Educational Dimension, 2025, Vol. **12**, pp. 41–52 https://doi.org/10.55056/ed.808

Importance of learning styles in teaching and learning during the COVID-19 pandemic: A critical review of recent studies

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Abstract. The COVID-19 pandemic has necessitated a shift toward online education, making it more critical than ever to understand the impact of learning styles on teaching and learning. This critical review examined recent studies on the topic and highlights the significance of catering to individual learning styles to optimize student performance in diverse educational settings. From all the articles, four main concepts emerged: implementing effective teaching strategies for diverse learners, identifying and using learning styles to cater to student's individual needs, supporting students with individualized needs during remote instruction, and evaluating and assessing student learning in an online environment. Schools and teachers could identify students' learning styles using various tools. They could also use these learning styles to fit their teaching strategies in the class and the assessments. Teachers used a variety of educational tools and artificial intelligence for individualized instruction. The review concluded that educators incorporated various teaching methods and technologies to accommodate students' learning preferences and foster meaningful engagement in virtual classrooms, particularly during these challenging times.

Keywords: learning styles, teaching strategies, classroom management, COVID-19 pandemic, critical review

1. Introduction

The COVID-19 pandemic has fundamentally shifted how learning and teaching are delivered. With schools, colleges, and universities closed to prevent the spread of the virus, educators have been forced to move to an online platform to continue delivering student learning experiences. As a result, students are now required to engage with digital devices, online content, and virtual classrooms, which makes it more challenging to keep them motivated and engaged in the learning process.

The effectiveness of teaching can only be achieved by considering students' preferred learning styles. One of the significant challenges facing teachers during the pandemic has been to ensure that the online delivery of education accommodates all learners regardless of their learning style [3]. Learning styles are how individuals approach and process information. A student's learning style includes their preferred way of receiving, processing, and retaining knowledge. As Dube [14] has said, each person has a unique learning style, and educators must recognize and adapt their teaching methodologies to meet each student's needs.

A recent study by Hassan et al. [21] suggests that recognizing learning styles and teaching to accommodate each student's learning style is essential for effective teaching. Students supported with personalized instruction significantly outperform those who receive instruction using a one-size-fits-all model. The concept of differentiation in teaching is based on recognizing different learning styles and adapting teaching methods to cater to them [36].

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Learning styles can be categorized into three major groups: visual, auditory, and kinesthetic [44]. Visual learners understand information quickly and engage best through visual aids. Auditory learners learn best through listening to information rather than seeing or applying it. Kinesthetic learners are hands-on and prefer to learn via interactive learning experiences. Filgona et al. [18] argued that educators must cater to these learning styles to keep their learners engaged and motivated throughout the online learning process. Effective pedagogy should recognize individual differences among learners and adapt to them. Egielewa et al. [16] argued that online educators should cater to students for whom the digital platform may be a more significant challenge than traditional classroom-based learning. For some students, the digital divide remains an issue, and educators must consider this when planning their curriculum delivery.

Providing students with a personalized learning experience motivates them and encourages them to assume ownership of their learning experience. As cited by Hassan et al. [21], students who are encouraged to take responsibility for their learning often perform better academically. Magulod Jr [29] explained that the ability to use different teaching methodologies around different learners' learning styles will determine educators' success in creating personalized learning environments. Teaching staff must diversify their approaches to provide a personalized learning experience for students. Using blended learning, which includes synchronous and asynchronous online sessions, group projects or discussions, and interactive games, can create a positive learning environment and engage learners according to their preferred learning style [26]. Technology integration in teaching and learning during the pandemic has made these initiatives more achievable.

2. Methodology

A critical review is the in-depth analysis and evaluation of an article, book, or any other literature or work [25]. It is a process of scrutinizing a text or a work to determine its relevance, credibility, strengths, and weaknesses, among other things.

So, this paper is not tasked to do a thorough and complete search, give a detailed report of previous research, or determine the best strategies in the field. The main goal was to carefully analyze the shortcomings in current theories, methods, and research findings. This paper only looked at articles published from 2019 up until the present. The chosen duration was set to present proof of current ideas regarding the pandemic in the discipline. To encompass a comprehensive variety of current thinking, the examination encompasses different forms of research, such as quantitative and qualitative studies, academic literature reviews, theoretical papers, case study analyses, curriculum assessments, evaluations, and descriptive research in formal and informal settings.

The article utilized various digital resources from distinct journal repository websites and platforms such as ERIC, EBSCO, Emerald, Elsevier, and Google Scholar. To retrieve relevant information, the primary keywords explored were teaching and learning during COVID-19, learning styles during COVID-19, and the importance of learning styles during the pandemic. The researcher also employed Boolean operators such as 'AND' and 'OR' to enhance their search results. Additional operators like + were also used.

Many articles were examined, but some were excluded since they did not relate to science and technology education or AI integration. Articles that provided only abstracts were also not included. Only articles published in 2019 were considered to cover all the themes and ideas about the importance of learning styles in teaching and learning during the COVID-19 pandemic. Non-English language articles were

also excluded. The study only focused on full original articles that used quantitative, qualitative, or mixed research methods. From the pool of articles, 12 original ones were included for the analysis, meeting the minimum requirement of 10 articles for a comprehensive textual narrative synthesis, as suggested by O'Donovan et al. [35].

3. Results and discussion

Four concepts emerged from the literature analysis: implementing effective teaching strategies for diverse learners, identifying and using learning styles to cater to student's individual needs, supporting students with individualized needs during remote instruction, and evaluating and assessing student learning in an online environment.

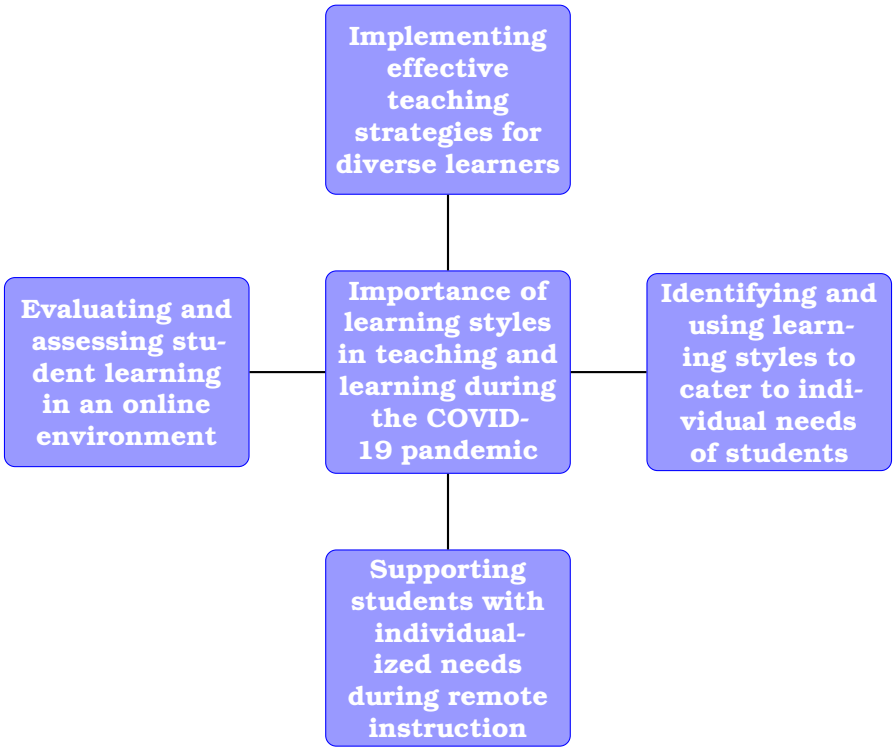

Figure 1: The four concepts that emerge from the literature review analysis. These concepts define the utility of learning styles in teaching and learning during the COVID-19 pandemic.

3.1. Implementing effective teaching strategies for diverse learners

The COVID-19 pandemic has brought new challenges in education as schools around the world have shifted to online and hybrid learning models. This change presents unique issues for teachers creating an effective learning environment for diverse student populations [22]. Practical strategies for teaching diverse learners include cultural responsiveness, inclusive pedagogy, differentiated instruction, and creating a welcoming online classroom community.

Cultural responsiveness is an effective strategy that addresses the needs of culturally diverse students. It involves incorporating the students' cultural backgrounds and values into the learning experience to make it more inclusive and engaging [20]. This strategy can be achieved by incorporating different perspectives and voices in the curriculum, speaking to students in their native languages when possible, and celebrating critical cultural events [39]. Moreover, several authors have noted suggestions for being culturally responsive. Mathrani, Sarvesh and Umer [31] emphasized that teachers were able to understand that students may have different home situations, such as caring for siblings or elderly relatives, that may impact their ability to

participate in remote learning. They added that teachers were also aware that some students may need access to technology or reliable internet, which makes it difficult for them to participate in remote learning. In addition, Brown, Correll and Stormer [12] claimed that teachers could provide culturally relevant resources and materials that reflect the diversity of the student population. Singh et al. [45] concluded that teachers were flexible and adaptable to the needs of the students to ensure they had equal access to educational opportunities during the pandemic.

Inclusive pedagogy is another strategy that recognizes that people learn differently and should have access to different forms of instruction [24]. It involves creating course content and assignments that are accessible to students with a range of abilities and learning styles. Teachers can incorporate multimedia resources, visual aids, and other digital tools to make learning more accessible. [46] added that it is essential to adopt a flexible approach to course design to accommodate different learning styles and cater to varied learning needs while considering the constraints caused by the pandemic. Egan et al. [15] argued that teachers have acknowledged and addressed the socio-emotional needs of students who may experience stress, anxiety, or depression due to the pandemic and allowed students to communicate their needs and encourage peer support systems. Birk et al. [8] added that schools have organized shorter and more efficient class sessions, with sufficient breaks between every sequence, to ease pressure on students, enable high-quality concentration levels, and give room for self-care.

Differentiated instruction during the pandemic is adapting teaching strategies to meet student's individual needs while providing them with various ways to access and demonstrate learning, emphasizing remote learning. Differentiated instruction is a strategy that recognizes that students have varied learning abilities and needs [11]. Many schools and teachers have adapted to remote learning environments during the pandemic, which has presented challenges to implementing differentiated instruction. However, there were still ways that differentiated instruction was accomplished through online learning. Morgan [32] explained that teachers encouraged students to pursue independent projects or assignments that align with their interests and skill sets. The most common was that teachers provided pre-recorded lessons that students could watch at their own pace and revisit as needed. According to Agarwal et al. [1], some teachers conducted virtual one-on-one sessions with students to discuss their progress and provide additional support or guidance. Hence, teachers have planned lessons that meet the needs of all students, from those who may be struggling with the subject to those who are advanced learners.

Creating a welcoming online classroom community was important during the pandemic when students were isolated and forced to work from home [47]. Teachers can use technology to foster relationships with their students and create a sense of community. Ye et al. [50] explained that teachers initiated regular communication using online forums and discussion boards and encouraged collaboration among students, which led to a supportive and engaged online classroom community. Additionally, teachers rethink how they assess student learning during the pandemic. Traditional assessment methods were only one of the effective ways to evaluate students' learning [22]. Alternative assessments, such as project-based learning, performance assessments, and portfolios, provide more relevant and authentic student learning assessments [8].

The COVID-19 pandemic has necessitated significant educational changes that require teachers to adopt new strategies for teaching diverse learners. Strategies that focus on cultural responsiveness, inclusive pedagogy, differentiated instruction, a welcoming online classroom community, alternative assessments, and additional support for disadvantaged students are essential in ensuring a practical learning

experience for all students during this challenging time.

3.2. Identifying and using learning styles to cater to the individual needs of students

Schools have identified and used learning styles to cater to student's individual needs during the pandemic by first assessing the learning styles of their students. This was done by asking students or parents to complete a survey. The Visual, Aural, Read, and Kinesthetic Sensory (VARK) questionnaire was a commonly used tool that classifies learning styles into visual, auditory, reading/writing, and kinesthetic. Several authors used this instrument during the pandemic (e.g., [4, 5, 40]. Other authors used the Morningness–Eveningness Questionnaire (MEQ) and Big16 Learning Modality Inventory like the research of Balcı and Çalışkan [7] and Kadiriye et al. [27]. In addition to studies that identified learning styles during the pandemic, Masela and Subekti [30] used Barsch's questionnaire on the visual learning style. Kyung-hee [28] utilized O'Brien's Learning Styles Questionnaire to reveal how students would like to learn during the shift to online education, and Balcı and Çalışkan [7] and Cuizon et al. [13] used the Learning Style Inventory (LSI) to gather students' learning styles and correlate to their academic achievement.

Once the learning styles of their students have been identified, schools have provided learning materials and resources that cater to each style. For visual learners, they provided more videos and graphics; for auditory learners, they included more audio-based activities and lectures; for reading and writing learners, they provided more written resources and assignments; and for kinesthetic learners, they provided more hands-on activities and project-based work [6]. In terms of using this approach during the pandemic, schools provided online resources for each learning style, such as interactive videos and quizzes for visual learners, podcasts and recordings for auditory learners, PDF and document readings for reading/writing learners, and virtual labs or simulations for kinesthetic learners [43]. Schools also mandated the teachers to record their classes so those who missed them could watch them later to understand the material better.

Furthermore, when schools shifted to online learning, they provided personalized learning plans for students. According to Singh, Steele and Singh [46], teachers assessed each student's learning style. They created customized learning plans based on their specific academic strengths and weaknesses, and they implemented accommodations such as extended time on assignments or alternative modes of assessment.

However, it is essential to note that only some students may fit into one specific learning style, so providing various resources that cater to different styles [48]. Teachers can also modify activities and resources to make them accessible for all students, regardless of individual learning style. Overall, schools used a variety of innovative strategies to cater to individual student needs during the pandemic. The focus was on creating an inclusive and personalized learning environment, using different techniques to engage every student, regardless of their unique learning style.

3.3. Supporting students with individualized needs during remote instruction

When the COVID-19 pandemic hit, it forced schools worldwide to switch to remote instruction quickly. For many students with individualized needs, this posed a significant challenge. However, teachers rose to the occasion and provided unique student support.

Some students with individualized needs require specialized equipment or software to complete their work [10]. These tools include software or hardware for online learning and do-it-yourself materials for project-based learning. Teachers made sure

to collaborate with parents or guardians to ensure these materials were provided to students in need. This could mean mailing equipment or arranging for pick-up at the school. Bishop [9] pointed out that teachers also ensured parents or guardians of students with individualized needs were kept informed and involved in their child's learning journey during remote instruction. They made sure to have frequent check-ins and provide regular updates regarding progress and any potential struggles.

One of the biggest challenges faced by students with individualized needs during remote instruction and the pandemic was the need for in-person interactions with teachers and peers. Teachers considered this and set up virtual office hours or increased their availability via email or messaging systems [49]. These extra contact points were critical for students who required more reassurance and assistance. Moreover, accommodations are essential to helping students with individualized needs reach their full potential. Teachers continued to offer accommodations such as extra time on assignments, break-out rooms for testing, or flexible deadlines. These accommodations were even more essential during remote instruction [45].

Some students need access to assistive technology or specialized software. Teachers worked hard to troubleshoot technical issues and find solutions to ensure all students had the necessary technology. Several computer science professionals developed an Intelligent Tutoring System (ITS) to assist students in their missed lessons. SeisTutor, an ITS for learning seismic data interpretation, was developed by Singh et al. [45]. This ITS provides personalized course materials and guided learning programs. Results have shown that students who had difficulty following the regular lesson flow have significantly progressed with the help of ITS's intelligent guidance. Another was captioning and transcription tools. [17] argued that these tools enabled real-time captioning and transcription of spoken words during online classes, making it easier for students to follow along.

3.4. Evaluating and assessing student learning in an online environment

Visual learners prefer to learn through images, graphs, and diagrams. Teachers have assessed these learners through visual aids, such as infographics or concept maps, and by incorporating visual elements into written assignments [33]. Furthermore, auditory learners learn best through spoken explanations and discussions. Teachers have assessed these learners by incorporating conversations, podcasts, or videos and allowing oral presentations or group discussions to demonstrate their learning [43]. In addition, kinesthetic learners like to learn through hands-on activities and movement. Teachers have assessed these learners by including experiential activities, such as simulations or role-playing activities, in their assessments [38]. Reading/writing learners prefer to learn through text-based materials. Teachers assess these learners by providing readings with annotations or summaries and by assigning written responses such as essays or research papers [41].

Each student has a unique style of learning. While some students learn best through visuals, others prefer audio-based learning. Governments and private computer experts have created online learning systems. The online learning system offers a variety of resources and options that can be customized in several ways. Huang et al. [23] argued that these online learning systems are the ideal method to create the best learning atmosphere tailored to each student's learning style. Some of these assessment tools are Kahoot, Edpuzzle, and Padlet. Kahoot is a game-based learning platform that offers a range of quizzes, surveys, and discussions that learners can participate in using their smartphones or computers. Ahmed and Opoku [3] explained that it is highly interactive and can be customized to suit different learning styles. Edpuzzle allows teachers to create interactive video lessons by adding questions, comments, and quizzes throughout the video. This allows students to engage with the

content in multiple ways and caters to auditory and visual learners [34]. Padlet is a versatile online tool that allows users to create virtual bulletin boards to collect and curate information. According to Ahmad, Rubayyi and Etfita [2], Padlet was helpful to students who prefer to learn through research and by organizing information in a visually appealing way.

For any learning style, feedback is essential in helping students improve their understanding and skills. Students may need extra guidance on what is expected of them. Pather et al. [37] emphasized that feedback helped clarify expectations—and assisted students in understanding how they can improve. Gopal, Singh and Aggarwal [19] argued that feedback helped students improve their academic performance by providing specific suggestions to overcome these challenges. In general, Ros and Neuwirth [42] highlighted that teachers have provided timely, precise, and constructive feedback as it can help students assess their strengths and areas for improvement.

4. Conclusion

The transition to online learning during the COVID-19 pandemic has profoundly illuminated the significance of learning styles in educational success. Our critical review reveals that the pandemic, while disruptive, has served as a catalyst for deeper understanding of how individual learning preferences shape educational outcomes. The evidence suggests that institutions that recognized and adapted to diverse learning styles were better positioned to maintain educational continuity during this unprecedented period.

Perhaps most striking was the emergence of innovative teaching approaches that transcended traditional classroom boundaries. Educators discovered that effective online pedagogy required more than merely digitizing existing content—it demanded a fundamental rethinking of how different learners engage with educational material. The successful integration of cultural responsiveness and inclusive pedagogy demonstrated that attention to learning styles could bridge the digital divide while fostering meaningful student engagement.

The widespread adoption of learning style assessment tools, from VARK questionnaires to Learning Style Inventories, yielded valuable insights into student needs. Yet these tools proved most valuable not as rigid categorization systems, but as frameworks for understanding the spectrum of learning preferences. This nuanced approach enabled educators to develop more flexible and responsive teaching strategies, particularly beneficial for students requiring individualized support during remote instruction.

Notably, the pandemic accelerated the development and implementation of sophisticated educational technologies. The emergence of Intelligent Tutoring Systems and adaptive learning platforms revealed the potential for technology to provide personalized learning experiences at scale. These innovations, while born of necessity, may well reshape educational practice in the post-pandemic era.

Assessment strategies underwent significant evolution during this period, with educators developing more nuanced approaches to evaluating student learning across different modalities. The integration of diverse assessment tools demonstrated that effective evaluation must account for varying learning preferences while maintaining academic rigor. This revelation challenges traditional assessment paradigms and suggests a need for more flexible evaluation frameworks in educational practice.

The experiences of the pandemic period suggest that educational institutions must maintain flexibility in their instructional approaches while investing in technologies that support diverse learning styles. However, technology alone cannot address the complex challenges of meeting individual learning needs—continued professional

development and institutional support remain crucial. Future research might productively explore how emerging technologies can better accommodate different learning styles while maintaining the human connection essential to effective education.

Acknowledgments: Thank you to Dr. Roland Obiedo for his comments and suggestions on this paper.

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