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Engagement, Learning Outcomes, Technology Integration, and Socioeconomic Status

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ABSTRACT

This systematic review synthesizes empirical studies on how technology integration in formal education relates to student engagement, learning outcomes, and socioeconomic status (SES). Following PRISMA 2020 procedures, studies were identified through systematic database searches, citation chaining, and predefined screening based on eligibility criteria. Extracted data covered features of technology integration and engagement, measures of learning outcomes, SES definitions, study design characteristics, and equity-focused analyses. Across the literature, technology integration was more consistently associated with improvements in proximal indicators of engagement than with reliable gains in learning outcomes. Digital tools supported learning most effectively when tightly aligned with instructional goals and when implementation included scaffolding, feedback, and teacher mediation that fostered cognitive interaction and self-regulated learning. Evidence on SES effects was mixed, but findings suggested that technology can either reduce or intensify learning inequalities depending on implementation conditions. Gap-narrowing patterns appeared when technology lowered access barriers and increased structured supports during the school day. In contrast, gap-widening patterns emerged when success depended on out-of-school resources such as stable internet access, quiet study space, caregiver support, and digital literacy. Many studies showed methodological limitations, including weak SES measurement, uneven reporting of implementation fidelity and dosage, and heavy reliance on single-method engagement measures. Overall, the review underscores the need for equity-oriented evaluation that reports distributional impacts, strengthens measurement of productive engagement, and assesses integration quality. Future research should emphasize stronger causal designs, longitudinal effects, and direct tests of SES-linked mechanisms connecting technology use, engagement, and learning.

1. Introduction

Digital technologies have completely entered the educational systems of different countries around the world and define the specifics of students obtaining information, working with learning resources, and proving their knowledge [1]. Learning management systems, adaptive platforms, educational applications, video-based training, collaborative tools, and data dashboards are becoming commonplace classroom tools used to support instruction

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in face-to-face, blended, and fully online courses. In addition to these changes, the long-term achievement gaps and unequal access to learning opportunities are the most important issues that educators and policymakers need to address. One of the major questions has thus become urgent, and that is, when technology is incorporated in teaching and learning, who is benefiting under what circumstances and how? To tackle this question, there is a strong necessity to analyze (a) technology integration and its effects on student engagement, (b) student engagement and its consequences on learning outcomes, and (c) student engagement and learning outcomes depending on their socioeconomic status [2, 3].

Student engagement has been universally accepted as a multidimensional construct that entails the behavior, feelings, thoughts, and interactions of learners throughout learning. Behavioral engagement normally incorporates participation, attendance, effort, persistence, and being on task. Emotional or affective involvement expresses interest, pleasure, belonging, and attitudes toward the learning activities. Cognitive engagement is a self-regulation, strategic learning, deep processing, and investment in understanding. Social engagement (participation in collaborative learning and discourse) and agentic engagement (proactive contribution to the creation of the instruction and learning conditions made by students) is also important features of many modern views. These dimensions are important not only because engagement is regarded as a proximal measure of the quality of learning, but also because engagement is oftentimes placed as a gateway to success: students who engage meaningfully, endure through difficulties, and employ efficient learning practices have higher chances of learning and remembering [4-6].

In educational research, though, learning outcomes are operationalized in a variety of ways. Research can be based on standardized achievement, course grades, conceptual learning, acquisition of skills, long-term retention, or ability to apply learning to new problems. This diversity matters: certain technologies might lead to an increase in participation or time-on-task without a significant improvement in the distal outcomes, whereas others might yield the benefits of learning with insignificant alterations in self-reported interest. As a result, reviews considering engagement and learning outcomes distinctly run the risk of overlooking the mechanisms that describe why technology is useful in certain environments and not others. A systematic review combining both should be in a better position to determine whether engagement is (1) a co-occurring benefit, (2) a mediator partially explaining learning gains, or (3) a possible false positive in which the increase in activity is not associated with a better understanding [7].

One of the most important obstacles to synthesizing this literature is the fact that technology integration is commonly employed as an umbrella term that hides a significant amount of variability in the implementation. Technology may be used as an adjunct to various traditional teaching forms (e.g., as practice quizzes, video review, digital textbooks), as an aspect of teaching (e.g., blended learning rotations, flipped classroom, online courses), or as a revolutionary redesign of pedagogy (e.g., project-based learning enabled by multimedia production tools, knowledge building in shared digital spaces). The results are not only based on the tool itself, but also on the manner in which the tool is applied - in line with the learning objectives, the quality of teaching design, the degree of scaffolding, teacher knowledge, student assistance, and fidelity to implementation [8]. Two classrooms on the same platform can yield different results when one of them focuses on meaningful feedback and guided practice, whereas the other allocates blank seat time.

Additionally, the integration of technology is becoming more data-rich, where real-time analytics, personalization, and automated feedback are being offered. Although these features can be used to differentiate instruction and intervene in time, they can also create new obstacles to the learners who have less prior knowledge, are less digitally literate, or lack access to a stable learning environment. Thus, to realize the effects of integrating technology into the process, one should not compare tech and no tech but rather make a more complex synthesis of the quality of integration, amount of integration, context, and learner characteristics [9].

Socioeconomic status (SES) is one of the most reliable forecasts of educational opportunity and educational achievement, which denotes the disparities in material resources, learning conditions, and social supports that influence academic patterns of students. The measures of SES usually involve household income, education of the caregiver, occupational status, income to receive subsidized meals, or compound indices on an individual, school, or neighborhood scale. Notably, SES is not one of the background variables only; it can mediate learning in various ways, such as the availability of learning material, time and space to study, the ability of the caregiver to facilitate schooling, and the exposure to rich experiences. SES can also determine (a) device access, (b) access to and access to high-quality and reliable internet access, (c) access to and development of digital literacy, and (d) the capacity of schools to provide infrastructure, technical support, and trained teachers in technology-mediated learning [10-12].

The digital divide is usually talked about as the une-

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qual access to devices and connection, though inequity is a broader concept. Students can be provided with a device, but without a good space to study, competing family needs, or they can be interrupted constantly because of not very good houses or low bandwidth. Learners also vary in their capacity to navigate through platforms, problem-solving, the quality of received information, and the strategic use of digital tools, even when the access is similar. Such differences may have an impact on engagement (e.g., frustration, disengagement, lack of persistence) as well as learning outcomes (e.g., less effective practice, lower quality work products). Therefore, it is plausible that technology integration will reduce disparities based on SES by increasing access to high-quality instructional resources and a tailored learning experience, or enhance disparities by increasing whether advantages are contingent on supports that are more accessible to higher-SES learners [13].

There is an increasing amount of empirical information that studies the impact of educational technology on engagement and achievement, although the evidence is scattered and inconclusive [14]. In some studies, the technology-supported instruction is reported to produce the effects of higher motivation, engagement, and performance; others show small or insignificant results, or particular effects on specific learners or situations. The variety of research designs (randomized trials, quasi-experiments, and correlational studies), outcome measurement (self-report engagement and learning analytics and standardized tests), and characteristics of the intervention (type of the tool, length of time, teacher training, integration model) make it harder to interpret. The cycle of Technology Integration in Education illustrating how integrating technology enhances student engagement, improves learning outcomes, and addresses socioeconomic disparities through a continuous, interconnected process, is shown in **Figure 1**.

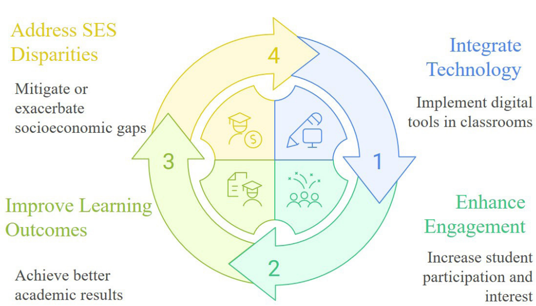

Figure 1. A continuous cycle where technology integration enhances engagement, improves learning outcomes, and addresses socioeconomic disparities.

Also, the measurement of SES is not always consistent and is inconsistently located in the analysis. In other research, SES is a control variable; in others, it is a focal moderator; and in many, it is not mentioned at all. SES can be approximated even when it is included with school-level proxies that cannot measure within-school variation and cannot easily be compared across examination studies and nations. As a result, there is no definitive, unified description of the effect of SES on technology-related engagement and learning in the literature, nor is there a consistent description of the mechanisms of inequity generation and elimination.

The systematic review that will in unison analyze the engagement, learning outcomes, technology integration, and SES can make three contributions. First, it may help understand the general picture and the strength of evidence describing the association between the technology integration and engagement and learning outcomes, as well as differentiating between the dimensions of engagement and the types of outcomes. Second, it can determine whether the relationships are moderated by SES and in what circumstances, pointing to the times when technology becomes an equalizer of advantage as well as when it becomes a multiplier of advantage. Third, it can determine the quality of methodology of the available evidence (e.g., risk of bias, control of confounding, fidelity reporting) and provide recommendations on how even more stringent and equity-oriented research can be performed [15].

Digital technology has fully integrated into the education systems of all global institutions, which predetermines the ways students gain access to information and explore learning resources, as well as how they express their knowledge. Classrooms are becoming more dependent on learning management systems, adaptive platforms, education applications, video-based learning, collaborative tools, and data dashboards to facilitate instruction in the face-to-face format, blended forms of instruction, and fully online instruction. Simultaneously, the ongoing disparity in achievement and unequal access to learning still becomes a challenge to educators and policymakers. This convergence has sharpened one major query, which is as follows: in what circumstances, under what conditions, and through what mechanisms are the benefits of technology in teaching and learning realized? To answer that question, one must go further than whether technology exists and whether they transform something in the everyday life of learners, how the context and socioeconomic status, in particular, influence the chances of students to learn and interact [16].

Student engagement is often put in the category of a near-term measure of quality of learning and a channel

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through which teaching is converted into success. Engagement is often viewed in terms of being multidimensional and including, what students do (behavioral engagement including participation, time-on-task, effort, and persistence), what students feel (emotional or affective engagement including interest, enjoyment, belonging, and perceived relevance), how students think (cognitive engagement including strategic learning, self-regulation, and deep processing), and how students interact (social engagement through collaboration and academic discourse). Other viewpoints are also concerned with agentic interaction, which is an act of proactive involvement by students in the process of defining the instructional actions and learning environments [17]. The dimensions are important in that they measure various aspects of the manner in which learners commit themselves to schooling, and they can be associated with learning outcomes in various ways. Increased involvement or duration of an activity could not generate any real learning unless students are deeply thinking, whereas a high level of cognitive involvement can generate learning even when the outward participation level seems to be low. This is why engaging studies or achievement-only research studies might fail to capture the processes that can describe the success of technology-supported learning in some contexts and not in others [18].

The learning outcomes alone are assessed in a very diverse manner, such as the performance on standardized tests, course grades, abstract knowledge, ability development, long-term retention, and the ability to apply the same to new problems. This is significant in that various technologies can have various outcomes within varying timelines. Immediate feedback, practiced frequently, tools can produce short-term performance improvement, whereas tools that encourage inquiry, collaboration, or metacognitive reflection can be beneficial, but only over longer periods, as well as reflected in other results not obtained by standard tests. On the other hand, there are those implementations of technology that can enhance activity, perceived enjoyment, or use of platforms with no long-term learning benefit. Synthesis that takes into account both engagement and learning results can thus streamline the extent of engagement being merely an incidental occurrence, a mediator that assists the clarification of learning gains, or even, in certain instances, a deceptive indicator that does not translate into a greater comprehension [19].

The other issue is that technology integration has historically been discussed as a homogenous intervention when, in fact, there is a high degree of variability in the type of tools used, the pedagogical intent behind the tool use, and the quality of the implementation [20]. Technology may serve as an auxiliary tool that facilitates traditional learning, e.g., practice quizzes, online readings, or video replays. It can also be used as a major means of communication in blended learning models, flipped classes, or online courses in their entirety. In other scenarios, it allows redesigning learning experience by means of multimedia production, collaborative knowledge construction, simulations, or data-driven personalization. Very different learning experiences may be achieved on the same platform, based on instructional design, its suitability to learning goals, facilitation by the teacher, and the supports provided to students. This can result in the fact that technology versus no technology comparisons might mask the more significant comparisons that define effectiveness like whether the use of technology is complemented by clear learning goals, whether students learn with scaffolding and feedback, whether teachers are viewed as active designers and facilitators and not passive implementers and whether technology use is long term in that it will affect skills and knowledge.

The swift increase in data-rich data systems contributes to additional complexity. Most current technologies gather fine-grained learning analytics, personalize content based on student outcomes, and automate feedback. These features can facilitate differentiated instruction as well as timely intervention, though they may also pose new barriers to students with less previous knowledge, lower digital literacy, or access to supportive learning settings. Personalization and instantaneous feedback may be empowering and encouraging to certain learners, whereas opaque algorithmic routes, thick interfaces, or continued performance indicators may become frustrating in the name of constantly failing and demotivating. The effects of integrating technology necessitate, therefore, an awareness that not only the tool, but the compatibility of the tool requirements with learner preparation, and the institutional capability to impart the training, technical support, and instructive guidance are important [21].

One of the main equity lenses that can explain such relationships is socioeconomic status, as it influences not only the availability of learning opportunities but also the circumstances in which learners may be able to take advantage of technology-mediated instruction. Some commonly used indicators used to measure SES include education of the caregiver, household income, occupation, eligibility to have a subsidized meal, or indices on areas that reflect the neighborhood resources and deprivation. These measures are not flawless and differ in degree, yet they are always associated with the disparities in educational opportunity and academic success. SES can work via other channels in technology-mediated learning that influence engagement and learning outcomes. These are

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having reliable devices and broadband, stability of internet connection, having enough space to learn in a quiet and secure environment, time, such as caring or employment obligations, and adult assistance in learning to operate on online platforms and in schools. When devices are accessible, varying quality of access, shared devices, scarce data plans, and high-frequency connectivity disruptions may have a direct impact on whether students can attend to them, finish their work, or even engage in lengthy cognitive activities [22].

Access is not the only concern of equity. The digital divide is being interpreted more as consisting of not only hardware and connectivity, but skills and uses as well. Students differ in their skill to operate interfaces, troubleshoot technical decisions, judge the credibility of information, manage attention, and strategically use digital technology to learn. These skills are developed through previous experience, school education, and the provision of support both at home and school, factors which tend to be related to SES. Such differences may affect the engagement of behavior, the engagement of emotion, and cognitive engagement. Based on this, the integration of technology can mitigate SES-related disparities if it provides access to high-quality teaching, specific support, and valuable feedback; however, it can also create disparities when resources or supports, which are unequally allocated to people, are considered as a source of advantages [23].

Whether technology is an equalizer or an amplifier of advantage is particularly acute in the context of a massive drive in the digital transformation of education. Positive stories underline that technology is able to amplify good resources, individualize teaching, and expose learners to the outside world. Greater warnings have been issued contending that technology can either replicate or accentuate disparity when implemented unevenly, when learners vary in conditions that support learning, or when systems are based on efficiency and surveillance rather than effective pedagogy. These competing possibilities are not exclusive to each other; they can be true in different conditions. The integration of technology may increase average performance, but increase inequalities or increase outcomes most among the lower-SES learners when combined with strong supports. It may also change patterns of engagement that cannot be measured by common tools, including more and more activity on a platform but less investment of attention. It is necessary to clarify these dynamics through systematic synthesis and not baseless research or generic assumptions [24].

Although the evidence base has been growing rapidly, studies of technology integration, engagement, and learning outcomes have been in disjointed disciplinary, educational sector, and methodological groups. There is a wide range of studies in terms of design, including randomized trials and quasi-experiments, correlational analysis, and mixed-method case studies. They also in terms of the methods of engagement measurement as well as in terms of the methods to measure learning outcomes (standardized tests, researcher-created measures, course grades, performance tasks). The descriptions of interventions are not evenly balanced, and in some cases, studies give a description of the design and fidelity of their instructional design development; in other cases, they mention the tool without describing the way it was utilized. Such differences complicate the interpretation of mixed findings, and it is hard to decide whether the inconsistent findings reflect actual variability in effectiveness or an actual variability in measurement and reporting [25].

SES also does not receive equal treatment in the literature. In others, SES is considered an additional control factor and makes the research not explanatory but an adjustment. In further studies, SES is considered a moderator, although with crude proxies, like school-level poverty rates, which do not allow within-school variations to be identified. Most studies do not even give a reference to SES, so that one cannot evaluate the implications of equity. Heterogeneity in operationalization still impedes comparing studies across different studies, even with the measurement of SES. These constraints are consequential in the sense that the processes of technology adoption and implementation are usually influenced by the availability of resources at school and district levels, whereas learner experiences are influenced by home settings and community settings. In the absence of regular consideration of SES, it is difficult to ascertain whether technology-supported learning will decrease the disparities, keep them constant, or increase disparities [26, 27].

Engagement, learning outcomes, technology integration, and SES may be integrated into a systematic review that can help to address these issues by systematizing the evidence with the main constructs and equity-relevant pathways. This type of review can explain the way that technology integration has been defined and applied to contexts, the types of engagement that have been affected most consistently, and the learning outcomes with the best evidence of improvement. It is also capable of determining when and how SES moderates the relations between technology integration and outcomes, in which studies explicitly test moderation and those studies that only suggest different effects. Lastly, it can formulate hypothesized and experimented mechanisms, including access and infrastructure, teacher support, implementation fidelity, and home learning conditions, that indicate why technology is

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beneficial in some situations but not others [28].

The current systematic review thus aims at reviewing empirical literature on the connection between technology integration, student engagement, and learning outcomes, with a particular focus on SES as an equity-relevant variable. It looks at the operationalization of core constructs, summarizes the effects pattern across educational contexts and research designs, and how much SES moderates the magnitude or direction of technology-related engagement and learning outcomes. It is hoped that this review can illuminate both research and practice: by summarizing what has already been known, and indicating gaps in these areas, one can help encourage more rigorous research to be conducted that reports equity-relevant evidence, and one can also help educators and policymakers in choosing technology integration strategies that are not only effective in practice, but also beneficial.

2. Methodology

This systematic review was reported and written per the Preferred Reporting Items statement, PRISMA 2020 [29]. To define the objectives of the reviews, eligibility criteria, search strategy, screening procedures, data extraction strategy, and synthesis of the reviews, a protocol was formulated in advance. In case the protocol was registered (e.g., OSF or PROSPERO), then the registration information should be provided; otherwise, it should be noted that registration was not done, and a short explanation should be provided [30]. **Figure 2** illustrates the systematic review methodology, outlining key stages from defining the review focus and search strategy to data extraction, synthesis, quality appraisal, study selection, and transparent reporting, ensuring rigor, reliability, and minimizing bias in research synthesis.

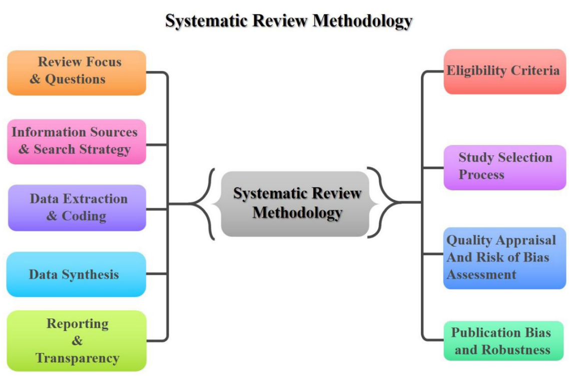

Figure 2. Illustrates the systematic review methodology, outlining key stages from defining the review focus and search strategy to data extraction, synthesis, quality appraisal, study selection, and transparent reporting, ensuring rigor, reliability, and minimizing bias in research synthesis.

2.1. Review focus and questions

The review analyzed the empirical evidence of the interrelations between technology integration, student engagement, learning outcomes, and socioeconomic status, taken as a key equity-relevant factor. The review questions were designed in a way that they reflected how technology integration has been conceptualized and implemented, how the engagement and learning outcomes have been measured, and whether SES alters the extent or the direction of the technology effects. The review also addressed the issue of whether or not engagement has been studied as a mechanism by which technology integration can be correlated to learning outcomes and how equity implications are reported in the literature [31].

2.2. Eligibility criteria

To be included in the study, the studies had to examine the potential of technology as an educational tool and report on student engagement and/or learning outcomes, and had to specifically evaluate or operationalize SES [32]. The term technology integration was described as the use of digital tools or platforms as instructional activities in teaching and learning, both online and blended learning environments, learning management systems, adaptive or intelligent tutoring systems, simulations, games, mobile learning applications, collaborative platforms, and digital assessment or feedback systems. Studies that provided a measure of behavioral, emotional/affective, cognitive, social, or agentic engagement based on self-report measures, teacher report, observational protocols, or digital trace/log measures were deemed eligible. The studies were deemed eligible upon reporting achievement, knowledge, or skill gains, grades, retention, transfer, or performance on standardized assessments or validated assessments. SES was found acceptable when operationalized based on individual or household outcome measures like parental education, income, or occupation; school-level measures like subsidized meal eligibility or neighborhood or area-level deprivation indices. Peer-reviewed journal articles based on quantitative, qualitative, or mixed-methods research were also included as well as conceptual papers, editorials, commentaries, and review articles were excluded. The time of publication and limitations concerning language were used as provided in the review protocol [33].

2.3. Information sources and search strategy

Multidisciplinary databases have been searched in detail, including education, psychology, and learning technologies, often containing Web of Science Core Collection, Scopus, ERIC, PsycINFO, and Education Source,

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and in cases where computing and learning technologies coverage was required, ACM Digital Library and IEEE Xplore were also included. Four concept groups that included technology integration, engagement, learning outcomes, and SES were combined using search strings with controlled vocabulary terms used where possible, and free-text keywords used on titles, abstracts, and author keywords. Each database search strategy was specific (to the difference in indexing and query syntax), and the final searches were recorded with dates and filters, as well as, exact query strings. In order to minimize the possibility of omitting any pertinent studies, all the included articles were forwarded to backward reference checking, and forward citation searching was done using database citation tools. The entire search plan and database-specific terms were ready to report in the additional resources [34, 35].

2.4. Study selection process

All the retrieved records were exported to reference management software, and duplicates were eliminated before screening. The screening was done in two phases, where titles and abstracts were analyzed alongside eligibility criteria to find potentially pertinent studies, and finally, full texts were accessed and evaluated to be included. Two independent reviewers screened the papers, any disagreements being addressed by discussion and, where feasible, by a third reviewer. Reasons why decisions were excluded were recorded at the full-text stage to enable clear reporting, and the process of making decisions was summarized with the help of a PRISMA flow diagram. In cases where possible, the inter-rater agreement was computed to assess consistency when screening [36].

2.5. Data extraction and coding

A common extraction form was created and tested in order to achieve similar codification in diverse studies. The information extracted was the bibliographic, geographic, educational level, learning modality, and subject domain; sample, sample characteristics and demographics; the source of the operationalization and measurement of SES, the type of technology and its integration into instruction, and the length thereof, use intensity, and implementation fidelity when reported; the constructs of engagement and method of measurement, that is, the dimension(s) it measured and evidence of measurement reliability or validity when available; learning outcomes and assessment characteristics, including this: when it was measured: when was it measured and whether the measure was standardized or Quantitative results were brought out detailed enough to describe reported effect estimates and uncertainty, and to facilitate effect size computation were the necessary statistics are made available. The extraction processes involved cross-checking of a sub-population of the studies by two or more reviewers to facilitate reliability and minimize extraction error [37].

2.6. Quality appraisal and risk of bias assessment

The quality of methodology and risk of bias were evaluated with the help of the established appraisal tools, which were aligned to the study design. A randomized study was rated as RoB 2, which is a bias that emerged through the use of the randomization of studies, the intervention that was supposed to be taken but was not, the absence of the result data, the measurement of the outcome, and selective reporting. Quantitative studies that were not randomized were evaluated through ROBINS-I, taking into consideration confounding, participant selection, classification, and fidelity of exposure, missing data, outcome measurement, and reporting bias. Mixed-methods studies were evaluated according to the Mixed Methods Appraisal Tool, and qualitative studies were evaluated according to MMAT qualitative criteria or a similar structured checklist. Two independent reviewers had to perform the appraisal, and disagreements were sorted out by consensus. The quality of the studies was contextualized to determine the strength of the evidence presented in the synthesis, and sensitivity analysis was to be conducted when quantitative pooling was developed to assess the strength of findings in the absence of studies with higher risks of bias [38, 39].

Since the heterogeneity was expected in the educational settings, types of technologies, constructs of engagement, measures of outcomes, and SES operationalizations, a structured narrative synthesis was the main synthesis method, with meta-analysis being used in cases of adequate comparability between studies. The synthesis of the narrative was done by grouping the studies based on the approach of technology integration and the purpose of instruction, educational level, and modality of instruction, the dimension and method of engagement, type of learning outcome, timing of it, and the SES measurement level. The patterns were summarized in direction and consistency of associations between technology integration and engagement and between technology integration and learning outcomes, and through express consideration of whether reported effects varied by SES group or SES context. In articles that examined mechanisms, synthesis also reported evidence on engagement being a pathway between technology integration and learning outcomes and how much access, digital literacy, instructional support, and home learning conditions were also proposed or experimented as explanatory variables [40].

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Where meta-analysis was possible, the extraction or calculation of effect sizes was with standard transformations, and standardized mean differences were used in the case of continuous outcomes and transformation of correlation-based effect sizes accordingly. Random-effects models were scheduled to take into consideration between-study variation, and the heterogeneity was going to be assessed through I2 and T2 statistics. There were prespecified moderator analyses that focused on SES-based variation, such as the difference by operationalization level of SES and the difference based on subgroup comparisons reported, and those moderating implementation, such as dosage, duration, and fidelity indicators. Sensitivity analyses were to be carried out to examine the impact of quality of studies and cases of influence on pooled estimates [41]. In order to preempt the equity implications, results were also summarized based on whether the results indicated gap-reduction, gap-increasing or gap-neutral patterns among groups based on SES, but only when explicitly reported rather than inferred subgroup or interaction findings. Where meta-analysis had enough studies to capture a particular outcome, they investigated the presence of a publication bias by using visual inspection of funnel plot asymmetry and a statistical test where necessary, like Egger regression. The checks of robustness were checking the pooled estimates by the quality strata of studies, the impact of omitting higher risk-of-bias studies, and leave-one-out analysis to test the sensitivity to selected studies. In the cases where quantitative pooling could not be done, the possibility of publication bias was debated qualitatively with references to the study designs and reporting practices that were followed in the included literature [42, 43].

The review has presented the study selection process through the PRISMA flow diagram and has presented summary tables detailing the study characteristics, measures, technology integration features, SES operationalizations, and important findings and results. The assessment of risks of bias was presented in a methodical format to help the reader interpret the confidence of the conclusions. The full database search strings, the template used to extract the data, and any code that has been employed in the computation and synthesis of the effect size were pre-prepared to be included as additional materials to facilitate transparency and replicability.

3. Results

3.1. Study selection

The search results of the databases provided a total of records that were then sent through the removal of duplicates, thus providing a collection of unique articles that were to be screened [44]. A title and abstract screening identified the studies that were not based on technology integration in an instructional design, did not provide any engagement and learning outcomes, or lacked a clear operationalization of SES. Full-text exclusion also removed the studies where the use of technology was restricted to general access and having a device, but not integrated into the instruction, when the outcomes were not measured empirically, or when the concept of SES was mentioned only in abstract terms without a numerical indicator. The ultimate corpus was a collection of the studies contained in the qualitative synthesis, a subset of which contained adequate and comparable quantitative data to be able to extract effect sizes, and, where possible, to pool meta-analytically. The identification, screening, eligibility, and inclusion process of the study are described in the PRISMA flow diagram [43, 45]. Three ways to integrate technology in education: as support to teaching, as the main instruction method, and with a focus on equity for all students. This is shown in **Figure 3**.

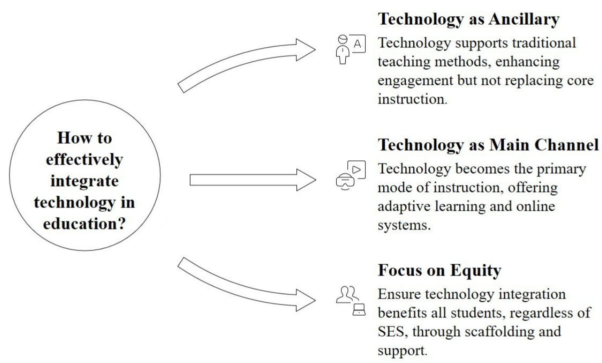

Figure 3. Three ways to integrate technology in education.

3.2. Characteristics of included studies

The studies included covered a period of a variety of years of publication and represented different educational levels, such as primary and secondary school, higher education, and other formal learning environments, based on the range of scopes outlined in the eligibility criteria [46]. The research was conducted in various countries and regions, with representation determined by the coverage of databases and language limitations. Sample sizes and compositions varied widely, ranging from single-school or single-course implementations to large multi-site samples, based on districts, national surveys, or learning analytics platforms. The research designs were heterogeneous, such as randomized controlled trials and quasi-experimental evaluations of technology-supported interventions, cor-

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relational and longitudinal studies of technology use in a natural setting, and qualitative or mixed-methods studies of implementation processes and learner experience. Among this heterogeneity, the most widespread analytic methods were regression-based, covariate models, multilevel models with classroom or school clustering, and pre-post comparisons with non-equivalent groups in non-experimental studies [47].

It was also modally different in contexts of technology integration. Other studies considered face-to-face classrooms that were supplemented with digital tools to facilitate practice, assessment, and collaboration, but others looked at blended learning models and supported the purely online learning environments. The time span of technology exposure was short-term unit-based to semester or year-based implementations, and most of the studies were different in the degree to which they reported on implementation fidelity, teacher preparation, or intensity of student usage [48]. The fact that it had such variability in design and reporting helped generate different interpretations of the findings, and it affected the viability of quantitative synthesis. The scope and the range of evidence-based can be determined by **Table 1**.

Table 1 summarizes the core characteristics of the included studies, including educational level, technology type, and study design.

Country/Region	Education Level	Sample (N)	Design	Technology Type	Integration Model	Duration	
China	Secondary	412	Quasi-experimental	LMS with analytics	Blended	16 weeks	[49]
USA	Higher education	238	RCT	Adaptive tutoring system	Supplemental	10 weeks	[50]
Spain	Primary	356	Longitudinal	Tablet-based apps	Core instruction	1 academic year	[51]
Kenya	Secondary	184	Mixed-methods	Mobile learning platform	Supplemental	12 weeks	[52]
Taiwan	Higher education	521	Correlational	Online course platform	Fully online	1 semester	[53]
USA	Secondary	1,204	Quasi-experimental	Flipped classroom videos	Blended	1 semester	[54]
Malaysia	Higher education	198	RCT	Game-based learning system	Supplemental	8 weeks	[55]
Brazil	Primary	267	Quasi-experimental	Digital formative assessment	Core instruction	20 weeks	[56]

3.3. Operationalization of socioeconomic status

The measurement of the SES was based on the basis of many indicators of varying granularity levels. These operationalizations of individual- or household-level SES most often used parental education, self-reported income ranges, occupational status, or composite indices based on a number of household indicators. School-level proxies of SES are often based on the eligibility to receive subsidized meals or school poverty rates, and other studies relied on the neighborhood or area-level indices, ensuring that they capture deprivation, education levels, and income inequality. It is interesting to note that the level at which SES was measured was frequently determined by the amount of data available, but not by theoretical considerations, and the implications of the decision are therefore reflected in the types of equity claims that studies could justify [57]. The school-level proxy positioning of studies tended to describe contextual differences between schools or districts, and the individual-level measures positioning of studies tended to be more able to test within-school variance and to perform subgroup analyses that directly compared learners of different socioeconomic backgrounds [58].

SES was assimilated into analyses in various aspects. In a relatively large percentage of studies, SES was treated as a covariate in order to minimize confounding effects, but consequently was only able to test the average relationship between technology integration and outcomes, and frequently did not show how these effects were different among SES. In articles that directly studied equity, SES was studied as an interaction term, or stratification of a subgroup, or it was considered as a subset of a wider range of disadvantage indicators. The smaller group directly considered SES-based mechanisms, including inequality in access to devices and connections, digital literacy, learning conditions at home, or disparities in the instructional supports received in lower- and higher-resource schools [59]. **Table 2** shows the heterogeneity of

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measurements and confirms the assertions of the SES and operationalization of engagement.

Table 2 presents how key constructs were operationalized across studies.

SES Measure (Level)	Engagement Dimension(s)	Engagement Measure	Learning Outcome Type	Learning Outcome Measure	Timing	
School poverty index (school)	Behavioral, cognitive	Log data + survey	Achievement	Standardized math test	Post	[60]
Parental education (individual)	Cognitive	Self-regulation scale	Skill acquisition	Domain-aligned test	Post	[61]
Free lunch eligibility (school)	Behavioral, affective	Teacher ratings	Achievement	Curriculum-based test	Post & follow-up	[62]
Household income (individual)	Behavioral	Platform usage logs	Achievement	End-of-term exam	Post	[63]
Neighborhood SES index	Behavioral, affective	Survey + logins	Course performance	Final course grade	Post	[64]
Free lunch eligibility (school)	Behavioral	Attendance & task completion	Achievement	State assessment	Post	[65]
Parental occupation (individual)	Cognitive, affective	Engagement questionnaire	Conceptual understanding	Researcher-designed test	Post	[66]
Composite SES index	Behavioral, cognitive	Observation + logs	Achievement	Literacy assessment	Post	[67]

3.4. Technology integration features and implementation reporting

The method of technology integration in the included studies was broad and included various tools and functions of pedagogies. Common types of forms that were researched comprised learning management systems and online course systems, adaptive learning and intelligent tutoring systems, digital practice and formative assessment systems, multimedia and video-based instruction that was applicable in flipped or blended models, collaborative platforms supporting peer interaction, simulations and games created to facilitate conceptual understanding, and mobile learning applications. Research was mixed with regard to the issue of technology as an ancillary element in otherwise traditional teaching or as the main channel through which teaching took place.

There was no even implementation of reporting. Other studies have described instructional design in more detail, teacher training, and a match between technology activities and curriculum standards, and a measure of fidelity, typically by measures of adherence to the planned routines and time on task, or log-based measures of use. The rest of the literature was not highly detailed, and it was hard to find out which of the null or mixed findings was due to the inabilities of the technology used, lack of pedagogical integration, lack of exposure, or a lack of context. Patterns in usage data reported where usage data were reported tended to show a significant range of variation in student participation, and this indicated that dosage was often learner-specific and possibly related to SES-linked limitations, such as reliability of connectivity or study conditions at home [68].

3.5. Engagement measures and patterns

The use of engagement was operationalized using various measurement methods that were both traditional and emerging digital trace indicators. Self-report surveys were prevalent, usually including affective engagement (e.g., interest, enjoyment, perceived relevance or belonging) or cognitive engagement (e.g., perceived strategy use or self-regulation). Self-report measures of effort and engagement, teacher rating, observation, or platform-based measures such as logins, time-on-task, completion, and interactions were used to measure behavioral engagement. In the studies that made most frequent attempts to measure social engagement, such measures as being involved in discussion forums, interaction with peers in terms of feedback, or coded discourse quality were most commonly used, although not all studies used the same definition of constructs.

The overall corpus also saw a large number of cases where technology integration was related to the growth in proximal measures of behavioral engagement, with tools tending to respond more quickly, with gamification or easy indicators of progress. Nevertheless, the improvement in cognitive engagement was less well supported, with more positive outcomes noted when the use of technology was accompanied by explicit scaffolding, structured strategy instruction, or teacher facilitation, encouraging deeper processing. The outcome of affective engagement also depended on context; those tools perceived to be relevant and easy to use were more likely to be linked to an

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increase in interest and enjoyment, and more frequent as platforms were challenging to use, students had connectivity issues, or the activity involved in task performance was not meaningful learning. Traces alone are capable of increasing activity, and studies that could not measure whether such activity was indicative of productive engagement as opposed to a mere surface execution of the tasks, which represented a lack of measurement between apparent involvement and investment of thought [69, 70].

3.6. Learning outcomes and patterns

The learning outcomes were achievement test scores, course grades, domain-specific performance tests, and measurement of knowledge or skill improvement. The impacts of technology integration on learning outcomes were heterogeneous, and the patterns were dependent on the type of technology, instructional design, duration, and outcome measure. Investigations to analyze the adaptive or tutoring systems frequently showed an enhancement of the proximal examinations to match the platform material, especially in cases where the exposure was persistent, and the feedback was appropriately directed. The implementation of blended learning and flipped classroom recorded conflicting results; the larger effect was observed when students were able to engage regularly with pre-class activities and when classroom time was planned to focus more on guided practice, problem solving, and feedback as opposed to content delivery repetitions. As the assessment was more frequently associated with the higher-order skills, including reasoning or transfer, collaborative and inquiry-oriented technology uses were more likely to report improvement on these outcomes when the assessment was consistent with those skills, but these were less commonly measured than standardized achievement indicators [71, 72].

Timing also mattered. Short-term post-intervention benefits were more frequently reported than delayed retention benefits, and relatively few studies incorporated long-term follow-ups that could be used to determine the sustainability of a learning effect. The more thoroughly controlled studies were done, the more likely to report smaller and more defendable estimates of effects, but designs with weaker controls and unclear counterfactual conditions also tended to report larger effects that could not be confidently explained by technology integration itself.

The evidence on the use of SES as a moderating factor of engagement and learning outcomes related to technology was inconsistent, heavy in analytic rigor, and reporting transparency. In research actually testing moderation, the patterns hinted at SES being able to change not only engagement but learning advantages, yet without a single general direction of effect [24]. Certain of these studies indicated that technology-supported instruction had a relatively higher benefit to lower-SES learners in the event that it led to higher access to quality instructional resources, offered formal feedback, and minimized dependence on outside resources. Such studies were more inclined to be done in an environment where schools offered devices, connection services and directed use during the instruction day so that the resources available at home had little influence on participation [5].

Gap-widening patterns were reported by other studies, especially when use of technology relied more on conditions outside the school, e.g. constant access to broadband, study quiet space, or parental support. Within such environments, students with higher-SES tended to be more intensive in usage, experienced less disruption, and showed greater persistence, which was associated with greater learning. Multiple researchers also proposed that the differences in digital literacy and acquaintances with academic technological settings were some of the early disadvantages that grew over time and influenced their engagement and outcomes. One of the most shared results in this group was that inequity becomes more probable in cases where the introduction of technology integration was not accompanied by proper scaffolding, technical assistance, and interventions targeted at students whose resources were limited [73].

The third group of studies reported quite gap-neutral findings, usually when technology integration was small-scale or when the impacts on learning outcomes were generally low. In other instances, the differences in SES were found to be lessened by the consideration of previous success or school level, which implies that SES can overlap with other structural variables influencing learning opportunities. Equity findings were most substantial in the entire corpus, where studies included explicit or direct subgroup analyses or interaction tests instead of using SES solely as a covariate, which indicates the relevance of analytic methods in the interpretation of distributive effects [74]. The synthesis concentration that aims at equity is supported by **Table 3.**

The process of quality appraisal revealed heterogeneity in the methodological power of the literature used. Randomized assessments typically offered much more plausible causal attribution, although not consistently as strong, with many limitations typical, such as attrition, not reporting all allocation procedures, not adhering to the designed exposure, and using outcomes that are moderately consistent with the intervention situation. Non-randomized studies were often at risk of confounding and selection bias, particularly when adoption or intensity of technology use

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was related to prior achievement, school resources, teacher expertise, or domestic learning conditions. Measurement bias was also observed in certain studies, especially in cases where engagement was measured using a single-source self-report measure without the corroboration of behavioral indicators or the validity of the measure.

Table 3 synthesizes directional effects and equity implications.

Tech Engagement	Tech Learning	SES Role	Equity Pattern	Key Implementation Notes	
Positive	Mixed	Moderator	Gap-neutral	Strong analytics use, in-class support	[75]
Positive	Positive	Moderator	Gap-narrowing	Structured tutoring, guided feedback	[76]
Positive	Positive	Contextual	Gap-narrowing	Devices provided in school	[77]
Mixed	Mixed	Moderator	Gap-widening	Home connectivity constraints	[78]
Positive	Neutral	Covariate	Gap-neutral	High autonomy, limited scaffolding	[79]
Positive	Mixed	Moderator	Gap-widening	Heavy reliance on home video access	[80]
Positive	Positive	Moderator	Gap-neutral	Short duration, intensive facilitation	[81]
Positive	Positive	Moderator	Gap-narrowing	Low-bandwidth design, teacher training	[82]

Triangulation studies that utilized more than one source and reported implementation fidelity and dealt with clustering and confounding in more detail were in a better place to make stronger inferences. Conversely, it was found that the studies that had a limited description of intervention or limited control over baseline differences often had to be interpreted carefully. Generally, the quality appraisal indicated that the literature has valuable information on probable patterns and mechanisms, but different levels of confidence exist depending on the type of technology, level of design rigor, and the clarity with which the conditions of the SES and implementation are presented [83].

Combined, the collected studies point to the fact that integration of technology is often related to the gains in proximal measures of engagement, especially behavioral engagement, but the impact on the learning outcome is more diverse and conditional. The available evidence upholds the perception that the quality of pedagogical integration and the availability of scaffolding and teaching support are the areas of paramount importance as regards whether the engagement will translate into quantifiable learning benefits. SES is revealed to be a critical equity-relevant factor capable of affecting access, participation, and benefit, where the results of closing gaps are more probable when technology decreases opportunity constraints and gives structured supports, and when outcomes of increasing gaps are more probable when participation is contingent on out-of-school resources and unaddressed variations in digital readiness. These trends emphasize the fact that technology integration cannot be assessed based on the average effects only; one should consider who is benefiting based on the conditions of implementation and explicit SES-sensitive analysis.

4. Discussion

4.1. Interpretation of main findings

The evidence that has been synthesized reveals that technology integration is more reliably related to the increase in proximal indicators of engagement than with consistent improvements in learning outcomes [1]. Digital tools seem to enhance the behavioral engagement, the accomplishment of tasks, and activity, particularly in the contexts where it is possible to get instant feedback, where the platforms have orderly directions or some motivator like a progress marker. Nonetheless, the correlation between technology-aided interaction and learning is not automatic. Outcomes of learning were more diverse and rather dependent on instruction design, correspondence between technology activities and curricular objectives, the sufficiency of scaffolds, and length and intensity of exposure. Such trends align with the perception that technology is an enabling infrastructure, but not a presupposed instructional treatment; its impacts are mediated by the manner in which it is integrated into pedagogy and the circumstances in which learners are enrolled [33].

One of the implications of the findings is that engagement cannot be viewed as a singular and uniformly positive construct. The most common method of capturing behavioral engagement in studies was by use of logins, time-on-task, clicks, or completion rates; the measures did not generally give evidence of cognitive investment or intensive processing. Conversely, those studies that directly measured and assessed cognitive engagement, e.g., strategy use, self-regulation, or elaboration processing, tended to find an improvement in learning outcomes, particularly in the case where instructional supports were made to activate reflection, explanation, and feedback utilization.

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This is to imply that integration of technologies can be most successful where it is geared towards successful types of engagements and not activity per se. The findings also suggest that decisions made about measurement can influence conclusions: a study based entirely on trace data can exaggerate meaningful learning when it cannot differentiate between truly learning and just performing a superficial task [6].

4.2. Technology integration as an equity-sensitive intervention

One of the key findings of this review is that it summarizes the patterns relating to SES in technology-based engagement and learning. The data show that technology-related benefits can be altered by SES, yet in an uneven manner, regardless of the setting. The integration of technology within the school day, which offered structured resources, guided practice, and feedback, had a higher likelihood of narrowing the gap, together with the provision of devices and access. Under such circumstances, technology can serve as a compensatory tool and enhance exposure to high-quality instructional resources, and facilitate a consistent presence of learners who would otherwise have scarcer opportunities to engage in enrichment [84].

In comparison, the gap-widening results were more probable when the success of technology integration relied on out-of-school resources, which may be a steady broadband, study calmness, caregiver assistance, and previous digital literacy. In this case, more intelligent learners were more likely to show high usage intensity, less disruption, and greater persistence, which reasonably were converted to better learning outcomes. This trend follows the explanation that technology can enhance advantage where there is participation and benefit contingent on inequality in the distribution of resources among socioeconomic groups. Notably, such equity dynamics could also be quite elusive in studies where SES was considered a control factor, and it is clear that equity-sensitive inferences demand explicit subgroup or interaction tests and attention to the measurement level [85].

4.3. Mechanisms linking SES, engagement, and learning

The studies reviewed have shown that there is a collection of mechanisms by which SES influences engagement and learning in technology-tainted settings. Mechanisms that are related to access are the availability of the devices, the reliability of the internet, and the stability of learning routines. The shared household devices, the limited data plans, or the unreliable connection may limit the capacity of learners to use their devices effectively, even in cases where the devices are available. The mechanisms of resources do not only involve access but also the home learning environment in terms of physical space, time, and adult support to persist and to be able to finish the tasks involving technology. Digital literacy and familiarity with academic technology platforms are examples of skill-related mechanisms because they influence the ability of the students to navigate interfaces, interpret feedback, control attention, and troubleshoot problems. The mechanisms of instruction are teacher preparation, the quality of classroom integration, as well as the extent to which the students are provided with scaffolding and responsive guidance in case of difficulties [86, 87].

Engagement seems to be a reasonable route through which these mechanisms are affecting the learning outcomes. With fewer resource constraints and more resources at their disposal, such students might be better placed to maintain productive engagement, i.e., with strategic effort and feedback utilization, whereas constrained students might have discontinuous engagement, i. e., interrupted participation in or poorer quality engagement with materials. Nonetheless, the research data to support the concept of mediation is still weak since not many studies formally tested the engagement as a mediator between the use of technology and learning outcomes, and even fewer of them included the concept of the SES in their mediation frameworks. This serves as a constraint on the causal knowledge of whether technology influences learning through the primary mechanism of altering engagement, altering the quality of instruction, or interacting with the structures of opportunity defined by SES [88-90].

4.4. Implications for research

The results point to some priorities for enhancing the research base. To begin with, a more specific and clear method of operationalizing technology integration would be of better benefit to studies. Numerous reports on technology adoption lack a sufficient description of the purpose of instruction, alignment, dosage, and fidelity, which also reduces the interpretability and hinders replication. The future research must define what was the pedagogical role of technology and what teachers and students actually did with technology, and report the level of usage and support of implementation in a manner that can be compared across situations [91].

Second, the measurement of engagement needs to shift towards a multi-methodology that draws the difference between productive and active engagement. Self-report, observational indicators, and trace data should be combined to enhance the construct validity and explain the nature

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of changes in engagement as a motivational, cognitive, or behavioral shift. In situations involving the use of trace data, researchers must explain the rationale behind the choice of indicators to map onto particular dimensions of engagement and analytic methods that represent sequence, persistence, and quality of interaction.

Third, measurements and analyses of SES should be done in a manner that can support the inference of equity. The use of school-level proxies would aggregate within-school differences and result in spurious conclusions if it were substituted with individual-level indicators. Reporting of SES source, timing, and operationalization. Researchers need to use multi-level SES measures where possible. Equally, equity analyses ought to be premeditated as opposed to accidental, and moderation and, where theories warrant it, mediation pathways are to be explicitly tested that encompass SES-related [92].

Fourth, cause and effect designs and longitudinal follow-up are required to determine durability and distributional impact. Numerous studies focus on short-term results; not many of them study retention or longer-term achievement patterns. Longitudinal designs, particularly those that entail learning analytics coupled with standardized tests, can help to answer the question of whether the gains brought by early engagement can be converted into lasting learning, as well as whether differences based on SES would continue to broaden or narrow in the course of time. Besides this, to consider intersectionality in future assessments is necessary since SES interacts with race/ethnicity, language status, disability, and geographic location to shape technology-mediated learning opportunity structures [93].

4.5. Implications for practice and policy

To practitioners, the evidence indicates that technology integration is most likely to facilitate learning when it is combined with well-designed instructional design, organized routines, and scaffolds that encourage cognitive activity. Instructors and school heads must consider technology as a learning objective, rather than an extension, and the digital tasks ought to be linked to the learning outcomes and integrated into the instruction that includes feedback. The engagement monitoring process should extend past platform activity to show signs of meaning and application of strategies, and intervention must take place when students exhibit signs of superficial processing or inattentiveness [94, 95].

The implications of the findings, as made by policymakers and system leaders, are that devices and connectivity are not the only primary areas of investment; the conditions under which they can be used effectively should also be considered. These are technical support, teacher improvement, and instructional resources that can accommodate low bandwidth and intermittent-access settings. The problem with policies that posit that all homes learn equally is that they will increase the disparity based on SES in terms of technology-mediated work during periods outside of school without providing compensatory issues. Equity-based implementation is expected to identify obstacles to lower-SES learners and address them with strategies like in-school access time, materials that can be used offline, specifically digital literacy education, and family-support systems. Distributional metrics should also be included in evaluation frameworks to evaluate the extent to which technology initiatives decrease or increase disparities instead of reporting average results.

5. Conclusion

This systematic review has taken the evidence of the relationships between technology integration, student engagement, learning outcomes, and socioeconomic status. In the literature, the integration of technology was more likely to be related to an increase in the proximal sign of engagement, especially behavioral participation and observable activity, rather than consistent increases in learning outcomes. The most obvious effects of the use of technology on learning were observed in the situation when the teaching objectives were strategically based on the use of technology, the pedagogical design was of high quality, and the scaffolding and feedback provided were directed to foster a deeper level of cognitive processing as opposed to surface accomplishment of tasks. On the contrary, the addition of technology with no clear instructional goal, weak implementation fidelity, and measurement of engagement as platform activity resulted in both positive and negative effects on learning outcomes, and in many cases, these effects could not be easily interpreted.

One of the other equity-relevant factors that is of critical importance in the review is SES, which determines both participation and benefit in technology-supported learning. There is evidence that technology can also be used to achieve gap-narrowing effects by facilitating access to quality learning experiences in conducive instructional settings, where quality resources are offered effectively, and feedback is provided on time, and where out-of-school supports are minimized. On the other hand, technology programs are at risk of generating disparaging impacts when the successful engagement is contingent on inequality in the distribution of conditions such as consistent connectivity, access to silent learning facilities, parental backup, and previous digital literacy. These trends highlight the fact that technology itself is not fair;

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distributions will be determined by how the systems are implemented and whether systems are proactive in dealing with the opportunity constraints that lower-SES learners are disproportionately met with.

There are still a number of evidence-based cross-cutting gaps. There is a great deal of variation in the way studies define and measure technology integration, engagement, learning outcomes, and SES as well, thus comparability becomes difficult and, in some instances, undermines the conclusions. There is a common tendency to consider SES as a control variable but not as a moderator or a mechanism, and implementation reporting is often not provided with details on dosage, fidelity, and instructional support. Subsequent studies would incorporate more causal designs, more regularities in equity-oriented analysis, multi-method engagement measurement that separates productive engagement and activity, and the explicit description of the quality of integration and contextual limitations. Longitudinal research and retention-oriented results are also required to understand whether the gains of technology-related engagement are translated into long-lasting learning and whether the differences with regard to SES increase or decrease as time goes by.

Putting together the results indicates that the most effective framing is not the question of technology working, but how the technology can be incorporated to facilitate meaningful learning and engagement in all students, including disadvantaged students with socioeconomic barriers. To practice and policy, this suggests going beyond the provision of devices to holistic equity-focused implementation, including reliable access, teacher professional growth, design instruction supports, low-bandwidth and offline capable, and targeted scaffolds to establish digital learning preparedness. Educational technology programs' report of evaluation needs to include distributional outcomes as well as average outcomes by the middle and disadvantaged socioeconomic groups. Education systems can enhance the chances of digital innovations being utilized in enhancing not only better learning but also equitable learning opportunities through aligning technology integration with pedagogical quality and equity commitments.

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