to different learning styles (Zhang and Zhang, 2024). Digital library resources can use diverse ways to provide information to students that help in retention of information.

Engagement is one of the very important

factors for the promotion of meaningful learning. It also helps students improve academic performance. Digital library resources play a very important role in fostering engagement among students as they get immediate access to high-quality and diverse educational materials, including multimedia content, databases, articles, magazines, and e-books (Zhu et al., 2025). With the availability of these resources, students are encouraged toward self-directed learning, critical thinking, and research. All these factors allow students to handle academic content of different formats. Digital platforms that are well-structured provide supportive collaborative learning through shared resources, annotation tools, and discussion forums, enhancing peer-to-peer engagement. Through the integration of efficient and effective delivery of information with interactive and accessible resources of the digital library, teachers can develop higher levels of student engagement (Uzorka and Odebiyi, 2025). All these factors in turn support retention of knowledge on long term basis, motivation and comprehension.

Innovation transforms the way knowledge among students is assimilated, shared, and accessed. Innovation in the field of education has made learning more student-centered, flexible, and interactive (Shen et al., 2025). The basic aim of innovation is to improve learning outcome's quality based on new ideas that emerge from new understandings. The purpose of innovation is also to develop different types of qualitative learning outcomes as per the need of society and nature of work. Innovation tries to enhance students' access to higher education. Digital library resources act as a base of innovation by providing students and faculty with access to different databases, multimedia, research journals, and e-books (Kumar, 2025). By using these resources, teachers can easily design research materials, teaching content and lesson plans through integration of different digital media platforms. Integration of digital content and technology driven instructions, efficiency and effectiveness of information delivery systems can be improved significantly.

Digital competency of teachers is important for efficient and effective integration of technology into academia. This integration improves engagement of students and helps with the delivery of lectures to the students. It also enables usage of digital resources efficiently, providing support to teaching strategies, preparing students for new demands of the technology-driven world, fostering critical thinking, and ensuring quality of education. All these factors contribute toward improved learning outcomes (Valverde-Berrocoso et al., 2021). Digital competency is also important for high quality learning experiences, engagement of students, and accessibility to academic resources. Competent teachers can use digital library resources effectively, select relevant content of academia, and design instructions based on multimedia materials, databases, journals, and e-books. The ability of teachers to guide, present, and organize students with the help of digital information improves student engagement, motivation, and comprehension. Moreover, digital competency of teachers helps with the effective usage of learning management systems, online collaborative tools, and interactive platforms. These elements help in improvement of learning of students (Gameil and Al-Abdullatif, 2023). Faculty members can help in minimizing the gap between pedagogy and technology through development of strong digital skills. They also need to ensure that digital library resources are used at the optimum level with purpose of supporting analytical thinking among students.

The popularization and wide application of new media have constructed a mediated living and working environment for people who live in a mediated environment and who experience the world through media (Xu, 2024). Media resource quality is important for the education of students at a higher level as it has ability to impact the basic behavioral norms, values and understanding of students (Santika et al., 2023). Furthermore, it creates additional influence on social existence and social conduct of students at a certain level. The social existence of the students will be altered as a result of the formation of new media. New forms of media are recognized at the global level with fast paced development of digital education and digital technology. The main purpose of digitalization and educational information is to achieve optimized allocation of academic resources, promote educational quality, and quality of education. The usage of digital resources to teachers provides space and time of flexible learning (Maziane et al., 2023). When faculty members use digital resources and technological tools in higher education in effective manner, students get equipped with expertise required for digital world and relevant knowledge.

Technology Acceptance model (TAM) is used in the field of research for the support of research

model in the area of digital learning and education (Shaengchart, 2023). TAM helps practitioners and researchers to understand the way students and teachers accept new media resources, online platforms and digital tools. The basic aim of this research is to analyse the effect of new media resource quality, teacher digital competence, and digital teaching innovation on student learning engagement and knowledge retention. This proposed relationship of the study is underpinned by TAM.

Literature Review

Student Learning Engagement and Knowledge Retention

Research by Farr (2012) explained knowledge retention as cognitive process of maintaining, storing and absorbing access to information with the passage of time. Different practical and theoretical models of education are based on different instructional strategies that has the ability to vary retention of knowledge as students. Retention of knowledge by the students can be affected by the usage of different pedagogical strategies. These skills are also identified as factors that can affect knowledge retention, learning and attention among students over time (Muljana and Luo, 2019). Whereas pedagogical constraints are few factors that affect teaching at universities. These constraints include technological advancements, materials and time. Thus, there is need to understand the type of pedagogy that can has positive influence on learning of students in long term and short-term level (Baker and Robinson, 2018).

Student engagement is important to achieve success in the learning process at a higher education level. Student engagement in literature is referred as level of passion, optimism, interest, curiosity and attention shown during process of learning by the student, that can be developed to certain level of motivation that a student must learn (Anjarwati et al., 2021). Past studies has discussed the importance of using technology to support learning engagement among students (Tseng, 2021).

Well-structured and interactive environment of digital information delivery improves efficiency and effectiveness of higher educational activities. The usage of new media by the students of education improves students' engagement and enthusiasm by promoting critical thinking. By providing access

to digital content to students, these platforms help students to take part in class activities by using modes with which they are familiar to create immersive and personal learning experiences. With the help if such engagement, students are allowed to understand and perceive academic material more deeply. It helps students in promotion of meaningful experience. Students understand and perceive academic material more deeply as a result of engagement that later promotes meaningful learning (Geana et al., 2024). Different tools of digital information delivery including online discussions, multimedia content and interactive modules provide several opportunities to students for active participation. Students are also encouraged for critical reflection and application of concepts. Digital databases have teacher guided digital instructions, interactive technologies and rich resources that collectively strengthen engagement of students that later improve different learning outcomes. It is more likely that engaged students will rehearse and revisit information that will reinforce memory, facilitating long-term retention. Personalized digital experience sustainable involvement and enhance motivation by adapting individual learning needs. The research by Zepke (2021) revealed that learning environment has positive effect on knowledge retention.

H1: Student Learning Engagement significantly influences Knowledge Retention.

Digital Teaching Innovation and Student Learning Engagement

Literature has discussed the concept of digital teaching innovation in different aspects. Some of the authors characterized it through a tool oriented and narrow perspective that is based on innovation by using multimedia and other digital platforms (Choi-Lundberg et al., 2023). Other authors have characterized it by transitioning this concept towards a comprehensive systemic transformation. Digital teaching innovation is one of the integrated processes that aims at the reconfiguration of learning and teaching for digital age. Scholars concluded in their studies that digital information delivery innovation is one of integrated and transforming advanced technology that redesigned different methods of teaching. Key factors of information delivery include organizational environment, teacher's capabilities and technological infrastructure. New digital information delivery is one of key form of media that is supported by diversified forms of communication integration,

television networks, cellphone network, formation of internet, advanced digital technologies and emerging technologies between the integration and convergence that dissemination of presentation of information a cross-cultural and super geographical open characteristic. Information tools and resources are used by students and teachers through digital libraries that were inaccessible conceptually and physically (Yan, 2021). Integration of online libraries as one of the innovative tools provide students with access to digital resources in the form of multimedia content, journals and e-books.

Educated individuals can have the opportunity to obtain the content they are interested in through the media and participate in the education classroom using the way they are most familiar with. Digital information delivery media can not only greatly enhance the enthusiasm of educated people for learning but also cultivate their critical thinking rather than just passively accepting knowledge**.** The combination of new media and education allows activities to be digitized, audio-visual, immersive, and more engaging (Gunness et al., 2023). The usage of methodologies of innovative new technologies is acknowledged as important factor in advancing student-centered pedagogies, participatory and active pedagogies. With the help of these methodologies experimental learning approaches, collaborative and project-based approaches are frequently included that engage students on active basis in the process of education. Therefore improving problem solving, critical thinking, and autonomy abilities (Nyongesa and Van Der Westhuizein, 2025). Therefore, new digital information delivery innovation improves student engagement by providing easily, timely and interactive accessible learning materials. With the help of personalized content delivery, multimedia resources, and digital platforms students feel more engaging and motivating in deeper academic involvement. The research of Saheli (2025) revealed digital technology innovation has positive effect on student learning engagement.

H2: Digital Teaching Innovation significantly influences Student Learning Engagement.

Teacher Digital Competency and Student Learning Engagement

Literature mentioned that digital competence is termed as digital skills. This concept is explained as responsible, critical and confident usage and engagement of digital technologies for participation, work and learning in society (Perifanou and Economides, 2019). Digital competency is based on more than understanding the way to use applications and devices that are interactively connected with student's skill to communicate with ICT along with information skills. Scholars have defined digital competence as ability of teachers to use ICT with awareness and sound pedagogical didactic understanding of the potential impact on learning of students' strategies and development of education. It is important for teachers to have understanding of digital competence skills to make teaching and learning effective (Quan and Baharom, 2025). In the presence of digital competency, students are enabled by teachers to integrate, evaluate and navigate efficiently online library resources into general teaching practice. Students can benefit from the rich teaching resources of digital media to obtain the latest theoretical knowledge and deliver new knowledge in the form of text, images, videos, and audio. With the assistance of new media, students can also be educated positively through WeChat, Weibo, QQ, etc., answering questions and solving puzzles promptly, improving work efficiency, and enhancing emotions and exchanges between teachers and students (Wang et al., 2022). Educators can save and manage educational data of college students and save them through the new digital information media platform or software, gradually forming a specialized database of college students education (Demissie et al., 2022). Researchers mentioned that teachers having digital competency can improve content of teaching that enhance performance and motivation of students (Ostrovska et al., 2023).

Researchers mentioned that proficiency of teachers using digital tools for the purpose of collaboration and communication was positively linked to academic performance and student engagement. Digital competency of the teacher provide strength to learning engagement that enables delivery of digital information (Chiu et al., 2021). When teachers use digital platforms, resources and tools skillfully, they present academic information in more visually engaging, clear and interactive ways. Past studies showed that digital resources are carefully chosen by teachers. Moreover, they regularly monitor engagement and facilitate collaboration in order to provide digital feedback, increase participation, motivation and attention of students. Teachers who

are competent provide guidance to students for self-directed learning, critical analysis and research that enhance knowledge retention and student engagement. Digital information that is provided to students through interactive tasks, online activities, presentations, and videos to learn easier and more relevant tasks (Salha et al., 2025). Thus, students get involved and active towards engagement and digital competence (Caberos and Dioso, 2025).

H3: Teacher Digital Competency significantly influences Student Learning Engagement.

New-Media Resource Quality and Student Learning Engagement

The formation process of new media is "a comprehensive process in which old media and new media are superimposed on each other, accelerating the growth of full coverage, which covers the whole technology formation, such as books, newspapers, magazines, movies, TV, CD-ROMs, web sites, telecommunication channels, databases, mobile terminals, and other full media" (Li, 2020). Digital media resources are described by scholars as multi-media rich, accessible and interactive tools that enhance flow and clarity of information (Drozdikova-Zaripova and Sabirova, 2020). The resource quality is usability, clarity, accuracy and relevance of information that is transmitted through different digital platforms. Studies have shown that support learner autonomy, quick comprehension and flow of information through multimedia rich formats and interactive formats is ensured. Compatibility across devise, intuitive navigation, reliable updates and well-structured content ensure effective digital delivery of information. Studies mentioned that when digital information is accessible, visually coherent and credible, it improves student engagement, and its learning. Online libraries provide curated and high-quality digital resources to ensure accessibility, relevance and accuracy. On the other hand, digital resources that are outdated or poorly designed reduce trust and develop cognitive trust. Therefore, media resource quality is important for user centered, efficient and meaningful digital information delivery in context of education (Joshi et al., 2025).

New media enriches educational resources due to its openness, sharing capacity, and rapid access to updated information. Relying on advanced science and technology, the new media can store information resources in large quantities (Xu, 2024). Access to online educational resources is inexpensive, convenient, time-sensitive and shareable. Electronic books, electronic periodicals, educational websites, open classes, knowledge-sharing platforms, and databases offer diverse and high-quality learning resources. New media platforms expand the forms of content delivery—text, images, charts, audio, and video—making learning more persuasive and effective. Scholars mentioned that New learning media resources has positive effect on student engagement (Arjomandi et al., 2023). Students that are actively engaged in different modules of online learning show improved academic performance. Scholars determined that different digital teaching resources that are composed of network technology platforms, online learning communities and multimedia network learning resources provide advantages in terms of space, location and time. It enables optimum usage of new educational resources by improving learning efficiency and minimizing learning costs students' engagement will be increased (Abdulganie et al., 2025). The research by Cabellos et al. (2023) mentioned that new media resource quality has positive influence on student learning engagement.

H4: New Media Resource Quality significantly influences Student Learning Engagement.

Following hypotheses of mediation are proposed in the current study:

H5: Student Learning Engagement mediates the relationship between Digital Teaching Innovation and Knowledge Retention.

H6: Student Learning Engagement mediates the relationship between Teacher Digital Competency and Knowledge Retention.

H7: Student Learning Engagement mediates the relationship between New-Media Resource Quality and Knowledge Retention.

Technology Acceptance Model (TAM)

Studies regarding information research have examined the way individuals adapt their behavior according to new technologies. This field of research is based on different streams of research. The focus of one these streams of research is on acceptance of technology by an individual, Known as Technology acceptance model (TAM). The main objective of TAM is to understand the process of underpinning the acceptance of technology with purpose of understanding and predicting the behavior of an individual. It also helps in understanding theoretical

explanation to provide implementation of technology successfully (Alsyouf et al., 2023). The main objective of TAM is to explain the way different measures can be taken for the implementation of systems.

TAM is used in research to understand behavior as outcome to predict behavioral intention, perceived usefulness and perceived ease of use. The expectations of belief and positive behavioral outcomes are captured through perceived usefulness and perceived ease of use (Davis, 1989). Studies mentioned that behavior can substitute behavioral intention as the outcome variable that can be evaluated effectively of the possible consequences of behavior (Davis, 1993). The chances of behavior will be higher if the affective response is higher. The proposed by the present study is underpinned through TAM where media resources and teaching innovation are examined as ease of digital tools and perceived usefulness that later influence student engagement, affecting knowledge retention.
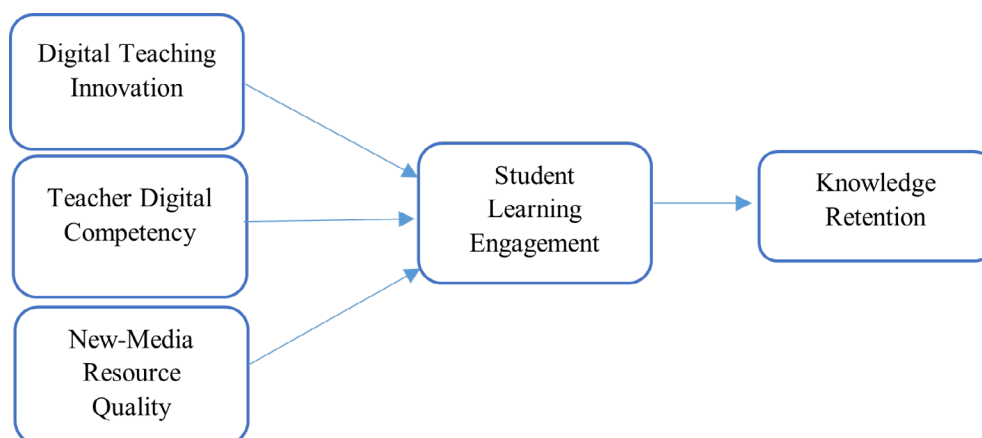

Figure 1: Theoretical Framework.

Methodology

Present research used cross-sectional research design. This research developed and used structured questions with purpose of collecting data from the respondents. The respondents of the study are students at Chinese universities. Developed questionnaire was distributed among 384 respondents. Researchers received back 247 usable questionnaires from the respondents. Simple random sampling technique was used to reach the students. The usable response rate of the study was 65%. Research adopted Structural equation modelling (SEM) for the analysis of data through PLS. This research used questionnaires for multiple reasons. Firstly, questionnaire was used to obtain reliable information and experience from students first in hand. Moreover, it becomes easy to collect data from the respondents in very short time. Furthermore, questionnaires play key role in saving resources and time and collecting large amounts of data from a variety of respondents. Questionnaires also help the researchers in evaluation of audience and give weightage to the response of each respondent. Also, questionnaires are one of very authentic ways to collect quantitative and qualitative data.

The questionnaire items of the variables were collected from past studies. This research adapted items of Arham et al. (2021), for questionnaire of knowledge retention, the questionnaire items of student learning engagement were adapted from Chein et al. (2021), items of digital technology innovation were adapted from Sofwan et al. (2024), questionnaire of digital competency were adapted from Guillén-Gámez et al. (2023), and items of new media resource quality were adapted from Sharma and Kumar (2021). These questionnaires were developed on the five-point Likert scale ranging from one to five. This study used PLS-SEM for the analysis of data collected from the students. Studies have used PLS-SEM extensively in their studies for analysis purposes (Hair et al., 2016).

Results

The initial stage of analysis is used for the evaluation of outer model regarding each variable. The second phase analyse inner model at the significance level of 5%. The outer model analysis begins with analysis of factor loading of each item. Whereas

composite reliability was tested for the confirmation of reliability testing. Furthermore, Average variance extracted and Cronbach Alpha were also examined.

Table 1: Factor Loading.

	DTI	KR	NMRQ	SLE	TDC
DTI1	0.794				
DTI2	0.864				
DTI3	0.844				
DTI4	0.864				
DTI5	0.853				
KR1		0.843			
KR2		0.851			
KR3		0.853			
KR4		0.854			
KR5		0.573			
KR6		0.754			
NMRQ1			0.887		
NMRQ2			0.849		
NMRQ3			0.873		
SLE1				0.870	
SLE2				0.883	
SLE3				0.891	
TDC1					0.841
TDC2					0.847
TDC3					0.851
TDC4					0.865

Table 1 of the study shows factor loading of the items is more than 0.50, that is the benchmark to retain any item. Moreover, table 2 of the study shows the composite reliability and Cronbach alpha values in terms of reliability and validity of the data. All these figures are more than desirable figure of 0.70 (Hair Jr et al., 2017). Also, present study examined average variance extracted for which Fornell and Larcker (1981) proposed minimum value to be more than 0.50. Table 2 of the analysis shows that AVE values are greater than 0.50.

Table 2: Reliability.

	Cronbach's Alpha	CR	AVE
DTI	0.899	0.925	0.713
KR	0.879	0.910	0.631
NMRQ	0.841	0.903	0.757
SLE	0.856	0.913	0.777
TDC	0.873	0.913	0.725

Later stage of the analysis determined the discriminant validity to show the variance among the variables of study. HTMT technique, and Fornell and Larker criteria were used for the analysis of discriminant validity in the study. Keeping in view HTMT criteria, values of matrix must be less than 0.90 (Henseler, 2005). Table 3 shows that HTMT criteria are fulfilled as all values are less than 0.90.

Table 3: HTMT.

	DTI	KR	NMRQ	SLE	TDC
DTI					
KR	0.706				
NMRQ	0.704	0.714			
SLE	0.739	0.887	0.797		
TDC	0.661	0.752	0.633	0.772	

Moreover, as per Fornell and Larcker (1981) criteria, statistical figures at the diagonal must be more than remaining values. Table 4 shows that values at the diagonal are higher than non-diagonal values. So, both criteria of discriminant validity are fulfilled.

Table 4: Fornell & Larker.

	DTI	KR	NMRQ	SLE	TDC
DTI	0.844				
KR	0.627	0.794			
NMRQ	0.616	0.623	0.870		
SLE	0.649	0.775	0.684	0.881	
TDC	0.587	0.662	0.548	0.667	0.851

After successfully assessing measurement models, this study examined structural models to confirm the relationship between proposed hypotheses. This research used bootstrapping procedures to evaluate Beta and t values. These values determine significance of relationships and nature of relationships. Bootstrapping procedure is also adopted to confirm R square value as well.

Table 5: Direct Results.

	B	SD	T value	P values
DTI -> SLE	0.232	0.060	3.888	0.000
NMRQ -> SLE	0.356	0.052	6.809	0.000
SLE -> KR	0.775	0.023	33.299	0.000
TDC -> SLE	0.336	0.057	5.915	0.000

The findings mentioned in Table 5 show that DTI has positive effect on SLE as t=3.888. Moreover, NMRQ has significant impact on SLE with t=6.809. Likewise, SLE has positive influence on KR with t=33.299, and TDC has significant positive influence on SLE having t=5.915.

Table 6 of the results shows mediating results of the study. These findings show that SLE mediates the relationship between TDC and KR with t=5.819. Moreover, SLE mediates among DTI and KR having t=3.812, and SLE also mediates among NMRQ and KR.

In the end of structural model analysis, this research explored R square value. This test is important to show the effect of independent variables on outcome variables. The results in Table 7 show that KR is affected 60.1% and SLE is affected 61.9% by the IVs of the study.

Table 6: Indirect Findings.

	B	SD	T value	P value
TDC -> SLE -> KR	0.261	0.045	5.819	0.000
DTI -> SLE -> KR	0.180	0.047	3.812	0.000
NMRQ -> SLE -> KR	0.276	0.041	6.759	0.000

Table 7: Square.
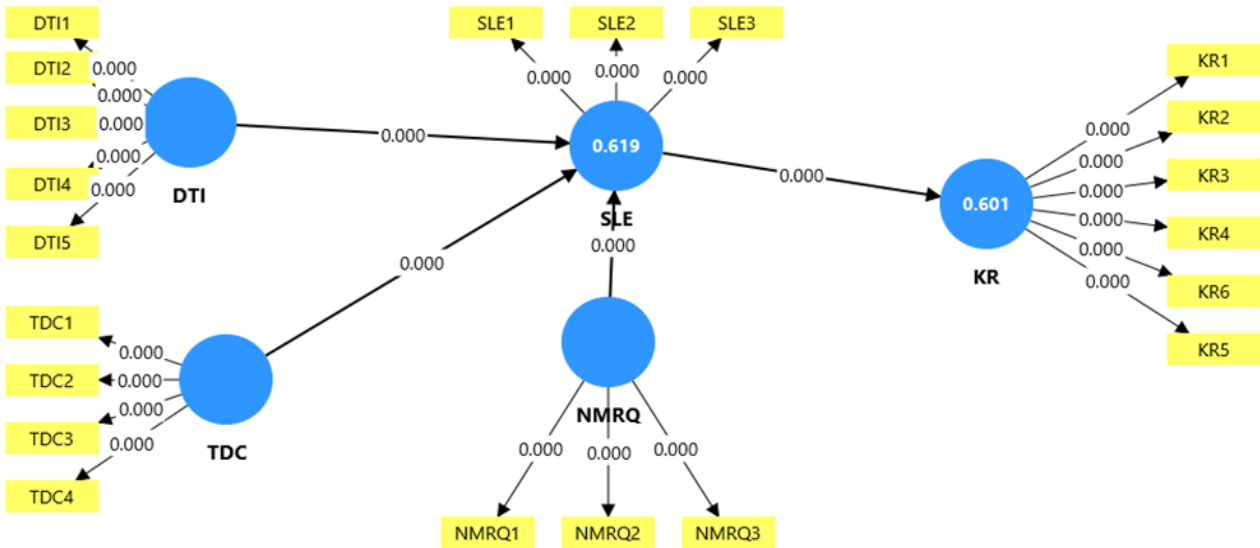
	R-square
KR	0.601
SLE	0.619

Figure 2: Structural Model.

Discussion

The findings of the present study mentioned that digital technology innovation has positive effect on student learning engagement. These results are similar to the findings of Saheli (2025) in past. These results of this research show that digital technology innovation has key influence on engagement of student learning. This finding is consistent with studies that emphasize key role of technology in higher education. From the perspective of information and library science, these results show the way digitally enriched environment in the form of data driven teaching tools, online repositories, and interactive platforms strengthen behavioral and cognitive involvement. These findings show that educational institutions should give priority to student centred digital systems that have ability to support regular access to data and information on regular basis.

Furthermore, integration of information and librarian professionals into the process can improve engagement by ensuring digital tools align with students' behavior of information seeking. These results highlight the way digital innovation is vital for students to have access to knowledge. By these initiatives students will get engaged in different learning activities. Moreover, students will participate more effectively in the classroom activities that are supported by technology. Academic content becomes easier to understand with the help of digital tools. Students will get learning opportunities that are flexible and develop an environment where students are more connected and motivated toward their education.

These findings also revealed that Teacher Digital Competency has positive effect on student learning engagement. The results are very important from the perspective of students. When teachers are expert in using digital technologies, students get clear explanations, interactive learning activities, and well-structured course materials. Students of different institutions perceive to get more support when teachers integrate multimedia content and digital resources. Additionally, teachers provide guidelines

to students in using different digital resources. They provide access to scholarly materials to students in a more meaningful, faster, and easier way.

Findings mention that students develop capability to explore authentic academic resources with the help of teachers that strengthen their academic and research skills. As a result, students remain engaged in the learning process. Teachers who have skills regarding digital tools have ability to develop an environment where students can easily get information. Students develop ability to provide feedback to teachers in a timely manner and make learning enjoyable for them. From the perspective of students, enhancement of digital skills is important to sustain engagement in present information and rich digital educational settings. These findings are similar to the results of (Caberos and Dioso, 2025).

The findings of the study also show that new media resource quality has positive influence on student learning engagement. This positive effect of new media resource quality on engagement of student learning is evident from the perspective of students. High quality digital resources, including responsive learning platforms, well-structured online modules, and interactive videos, have made academic material easier with purpose of understanding it. When these academic resources are user-friendly, updated, and clear, motivation is developed in students with purpose of participating in activities to learn. Students also have ability to revisit academic material at their own time of easiness.

From this context, digital library also plays an important role in providing reliable access to academic content, e-books, and scholarly articles that can be easily navigated by the students. Different organized repositories, efficient search tools, and high-quality digital interface also strengthen capabilities of students toward research. Digital libraries also deepen learning experience of students. As students have ability to search meaningful information, their engagement and confidence increase. Quality of new media resources provides support to a well-developed digital library. This also creates user friendly environment for student who remain informed, involved and committed toward process of learning (Cabellos et al., 2023).

The results of the study determined that student learning engagement has positive influence on knowledge retention as mentioned by Zepke (2021). This study also strongly supports the perspective of students. When students of different institutions are involved in learning activities including exploration of

resources by digital libraries, interaction through digital content, and participation in discussions, students are more likely to understand academic content deeply. Moreover, students will remember academic content for a longer period. Students who are engaged develop focus for the process of information. They also have ability to review academic work more frequently whenever they want. Students make meaningful connection between existing knowledge and new knowledge.

The digital library access can be used by students to further strengthen learning process by offering accessible, credible and organized academic resources that can be explored by students. When these resources are actively used by resources, they get chance to internalize important ideas, clarify doubts and reinforce classroom learning. As a nutshell, digital academic environment supported by higher level of engagement has direct effect on knowledge retention among students for a longer period.

Conclusion

In conclusion, the results shed light on the important role of digital innovation to further strengthen learning experience of students. Higher quality new media resources, teaching digital competency ad digital technology are key factors to enhance student engagement. These factors are vital to show the way digital environment plays role in shaping confidence, participation and motivation among students. The integration of digital libraries enriches academic environments by providing credible and structured knowledge sources that have ability to support classroom activities and independent learning activities.

These findings also show students' knowledge retention will increase through higher levels of engagement. These finds emphasize that when students actively interact with academic resources and digital tools, students develop ability to recall and internalize important academic concepts. These results suggest that regular investment in digital library systems, resource quality and digital teaching practices is important to sustain meaningful outcomes.

Limitations

There are few limitations of the present study that will be discussed in this section. The proposed framework has one DV, one mediator and three independent variables. It is proposed to add one more moderator in similar model in future studies.

Moreover, this research used qualitative methodology for analysis in present study. Future studies are proposed to use mixed methodology in their studies. Also, the sample of the study was taken as the students from China. It is proposed to take sample from other geographical locations like Thailand in studies. The analysis of the present study is conducted by using Smart PLS 4. It is proposed to use AMOS as tool for analysis in upcoming studies.

Contributions

In this section, managerial and theoretical contributions are discussed. From theoretical lens, this study is among very few ones that have discussed mediating role of student learning engagement as most of studies discussed student engagement as mediator. Moreover, this study adds to the body of knowledge by discussing digital technology innovation, teacher digital competencies and new media resource quality as key antecedents of knowledge retention. These findings can be used by policy makers of academics to increase knowledge retention among students. Also, scholars can use these findings in future studies.

Funding Information

References

Abdulganie, N., Alingig, C. F., Balatero, L. C., Bande, M. R., Bantillo, N., Berdin, J. P. *et al.* (2025). The Relationship of Technological Resources and Student Engagement Among Senior High School Students. *International Journal of Research and Innovation in Social Science*, 9(2): 3378-3393. https://doi.org/10.47772/IJRISS.2025.9020263

Alsyouf, A., Lutfi, A., Alsubahi, N., Alhazmi, F. N., Al-Mugheed, K., Anshasi, R. J. *et al.* (2023). The Use of a Technology Acceptance Model (TAM) to Predict Patients' Usage of a Personal Health Record System: The Role of Security, Privacy, and Usability. *International Journal of Environmental Research and Public Health*, 20(2): 1347. https://doi.org/10.3390/ijerph20021347

Anjarwati, R., Sa'adah, L., Inggris, P., Jombang, S. and Pattimura, J. (2021). Student learning engagement in the online class. *EnJourMe (English Journal of Merdeka): Culture, Language, and Teaching of English*, 6(2): 39-49. https://doi.org/10.26905/enjourme.v6i2.6128

Arham, A. F., Norizan, N. S., Norizan, M. N., Arham, A. F. and Ibrahim, S. N. (2021). A SmartPLS visiting to knowledge retention: A study among SMEs in Peninsular Malaysia. *Journal of Educational and Social Research*, 11(4): 84-84. https://doi.org/10.36941/jesr-2021-0079

Arjomandi, A., Paloyo, A. and Suardi, S. (2023). Active Learning and Academic Performance: The Case of Real-time Interactive Student Polling. *Statistics Education Research Journal*, 22(1), article no. 3. https://doi.org/10.52041/serj.v22i1.122

Baker, M. A. and Robinson, J. S. (2018). The Effect of Two Different Pedagogical Delivery Methods on Students' Retention of Knowledge Over Time. *Journal of Agricultural Education*, 59(1): 100-118. https://doi.org/10.5032/jae.2018.01100

Cabellos, B., Pérez Echeverría, M. P. and Pozo, J. I. (2023). The Use of Digital Resources in Teaching during the Pandemic: What Type of Learning Have They Promoted? *Education Sciences*, 13(1): 58. https://doi.org/10.3390/educsci13010058

Caberos, M. M. and Dioso, E. D. (2025). Teachers' Digital Competence and Learner Engagement: A Descriptive-Correlational Study. *Educational Research (IJMCER)*, 7(4): 110-134. https://www.ijmcer.com/wp-content/uploads/2025/07/IJMCER_K0740110134.pdf

Chein, T. S., Jie, S. Z. and Choo, K. A. (2021). Collaborative Learning and Social Media Acceptance for Student Engagement. *Journal of International Business, Economics and Entrepreneurship*, 6(2): 16. https://doi.org/10.24191/jibe.v6i2.16639

Chiu, T. K. F., Meng, H., Chai, C.-S., King, I., Wong, S. and Yam, Y. (2021). Creation and Evaluation of a Pretertiary Artificial Intelligence (AI) Curriculum. *IEEE Transactions on Education*, 65(1): 30-39. https://doi.org/10.1109/TE.2021.3085878

Choi-Lundberg, D. L., Butler-Henderson, K., Harman, K. and Crawford, J. (2023). A Systematic Review of Digital Innovations in Technology-Enhanced Learning Designs in Higher Education. *Australasian Journal of Educational Technology*,

39(3): 133-162. https://doi.org/10.14742/ajet.7615

Davis, F. D. (1989). *User Acceptance of Information Systems: The Technology Accepmance Model (TAM)*. Working Paper #529. University of Michigan. https://quod.lib.umich.edu/b/busadwp/images/b/1/4/b1409190.0001.001.pdf

Davis, F. D. (1993). User acceptance of information technology: system characteristics, user perceptions and behavioral impacts. *International Journal of Man-Machine Studies*, 38(3): 475-487. https://doi.org/10.1006/imms.1993.1022

Demissie, E. B., Labiso, T. O. and Thuo, M. W. (2022). Teachers' digital competencies and technology integration in education: Insights from secondary schools in Wolaita Zone, Ethiopia. *Social Sciences & Humanities Open*, 6(1): 100355. https://doi.org/10.1016/j.ssaho.2022.100355

Drozdikova-Zaripova, A. R. and Sabirova, E. G. (2020). Usage of Digital Educational Resources in Teaching Students with Application of" Flipped Classroom" Technology. *Contemporary Educational Technology*, 12(2): ep278. https://doi.org/10.30935/cedtech/8582

Farr, M. J. (2012). *The Long-Term Retention of Knowledge and Skills: A Cognitive and Instructional Perspective*. Springer. https://doi.org/10.1007/978-1-4612-1062-7

Fornell, C. and Larcker, D. F. (1981). Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *Journal of Marketing Research*, 18(1): 39-50. https://doi.org/10.1177/002224378101800104

Gameil, A. A. and Al-Abdullatif, A. M. (2023). Using Digital Learning Platforms to Enhance the Instructional Design Competencies and Learning Engagement of Preservice Teachers. *Education Sciences*, 13(4): 334. https://doi.org/10.3390/educsci13040334

Geana, M. V., Cernusca, D. and Liu, P. (2024). Beyond the dawn of virtualized learning environments: A comparative study of video and augmented reality information delivery on student engagement and knowledge retention. *Journal of Computer Assisted Learning*, 40(2): 394-409. https://doi.org/10.1111/jcal.12890

Guillén-Gámez, F. D., Ruiz-Palmero, J. and García, M. G. (2023). Digital competence of teachers in the use of ICT for research work: development of an instrument from a PLS-SEM approach. *Education and Information Technologies*, 28(12): 16509-16529. https://doi.org/10.1007/s10639-023-11895-2

Gunness, A., Matanda, M. J. and Rajaguru, R. (2023). Effect of student responsiveness to instructional innovation on student engagement in semi-synchronous online learning environments: The mediating role of personal technological innovativeness and perceived usefulness. *Computers & Education*, 205: 104884. https://doi.org/10.1016/j.compedu.2023.104884

Hair, J., Joe F., Sarstedt, M., Matthews, L. M. and Ringle, C. M. (2016). Identifying and treating unobserved heterogeneity with FIMIX-PLS: part I – method. *European Business Review*, 28(1): 63-76. https://doi.org/10.1108/EBR-09-2015-0094

Hair Jr, J. F., Matthews, L. M., Matthews, R. L. and Sarstedt, M. (2017). PLS-SEM or CB-SEM: updated guidelines on which method to use. *International Journal of Multivariate Data Analysis*, 1(2): 107-123. https://doi.org/10.1504/IJMDA.2017.087624

Henseler, J. (2005). Einführung in die PLS-Pfadmodellierung. *Wirtschaftswissenschaftliches Studium*, 34(2): 70-75. https://ris.utwente.nl/ws/files/7015328/2005_WiSt_Henseler.pdf

Joshi, D. R., Khanal, J., Chapai, K. P. S. and Adhikari, K. P. (2025). The impact of digital resource utilization on student learning outcomes and self-efficacy across different economic contexts: A comparative analysis of PISA, 2022. *International Journal of Educational Research Open*, 8: 100443. https://doi.org/10.1016/j.ijedro.2025.100443

Kumar, R. (2025). Utilization of E-Resources in University Libraries: A Survey-Based Analysis of User Behavior and Preferences. *International Journal of Research in Library Science (IJRLS)*, 11(3): 63-76. https://doi.org/10.26761/IJRLS.11.3.2025.1916

Li, W. (2020). Does New Media Substitute Old Media? A Cohort Analysis of Media Use in China. *Cultural and Religious Studies*, 8(9): 525-537. https://doi.org/10.17265/2328-2177/2020.09.004

Maceiras, R., Feijoo, J., Alfonsin, V. and Perez-Rial, L. (2025). Effectiveness of active learning techniques in knowledge retention among engineering

students. *Education for Chemical Engineers*, 51: 1-8. https://doi.org/10.1016/j.ece.2025.01.003

Maziane, B., Tridane, A. and Belaaouad, S. (2023). Digital Resources' Role in University Teaching and Learning Exploration. *International Journal for Innovation Education and Research*, 11(8): 1-14. https://doi.org/10.31686/ijier.vol11.iss8.4134

Muljana, P. S. and Luo, T. (2019). Factors contributing to student retention in online learning and recommended strategies for improvement: A systematic literature review. *Journal of Information Technology Education: Research*, 18: 19-57. https://doi.org/10.28945/4182

Nyongesa, W. J. and Van Der Westhuizein, J. (2025). The Impact of Digital Teaching Tools on Student Engagement and Learning Outcomes in Higher Education in Africa. *International Journal of Innovative Research and Scientific Studies*, 8(4): 264-280. https://doi.org/10.53894/ijirss.v8i4.7777

Ostrovska, M., Vasylykiv, I., Gaboda, E., Bopko, I. and Fentsyk, O. (2023). Aplicación de tecnologías digitales en la actualización de contenidos de las ramas educativas de educación primaria. *Revista Eduweb*, 17(3): 270-283. https://doi.org/10.46502/issn.1856-7576/2023.17.03.23

Perifanou, M. A. and Economides, A. A. (2019). The Digital Competence Actions Framework. In: *ICERI2019 Proceedings, 12th annual International Conference of Education, Research and Innovation.* IATED Digital library, pp. 11109-11116. https://doi.org/10.21125/iceri.2019.2743

Quan, J. and Baharom, S. (2025). The Effect of Teachers' Digital Competencies on Students' Academic Achievements: A Systematic Review. *Journal of Information Systems Engineering and Management*, 10(18s): 446-461. https://doi.org/10.52783/jisem.v10i18s.2931

Saheli, J. (2025). Innovative Teaching Strategies for Better Student Engagement and Tips of Implementation. *Pen and Prosperity*, 2(3): 145-155. https://doi.org/10.70798/PP/020300018

Salha, S. H. M., Impedovo, M., Khalid, M. S., Chan, M. K. Y. and Ling, S. E. (2025). A Scoping Review of Frameworks in Video Conferencing-Mediated Teaching: Enhancing Digital Competence for Educational Engagement.

European Conference on e-Learning, 24(1): 353-362. https://doi.org/10.34190/ecel.24.1.3920

Santika, R., Charisma, D. and Sugesti, I. (2023). The Implementation of Digital Resources As Supporting Learning Media In Teaching Narrative Writing Text. *Jurnal Indonesia Sosial Teknologi*, 4(9): 1261-1271. https://doi.org/10.59141/jist.v4i9.711

Shaengchart, Y. (2023). A Conceptual Review of TAM and ChatGPT Usage Intentions Among Higher Education Students. *Advance Knowledge for Executives*, 2(3): 1-7. https://ssrn.com/abstract=4581231

Sharma, D. and Kumar, S. (2021). Expected learning outcomes by New Media usage for Senior secondary school students- A Structural Equation Modelling perspective. *Turkish Journal of Computer and Mathematics Education*, 12(11): 3604-3613. https://doi.org/10.17762/turcomat.v12i11.6433

Shen, Y., Deng, Y., Xiao, Z., Zhang, Z. and Dai, R. (2025). Driving green digital innovation in higher education: the influence of leadership and dynamic capabilities on cultivating a green digital mindset and knowledge sharing for sustainable practices. *BMC Psychology*, 13(1): 288. https://doi.org/10.1186/s40359-025-02552-z

Sofwan, M., Habibi, A., Attar, R. W., Alqahtani, T. M., Alahmari, S. A. and Alhazmi, A. H. (2024). Factors Affecting Teachers' Behavior of Innovative Teaching with Technology: Structural Equation Modelling. *Sustainability*, 16(19): 8496. https://doi.org/10.3390/su16198496

Tseng, S.-S. (2021). The influence of teacher annotations on student learning engagement and video watching behaviors. *International Journal of Educational Technology in Higher Education*, 18(1): 7. https://doi.org/10.1186/s41239-021-00242-5

Uzorka, A. and Odebiyi, O. A. (2025). Impact of Digital Learning Tools on Student Engagement and Achievement. *Journal of Digital Learning and Distance Education*, 4(1): 1436-1445. https://doi.org/10.56778/jdlde.v4i1.511

Valverde-Berrocoso, J., Fernández-Sánchez, M. R., Revuelta Dominguez, F. I. and Sosa-Díaz, M. J. (2021). The educational integration of digital

technologies preCovid-19: Lessons for teacher education. *PloS One*, 16(8): e0256283. https://doi.org/10.1371/journal.pone.0256283

Wang, X., Zhang, R., Wang, X., Xu, D. and Tian, F. (2022). How Do Mobile Social Apps Matter for College Students' Satisfaction in Group-Based Learning? The Mediation of Collaborative Learning. *Frontiers in Psychology*, 13: 795660. https://doi.org/10.3389/fpsyg.2022.795660

Xu, Q. (2024). The Impact of New Media Technology Applications on Educational Equity in Rural Areas. *Education Journal*, 13(5): 284-293. https://doi.org/10.11648/j.edu.20241305.15

Yan, E. M. Y. (2021). Embracing Digital Teaching and Learning: Innovation Upon COVID-19 in Higher Education. In: S. X. B. Zhao, J. H. C. Wong, C. Lowe, E. Monaco, & J. Corbett (Eds.), *COVID-19 Pandemic, Crisis Responses and the Changing World: Perspectives in Humanities and Social Sciences*. Springer Nature Singapore, pp. 299-327. https://doi.org/10.1007/978-981-16-2430-8_19

Zepke, N. (2021). Student Engagement: Key to Retaining Students. In: M. Shah, S. Kift, & L. Thomas (Eds.), *Student Retention and Success in Higher Education: Institutional Change for the 21st Century*. Springer International Publishing, pp. 63-87. https://doi.org/10.1007/978-3-030-80045-1_4

Zhang, J. and Zhang, Z. (2024). AI in teacher education: Unlocking new dimensions in teaching support, inclusive learning, and digital literacy. *Journal of Computer Assisted Learning*, 40(4): 1871-1885. https://doi.org/10.1111/jcal.12988

Zhu, X. A., Whitaker, E. E., Cho, M. and Zhang, M. (2025). Student Engagement in Academic Libraries: A Conceptual Framework. *College & Research Libraries*, 86(2): 275-293. https://doi.org/10.5860/crl.86.2.275

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