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Technology Integration in Classroom Instruction and Its Influence on Student Engagement and Academic Achievement in Secondary Education

Masa Sylvester Motadi
Afrocentric Governance of Public Affairs (AGoPA), North-West University

*Corresponding Author
Email: mmotadi@yahoo.com

Abstract

The integration of digital technologies into classroom instruction has become a defining feature of contemporary secondary education. Schools increasingly adopt digital tools, smart classrooms and technology-supported learning platforms to enhance teaching practices and improve student learning outcomes. This study examines how technology integration in classroom instruction influences student engagement and academic achievement in secondary education. The research adopted a qualitative secondary research design based on the systematic analysis of peer-reviewed studies published between 2020 and 2025. Ten empirical studies focusing on technology-enhanced learning environments, teacher digital competence and student engagement were analysed using thematic synthesis. The analysis identified five major themes: technology-supported student engagement, teacher digital competence and pedagogical mediation, smart classrooms and digital learning environments, technology integration and learning outcomes, and learner agency and self-regulated learning. The results show that technology can enhance behavioural, cognitive and motivational engagement when it is integrated into meaningful learning activities. The findings also reveal that the effectiveness of classroom technology depends strongly on teachers' digital competence, classroom interaction and student-centred instructional approaches. Furthermore, technology-supported learning environments appear to contribute to academic achievement, collaboration and the development of digital competencies when learners actively participate in the learning process. The study concludes that the impact of technology integration in secondary education depends less on the presence of digital devices and more on the quality of pedagogy, teacher support and learner engagement within technology-enhanced classrooms.

Keywords: Technology Integration, Academic Achievement, Digital Learning Environments, Classroom Technology, Teacher Digital Competence.

INTRODUCTION

The application of digital technology in secondary education has turned into a growing trend in most parts of the world. Schools are no longer run on conventional classroom approaches that focus on textbook and educator-based education. Rather, digital technology, learning management systems, and interactive applications are being used in order to facilitate teaching and learning processes. Therefore, the appropriate application of digital technology in assisting education processes and improving student learning outcomes is referred to as technology integration in education (Msafiri, Kangwa, & Cai, 2023). Consoli, Désiron, & Cattaneo (2023) emphasized that technology integration in education refers to the appropriate match of technology with teaching goals instead of the mere application of technology in the classroom. As highlighted by Bergdahl, Nouri, Fors, & Knutsson (2020), technology-based learning has the potential to influence student involvement in the classroom and in other education materials. This has raised issues regarding the influence of digital technology on the learning process in secondary schools. Therefore, the application of technology in education has turned into a growing concern among scholars and educators in order to learn about its influence on students and their academic performance.

Most education systems have adopted the use of digital technology in a bid to improve education results while preparing the students for their roles in knowledge-based societies. According to Wang, Tigelaar, Luo & Admiraal (2022), technology-enhanced classrooms have been developed in most instances in a bid to support the collaborative learning process, problem-

solving, and interactive approaches of teaching. Based on the argument presented by Cheng & Yang (2023), digital technology and smart classrooms have been seen as an opportunity towards the development of student-centered approaches towards ensuring the engagement of the learners in the learning activities. At the same time, Chiu (2021) points out that digital technology can be highly motivating for the students when it is developed in a bid to promote autonomy, competence, and meaningful interaction. Nevertheless, the effective use of digital technology in the classrooms is largely dependent on the ability of the teachers to integrate the technology in the teaching approaches. According to Demissie, Labiso & Thuo (2022), the digital technology skills of the teachers have been seen as instrumental in defining the effective use of technology in the classroom. This view seems to propose that technology per se does not have any impact on the learning experience; rather, the impact is dependent on the approaches used in teaching.

One of the widely discussed effects of the technology-supported learning environment is the engagement of the learners. Engagement has been defined as the extent of involvement of learners in the learning processes in terms of cognitive, emotional, and behavioural involvement. According to Lu, Xie, and Liu (2022), it has the potential for increasing the situational engagement of learners in the classroom by providing learners with an interactive form of learning. As Bergdahl et al. (2020) indicate, technology has the potential for improving enhanced learner engagement in the learning processes when it is used for facilitating collaborative and inquiry-based learning processes. Consoli et al. (2025) have shown that technology integration of high quality has a relationship with improving the enhancement of behavioural learner engagement and digital learning potential. Although these are some of the significant effects of the technology-supported learning environment, there are also some adverse effects, including distractions in the learning processes. As Darmanova et al. (2025) indicate, the educational value of technology is in its integration into the processes of meaningful learning activities. Thus, from the various discussions regarding the effects of the technology-supported learning environment, it can be assumed that the relationship between technology and learner engagement is still complicated and requires more research.

The digital competence of the teachers seems to be one of the elements which affect the integration of technology in schools. The role of the teachers is to select the appropriate technology tools, to design technology-based learning activities, and to guide the learners in the performance of the activities with the help of the technology tools. Tzafilkou, Perifanou & Economides (2023) observe that the teachers must be technologically competent, pedagogically competent, and professionally competent in order to use the digital technologies in the classroom. According to Baytar, Elyacoubi, Saqri & Ouchaouka (2023), the teachers who are confident about their digital competence tend to use technology in their daily teaching practice. Moreover, the level of digital competence of the teachers has an impact on the frequency and creativity of the use of the technology tools in the classroom, as observed in the study by Suzer & Koc (2024). However, Sellami, Santhosh, Bhadra & Ahmad (2024) observe that the educators face certain difficulties in the integration of the digital technologies in the classroom. The difficulties faced by the educators include the lack of training and technical support and the lack of clear understanding about the appropriate digital pedagogies. The possible benefits of the integration of the technology in the classroom may be limited to the learners.

In addition to the teacher's competence, the classroom practices and the design of the instruction can influence the effects of technology integration on the learning process. Antonietti, Schmitz, Consoli, Cattaneo, Gonon, Petko (2023) note that it is vital to consider the integration of technology in the classroom by considering the kind of learning activities it can support instead of the presence of technology in the classroom. According to Raave, Saks, Pedaste, Roldan Roa (2024), the teachers can carry out the integration of technology in different ways such as the basic presentation tools or the interactive learning spaces where building knowledge can be done in an active way. According to Wang, Zhou, Chen, Tong, Yang (2024), the integration of technology

can be used in the implementation of self-regulated learning in case the students are guided to study the digital materials in their own way. The application of technology in the teaching practice in a considerate way can create the possibilities of learning more and the involvement of more students. Nevertheless, in case the application of technology is used in the classroom, but it is not different from the way it was done in person, the value of the application can be very low.

Despite the growing body of literature on the integration of technology in education, there is still a gap in the research about the impact of the application of technology in the classroom on the engagement of the students in their learning in high schools. According to Dabengwa, Moyo, Ncube, Gashirai, Makaza, Makoni, Pasipamire, Chademana, Mafoti, Mapfumo, Mandaza (2024), it was a general trend in the majority of the previous studies to concentrate on the technological infrastructure and forget the real classroom experiences of the teachers and the students.

The main aim of the proposed research study is to investigate the impact of technology integration in classroom learning on student engagement and academic achievement in high schools. Specifically, the research questions to be answered in the proposed study are: What is the impact of the integration of digital technologies in classroom learning on student engagement and academic achievement in high schools? This research question has been developed based on the ongoing discussion on the potential benefits technology-mediated learning has to offer to the field of education. The existing research has generated considerable insights on the benefits and challenges associated with technology-mediated learning. However, there has been a gap in the research in the area of the relationship between student engagement and academic achievement in technology-mediated classrooms. Such integrated research on the relationship between the two variables would provide a more significant contribution to the field of research in the area of technology-mediated learning in high schools.

The rationale for the proposed research study is the fact that digital technologies have become a more integral part of the field of education. Today, educational institutions all over the world invest a lot in the infrastructure and technology-mediated learning software. However, the success of such a move depends on the effective utilization of technology in the classroom learning process. For the effective utilization of technology in the classroom learning process and to ensure the positive impact technology has on the learning process, it is necessary to identify the impact technology has on the learning process. By understanding the impact technology has on the learning process, the proposed research study aims to contribute to the field of research in the area and provide the necessary information to the field to utilize technology more efficiently in the classroom learning process.

RESEARCH METHODS

Research Design

The design of the research in this specific paper was the qualitative secondary research design. The secondary research design was primarily informed by the use of the systematic review of the literature on the use of technology in secondary education. The use of secondary research has been deemed useful by scholars in the sense that it enables them to investigate the literature that has already been published previously in order to determine the new revelations in the specific research area. According to the research by Msafiri, Kangwa, and Cai (2023), the secondary research in the specific area of education has been deemed useful in the synthesis of the results obtained from the studies that have been carried out previously in the specific area of the integration of technology in the classroom. According to the research by Consoli, Désiron, and Cattaneo (2023), the studies carried out previously in the specific area of the integration of

technology in K-12 education use various measurement tools. Therefore, the use of the secondary research design was deemed useful in the specific paper in the sense that it would be useful in the determination of the effects of the integration of technology in secondary school. According to the research by Msambwa, Kangwa, and Cai (2024), the use of the secondary research design would be useful in the determination of the typical themes in the effectiveness of the integration of digital technologies in the specific process of learning and teaching. The secondary sources were used in the paper in the determination of the effects of the integration of technology in secondary school. The design was deemed useful in the specific paper in the sense that the research question required the study of extensive trends in the specific empirical areas.

Data Sources and Selection Criteria

The authors based their research on peer-reviewed scholarly articles published in 2020-2025, discussing the incorporation of technology in secondary schools, also known as K-12. The articles were based on academic databases containing valid research within the field of education. Darmanova, Abylkassymova, and Nurmukhamedova (2025) point out how, through the systematic review of published literature, it is possible to pose questions about the use of technology in real-life situations. Wang, Tigelaar, Zhou, and Admiraal (2023) emphasize how, through recent empirical literature, it is possible to gather significant amounts of information about cognitive and behavioral aspects concerning the influence of digital technologies on students. As it is proved by Bergdahl, Nouri, Fors, and Knutsson (2020), when it is a matter of analyzing the impact of digital technologies on student engagement and academic achievement in a secondary school, through technology-supported learning environments, it is common to limit the dataset to articles focusing solely on this topic. The articles were included in the dataset if they addressed the topic of student engagement, technology, digital pedagogy, and academic achievement in the school setting. The dataset was limited to articles focusing solely on higher education or non-instructional technologies.

Data Collection and Organisation

The study material was conceptual arguments, methodological and empirical findings that were provided in the selected scholarly articles. According to Antonietti, Schmitz, Consoli, Cattaneo, Gonon and Petko (2023), embedding digital tools into the processes of instructions should be given special attention in the research analysis of technology integration. According to Lu, Xie and Liu (2022), studies that address the question of student engagement in technology-supported classrooms are likely to concentrate on perceptions and motivation and behavioural engagement of the learners. According to Wang, Tigelaar, Luo and Admiraal (2022), technology-enhanced learning environments are extremely influenced by the teacher practice and in-classroom procedures. The identified articles were therefore discussed to record the valuable data concerning the lessons delivery, the outcomes of student interaction, and the outcomes of learning achievements reported.

Data Analysis

The literature review was based on the thematic approach of analysis that aimed at deriving common patterns in the research findings. The use of thematic analysis is common in education research to provide synthesis of various studies based on empirical research. Raave, Saks, Pedaste and Roldan Roa (2024) claim that studies on the integration of technology tend to uncover various instructional models employed by educators in the process of integrating digital technologies in the classroom. Cheng and Yang (2023) show that classrooms that are technology-enhanced can be used to promote student-centred pedagogies that promote interactive learning. As demonstrated by Fang, Li, Chan and Kalogeropoulos (2024), teacher support has a vast influence on student interaction with digital learning environments.

The chosen studies were thoroughly read and coded during the analysis process based on the key themes connected with the engagement, academic achievement, and teacher practices. Special consideration was made on how the researchers explained the connection between digital

tools and behavioural, cognitive and emotional engagement of students. Chiu (2021) claims that the student motivation can be boosted using technology-supported learning environments promoting interaction and autonomy. Wang, Zhou, Chen, Tong and Yang (2024) propose that self-regulated learning behaviours in secondary school students can also be fostered in the digital environment. Through these trends in various studies, the analysis was going to create a consistent picture of the way technology integration affects classroom learning processes.

Ethical Considerations

Since the research was based on the use of published scholarly literature, there was no direct contact with human subjects. However, the principles of ethical research were followed in the study. The intellectual integrity was appropriately considered by referencing all the sources in an academic manner. Tzafilkou, Perifanou and Economides (2023) indicate that to ethically use scholarly work, original research and work should be cited properly. According to Sellami, Santhosh, Bhadra and Ahmad (2024), responsible scholarship entails transparent utilization of past researches that have been published. In this paper, all the articles analysed were referenced as per established academic referencing standards. This methodology made the research an acknowledgement of intellectual contributions made by past researchers and it has continued to be academic.

RESULTS AND DISCUSSION

Theme 1 – Technology-supported student engagement

Sub-theme	Pattern identified across studies	Studies supporting the pattern	Focus of reporting
1.1 Behavioural and cognitive engagement	Learners were more engaged and focused once technology was strictly related to the learning activities.	Bergdahl *et al.*; Consoli *et al.*	Reports on participation, concentration and sustained task involvement
1.2 Motivational and affective engagement	Interaction was enhanced when technology was in favor of autonomy, competence, relatedness, and classroom fit.	Chiu; Lu *et al.*; Wang *et al.* (2022)	Reports on motivation, interest and emotional connection
1.3 Engagement versus disengagement	Differences among learners based on support and preparedness were also revealed by technology.	Bergdahl *et al.*; Heilporn *et al.*	Reports on both productive use and barriers to meaningful participation

Source: Author's synthesis from the engagement-focused studies.

Sub-theme 1.1: Behavioural and cognitive engagement

Both behavioural and cognitive engagement were evident in a number of studies. Bergdahl, Nouri, Fors and Knutsson (2020) have shared that students who scored well in their academics also reported more concentration in learning technologies. The analysis revealed that technology-based learning was not only concerned with being present at the classroom but also

being attentive, focused and task oriented. Similar findings were obtained by Consoli, Schmitz, Antonietti, Gonon, Cattaneo and Petko (2025) who determined that the relationship between better quality of technology integration and behavioural engagement among students in upper secondary schools was positive. They found that relevant technology integration was related to active engagement in the classroom and not passive exposure to digital tools. Similar outcomes were demonstrated by Wang, Tigelaar, Luo and Admiraal (2022), who argued that student engagement in smart classrooms was correlated with classroom process quality, which implied that behavioural participation in smart classroom was higher when classroom interaction and organisation facilitated learning. In all these studies, the behavioural and cognitive engagement was introduced as apparent engagement in digital learning activities, focus during school classes and involvement in classroom tasks.

Sub-theme 1.2: Motivational and affective engagement

It was also found that the motivation and affective engagement was also strong in the dataset. According to Chiu (2021), digital support that was modeled after the self-determination theory reinforced student engagement in blended learning by promoting autonomy, competence and relatedness. The researchers found that learners reacted positively when online learning platforms provided them with a feeling of control, guidance and self-efficacy. Lu, Xie and Liu (2022) discovered that self-efficacy, environmental perception, and motivational states of students determined the situation engagement in smart classrooms. Their results revealed that the engagement was determined by the perception of students about the learning environment and the level of confidence they had and were capable of in dealing with learning activities. In their report, Wang, Tigelaar, Luo and Admiraal (2022) found the concept of connectedness relating to the emotional and relational aspects of digital learning in the smart classroom environment and student engagement. These studies introduced engagement as not only physical involvement, it involved motivation, interest, confidence and emotional engagement to technology enhanced teaching.

Sub-theme 1.3: Engagement versus disengagement

The studies reviewed also had the ability of revealing how engagement and disengagement co-existed in learning environments rich in technologies. Bergdahl, Nouri, Fors and Knutsson (2020) clearly stated engagement and disengagement as a learning experience among the students in the case of technology. Their results indicated that, even though other students took advantage of technology to focus and deliver high results, others showed a less productive behavior of engagement. According to Heilporn, Majdoub, Diab, Paré, Hejazian, Lakhal and Hamel (2025), students did not refer to technology as something useful in every case. Rather, students elaborated that digital tools were useful when they were congruent with a learning activity and when they are supported, but not always when the task needed an alternative way of operation. This demonstrated that the use of classroom technology was not automatic, but conditional. In all these studies, disengagement was evident where students were not guided, the digital tool was not suitable in the task or the conditions in which learning was to be used were not conducive to productive use.

Theme 2 – Teacher digital competence and pedagogical mediation

Sub-theme	Pattern identified across studies	Studies supporting the pattern	Focus of reporting
2.1 Teacher competence and training	The more intense technology integration was observed in cases where educators were digitally and pedagogically competent.	Demissie *et al.*	Competence, training, attitudes and administrative support reports.

2.2 Teacher support and scaffolding	Students were more responsive in areas where teachers offered instructions and organized help.	Chiu; Wang *et al.* (2024)	Reports on strategy instruction, encouragement and resource support
2.3 Enacted classroom quality	The impact of technological outcomes was linked to the real classroom procedures and school situations.	Wang *et al.* (2022); Fang *et al.*	Reports on connectedness, classroom process quality and wider school influences

Sub-theme 2.1: Teacher competence and training

The most obvious one was the study by Demissie, Labiso and Thuo (2022), which concerned teacher competence and training. They claimed that increased technology integration at the secondary education was linked with digital competence of teachers, their attitudes to ICT and the degree of in-service professional training they underwent. Their research also revealed that school leadership support and mentoring structure helped in more effective integration of technology in classroom practice. Baytar, Elyacoubi, Saqri and Ouchaouka (2023) also were not one of the ten core studies but also supported the role of teachers sense of competence in using ICT. Tzafilkou, Perifanou and Economides (2023) also demonstrated that digital competence in the teaching profession at schools entails a mixture of pedagogical and professional factors. Among the ten chosen articles, the results showed that the competence of teachers was not confined to technical competence only, but comprised of confidence, training, and the capacity to relate digital tools to instruction objectives.

Sub-theme 2.2: Teacher support and scaffolding

Teacher support and scaffolding also came out strongly. The study by Chiu (2021) revealed that online support improved the engagement, particularly when the learning environment promoted fundamental psychological needs, and this indicates the significance of instructing design planning. Wang, Zhou, Chen, Tong and Yang (2024) reported that the concept of teacher support of self-regulated learning in technology-enhanced language learning was multidimensional. They found that strategy instruction, provision of resources, emotional support, and clear instructions on the issue of how to control their learning in e-learning settings benefited the students. The research also revealed that various types of support had a strong connection in the application of self-regulated learning habits by students. These results described teacher support as an organized process and not a general presence in the classroom. The studies demonstrated that in cases where teachers played a very proactive role in guiding students, the technology-supported learning was more linked with more engagement and mastery of learning activities.

Sub-theme 2.3: Enacted classroom quality

Another trend in the outcome was implemented classroom quality. According to Wang, Tigelaar, Luo and Admiraal (2022), the student engagement activity in smart classrooms was linked to the classroom process quality, such as connectedness and meaningful use of technology. Their conclusions were that whatever occurred in the classroom was more important than generic beliefs about the use of technology. Fang, Li, Chan and Kalogeropoulos (2024) found that the use of technology with the assistance of the teacher under different characteristics of teachers and schools in general. Their study multilevel revealed that the technology integration had other factors other than the immediate lesson such as school-level conditions. Collectively, these studies revealed that the quality of enacted classroom was both daily classroom practices as well as broader institutional factors. The findings hence defined classroom quality as seen in interaction, support and organisation than the abstract or assumed.

Theme 3: Smart classrooms and digital learning environments

Sub-theme	Pattern identified across studies	Studies supporting the pattern	Focus of reporting
3.1 Environmental affordances	Students' engagement was shaped by how they perceived the digital environment	Lu *et al.*	Reports on perceptions of affordances and motivational fit
3.2 Connectedness and interaction	Smart classrooms were more effective when they supported interaction and connectedness	Wang *et al.* (2022)	Reports on relational quality and interaction in technology-rich spaces
3.3 Student-centred smart pedagogy	Better outcomes appeared when smart classrooms were paired with active pedagogies	Cheng and Yang	Reports on smart classrooms with PBL, PjBL and TBL approaches

Source: Author's synthesis from smart-classroom studies.

Sub-theme 3.1: Environmental affordances

The most clear evidence on environmental affordances was given by Lu, Xie and Liu (2022). Their real time longitudinal research revealed that situational involvement of students in smart classrooms depended on their perceived approach of the environment. Environmental perception was one of the significant factors that were found in the study in terms of engagement, along with self-efficacy and motivation. This implied that the classroom as a digital place was not neutral, as students did not react to the features in the same manner. The results indicated that engagement depended in part on whether the students found the environment conducive to learning. Here, the smart classroom was shown as an active component of the learning process and not some passive background.

Sub-theme 3.2: Connectedness and interaction

The trait of connectedness and interaction also emerged as the important aspect of smart classroom learning. According to Wang, Tigelaar, Luo and Admiraal (2022), there was a relationship between connectedness and quality of classroom processes and student engagement in smart classrooms. Their multilevel results revealed that technology intensive classrooms worked better in case there was interaction and quality relationship. The findings showed that the online setting did not substitute social and pedagogical interaction. Rather, connectedness was still incorporated in the ways students felt engaged in the classroom. Fang, Li, Chan and Kalogeropoulos (2024) also indicated that the use of technology with the assistance of teachers was based on the teacher and school-related variables, which indicated the systematic nature of interaction within these settings. In the studies assessed, the smart-classroom was specified as a interactive environment in which relations and classroom organisation were still apparent in student learning.

Sub-theme 3.3: Technology-rich pedagogy

The last sub-topic in smart classrooms was pedagogy. According to Cheng and Yang (2023), the smart classrooms were associated with better academic performance, teamwork and problem-solving when combined with the student-centred pedagogies like problem-based

learning, project-based learning and team-based learning. Their meta-analytic results also indicated that more years of implementation had stronger results. These findings made smart classrooms appear more than just a room furnished with computer technology. They demonstrated that pedagogy had been included in the outcome pattern which was reported in the reviewed literature. In this theme active learning methods were associated with the digital environment as opposed to mere access to technology.

Theme 4: Technology integration and learning outcomes

Sub-theme	Pattern identified across studies	Studies supporting the pattern	Focus of reporting
4.1 Academic achievement	The productive use of technology was related to better achievement, although not to all learners.	Bergdahl *et al.*; Wang *et al.* (2024)	Reports on performance-related outcomes
4.2 Collaboration and problem-solving	The use of technology in a student-centred manner facilitated collaboration and problem solving.	Cheng and Yang	Reports on broader learning outcomes beyond test scores
4.3 Digital competence development	The stronger digital competence in learning was related to better technology integration.	Consoli *et al.*	Reports on digital competencies as an educational outcome

Source: Author's synthesis from outcome-oriented studies.

Sub-theme 4.1: Academic achievement

Research was reported that academic achievement was done. Bergdahl, Nouri, Fors and Knutsson (2020) have concluded that high-achieving students who utilize technologies to learn concentration were better and these tendencies were linked to their performance outcomes in upper secondary education. According to Cheng and Yang (2023), smart classroom and student-centred pedagogy were identified to positively affect the academic performance of students. These findings showed that achievement related results were observed when the use of technology was associated with participation besides structured pedagogy. It was also found that achievement gains did not stand alone of the classroom processes because the engagement and the instructional design were of the same result pattern.

Sub-theme 4.2: Problem-solving and collaboration

The area of problem-solving and collaboration in the findings by Cheng and Yang (2023) was highly expressed. They demonstrated through their meta-analysis that smart classes enabled collaboration and problem solving particularly when student-centred pedagogies were employed. These results expanded the findings beyond performance in exams and indicated the interaction and collaborative processes of learning. In the studies reviewed, collaboration was mentioned as one of the outcomes derived due to the active use of technology in the classroom. The findings consequently revealed that the integration of technology was linked to both the process and academic oriented learning.

Sub-theme 4.3: Digital competence development

The development of digital competence was most evident in Consoli, Schmitz, Antonietti, Gonon, Cattaneo and Petko (2025). Their results indicated that the quality of technology integration was positively related to self-assessed learning digital competencies of the students.

It implied that integration of technology also served as an input in the learning process, and a source of development of competence. In the studies chosen, the digital competence was thus stated as an educational outcome as such. The results indicated that students had greater learning abilities to use technology when subjected to better quality digital learning environments.

Theme 5: Learner agency and self-regulated learning

Sub-theme	Pattern identified across studies	Studies supporting the pattern	Focus of reporting
5.1 Autonomy and competence	The learner agency enhanced when digital tools promoted independence and confidence.	Chiu	Reports on autonomy, competence and relatedness
5.2 SRL strategies and scaffolds	Students who gained advantage were those with clear self-regulation instructions on use of technology.	Wang *et al.* (2024)	Reports on strategy support and regulation of learning
5.3 Informed learner choice	Students appreciated the chance to get access to digital and non-digital options.	Heilporn *et al.*	Reports on learner preference, fit and contextual choice

Sub-theme 5.1: Autonomy and competence

According to Chiu (2021), digital support increased student engagement in which learners felt autonomy, competence and relatedness in blended learning. This demonstrated that agency among the learners in online platforms was associated with the students feeling empowered and enabled. Lu, Xie and Liu (2022) also demonstrated that self-efficacy led to the situational engagement in smart classrooms. These findings provided autonomy and competence as reported conditions of effective learning with technology. In the chosen articles, the students were not just the users of digital tools, but learners whose feeling of competence and autonomy conditioned their communication.

Sub-theme 5.2: Self-regulated learning strategies and scaffolds

According to Wang, Zhou, Chen, Tong and Yang (2024), the teacher support provided to self-regulated learning in technological-enhanced language learning was positively correlated with self-regulated learning practices of the students. They found that the support of planning, monitoring, use of strategy and resource management was significant in online learning environments. The research also revealed that self-regulated learning was multi-dimensional and directly related to the types of support that students were getting through teachers. These findings meant that self regulation was an observable aspect of learning process in technology improved classrooms. Learner agency in the studies reviewed thus involved the practical techniques that the students adopted in order to control their learning.

Sub-theme 5.3: Informed learner choice

Heilporn, Majdoub, Diab, Parere, Hejazian, Lakhal and Hamel (2025) found out that students found technology useful when they perceived the affordances to be applicable to the learning task, and provided suitable guidance advised by the teachers. Their qualitative results revealed also that, sometimes students chose to go with paper or non-digital alternatives based on the activity. This implied that the students did not make technology look highly desirable in all the classroom activities. They rather conceptualized productive learning by using the terms of fit, context and choice. Informed learner choice was also present in the results in the form of a

definite pattern of whose pattern is to choose or appreciate the mode of learning that was the most effective in tackling the task at hand.

Discussion

The research results also show that there are some interrelated issues of integrating technology in secondary schools particularly on how it affects student engagement, teacher mediation, learning and learning environment and student performance. One of the clearest findings on the studies considered, the centrality of engagement as the process of technology-enhanced learning can be mentioned. According to Bergdahl, Nouri, Fors and Knutsson (2020), students who reported greater use of the digital learning tools also reported to be more focused and their academic outcomes were better. Chiu (2021) goes further and shows that with the digital learning environment, one can engage in case of autonomy, competency and meaningful interaction with the learners in the learning process.

Another point that is raised in the findings is that engagement in technology-enhanced classroom is not a one-dimensional aspect i.e. behavioural only. Wang, Tigelaar, Luo and Admiraal (2022) demonstrate that the connection of classrooms and the overall quality of instructional processes have an influence on the engagement in smart classrooms. It is also shown that quality of technology integration is a superior determinant of behavioural engagement differences compared to the frequency of technology use (Consoli, Schmitz, Antonietti, Gonon, Cattaneo and Petko 2025). Another piece of evidence provided by Heilporn, Majdoub, Diab, Parre, Hejazian, Lakhal and Hamel (2025) is that the students themselves admit that they can learn with the assistance of digital tools only when some instructional activities are reflected. The results confirm the assumption that engagement is created when technology, pedagogy and relationships interrelate in the classroom. To this extent, technology is not an automatic process of creating learner engagement; engagement appears to be created as digital tools are implemented in substantive learning contexts.

The results also indicate the effects of technology in the supporting learning processes are dependent on the learning environment structure/quality. Lu, Xie and Liu (2022) demonstrate that how students perceive the smart classroom setting is important in shaping how students interact during the learning process during the learning activities. Connectedness and quality of classroom processes are also introduced by Wang, Tigelaar, Luo and Admiraal (2022) as the determinants of success of technology-based learning environments. Further support that smart classrooms have increased learning outcomes is also provided by Cheng and Yang (2023) under the circumstances of being complemented by student-centered pedagogues, such as project-based learning and collaborative learning strategies. As these findings suggest, the availability of digital tools does not always improve the educational performance. Instead, it appears that the usefulness of technology to the learning process is determined by how learning environment is structured and the type of teaching method that the teachers apply.

The link between technology integration with the performance of the school also comes out brightly in the results. Bergdahl, Nouri, Fors and Knutsson (2020) indicate that the application of technology-based engagement can be associated with the academic performance of learners in high-school schools. On the same note, Cheng and Yang (2023) show that smart classroom environments work well to facilitate academic achievements along with student-focused instruction designs. Wang, Tigelaar, Zhou and Admiraal (2023) also report that mobile and digital technologies can positively influence cognitive and behavioural learning outcomes in the primary and secondary school setting. At the same time, the reviewed literature suggests that not every learner is capable of producing academic benefits in case technology is introduced. Differences in interaction, digital literacy and pedagogical format could have some influence on the degree to which technology could be useful in generating academic results. This means that the benefits of technology integration as far as academics are concerned are in the way the digital tools are integrated into the structured learning processes.

Also identified as significant in technology enhanced education due to the analysis are agency of the learner and self-controlled learning. According to Chiu (2021), digital learning environments might be used to make students feel more engaged with the help of autonomy and personal competence. Another study by Wang, Zhou, Chen, Tong and Yang (2024) supports this by demonstrating that the teacher support of self-regulated learning is significant to the ability of the students to regulate their learning during technology-enhanced learning. As Heilporn, Majdoub, Diab, Paré, Hejazian, Lakhal and Hamel (2025) show, students enjoy technology as it enables them to make wise judgments on how they are going to complete learning tasks. These findings indicate that the application of technology will be capable of supporting self-directed learning in case the students are appropriately instructed and given control over the learning process. However, the results also demonstrate that learner autonomy is not a coincidental occurrence but should be facilitated by educators as well as the planned online learning environments.

CONCLUSION

This paper discussed the role of technology use in classroom learning and its impact on student involvement and performance in high school. The synthesis of the reviewed studies demonstrates that it is possible to support learning by the digital technologies in case of their meaningful incorporation in classroom teaching. The results repeatedly prove that technology-enhanced learning environments can reinforce behavioural, cognitive and motivational engagement in students in case of connecting digital tools with any instructional goals. Meanwhile, the findings show that engagement does not emerge out of merely access to devices or digital platforms. Rather, learners are likely to react positively to technology whenever learning processes are interactive, relevant and well facilitated by instructors.

The results also indicate the significant impact of teachers in determining the functioning of technology in classroom learning. The digital competence of teachers, design and facilitation ability to guide the learners seems to contribute to whether technology will boost or restrain student engagement. On the one hand, technology assists teachers in achieving meaningful learning experiences by actively guiding them through understanding the process by scaffolding and developing activities. Conversely, when there is no intensive pedagogical assistance when introducing digital tools, it seems to hinder the potential of educational benefit.

The findings also show that the tech integration to academic achievement is very much linked to the student involvement and teaching practices. Digital tools seem to be helpful in achieving learning outcomes in cases when they facilitate collaboration, problem-solving and independent learning. The implication of this is that the educational usefulness of classroom technology does not just exist in enhancing academic achievement but also in enhancing the ability of students to engage actively in their own instruction. The research demonstrates that the best way to implement technology in secondary school learning is the collaboration of digital tools, instructions and the involvement of learners. Relevant use of technology is thus not necessarily on the presence of digital devices but rather the quality of teaching practices that inform the application of digital devices.

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