A Systematic Review of the Use of Education Technology in Inclusive Primary Education

Erica Ranzato, Catherine Holloway, Maryam Bandukda

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Abstract

Background: Educational technology (EdTech) has been instrumental in the last few decades in promoting inclusive education by overcoming various learning barriers and offering tools and opportunities to all students, including those with special educational needs and disabilities (SEND). However, there is limited understanding of current classroom practices and policies and of the effects of the COVID-19 pandemic on EdTech use in the inclusive classroom.

Objective: This systematic review aims to outline the current knowledge on the use of EdTech to support the learning of students with SEND in inclusive primary schools in high-income countries.

Methods: We followed the PRISMA-P (Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols) and the Generalized Systematic Review Registration Form in reporting the details of this protocol. The inclusion criteria for the systematic review require that studies focus on students with SEND who are attending the primary stage of school in high-income countries. The studies can be qualitative or quantitative and should explore the design and use of EdTech with these students. Eligible studies must be published between 2016 and 2024, be peer-reviewed with the exception of relevant reports from Non-Governmental Organizations, and be available in English. We systematically searched the ACM, Directory of Open Access Journals, British Educational Index, ERIC, Google Scholar (first 100 records), IEEE, PsycINFO, Scopus, and Web of Science databases. The titles and abstracts of all records will be screened for relevance according to the inclusion criteria. Following this, the full text of the articles will be screened. To ensure the reliability of the screening process, an independent reviewer will screen a percentage of the records for the first screening round. The data extraction process for this systematic review will start with a pilot stage to validate and eventually update the list of entities to be extracted. Following the pilot stage, the final data extraction will be undertaken. An independent reviewer will extract data from a subsample of the records to ensure the reliability of the data extraction process.

Results: The database search was conducted in July 2024. The database search identified a total of 549 records. It is anticipated that the study findings will be submitted for publication in a peer-reviewed journal by the end of September 2024.

Conclusions: This study will provide up-to-date evidence of the use of EdTech in inclusive primary school settings in high-income countries and will describe the impact of the COVID-19 pandemic on the use of Ed-Tech with students with SEND. Clinical Trial: https://doi.org/10.17605/OSF.IO/YS7AZ

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the use of Ed-Tech with students with SEND.

Introduction

Educational Technology[1] (EdTech) has transformed education and learning in the last few decades by offering multiple means to represent information, express knowledge and engage in learning (UNESCO, 2023). Moreover, EdTech has played a crucial role in supporting inclusive education by addressing multiple barriers to learning and by providing tools and opportunities to all students, including students with special educational needs and disabilities (SEND). For instance, EdTech has supported fair and optimised access to the curriculum while developing students' independence, agency and social inclusion (UNESCO, 2023). Additionally, it has facilitated personalised learning, enhanced communication and interaction among peers and teachers, and strengthened social skills (UNESCO, 2023). However, as noted in the UNESCO (2023) report, the overall benefits and drawbacks of the implementation of EdTech are still not fully understood. Several factors contribute to this lack of understanding. First, the effectiveness of EdTech tools varies by the socioeconomic level of the students and by the income level of the country. It also depends on teacher willingness to adopt these tools and their readiness to use them as well as on the education stage. In fact, students at different stages show distinct behaviour habits in terms of online learning experiences (Zuo et al., 2021). Second, the costs associated with implementing and maintaining EdTech, both in the short term and in the long term, may be higher than initially anticipated, posing affordability challenges, especially in poorer countries. These costs include the costs of training teaching staff, which is necessary for the effective use and the appropriate selection of technologies for specific students. Finally, not all technologies are suitable for students with different types of SEND. To be effective, these technologies must be tailored to each student's specific learning needs.

With such numerous factors affecting the effectiveness of EdTech and the wide range of software applications, devices, and other technologies available on the market, teachers and policymakers can easily feel overwhelmed. Therefore, systematic reviews are needed to understand the available options and to help them make informed decisions for effective and manageable employment of EdTech in education to facilitate the inclusion of students with SEND. In recent years, a few systematic reviews have examined the use of EdTech for students with SEND. Despite the importance of these studies, some are limited in their scope and in the variety of EdTech tools examined, while others encompass all educational levels, preventing a focused analysis of EdTech effectiveness for specific educational stages. Additionally, only one study included research published after the COVID-19 pandemic.

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[1] EdTech usually includes a number of broad definitions across disciplines. For the purposes of this systematic review this term includes any use of Information and Communication Technology (ICT) and Assistive Technology (AT). ICT refers to the technologies used for accessing, processing, and communicating information and encompasses a wide range of technologies, including a) computers and software applications; b) internet and network systems; c) mobile phones and other handheld devices; d) digital broadcasting technologies (radio, TV); e) email and other communication tools. AT includes any item or piece of equipment that helps a person with a disability increase, maintain, or improve their functional capabilities as a learner and any related AT service (Lynch, Singal, & Francis, 2024).

Olakanmi et al. (2020) investigated technology practices in special education contexts and included 126 studies published between 2014 and 2018. The results revealed that the most examined technology was games, and the most studied outcome was the improvement of learners' cognitive abilities. The majority of the studies included pre-college students with learning disabilities and focused on natural sciences. Interventions were primarily conducted in formal educational environments and were mainly implemented over 5–10 weeks. Based on their results, the authors recommended providing a greater level of detail in reporting research findings and placing more emphasis on promoting life, job, and social skills.

Fernández-Batanero et al. (2022) investigated the impact of using augmented reality in the education of students with special educational needs. They included 18 studies published between 2016 and 2021. The authors noted a decrease in studies from 2020 onwards, which they attributed to the COVID-19 pandemic and to the consequent closure of educational centres. The majority of the included studies used quantitative methodologies. Most of these studies focused on primary and secondary school students, with very few examining early childhood education or higher education. The experiences were primarily conducted with students with intellectual disabilities, followed by students with autism, learning difficulties, and hearing impairments. The use of augmented reality showed positive results in the learning of students with special educational needs. Improvements were observed in academic performance, motivation, communication, social interaction, and level of autonomy. However, the authors identified several limitations to the use of augmented reality in the education of students with special educational needs. These included low levels of teacher training, limited availability of augmented reality technology, lack of support from educational institutions, and technical and accessibility issues.

Gallud et al. (2023) presented a systematic review investigating technology-enhanced and game-based learning activities employed with children with special educational needs. The authors included 18 studies published between 2009 and 2019. They reported that about one-third of the studies involved participants with intellectual disabilities, another third included autistic participants, and the remaining studies involved participants with Down syndrome, motor impairments, visual impairments, and hearing impairments. The primary goal of the game-based activities was to support students' cognitive skills. These activities covered a wide range of academic areas, including mathematics, functional skills, and communication. The results of the studies were mixed, with some interventions improving the learning of participants and others promoting their motivation.

Finally, Lynch, Singal and Gill Althia (2024) investigated the use of assistive technology among primary school students with disabilities in low- and middle-income countries. They included 51 studies published between 2007 and 2020. The authors found little evidence of the efficacy of educational interventions, with learning outcomes often considered secondary to the technological aspects of the studies. They reported a considerable variation in the number of studies addressing different types of impairments, with two-thirds of the studies involving students with sensory

impairments. Additionally, teachers and parents were often excluded from the process of using and evaluating EdTech. A consistent theme was the reluctance of teachers to adopt EdTech solutions in their everyday teaching practices. Most of the studies were case studies or small-sample multiple baseline studies and rarely included control groups.

The current systematic review aims to summarise the current understanding of how EdTech supports the learning of students with SEND in inclusive primary schools in high-income countries. Moreover, this investigation will allow the investigation of the effects of the COVID-19 pandemic on the use of EdTech in this specific setting.

Review Questions

This systematic review seeks to answer the following questions:

- How can EdTech support students with SEND in primary school settings in high-income countries?
- What EdTech interventions are employed to support students with SEND in high-income countries?
- What are the gaps in the literature, and what is the potential for further development in this field?
- How has the COVID-19 pandemic impacted the use of EdTech in primary inclusive classrooms?

Methods

Study Registration

This systematic review follows the PRISMA Protocol (Moher et al., 2015) and the Generalized Systematic Review Registration Form (Van den Akker et al., 2023). The protocol of the systematic review was pre-registered prior to the analysis of the data in the Open Science Framework in July 2024 (https://doi.org/10.17605/OSF.IO/YS7AZ).

Eligibility criteria

To be included in the systematic review, studies must meet the following criteria:

Population

- Students with SEND
- Attending primary school
- Located in high-income countries, as defined by World Bank (2024).

Study Design

- Qualitative and quantitative studies exploring the design and the use of EdTech with students with SEND

- No restrictions were placed on the study design
- Published between 2016 and 2024. This timeframe encompasses four years before the COVID-19 pandemic, which provides a baseline, and four years after, allowing us to assess the immediate and evolving effects of the pandemic. Moreover, focusing on this timeframe complements existing literature, which already covers earlier years, and provides a comprehensive and up-to-date perspective on the subject
- Peer-reviewed studies, peer-reviewed conference proceedings, and relevant Non-Governmental Organization (NGO) reports. Including reports from established NGOs was deemed important because these organisations have historically played a significant role in the field of education. Although their reports are not peer-reviewed, they are often methodologically sound
- Studies reporting on other reviews of the literature, as well as Master theses and PhD theses, will be excluded. While Master and PhD theses can be valuable, they may not be subjected to the same level of scrutiny as peer-reviewed articles, depending on the country in which they are conducted. Additionally, their length and the challenge of assessing them raised concerns about data extraction and synthesis of the findings. Moreover, these documents are less accessible and less widely disseminated compared to other sources, which could complicate replicability and comprehensive data extraction. Finally, we assumed that if a study is of high quality, it is typically published in a peer-reviewed journal
- Available in English.

Search strategy

Starting from the list of keywords used by Lynch, Singal and Francis (2024), the list of keywords was optimised by including synonyms and relevant terms derived from the research questions. The search strategy underwent several iterations to refine the terms and optimise the query string. The desirability of reducing the number of keywords or adding new terms to the query was evaluated based on the effect on the number of hits (Bramer et al., 2018). The terms evaluated were not considered necessary and hence deleted if the number of hits increased greatly and included a high ratio of non-relevant references. To further validate the search results, we ran the search using alternative search terms to confirm that the strategy captured the relevant studies. Search terms were limited to the title, the abstract and the keywords of the papers, when possible. Alternatively, they were limited to the abstract of the paper only. When possible, the search was restricted to specific subject areas (such as "psychology" or "education") or educational levels (such as "primary school"). The search strategy was guided by prior systematic reviews in the field and through consultation with a specialist librarian from UCL, who provided recommendations on the list of keywords as well as on the database selection. The search strategy was guided by prior systematic reviews in the field and by consultation with a specialist librarian from UCL, who provided recommendations on the list of keywords and the selection of databases. Table 1 displays the search strategy for each database, along with the date each search was conducted.

Table 1. Search string used on each database.

Database (date of search)	Search strategy

PsycINFO (26/07/2024)	(blind or deaf* or autis* or neurodiver* or "intellectual dis*" or "learning dis*" or "mental* retard*").mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh word] AND (tech* or assistive or smartphone or tablet or laptop).mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh word] AND ("primary school" or "elementary school" or "junior school" or "middle school").mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh word] Filters applied: limit to (english language and abstracts and 180 school age <age 6 to 12 yrs> and journal article and yr="2016 - 2024")
Web of Science (26/07/2024)	(((TS=(blind OR deaf* OR autis* OR neurodiver* OR "intellectual dis*" OR "learning dis*" OR "mental* retard*")) AND TS=(tech* OR assistive OR smartphone OR tablet OR laptop)) AND TS=("primary school" OR "elementary school" OR "junior school" OR "middle school")) AND (DT==("ARTICLE") AND TASCA==("EDUCATION SPECIAL" OR "PSYCHOLOGY EDUCATIONAL" OR "EDUCATION EDUCATIONAL RESEARCH") AND LA==("ENGLISH") AND PY=2016-2024)
Scopus (26/07/2024)	(TITLE-ABS-KEY (blind OR deaf* OR autis* OR neurodiver* OR "intellectual dis*" OR "learning dis*" OR "mental* retard*") AND PUBYEAR > 2015) AND (TITLE-ABS-KEY (tech* OR assistive OR smartphone OR tablet OR laptop) AND PUBYEAR > 2015) AND (TITLE-ABS-KEY ("primary school" OR "elementary school" OR "junior school" OR "middle school") AND PUBYEAR > 2015) AND LANGUAGE (english) AND SUBJAREA (psyc OR soci-edu OR comp-csa OR comp-hci) AND (LIMIT-TO (DOCTYPE,"ar") OR LIMIT-TO (DOCTYPE,"cp"))
ERIC (26/07/2024)	noft(blind OR deaf* OR autis* OR neurodiver* OR "intellectual dis*" OR "learning dis*" OR "mental* retard*") AND noft(tech* OR assistive OR smartphone OR tablet OR laptop) AND noft("primary school" OR "elementary school" OR "junior school" OR "middle school") AND rtype.exact("Article") AND la.exact("English") AND lv("primary education" OR "elementary education" OR "middle schools") AND PEER(yes) AND PEER(yes) AND pd(20160101-20240630) Filters applied: Document type: Article; Language: English; Education level: Elementary education, Middle schools, Primary education
British Education Index (26/07/2024)	AB (blind OR deaf* OR autis* OR neurodiver* OR "intellectual dis*" OR "learning dis*" OR "mental* retard*") AND AB (tech* OR assistive OR smartphone OR tablet OR laptop) AND AB ("primary school" OR "elementary school" OR "junior school" OR "middle school") Limiters: Peer Reviewed; Publication Date: 20160101-20241231; Publication Type: Academic Journal; Language: English Expanders: Apply equivalent subjects Search modes: Proximity
Directory of Open Access Journals (26/07/2024)	blind OR deaf* OR autis* OR neurodiver* OR intellectual dis* OR learning dis* OR mental* retard* AND tech* OR assistive OR smartphone OR tablet OR laptop Filters applied: 2016-2024
ACM Digital Library (26/07/2024)	[[Abstract: blind] OR [Abstract: deaf*] OR [Abstract: autis*] OR [Abstract: neurodiver*] OR [Abstract: "intellectual dis*"] OR [Abstract: "learning dis*"] OR [Abstract: "mental* retard*"]] AND [[Abstract: tech*] OR [Abstract: assistive] OR [Abstract: smartphone] OR [Abstract: tablet] OR [Abstract: laptop]] AND [[Abstract: "primary

	school"] OR [Abstract: "elementary school"] OR [Abstract: "junior school"] OR [Abstract: "middle school"]] AND [E Publication Date: (01/01/2016 TO 30/06/2024)]
IEEE Xplore (26/07/2024)	("Abstract": blind OR "Abstract": deaf* OR "Abstract": autis* OR "Abstract": neurodiver* OR "Abstract": "intellectual dis*" OR "Abstract": "learning dis*" OR "Abstract": "mental retard*") AND ("Abstract": tech* OR "Abstract": assistive OR "Abstract": smartphone OR "Abstract": tablet OR "Abstract": laptop) AND (OR "Abstract": "primary school" OR "Abstract": "elementary school" OR "Abstract": "junior school" OR "Abstract": "middle school").
	Filters applied: 2016-2024 & Journals & Conferences
Google Scholar (26/07/2024)	(blind OR deaf* OR autis* OR neurodiver* OR "intellectual dis*" OR "learning dis*" OR "mental* retard*") AND (tech* OR assistive OR smartphone OR tablet OR laptop) AND ("primary school" OR "elementary school" OR "junior school" OR "middle school")
	Filters applied: 2016-2024

Screening

An online literature review software, Rayyan[2], will be used to remove the duplicates. The titles and abstracts of all the records will be screened for relevance against the inclusion criteria by the first author. Following this, the same reviewer will evaluate the full text of the articles deemed eligible. The reference list of all the studies that ultimately will meet inclusion criteria from the database search will be screened for any additional records that may have been missed.

An independent reviewer will screen a subsample of all records in the first round to establish the reliability of the screening process. The percentage of records to be independently screened will be determined based on the total number of records, according to the following rule: if there are more than 201 records, 5% will be screened; if there are between 100 and 200 records, 10% will be screened; and if there are 100 or fewer records, 20% will be screened. Disagreements will be discussed and resolved during agreement meetings through consensus or by consulting a third reviewer. The rationale for excluding records that do not meet the eligibility criteria will be documented.

Data extraction

The data extraction process will begin with a pilot stage, during which the first author and the last author will independently extract data from a randomly selected sample of the included studies. The sample size will be determined based on the total number of studies included at this stage of the review, following the same criteria used for the screening process. The purpose of the pilot phase is to ensure adherence to standardised procedures and to validate and, if necessary, update the data extraction criteria. After the pilot stage, the first author will complete the final data extraction for all included studies, using Microsoft Excel to collect and organise the information.

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[2] https://www.rayyan.ai/

The provisional list provided below outlines the data to be extracted and the coding rules to be used. Based on the pilot stage, this list and the corresponding criteria will be finalised. If significant updates are made to the list of entities to be extracted, the last author will independently review the data extraction to ensure the reliability of the final process.

For each study, the following data will be extracted:

Section 1: Characteristics of the study

- Author(s)
- Year of publication
- Country where data was collected
- Country income level, as defined by the World Bank (2024) for the current 2025 fiscal year on the basis of the Gross National Income (GNI) per capita calculated using the World Bank Atlas method:
  a. Low-income economies are defined as those with a GNI per capita of $1,145 or less
  b. Lower middle-income economies are those with a GNI per capita between $1,146 and $4,515
  c. Upper middle-income economies are those with a GNI per capita between $4,516 and $14,005
  d. High-income economies are those with more than a GNI per capita of $14,005.
- Study design, based on the number of data points collected for the same sample:
  a. Cross-sectional design: study collecting data for one data point
  b. Longitudinal design: study collecting data at multiple data points.
- Type of study, according to the following taxonomy:
  o Case study: studies which involve an in-depth examination of an individual or a group and which include a detailed description and analysis of the subject, often based on various data sources, such as clinical reports, interviews, or observations
  o Correlational study: studies measuring a relationship between two variables without any manipulation
  o Case-control study: studies comparing the outcome of a dependent variable (e.g., educational outcome) of two or more pre-existing groups
  o Intervention study: studies in which the researcher manipulates a variable to assess the impact of exposure to an intervention
  o Single-case research: study in which the researcher manipulates an independent variable and collects repeated measurement of a dependent variable before (i.e., baseline) and after (i.e., intervention phase) the introduction of the independent variable and where the individual case being studied serves as its own control. Although single-case research falls under the broader category of interventions, it is categorized separately due to its unique characteristics. Unlike traditional intervention studies, single-case research uses distinct data analysis methods, often relying on visual analysis. Additionally, single-case research focuses on the impact of the intervention on an individual case, which influences both the depth

of insight gained and the generalizability of the findings. Framing of the intervention or of the single-case research in relation to the Multi-Tiered System of Support model that teachers can use to operationalise the Universal Design for Learning, as reported by Banes et al. (2020):

a. Core classroom instruction
b. Targeted small groups instruction
c. Intensive individual intervention
d. Length of time over which the intervention or the single-case research was conducted.

Section 2: Characteristics of SEND sample

- Sample size
- Chronological age of participants (Mean and Standard Deviation)
- Sex of participants
- Socio-economic status
- Diagnosis or disability categorisation

Section 3: Characteristics of EdTech

- Use of EdTech terminology, and in particular reference to terms such as "Information and Communication Technology" (ICT) and "Assistive Technology" (AT)
- Overall cost of the EdTech employed
- Level of technology of the EdTech tools used based on the taxonomy reported by Lynch, Singal and Francis (2024):
   o Low-tech, such as reading stands that help learners to access prints
   o High-tech, such as voice-activated software programs or devices
- Type of EdTech used, based on the categorisation developed by World Bank (2022) and shown in Table 2.

Table 2. Type of EdTech.

Type of EdTech
Augmentative and alternative communication
Accessible textbooks
Assistive hearing and listening technology
Braille reading and writing equipment
Mainstream accessible software and applications
Mobility technology
Personal electronic devices
Platforms and applications for learning support

| Technology for teaching support |
| Technology for vision enhancement |
| Text-to-speech technology |

Results

As shown in Figure 1, a database search was conducted in July 2024, identifying 549 records. We expect to complete the screening process by August 2024 and submit the manuscript for peer review by the end of September 2024. The results of the completed study will be submitted to a journal relevant to the SEND population, and findings will be presented at relevant conferences and shared with stakeholders, such as NGOs, education and healthcare organisations, AT developers, and policymakers.

Figure 1. Flow diagram of the search process.
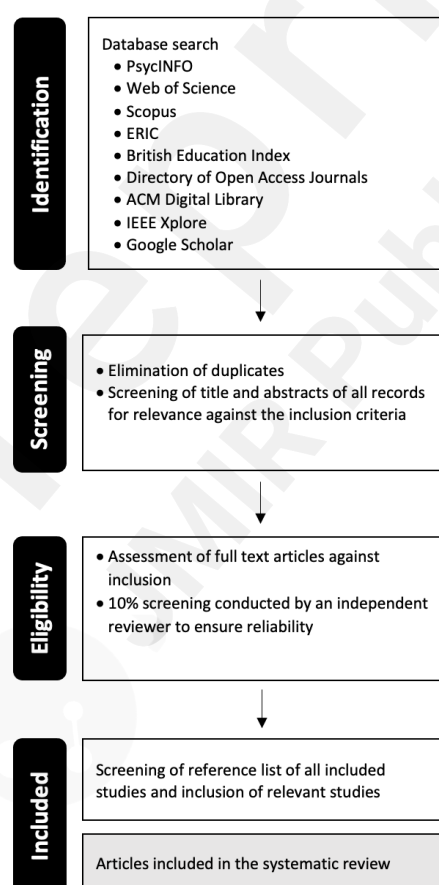
Discussion

Expected findings

Many reviews have already been conducted on the use of EdTech with students with SEND. However, these reviews are limited by their focus on specific tools, such as augmented reality or

educational game-based activities. Additionally, some reviews encompass all educational levels, which prevents a detailed examination of the effectiveness of these tools for specific educational stages (such as primary, secondary, or higher education). These limitations reduce their usefulness for making targeted decisions about EdTech implementation. Furthermore, some reviews have a narrow scope regarding publication years, covering studies only up to 2021. It is essential to have current insights into classroom practices, as technology and devices used just five years ago may now be outdated or unavailable, and new EdTech devices may have been introduced and evaluated. To fill this gap, our systematic review will collect and analyse data on the use of EdTech in inclusive primary school settings in high-income countries and will also discuss findings in comparison with previous reviews of literature in this field. Finally, this study will describe the impact of the COVID-19 pandemic on the use of EdTech in the field of research education. We anticipate that the review will reveal an increase in the use of EdTech in the inclusive classroom following the COVID-19 pandemic. These findings are expected to inform the use and the design of inclusive EdTech and AT tools to support students with SEND in the primary classroom and to establish best practices for the seamless integration of EdTech, ultimately producing positive outcomes for these students.

Additionally, one of the outcomes of our systematic review will be the creation of an updated database that catalogues all studies investigating the use of EdTech in inclusive primary schools in high-income countries. This database will offer accessible, current evidence on how EdTech supports students with SEND in this setting. The final database, which will be published in the Open Science Framework platform, aims to facilitate evidence-based decision-making, support the development of guidelines, interventions, and policies, and identify gaps in the current research landscape. It is expected to serve as a valuable resource for researchers, educators, AT developers, policymakers, and other stakeholders.

Limitations

While we will employ a comprehensive search strategy, it is possible that relevant studies could be overlooked. Additionally, our search is restricted to English-language and peer-reviewed publications, with the exception of NGO reports, potentially excluding studies in other languages and unaudited studies and thereby limiting the comprehensiveness of the evidence available.

Conclusions

To our knowledge, this will be the first systematic review to describe the impact of the COVID-19 pandemic on the use of a wide range of EdTech to support the learning and inclusion of primary school students with SEND in high-income countries. This review aims to facilitate evidence-based decision-making and contribute to the future improvement of guidelines for the effective use of EdTech to support inclusion in primary school settings. Such knowledge is crucial for promoting educational equity, enhancing learning outcomes, and supporting the diverse needs of all students.

Funding

Conflicts of Interest

None declared.

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