

Implications of Major Learning Theories for Online Medical Education: A Narrative Review

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ABSTRACT

Background: Online education has transformed learning by enabling participation regardless of geographical or temporal constraints. However, effective online instruction requires alignment with learning theories to meet learners' needs. This narrative review examined the major learning approaches (behaviorism, cognitivism, constructivism, and connectivism) and their implications for online medical education.

Methods: A narrative review of the literature from 2000 to 2023 was conducted using ERIC, Scopus, Google Scholar, and ProQuest. The inclusion criteria consisted of peer-reviewed articles focusing on learning theories in higher education, while the exclusion criteria ruled out non-English studies and those lacking empirical or theoretical analysis. Data were synthesized to compare the four learning theories, identifying aspects of their approaches, implications, strengths, and limitations in online medical education.

Results: This review synthesized 59 studies on four learning theories in online medical education. Behaviorism emphasizes structured, measurable outcomes through multimedia and skill reinforcement but overlooks cognitive processes. Cognitivism enhances critical thinking through case studies and simulations, though internal mental processes are difficult to quantify. Constructivism promotes active, collaborative learning through real-world scenarios but requires a shift towards student-centered methods. Connectivism leverages digital networks for self-directed learning but demands high digital literacy and is challenging to implement in traditional settings. Each approach offers distinct strengths and limitations for the design of medical education.

Conclusion: The fundamental ideas and structures of various schools of thought share similarities, providing an opportunity to incorporate principles from different approaches into online medical education materials. Learning theories can be utilized for selecting appropriate practice for various learning goals.

Keywords: Distance, Education, Online learning, Learning theories, Practice, Medical

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Introduction

The extensive use of technology currently enables learners and educators to use a variety of tools that can improve education. Due to the Internet's ability to overcome geographical borders online, education has quickly evolved into a methodology that is not only acceptable but also in high demand (1). In online learning, students can take advantage of online materials without time and place restrictions in addition to the immediate interaction of learners. Instructors can tutor everywhere and at any time without limitation. Online materials and resources can be updated, and learners can approach them immediately. If properly designed, online learning systems can be utilized to discover learners' needs and existing amount of competence. Online learning is the application of any electronic means in all aspects of online and offline teaching and learning (2, 3).

The mission of any educational system is to improve learning. Therefore, before designing learning instructions and developing education materials, educators must be aware of the learning principles and the students' learning scheme. This is particularly true in online learning since teachers and students are not in the same environment. Effective online learning materials should be created based on well-researched learning theories. There are several schools of thought on learning, and only some schools are applied to create online learning products. We can employ a combination of theories to design online learning resources because there is no single learning theory to follow (4).

David Higgins and colleagues explored the influences and relevance of experiential learning methods within a new era of entrepreneurial education. They recommended that educators incorporate theories of learning and motivation into creating straightforward, accessible, and efficient online teaching to enhance learner participation (5). In another study, Vishal Arghode and colleagues compared adult learning theories and implications for online instruction (5) and found that none of them

can fully explain adult online learning; all of them explain certain aspects of it; they are all contextual, and parts of them can be used to enhance online learning.

The main schemas of learning theories are Behaviorism, Cognitivism, Constructivism, and Connectivism. Behaviorism theory emphasizes conditioning and reinforcement to shape behavior. It is useful for developing skills and knowledge through structured practice and feedback. To effectively implement behaviorism theory in online medical education, instructors can design structured practice sessions with feedback and reinforcement to develop skills and knowledge (6).

Cognitivism theory focuses on understanding concepts and making connections. It is valuable for promoting deep understanding and critical thinking in medical education. To effectively implement cognitivism theory in online medical education, instructors can encourage critical thinking and conceptual understanding by providing opportunities for students to make connections and apply knowledge (7).

Constructivism theory emphasizes learner-centered, active construction of knowledge. It is useful for promoting autonomy, critical thinking, and active participation in the learning process. To effectively implement constructivist theory in online medical education, instructors can foster learner autonomy and active participation by encouraging them to construct their own understanding and engage in collaborative learning (8).

Connectivism theory emphasizes the importance of connections and networks in learning. It is useful for promoting collaboration and the development of a personal learning network. To effectively implement constructivist theory in online medical education, instructors can promote collaboration and the development of a personal learning network by providing opportunities for students to connect with peers, experts, and resources (9).

In this review, we will go through each to

find the concepts, principles, and implications for online learning. The theories were considered based on their relevance and applicability in improving online medical education. First, we should bear in mind that learning strategies should be selected based on the aim and strategies of learning to motivate students, facilitate deep learning, promote meaningful learning, and encourage learner engagement. Learning theories bring forth directions to enhance learning instruction. Research on learning and theories is attributed to convincing significance in the literature. Learning theories have been discussed in the literature (10); however, explicit specifications of learning theories, their function and implications for online learning must be investigated. As a result, considering the necessity to extend learning theory principles to online learning to improve online instruction, we analyzed four major learning theories and their implications for online medical education.

Methods

This was a narrative review study which synthesized knowledge to identify and synthesize an emerging body of literature on learning theories and their implications in online medical education. In this study, we utilized the ERIC, Scopus, Google Scholar, and ProQuest databases to review the literature on various aspects of learning theories and their implications in online learning. The key search terms used in our search were online learning strategies, e-learning strategies, learning theories in practice, learning schools in practice, learning school's implication, online instruction and learning theories, medical education, behaviorism, cognitivism, constructivism, and connectivism. The recognized articles were first reviewed for relevance and applicability of the title, followed by the abstract based on the research question.

The research for this review encompasses the literature published over the span of 23 years, from 2000 to 2023. This timeframe was selected to encompass contemporary

studies that resonate with online learning and education and online medical education. The key information was extracted from each study's findings. Then, the authors collated, summarized, and reported the review results.

The criteria for inclusion centered on complete English-language articles in the higher education field that were published in peer-reviewed academic journals or conference proceedings. On the other hand, the criteria for exclusion were research that lacked empirical or theoretical analysis. After reviewing titles, abstracts, and keywords to ensure they matched the research objectives, three experts examined the full text of the articles using the PRISMA checklist to analyze the retrieved manuscripts.

Results

The primary searches based on the aim of this study yielded over 198 articles; after applying the inclusion and exclusion criteria, 59 articles met the criteria for review and analysis (Figure 1). Out of 66 reviewed articles, the following results were found:

The following sections present the four selected learning theories for this article and their implications for online learning. Table 1 summarizes the learning approaches and their implications for online learning and in medical education.

Behaviorist School of Learning

Behaviorism is a theory of learning that focuses on observable and measurable aspects of human behavior. It emphasizes behavior changes resulting from the stimulus-response associations made by the learner (11). It emerged in the early 1900s in response to depth psychology and other conventional branches of psychology, which struggled to make experimentally testable predictions. Behaviorism fundamentally believes that behavior analysis should be approached as a natural science, akin to disciplines like chemistry or physics (12).

Learning was viewed as a process that resulted in a change in behavior due to exposure to new situations. According to behaviorism,

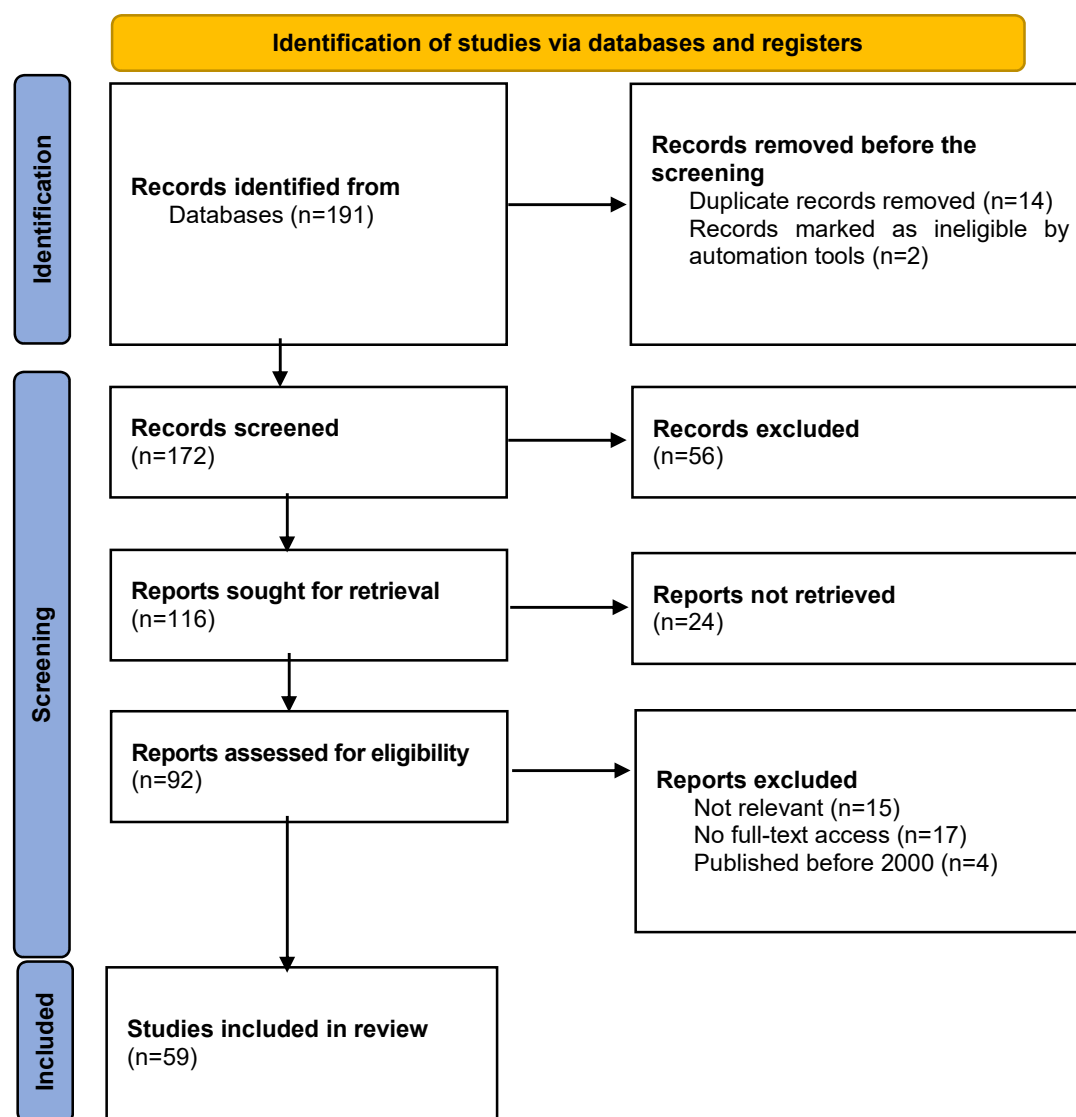


Figure 1: PRISMA flow diagram of the study.

Table 1: Learning approaches and their implications for online medical education

Learning approach	Aspect of approach	Implication	Strength and limitations
Behaviorism	Being aware of outcomes at the beginning of the online classroom	Multimedia presentation	Strength: Emphasizes observable behaviors, making it easier to measure and assess learning outcomes Limitation: Focuses on external factors, potentially overlooking internal cognitive processes
	Reinforcement of Correct Skills	Breaking down complex medical concepts into manageable chunks	
	Structured Teaching Methods	Clear guidelines and expectations can help students navigate the learning material more efficiently	
	Addressing Individual Learning Needs	Recognizing and responding to students' unique requirements	
	Rewarding students	Gamification	

Learning approach	Aspect of approach	Implication	Strength and limitations
Cognitivism	Active Information Processing, active role of learners	Engaging in online activities, critical thinking, analysis, synthesis of information, problem-solving, case studies, simulations, and collaborative projects	Strength: Focuses on cognitive functions such as memory and problem-solving, improving insights into the mechanisms through which students acquire knowledge. Limitation: Observing and quantifying cognitive processes directly can be quite difficult
	Metacognition and learners' awareness and understanding of their own thought processes	Forums and social media platforms	
	Personalized Learning and considering individual differences	Adoptive learning, sharing information with the learner, multimedia, and various information resources	
	Cognitive load theory	Helps manage cognitive load and promotes effective learning	
	Learners process information through multiple channels	Multimedia presentation	
Constructivism	Social Interaction and active learning	Forum, discussions, and peer feedback	Strengths: Encourages active participation and engagement in learning, promoting deeper understanding. Limitations: Requires a shift in traditional teaching methods towards more student-centered approaches.
	Authentic and real-life learning experiences	Project-based learning, and scenario-based learning	
	Problem-Based Learning	Learners actively engage with real-world problems, utilize their cognitive abilities, think critically, and construct new knowledge collaboratively	
Connectivism	Importance of networked learning	Social media, and online communities	Strengths: Focuses on the importance of networks and connections in learning, aligning well with online education platforms. Limitations: Can be complex to implement in traditional educational settings. Requires a high level of digital literacy and self-regulation.
	Role of technology in enabling distributed learning experiences	Open educational resources and online communities of practice	
	Role of social interaction and collaboration in the learning process	Social media, discussion forums, and collaborative tools	
	Self-directed learning: enables learners to take control of their learning process and pursue their interests	Online courses, synchronous and asynchronous courses, and personalized learning	

learning is a process that is impacted solely by physical variables, including environmental or material reinforcement, and results in changes in behavior, and learning can be deduced from the context and environment, as well as subsequent behavior. Humans

and animals both learn in the same way, according to popular belief of behaviorism (13, 14). According to behaviorist learning theory, behavior is the process objectively without considering cognition. Behaviorist approaches propose that responses may be

determined and conditioned by ignoring the influence of mental variables. Pavlov, Watson, and Skinner are influential in developing these theories (13).

The behaviorist's main concept mainly explains learning in terms of imitation, practice, reinforcement, and habit formation. Students memorized dialogs and patterns through classroom exercises that emphasized mimicking and memorization. Learning was considered the establishment of habits that could interfere with forming new habits (15). Behaviorism is a psychological approach that places emphasis on the observable and measurable aspects of human behavior. It is primarily concerned with changes in behavior that result from stimulus-response associations made by the learner. According to this approach, development is viewed as a continuous process, with children playing a relatively passive role (16).

They believe internal processes cannot be objectively observed or measured and should be excluded. Learning is a stimulus-response process that the correlation of observable occurrences would define. Learning is a process that results in a change in one's behavior. When certain events occur at the same time, learning is observable (4). They believe that the environment influences human behavior through incentives or reinforcement. As a result, there is a strong link between behavioral responses and stimuli in the learning process (13, 17).

Several scientists have played a crucial role in the development and progression of behaviorism as a learning theory. Their work has contributed significantly to our understanding of human behavior and the development of behavioral interventions. Thorndike introduced the law of effect, a technique used consequences to reinforce or diminish behavior (18). Pavlov was a Russian physiologist who conducted experiments on classical conditioning, a process by which a neutral stimulus comes to evoke a response previously associated with a reward or punishment (19).

Skinner was an American psychologist

who developed the concept of operant conditioning, which involves modifying behavior through reinforcement or punishment based on the outcome (20). Watson coined the term "Behaviorism" for his proposal to put the study of human psychology on a firm experimental footing (21). Bandura is a Canadian-American psychologist known for his work on social learning theory (SLT), which emphasizes the role of cognitive processes in shaping behavior. Bandura proposed a theory that suggests people learn by observing, imitating, and modeling the behavior of others. This method acknowledges the significance of reinforcement in the learning process and highlights the value of observing, mimicking, and modeling the emotional responses, attitudes, and actions of others. Bandura's SLT is seen as a connecting link between behaviorist and cognitive learning theories, covering aspects like attention, memory, and motivation (22).

The Implications of Behaviorist Approach for Online Medical Education

Among the methods derived from behaviorist theory for practical classroom application are various implications, including consequences, feedback, gamification, negative or positive reinforcement, extinction, and behavior modification (23).

Firstly, Learners should be aware of *outcomes* at the beginning of the online classroom, which can be conveyed via a slide or multimedia presentation showing the aims and contents covered during the course. Additionally, instructors should provide learners with proper feedback and suitable educational substances to increase learning achievements. Immediate *feedback* is often provided by software applications, which reinforces positive advancement in the material.

Programmed learning or programmed instruction involves the use of books and teaching machines designed based on the principles of *operant conditioning*. Online learning is often structured and uses *drill and*

practice tasks, which follow behavioristic principles. Learners achieve desired outcomes through repeated practice and following task steps (24). In addition, behavioral principles are applied to *gamification* in online learning, entertainingly presenting materials and rewarding students with points or badges for showing the desired behavior or response.

A course management system (CMS) can be used by administrators to transmit information to their learners; furthermore, creating computer-based activities, including facilitating synchronous or asynchronous chats, and developing tests with *feedback* for each response, indicate a progressive approach to integrating CMS features in a behaviorist approach (25). Educational Implications Using behaviorist theory in the online classroom has advantages for both instructors and learners. Alternating behavior occurs for a reason; learners change behaviors to convince the preference they have learned to value. The total principle of behavior moderation is that most behavior is absorbed. An ignored behavior will disappear, and as a result, an unpleasant behavior can be removed (26).

Implementing structured teaching methods based on behaviorism principles can enhance medical students' engagement and facilitate effective behavior management in online medical education. Clear guidelines and expectations can help students navigate the learning material more efficiently (27). Behaviorism emphasizes the mastery of prerequisite steps before progressing to subsequent ones, reinforcing correct skills along the way. In online medical education, this approach can be valuable for breaking down complex medical concepts into manageable chunks for students (8). Behaviorism offers insights into tailoring instruction to address individual learning needs, fostering academic success in online medical education. By recognizing and responding to students' unique requirements, educators can optimize the learning experience (28).

Cognitivist School of Learning

Cognitivism, as a theoretical framework for

understanding the mind, gained prominence in the 1950s as a response to behaviorism. The movement towards cognitivism was driven by the increasing criticism of simplistic learning models and the recognition of the limitations of behaviorism in fully explaining mental function (29).

Cognitivist theories emphasize how the mind perceives, retains, organizes, and retrieves information. It contains scientific research on mental life symptoms related to how people acquire knowledge, process the impressions that come through their senses, and solve problems in everyday life (17). This philosophy considers the learner's active participation in learning, engaging in activities that construct understanding and knowledge. The role of internal mental processes, including perception, attention, memory, and problem-solving, in learning is also emphasized in cognitivism (30).

Cognitivism emphasizes metacognition, the awareness and understanding of one's own thought processes. This self-awareness enables learners to monitor and regulate their thinking, leading to more effective learning (31). In strategies for online learning, it is essential to present the content in a manner that enables students to process it efficiently. Due to the limited capacity of working memory, it is beneficial to organize or chunk the content into suitable pieces to improve processing. Given that individuals have restricted short-term memory capacity, it is advisable to arrange information into meaningful sequences, comprising five to nine significant units (4).

Cognitive learning theory has been shaped by influential theorists who contributed to understanding internal mental processes and their implications for learning. Social Cognitive Theory, developed by Albert Bandura, combines cognitive and behavioral learning principles to explain how individuals learn from observing others and the environment (32). Piaget's contributions to developmental psychology profoundly impacted cognitive science and education. His theory of cognitive development

suggested that learners actively construct their knowledge through interactions with their environment (33). Vygotsky's sociocultural theory of cognitive development emphasized the role of social interaction and cultural tools in shaping cognitive processes, highlighting the importance of language and social context (34). In cognitive psychology and educational theory, Bruner focused on the role of active learning, discovery, and narrative in knowledge construction, introducing the concept of scaffolding, which involves providing support to learners as they engage in challenging tasks (35). Ausubel's theory of meaningful learning stressed the importance of prior knowledge and the organization of new information about existing cognitive structures. He proposed the use of advanced organizers to facilitate learning (36).

The Implications of Cognitivist Approach for Online Medical Education

Cognitivism highlights the active processing of information by learners. Online learning, can encourage this through activities that promote critical thinking, analysis, and synthesis. To improve perception and attention to online learning, which was highlighted by cognitivism, Instructors can explain why the learners should take the lesson so that the online learner can focus on the content. Important information should be in the center of the screen for reading, highlighting critical information to focus learners' attention (37).

To activate the existing cognitive structure, use comparative advance organizers. Set expectations and engage the learners' existing knowledge with pre-instructional questions. Prerequisite test questions can be used to activate the knowledge structure needed to learn new content. Moreover, chunk information about how to avoid working memory saturation during processing (38). To enhance deep processing, learners should be invited to create information maps either during the learning process or as a post-lesson activity. To contextualize learning and encourage deep processing, learners should be able to apply what they have learned in

real life (39).

The online learning materials must contain activities to link with the learners at the beginning of the learning session. Demonstrate how students would benefit from getting the class and how they will be able to use what they have learned in real-life circumstances, designed by sequencing from straightforward content to complicate to ensure success. Allow learners to apply what they have learned in real-life settings and provide feedback on their performance (4).

Cognitivism highlights the active role of learners in processing information. Online learning activities that reflect this include critical thinking, analysis, synthesis of information, problem-solving, case studies, simulations, and collaborative projects (40). This approach recognizes the importance of metacognition, which involves learners' awareness and understanding of their own thought processes. Online learning environments can provide opportunities for learners to reflect on their learning, set goals, and monitor their progress, promoting metacognitive skills. Developing forums and social media platforms can enhance this goal. It is acknowledged by cognitivism that learners tend to process information through several channels, including visual, auditory, and kinesthetic. To accommodate diverse cognitive processing styles and enhance learning experiences, online learning environments can make use of multimedia elements, including multimedia presentations that reduce cognitive load and synchronous and asynchronous teaching styles.

Understanding cognitive load is essential in online medical education subjects, including anatomy and pathology, and can be quite challenging because of the high amount of information they contain. It is essential to design courses in a way that helps manage cognitive load and promotes effective learning based on the cognitive load theory. Experts' cognitive schemata, developed through experiences, can be used as worked examples to facilitate medical students' learning and enhance their clinical reasoning skills. This process allows students

to benefit from the structured knowledge and problem-solving approaches of experienced practitioners, helping them to develop their own schemas and improve their diagnostic and decision-making abilities in a clinical setting (41). Interventions based on cognitive psychology play a crucial role in enhancing learning and expertise development in medical education. These interventions involve encouraging self-explanation, engaging in elaborative discussions, practicing distributed learning, reducing cognitive load, advocating for retrieval, and endorsing interleaving practice (42).

Constructivist School of Learning

Constructivism is an evolution of cognitive learning theory. The concept of constructivism dates back to classical antiquity, specifically to the dialogues of Socrates with his pupils, in which he asked probing questions that led his students to discover the flaws in their thinking (43). The essence of constructivist theory is based on the idea that students must uncover and change complex information into other contexts, and this information can then become their own if wanted. Based on this theory, learning must be framed as constructing rather than receiving knowledge (44).

During the 20th century, Jean Piaget and John Dewey formulated theories on childhood development and education, leading to the emergence of constructivism. Piaget's contributions to developmental psychology and cognitive development significantly influenced the constructivist theory. According to his theories, individuals build knowledge by interacting with their experiences and ideas, highlighting the active involvement of the individual in the process of acquiring and creating knowledge (45).

This approach is based on the acquisition of knowledge or the construction of individuals who are learning, which starts with the emergence of cognitive conflict and concludes with the building of knowledge through experience from the results of interaction with the environment at the end of the learning process. The concept of activity

theory within constructivism underscores the significance of learner involvement and participation in aiding the learning process. Learning is viewed as a dynamic process that is intertwined with practical actions and focuses on the activities of learners rather than just passively gaining knowledge. Experiential learning stresses the essential role of hands-on experiences in shaping knowledge. (46).

Vygotsky, who was a contemporary of Piaget, contributed to constructivism by introducing the social aspect of learning. He emphasized the significance of social interaction and cultural tools in shaping cognitive processes. His work further refined the constructivist approach by highlighting the vital role of social and cultural influences on learning (47). Jerome Bruner emphasized active learning, discovery, and narrative in knowledge construction. He proposed scaffolding, which provides support to learners during challenging tasks (48).

The Implications of Constructivist Approach for Online Medical Education

From the constructivist perspective, learning should be an active process. Maintaining learner engagement through meaningful activities promotes high-level processing, which aids in producing individualized meaning. Asking students to apply what they have learned in a real-world setting is an active process that promotes personal interpretation and relevance. In addition, interactive exercises, simulations, and collaborative projects that encourage learners to explore, question, and reflect on the content can be helpful in facilitating active learning (49).

Knowledge is constructed by the learner and is facilitated through interaction with other learners and the instructors. Encouraging cooperative learning and giving control of learning facilitate learning. In addition, learners should have the opportunity to decide on learning goals and time to reflect on and process the information. In online learning, this can be achieved through

adaptive learning technologies and the use of diverse multimedia resources that cater to individual learning styles and preferences (50). Meaningful learning is a focal point, and lessons and content should be made meaningful using associated examples. Personalization of the tasks is another practical suggestion to generate meaningful learning. Interactive learning encourages higher-level learning and allows learners to develop personal meaning (4, 51). Situated learning with a particular focus on meaningful learning, which can create an effective learning environment in online education. Constructivism also highlights the role of social interaction in the learning process. Online learning environments provide opportunities for learners using forums and other platforms to engage in collaborative activities, discussions, and peer feedback, allowing them to construct knowledge through interaction with others (52). Constructivist design principles can serve as the foundation for online learning programs, which aim to provide learners with authentic and real-life learning experiences that help them actively construct their own knowledge. To achieve this, online instructional design can include approaches like problem-based, project-based, and scenario-based learning (53).

Constructivist learning theories advocate for active participation and collaboration among learners. In online medical education, fostering teamwork, collaborative projects, and cooperative learning environments can facilitate knowledge construction and a deeper understanding of medical concepts (54). Constructivism highlights the importance of tailoring instruction to meet individual learning needs and experiences. Online medical educators can design assignments, projects, and activities that allow students to apply and personalize information based on their unique backgrounds and interests (55). Constructivist principles align well with problem-based learning approaches in online medical education. Problem-based Learning encourages learners to engage with real-world problems actively, utilize their cognitive

abilities, think critically, and construct new knowledge collaboratively within a small group setting (56).

Connectivism School of Learning

The connectivism approach to learning theory was introduced by George Siemens and Stephen Downes in 2005. This theory proposes that learning happens when people connect different pieces of information, or “nodes.” It also recognizes the crucial role of technology in the learning process (57). This approach can be defined as a development of constructivism in response to the contemporary situation of substantial use of technology in education (58) functioning as an educational philosophy. It is also the third generation of distant education pedagogy, following behaviorism/cognitivism and social constructivism, and is associated with various educational technologies, designs, and activities (59). Compared to previous schools of thought, Connectivism conveys the learning that takes place outside the learner knowledge utilized by technology within the organization. In addition, learning can be created as an activity directed by a network rather than an experienced peer (46).

Connectivism is a theory that holds the belief that knowledge and learning are not confined to humans alone. It emphasizes that learning is a process of connecting to different opinions and perspectives. The theory also recognizes that non-human appliances can serve as sources of learning. Moreover, it views knowledge as a network and learning as a pattern recognition process. This theory highlights the importance of connections that enable individuals to learn and grow (60). It has also been described as a learning theory for the digital age, highlighting the impact of technology on how people live, communicate, and learn. It integrates principles related to chaos, network, complexity, and self-organization theories (59).

The Implications of Connectivism Approach for Online Medical Education

To build precise and rational knowledge,

learners need to be independent and autonomous and should be allowed to investigate the information. A perfect learning policy in today's digital society is the employment of the internet based on the availability of information (61). Learners must stay up-to-date in their domain and should be active participants in the learning system. As a result, to examine others' thinking and beliefs, learners must connect with others around the world. Therefore, mobile learning is an appropriate tool that provides learners with a networked world that enables them to learn just in time (62).

One of the most notable consequences of connectivism is massive open online courses (MOOCs). Using video-based instructional content in online open access, MOOCs create the opportunity to educate learners to learn anytime and anywhere (63). Furthermore, Wikis, blogs, social media, mobile apps, virtual worlds, and learning management systems are appropriate digital tools that can be used in online learning situations to improve instructor and learner interactions. Connectivism highlights the importance of networked learning, where learners engage in activities that involve making connections and accessing information from diverse sources. In online learning, this can be facilitated through collaborative activities, social media, and online communities that allow learners to interact and share knowledge (64).

Learning in today's world takes place across interconnected networks, and connectivism acknowledges this fact. Furthermore, it recognizes the importance of technology in facilitating such experiences. Online learning allows learners to participate in distributed knowledge networks, such as open educational resources and online communities of practice, providing them with valuable opportunities to learn and contribute (65). This approach promotes social learning, emphasizing the role of social interaction and collaboration in the learning process. Online learning environments can facilitate social learning through social media, discussion forums, and collaborative tools that enable learners

to engage with peers and experts (66).

Connectivism is a learning theory that emphasizes the importance of self-directed learning. It enables learners to take control of their learning process and pursue their interests. Online learning effectively promotes self-directed learning by providing access to open educational resources, online courses, synchronous and asynchronous courses, and personalized learning pathways that cater to individual learning goals and preferences. By leveraging these tools and resources, learners can customize their learning experience and achieve their desired learning outcomes (67).

Connectivism views learning as a networked group effort where individuals connect to nodes within a diverse network. In online medical education, leveraging network technologies at the classroom level can provide students access to a wide range of resources and expertise, enhancing their learning experience. Connectivism emphasizes the need for continuous learning and adaptability in a rapidly changing digital world. In online medical education, this theory encourages educators to design flexible and dynamic learning environments that promote lifelong learning skills and digital literacy among students (68).

Connectivism underscores the importance of nurturing and maintaining connections to facilitate continual learning and community building. Online medical educators can create interactive platforms encouraging collaboration, knowledge sharing, and active student participation, fostering a sense of belonging and engagement (69).

Discussion

The selected learning theories contradict the determined framework: The behaviorism principal assumption is learners' conditioning for learning. Therefore, instructors must generate a controlled, beneficial learning environment. Students are conditioned to bring forth the preferred response for the particular stimulus. The learning process takes place through awareness of results, reinforcing desired responses and supplying

feedback for learners. The affective domain is scarcely considered, contrasting in the case of constructivism. Behaviorism believes in repetition in learning; “The more frequently a stimulus and response occur in association with each other, the stronger the habit will become,” John Watson declared. Repetition is widely applied to online learning. In online situations, when a question is introduced, learners are led to progress to the next screen when they come up with the correct answer. However, if they provide a wrong answer, a statement for the reason of mistake is provided and they are permitted to second chance (5).

Some studies analyzed various aspects of online learning. Suwannaphisit and colleagues analyzed expectations for an online orthopedic course using constructivism theory. This study explores the expectations for an online orthopedic course based on constructivism theory, highlighting the benefits of online learning rooted in constructivist principles for medical education (70).

In another study, the researcher analyzed the impact of E-Learning in medical education. This manuscript discussed the efficiency of e-learning in medical education, emphasizing how learners can acquire knowledge, skills, and attitudes faster through online platforms compared to traditional instructor-led methods. It also addressed the challenges and opportunities presented by e-learning in medical education, including the need for centers of excellence in e-learning and technological advancements to enhance the learning experience (71).

Masters and colleagues published a study entitled “Online Learning in Health Professions Education”. As part of the AMEE Guide for online learning in health professions education, this article delved into foundational concepts, theories, and methods related to online learning in health professions education. It provided insights into how online learning can be effectively integrated into medical education to enhance learning outcomes (72). Our study discussed that, unlike behaviorism, cognitivism looks beyond observable behavior, and cognitivism

considers learning as an internal mental process. Cognitivists focus on the correlation of new learning to previous knowledge. Cognitivists maintain the idea that learners should be actively involved in the learning process, in addition to the cognitivist emphasis on acquiring, processing, and assimilating knowledge in the learning process (73).

According to constructivists, acquiring knowledge demands both individual mental work and social interaction, and learning instruction should be designed to help learners develop meaning for the concepts being taught, ultimately resulting in enhanced learning (74). In addition, constructivism focuses on creating cognitive tools that reflect the cultural perception of the learning environment and the learners’ effort and enthusiasm for learning and applying the concept (75).

Unlike previous learning theories, connectivism holds that learning can be developed through cyber nodes precisely embedded in social networks. It also encourages diversity in thinking to produce knowledge. The learning process is concentrated in the cognitive and affective domains, and the learning is objected to developing rapid connections to networks for gaining knowledge. Instructors expand learning by organizing links to neural networks (76).

Our study revealed that behaviorist, cognitivist, constructivist, and connectivist, share some similarities and dissimilarities, Cognitivism, constructivism, and connectivism believe in operating in the cognitive domain and within learning principles. Behaviorism, as opposed to connectivism and cognitivism, supports the belief that instructors should be learning facilitators, whereas two others focus on the active involvement of the instructors. Cognitivism can be critiqued for its extensive focus on human mental functions as an information-processing model.

All in all, the above-discussed theories offer a variety of recommendations for enhancing the online learning experience.

Based on behaviorist theory, presenting information within context can help learners create associations. Acquired from cognitivism, media-based instruction particularly designed for working memory can be used. As constructivist, instructors can generate both synchronous and asynchronous online activities, using discussion boards, videos, or audios to introduce the subject to the learners. The learners then analyze and discuss the lesson on the discussion board. In addition, connectivism instructors can design the course with technology to establish access to learning networks and promote learning via the integration of technology with a learning experience.

Conclusion

As mentioned, there has been considerable alternation in the thinking, tools, and methods that are used for learning through the past decades from behaviorists until now. Apparently, many overlaps exist in the principles and designs of all existing schools of thought. Therefore, in designing online learning instructions, we can utilize principles from all of them. We can apply Behaviorists' principles to teach the facts, cognitive principles to processes, and constructivist principles for situated learning, and connectivist principles for the design of web-based instruction.

Similarly, it is up to the institutions and instructors to examine the educational aims and situations and select and implement the most appropriate strategies for their instructions. A behavioral approach would be suitable if instructors and educators aim for a learner to acquire a new skill. If the goal is for students and trainees to enhance critical thinking and problem-solving abilities, a cognitivist approach is suggested to be most effective. For fostering the adoption of best practices in a medical environment, utilizing social learning methods where learners emulate expert behavior may prove the most advantageous. Finally, to ensure an understanding of complex concepts like physician-patient relationships or family

dynamics, a constructivist approach may help unravel underlying meanings and challenge assumptions.

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Authors' Contribution

All authors (ZZ, AM, and ZZ) conceptualized the study, and all were major contributors to writing the manuscript. ZZ performed the literature search, in consultation with ZK, assisted with AM. ZZ and AM provided writing and critical revision of the manuscript. ZK has supervised the process. AM and ZZ performed critical revision of the manuscript. All authors approved the final manuscript.

Conflict of Interest

The authors declare no conflict of interest.

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