

Integrating Educational Technology in Special Education Classrooms: Enhancing Learning Outcomes for Students with Disabilities

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ABSTRACT:

Educational technology has become increasingly important in promoting inclusive education and supporting students with disabilities through accessible and adaptive learning environments. This study examined the relationship between educational technology engagement and learning outcomes among students with disabilities using a secondary quantitative dataset obtained from Kaggle. The study employed a cross-sectional research design and analyzed variables related to digital learning engagement, including time spent on educational platforms and assignment completion, alongside academic, cognitive, behavioral, and social learning outcomes. Descriptive statistics, Pearson correlation, multiple regression, logistic regression, one-way ANOVA, and Tukey HSD analyses were conducted using SPSS version 27. The findings revealed weak correlations between educational technology engagement variables and learning outcomes. Regression analyses further indicated that time spent on digital platforms and assignment completion did not significantly predict reading comprehension or final academic performance. However, ANOVA results demonstrated statistically significant differences in reading comprehension scores across disability categories, although post

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hoc comparisons showed limited pairwise group differences. The study concludes that educational technology engagement alone may not substantially improve learning outcomes without effective instructional strategies, assistive technologies, and inclusive educational practices. The findings contribute to the literature on special education and provide practical implications for educators, policymakers, and educational technology developers seeking to enhance inclusive digital learning environments.

Keywords: educational technology, inclusive education, students with disabilities, learning outcomes, special education.

1. Introduction

Technology has revolutionized the landscape of education by improving the way teaching is done, making it more accessible, and offering learner-centered approaches. In recent years, the development of educational technology has shifted from traditional teaching equipment to modern digital teaching platforms, providing new opportunities for inclusive and personalized teaching (Li, 2023). Overall, technological advancements like online learning systems, adaptive educational software, and interactive digital platforms have provided educational institutions with the means to better serve diverse students (Kaswan et al., 2024). The use of educational technology in special education has grown in significance for meeting the educational and developmental needs of students with disabilities.

The concept of inclusive education is one where everyone is given equal opportunity to learn despite physical, cognitive, sensory or emotional impairments. Inclusive education practices are increasingly taking place in schools to allow students with disabilities to engage in educational activities with their peers (Palmer & Williams-Diehm, 2020). Previous studies have demonstrated that inclusive education has positive effects on the personal, social and educational growth of children with special educational needs (Kolbina et al., 2023). In this context, the role of educational technology is very important because it provides an access and

adaptation learning environment that is able to accommodate various learning needs.

Technology-supported personalized learning systems, assistive technologies, and digital learning platforms have shown great promise in enhancing learning opportunities and student engagement. Speech-to-text apps, screen readers, adaptive learning platforms are technologies that facilitate access to learning materials for students with disabilities at their own pace and in their own way (Therasa, 2023). Moreover, a technology-facilitated personalized learning approach can be linked to better instructional quality and better learning outcomes (Schmid et al., 2022). While this could be beneficial, students with disabilities still experience challenges due to unequal access to digital resources and the lack of integration of technology in learning environments. The existing empirical studies that investigated the relationship between educational technology engagement and learning outcomes among students with disabilities is still limited, requiring further exploration in this research area (Balouch et al., 2025).

Research Objectives

1. To examine the relationship between educational technology engagement and learning outcomes among students with disabilities.
2. To evaluate the impact of digital learning engagement variables, including time spent on educational platforms and assignment

completion, on students' academic, cognitive, and behavioral outcomes.

3. To analyze differences in learning outcomes across disability categories and determine the effectiveness of educational technology in supporting inclusive learning environments.

2. Literature Review

2.1 Theoretical Framework

One of the most important frameworks that supports inclusive education and integration of educational technology is Universal Design for Learning (UDL). The concept of UDL focuses on creating flexible learning spaces that meet a variety of learning needs by providing multiple ways to represent, engage, and express. (Al-Azawei et al., 2016) The framework encourages access by making instructional materials and learning activities flexible with regard to student disability. UDL in special education promotes the use of assistive technologies, multimedia learning systems and adaptive digital resources that eliminate educational barriers and enhance participation. Constructivist Learning Theory is a theory which sees learning as an active construction of the learner, where learning takes place through interaction, collaboration and experiences. Bada and Olusegun (2015) reported that student learning is more effective when they are involved in problem-solving activities and the learning is hands-on. Learning technologies, such as interactive platforms, virtual learning systems, and multimedia applications, facilitate constructivist learning because they encourage the student in learning. Learning technologies like interactive platforms, virtual learning systems and multimedia applications are used to promote constructivist learning using the student as the center of learning. Constructivist techniques enable students with special needs in special education to learn in ways that match their ability and learning style in special contexts. The Technology Acceptance Model (TAM) accounts for the relationship between perceived usefulness and ease of use to technology adoption and technology engagement by users.

Schorr (2023) suggested that accessibility and usefulness were important factors in the use of digital technologies. In education, TAM could account for students' and teachers' acceptance of digital learning platforms and educational technologies. The framework is especially applicable in special education, where educational technology is much of its effectiveness is contingent on its accessibility, usability, and acceptance by learners. The Assistive Technology Framework is a set of technologies that are especially designed to make things easier to use and more functional for a person with a disability. Assistive technology refers to systems such as screen readers, speech recognition, adaptive keyboards and haptic devices that help people learn and communicate (Pawluk et al., 2015). These technologies facilitate learning by helping the student with a disability to overcome learning obstacles and be more involved in education activities. Assistive technologies therefore become a very important tool to facilitate inclusive education and enhance learning outcomes.

2.2 Educational Technology and Inclusive Education

Digitalisation in education has had a significant positive effect on inclusive education by making it more accessible, flexible and personalized. The use of educational technology in schools and classrooms can facilitate the development of adaptive learning environment to respond to the different needs of learners. Technology enhanced instruction leads to greater student participation, engagement, and quality of instruction for students with disabilities, Navas-Bonilla et al. (2025) found. In the field of special education, the use of personalized and adaptive learning systems is especially beneficial, as the learning activities and content can be modified based on student ability and preference. These systems can be used to support self-paced learning, continuous feedback and differentiated instruction. Technology-assisted instruction is also beneficial for improving classroom participation, using interactive learning software,

multimedia and online educational materials. These technologies can foster inclusive learning settings in which students with disabilities are able to participate in learning activities as fully as their peers.

2.3 Students with Disabilities and Learning Challenges

Students with disabilities may encounter a number of challenges that impact their performance in school and their ability to participate in class. Memory problems, attention deficits, and/or difficulties processing information can impair students' ability to learn and comprehend teaching material. Emotional regulation problems, adaptive behavior issues, and other behavioral difficulties can also impact engagement in learning and interactions in the classroom. Among students with disabilities, communication and social interaction barriers are prevalent especially for students with developmental and communication disorders. The barriers can have a detrimental impact on collaborative work with peers, engagement in class and academic self-confidence. Students with disabilities also commonly struggle with academic success, including in reading comprehension and mathematics performance. Grimes et al. (2017) reported that too many students with learning challenges are not receiving adequate support in their school systems, both as a result of lack of support mechanisms and lack of accessibility accommodations.

2.4 Educational Technology Engagement

Engagement in educational technology means that the student is actively involved and interacting with the digital learning system and/or educational platform. Educational technology engagement is operationalized by the time spent on digital platforms, assignment completion, and learning participation indicators in this study. These variables are indicators that can be measured of student engagement in technology-based learning activities. Engagement in a learning platform is a measure of students' exposure to educational material

and digital learning, and completing an assignment is a measure of academic engagement and commitment to learning. The use of technology is important in special education because the digital learning environment offers flexibility and accessibility to learners of all types. Self-paced learning systems allow the disabled learner to learn at his or her own pace and at his or her own learning style. Interactive learning spaces also promote engagement, involvement and effectiveness in learning. Bond et al., 2020, found that positive relationships exist between the engagement of educational technology and student motivation, participation, and academic achievement. Digital learning systems are designed with accessibility features built-in, which can further aid students in addressing learning barriers and enhance learning experiences. The learner will describe how to apply various methods in the teaching of special education. In special education, learning outcomes are academic, cognitive, behavioral and social, and manifest students' learning and performance. The indicators used to assess academic outcomes vary, but often include reading comprehension, mathematics performance, and final academic scores. These results reflect students' comprehension of the teaching material, problem solving capabilities and learning goals.

2.5 Learning Outcomes in Special Education

Cognitive outcomes relate to memory, attention and auditory processing, which are factors affecting learning efficiency and information retention. Students with disabilities may have cognitive difficulties that make it hard for them to pay attention and do well in school. Adaptive technologies and technologies that enable interactive learning may be useful in enhancing these cognitive functions. It is important to consider behavioral and social outcomes when assessing educational development of students with disabilities. Emotional regulation and social interaction skills affect participation in the classroom, peer relationship, and learning

experiences in general. The use of technology in teaching can enhance the communication, confidence, collaboration, and social engagement of students with disabilities. Juarez and Purper (2018) stressed that the quality of instruction is a crucial part of the transfer of learning and learning development in special education settings. Thus, the assessment of multidimensional learning outcomes is crucial to understanding the learning effectiveness of the educational technology engagement in special education settings.

3. Methodology

3.1 Research Design

The study used a quantitative research design with secondary data analysis method to explore the correlation between educational technology engagement and learning outcomes of students with disabilities. The study used cross sectional research design because the data were information gathered at one particular time. It was determined that the quantitative analysis is appropriate for measuring the relationship of the variables of educational technology and the multidimensional educational outcomes. The work was centered on the statistical analysis of academic achievement, cognitive and behavioral measures of the students with disabilities.

3.2 Data Source and Sample

The study was based on a publicly available secondary data set obtained from Kaggle that included information on educational and behavioral data for students with disabilities. The variables covered aspects of educational technology engagement, academic performance, cognitive abilities, and social interaction outcomes. The sample comprised students with varying disabilities in the data sample. To guarantee a thorough statistical assessment of the data and reliable interpretation of the results, all the observations in the dataset were used.

3.3 Variables of the Study

The independent variables of the study were the educational technology indicators, which were the amount of time spent on the digital learning platform and assignment completion rates. Reading comprehension scores, mathematics performance, final academic performance, memory, attention, auditory processing, emotional regulation, and social interaction scores were used as dependent variables. Type of disability was taken into account as a moderating variable in analysis. The variables were chosen as they directly matched with the study goal and the conceptual area of educational technology in special education.

3.4 Data Analysis Techniques

Data that were collected were analyzed with the aid of the Statistical Package for Social Sciences (SPSS) version 22. The characteristics of the variables were summarized using descriptive statistical measures such as frequencies, percentages, means and standard deviations. To explore the relationship between and differences in variables, inferential statistical techniques were used, specifically Pearson correlation analysis, multiple regression analysis, and one-way ANOVA. The level of 0.05 was used as the significance level for statistical significance. The aim of this analysis was to find out the effect of the educational technology engagement on the learning outcomes of the students.

3.5 Ethical Considerations

All of the data used in this research were obtained from a secondary dataset that is publicly accessible, thus there was no direct contact with human subjects in the research process. All Data was collected anonymously and confidentially. Academic integrity, responsible use of data, and proper data source citation were upheld throughout the study. The researcher ensured that the data used in this research was only used for educational and research purposes as per the ethical guidelines of research.

4. Results

4.1 Descriptive Statistics

Descriptive statistics for the study variables are shown in the Table 1. The results indicated that the mean age of the students was 11 years ($SD = 3.76$). The average scores for reading comprehension were 49.88 ($SD = 14.85$) and for mathematics were 54.89 ($SD = 15.03$). The

scores for cognitive outcome measures (memory score: $M = 60.05$, $SD = 10.01$, attention score: $M = 59.94$, $SD = 19.79$) were moderate. In addition, the students had a mean of 60.20 hours spent on the learning platform ($SD = 14.91$) and a mean assignment completion score of 4.47 ($SD = 2.88$). The average value of teacher feedback score was 74.95 with a relatively high SD value of 9.89.

Table 1: Descriptive Statistics of Study Variables

Variable	Mean	SD	Minimum	Maximum
Age	11.00	3.76	5.00	17.00
Reading Comprehension Score	49.88	14.85	0.00	100.00
Mathematics Score	54.89	15.03	0.00	100.00
Memory Score	60.05	10.01	17.05	95.37
Attention Score	59.94	19.79	0.00	100.00
Visual Spatial Score	50.12	14.89	0.00	100.00
Auditory Processing Score	54.90	15.06	0.00	100.00
Social Interaction Score	65.13	14.88	13.60	100.00
Emotional Regulation Score	59.92	9.98	22.95	97.66
Time Spent on Platform	60.20	14.91	10.00	120.00
Assignments Completed	4.47	2.88	0.00	9.00
Teacher Feedback Score	74.95	9.89	35.01	100.00

4.2 Frequency Distribution of Participants

The frequency distribution of participants with regard to the gender, type of disability and academic performance is given in Table 2. The percentage of male students was 45.62% and

44.65% for the female students. The highest disability groups were ASD (20.24%), ADHD (19.63%) and Dyslexia (18.83%). Also, 70.34% of students' final performance outcomes were satisfactory.

Table 2: Frequency Distribution of Participants Gender Distribution

Gender	Frequency	Percentage
Male	4562	45.62
Female	4465	44.65
Non-Binary	973	9.73

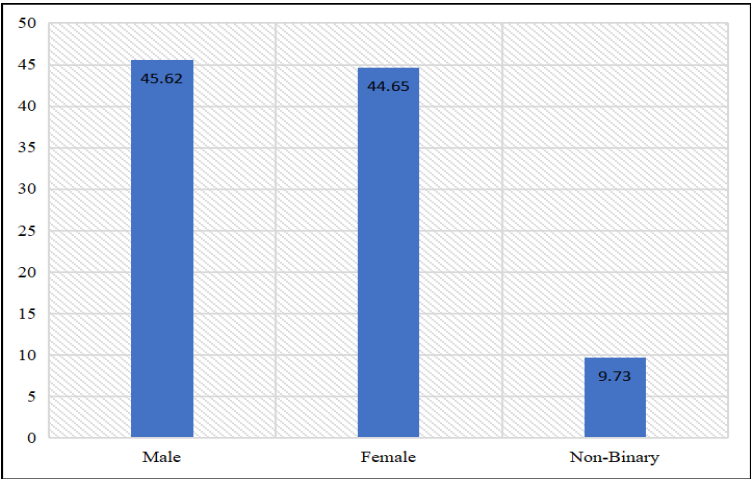


Figure 1. Gender Distribution of Students with Disabilities

Figure 1 illustrates the gender distribution of students included in the study. Male students represented the largest proportion of the sample (45.62%), followed closely by female students (44.65%), while non-binary students

accounted for 9.73% of the participants. The findings indicate a relatively balanced gender representation within the dataset, enhancing the diversity and inclusiveness of the study sample.

Disability Type Distribution

Disability Type	Frequency	Percentage
Autism Spectrum Disorder	2024	20.24
ADHD	1963	19.63
Dyslexia	1883	18.83
Visual Impairment	1604	16.04
Hearing Impairment	1469	14.69
Intellectual Disability	1057	10.57

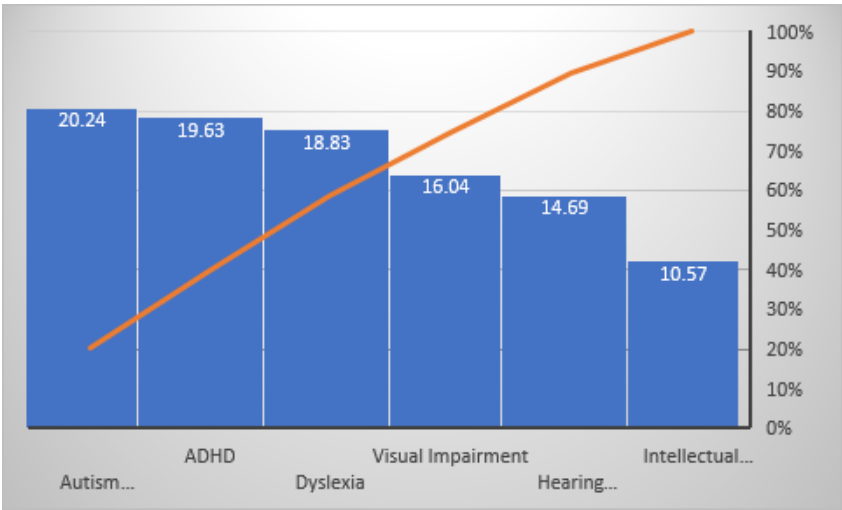


Figure 2. Distribution of Disability Categories Among Students

Figure 2 presents the distribution of disability categories represented in the study sample. Autism Spectrum Disorder constituted the largest proportion of participants (20.24%), followed by ADHD (19.63%) and Dyslexia

(18.83%). Visual impairment, hearing impairment, and intellectual disability represented comparatively smaller proportions within the dataset.

Final Performance Distribution

Final Performance	Frequency	Percentage
High Performance (1)	7034	70.34
Low Performance (0)	2966	29.66

4.3 Correlation Analysis

Pearson correlation analysis was used to explore the relationships between the learning outcomes and educational technology engagement variables. As can be seen in Table 3, there were only weak correlations among the variables. INVERSE relationships emerged with the reading comprehension score ($r = -.024$),

mathematics score ($r = -.035$), and attention score ($r = -.041$) when time was used as a predictor. Weak positive correlations were also found between the completion of the assignments and mathematics score ($r = .011$) and memory score ($r = .013$). Overall, the findings showed there were weak relationships between the engagement with educational technology and learning outcomes.

Table 3: Pearson Correlation Matrix

Variables	1	2	3	4
1. Time Spent on Platform	1.000			
2. Assignments Completed	-0.003	1.000		
3. Reading Comprehension Score	0.006	-0.001	1.000	
4. Mathematics Score	0.011	0.011	0.004	1.000

4.4 Multiple Regression Analysis

To explore reading comprehension performance, multiple regression analysis was used to determine if there was a relationship between the educational technology engagement variables and reading comprehension. The results of the regression model are presented in table 4. The regression model was not

statistically significant ($F(3, 9996) = 1.703$, $p = .164$), and it explained very little ($R^2 = .001$). There were no significant predictions of reading comprehension performance from time on the platform or assignments completed. The teacher feedback score showed a small statistically significant negative effect, however ($\beta = -.033$, $p = .030$).

Table 4: Multiple Regression Analysis Predicting Reading Comprehension Score

Predictor Variables	B	Std. Error	t	p-value
Constant	52.008	1.311	39.669	.000
Time Spent on Platform	0.006	0.010	0.573	.566
Assignments Completed	-0.005	0.052	-0.097	.922
Teacher Feedback Score	-0.033	0.015	-2.175	.030

4.5 Logistic Regression Analysis

The logistic regression analysis was used to examine if the educational technology engagement variables could predict students'

final academic performance. Table 5 shows that the logistic regression model was not statistically significant, $\chi^2(3) = 3.70$, $p = .295$. None of the predictor variables were found to be significant in predicting final academic performance.

Table 5: Logistic Regression Analysis Predicting Final Performance

Predictor Variables	B	Std. Error	z	p-value
Constant	0.934	0.193	4.829	.000
Time Spent on Platform	-0.002	0.001	-1.099	.272
Assignments Completed	0.012	0.008	1.571	.116
Teacher Feedback Score	-0.0004	0.002	-0.160	.873

4.6 One-Way ANOVA Analysis

The differences in reading comprehension scores from one category of disability to

another were evaluated using a one-way ANOVA. The results showed that the disability groups were different, $F(5, 9994) = 2.274$, $p = .045$, as presented in Table 6

Table 6: One-Way ANOVA Results

Source	F	p-value
Between Disability Groups	2.274	.045

4.7 Tukey HSD Post Hoc Analysis

A Tukey HSD post hoc analysis was performed to determine the pairwise group differences in

reading comprehension scores. None of the comparisons made between the disability categories were significant at the 0.05 level as indicated in Table 7.

Table 7: Tukey HSD Post Hoc Analysis

Comparison Groups	Mean Difference	p-value	Significant
ADHD vs Dyslexia	1.148	.157	No
Dyslexia vs Visual Impairment	-1.373	.071	No
Hearing Impairment vs Visual Impairment	-1.056	.359	No
Autism Spectrum Disorder vs ADHD	0.342	.979	No

4.8 Normality Testing

To check if the reading comprehension scores were normally distributed, Shapiro–Wilk test was performed. Table 8 indicates that the data

were normally distributed, $W = .998$, $p = .863$. The assumption of normality was met because the p-value was greater than .05, thus parametric statistical analysis techniques could be used.

Table 8: Shapiro–Wilk Normality Test

Variable	Statistic (W)	p-value	Interpretation
Reading Comprehension Score	.998	.863	Normally Distributed

5. Discussion

The present study involved a secondary quantitative data analysis of the relationship between educational technology engagement and learning outcomes with students with disabilities. The results showed that the factors of educational technology engagement (time spent on digital learning platforms, and access to completed assignments) did not exhibit significant statistical associations with academic, cognitive, and behavioral outcomes of learning. The relationships were mostly low but the results add to the literature on integration of inclusive education and the integration of educational technologies in special education schools. The descriptive results showed that the performance of students with disabilities in academic and cognitive were in moderate category. The average scores of students were found to be average in reading comprehension and mathematics, and moderate in term of memory, attention and emotional regulation scores. These results support prior studies that highlight the different academic and cognitive difficulties that can impact educational success and classroom engagement for students with disabilities (Grimes et al., 2017). The findings also provide further evidence for the need to create a learning environment that is adaptive and accessible to meet the needs of diverse learners in inclusive education systems (Palmer & Williams-Diehm, 2020). The correlation analysis showed very low correlations between the use of educational technologies and learning outcomes. The amount of time spent on the

educational platform showed only very weak positive correlations with reading comprehension, mathematics performance and attention score. Likewise, there were low positive correlations with academic and cognitive variables in terms of the completion of assignments. The results are somewhat at odds with some previous research saying that technology-based personalized learning positively improves student achievement and engagement (Major et al., 2021; Schmid et al., 2022). The weak relationships may be due to the fact that educational technology involvement alone is not enough to understand the relationship between educational technology and educational outcomes, because other factors like the instructional quality, accessibility design, teacher support and students' learning characteristics are needed for this explanation. The regression analysis also showed that none of the educational technology engagement variables significantly predicted reading comprehension or final academic achievement. There was a negative statistically significant correlation between teacher feedback score and reading comprehension, but it was very small. The data presented here indicates that the educational technology factors in the data set may not reflect the rich complexity of the learning experience with technology for students with disabilities. The integration of technology in education has been emphasized in previous studies, not only for access to digital platforms but also for pedagogical practices and assistive technologies and personalized instructional

support (Cagiltay et al., 2019; Alanazi et al., 2023). Results of the one-way ANOVA showed that there were significant differences between the reading comprehension scores of the different disability groups. The post hoc Tukey HSD test, however, revealed no significant differences between specific disability groups. This finding indicates that while there is some overall variation in achievement across disability categories, the variation in achievement within each category may not be large enough to lead to meaningful differences at the group level. The findings are aligned with the view that other factors, besides the type of disability, are interconnected and affect the learning outcomes of students with disabilities (Kolbina et al., 2023). The study's results can also be analysed in the light of the theories which provide the basis for the study. Universal Design for Learning (UDL) places emphasis on the need to have flexible instruction and accessible learning environments for diverse learners (Al-Azawei et al., 2016). That limited relationships were observed in the present study can be understood as a sign that if digital engagement is not accompanied by a holistic inclusive instructional design, then it may not be enough to achieve better learning outcomes. Likewise, Constructivist Learning Theory proposes that learning is meaningful when a person is actively engaged in the learning process and interacts with the learning materials (Bada & Olusegun, 2015). Thus, technology-enriched learning contexts can only be effective if they are integrated with interactive forms of teaching and learning that are student-centered. The findings also have important practical and policy implications. Educational roles and schools must not only promote the use of technology but also enhance the quality, accessibility, and effectiveness of digital learning environments for students with disabilities. Teachers need sufficient professional training to conduct effective teaching with technology for inclusive learning. Moreover, policymakers need to place greater focus on creating accessibility standards and assistive technology programs to ensure fair

access to education for students with disabilities (Therasa, 2023). There are some limitations which are to be noted in the study. The research was based on a secondary data set which lacked specifics of the classroom environment, instructional approach and the socioeconomic status or technological competence of the teachers. In addition, the relations among the data variables were low, which reduced the explanatory power of the statistical models. Longitudinal and mixed methods studies are recommended for future research to gain insight into the effect of educational technology on multi-dimensional learning outcomes of students with disabilities. The impact of adaptive instructional design, assistive technologies, and teacher support mechanisms on digital learning experiences that enhance inclusive learning experiences should also be explored. It also emphasizes that the level of engagement with education technologies and academic and behavioral outcomes for students with disabilities are not strongly tied together. Yet, as part of inclusive education, the use of educational technology is also significant if it is supported with accessible instructional design, personalized learning strategies and supportive learning environments.

6. Conclusion

This study is based on a secondary quantitative analysis of the relationship between educational technology engagement and learning outcomes for students with disabilities. The results indicated insufficient statistical significance in the relationship between educational technology engagement variables, such as the duration of use of digital learning platforms and the completion of assignments, with academic, cognitive and behavioral outcomes. While some weak correlations were found and a little predictive effect, the study indicated the ongoing relevance of digital learning environments in inclusive education. There were significant differences between the reading comprehension scores by disability category, but these differences were relatively small when

comparing scores across disability categories using post hoc analyses. The results indicate that the integration of educational technology into education is not enough to significantly enhance learning outcomes if it is not supported by good teaching methods, appropriate learning environments, and individual support in learning. The study adds to the expanding body of literature on inclusive education by offering empirical findings with respect to the engagement of students with disabilities in the use of educational technology. Moreover, the

results highlight the need to use assistive technologies, adapt instructional practices and improve teachers' skills to enhance the effectiveness of digital learning systems. Further studies need to investigate other contextual and pedagogical contextual factors affecting the learning outcomes of technology-supported learning and the longitudinal effects of education for a wide range of disability groups and educational environments.

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