



## Online learning in supporting students' procedural abilities viewed from a constructivist approach

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### Abstract

The aim of the research is to explain the perspective of online learning in supporting students' procedural abilities from a constructivist perspective. This research uses a literature review methodology to describe topics about online learning, procedural abilities and constructivist theory. Scopus article search engines such as Springer Nature, SAGE, Taylor & Francis and Google Scholar provide the collected literature. There are 350 articles covering the search topic. There were 78 additional articles that met the research variables. Selected articles were evaluated together with 47 references. Online learning has features that conform to the fundamental principles of constructivism. The philosophy of constructivism encourages a learning process that places students as the source of the process through concrete empirical and systematic procedural activities. Meanwhile, online learning provides a new model for how the learning process can be carried out without face to face, and can increase students' abilities, especially in terms of practicums which require procedural abilities in each learning process.

**Keywords:** Learning, online, skills, procedural, constructivist

### Introduction

Continuous growth in distance online learning has been observed in recent years and this learning method is quickly becoming a significant constituent in higher education. However, compared to face-to-face learning, online learning is often faced with lower student persistence and consequently graduation rates. Therefore, the challenge for teachers is to design learning environments that consider students' online learning readiness and motivation factors so that students remain engaged with the material and their assignments (Bovermann *et al.*, 2018) [9]. Fully online programs do not require participants to be on campus for course-related purposes, except with the option to use extracurricular resources (Laborda, 2014) [24]. In these programs, individuals engage in learning activities in a shared "digital space" using a variety of synchronous and asynchronous means. Among fully online programs and models, some focus on supporting highly individualized learning modes with optional forms of collaboration (Blayone *et al.*, 2017) [8]. As online learning becomes more prevalent in higher education, it has become increasingly important to be able to track its progress (Bates, 2018) [7].

Online learning has many challenges in developing a learner-centered environment, most of which stem from the fact that all interactions within it must be mediated through the online environment (Cerro Martínez *et al.*, 2020) [12]. Most online courses must be created before students join (Hew *et al.*, 2020) [18]. At the same time, the characteristics of online media that create these challenges offer unique facilities to be learner-centered (Yu, 2021) [47]. For example, computer-based learning in general has long supported individualized teaching (Han & Ellis, 2021) [17]. The paradigm shift in online learning, overall, is that individualization is the key to innovation in distance education (Lu & Cutumis, 2022) [26].

Quality online learning must include an initial assessment of students' knowledge and skills, (Koh & Daniel, 2022) [21] and an individual learning plan that involves a series of interactive and built-in learning materials (Ouyang *et al.*,

2023) [31]. Online learning with various applications that currently exist is the result of the development of science and technology as a solution to facing various forms of problems in human life, such as the Covid-19 outbreak which has an impact on learning (Richardo *et al.*, 2021) [37]. The existence of online learning will certainly make it easier for students to learn individually, collaboratively in groups or with students, meaning that with this technology students can make it easier to carry out activities in their learning (Ally, 2008) [3]. Some researchers are even experimenting with adaptive hypermedia that adapts to individual learning styles, but there is still a lot of research and development that needs to be done in the area of individualization.

In online learning, students must also be responsible for their learning independence (Syauqi *et al.*, 2020) [44]. Procedural and conceptual knowledge is important knowledge that must be possessed, and it is an interconnected aspect in solving problems in learning (Afrillia *et al.*, 2022) [2]. Procedural knowledge involves understanding rules and routines (Chinnappan & Forrester, 2014) [13]. Procedural Knowledge can also explain how to do something or knowledge about the steps that we must refer to in solving problems and mention or justify ways to solve problems (Pujawan *et al.*, 2022) [33]. Another opinion says that procedural knowledge is knowledge about skills, algorithms, techniques, and special methods in a subject or discipline (Afriliziana & Kartini, 2021) [1]. From several expert opinions, we conclude that procedural knowledge is knowledge of the steps that solve problems using special skills, algorithms, techniques and methods in a subject or scientific discipline.

Student-centered teaching thus recognizes the importance of building the conceptual and cultural knowledge that students bring to their learning experiences (Putri *et al.*, 2023) [35], linking learning to students' experiences and accepting and exploring different perspectives and understandings (Geng *et al.*, 2019) [16]. At the same time student-centered teaching must pay attention to and correct student misconceptions. (Sari, 2021) [38].

The constructivist school believes that the inquiry process is part of the fundamental source of information. Direct interaction activities will build students' knowledge more firmly. A constructivist approach encourages self-confidence, enthusiasm, and deeper curiosity. The process of involving students as learning resources can encourage creativity and productivity. The position of constructivist philosophy on online learning models will be resolved through a comprehensive theoretical study. Theoretical study by paying attention to fundamental principles and aspects from various journals relating to online learning from a constructivist approach. Jean Piaget used the term constructivist in relation to human genetic development (Hof, 2021) [19]. There are four stages of cognitive development, namely sensorimotor (0-2 years), preoperational (2-7 years), concrete operational (7-12 years) and formal operational (12-adult) (Babakr *et al.*, 2019) [4]. Piaget emphasized that individuals construct their own understanding of the world through direct experience and reflection, and that this construction depends on the stage of cognitive development that the individual is undergoing.

At the beginning of the last century, it called for an end to traditional teaching methods and practices and urged to build student experiences (Leshem, 2012) [25]. Piaget's constructivist theory is based on an analogy with evolution and biological adaptation. He believed that children's own actions in the world were important for cognitive development. Cognitive structures are built from simple initial processes in relation to personal actions and experiences. Development is a form of adaptation to the environment. Constructivism is a cognition-based approach that occurs in the learner's world with an individual mental construction process, and the learner is at the center of the learning process in knowledge construction (Zhao *et al.*, 2016) [48]

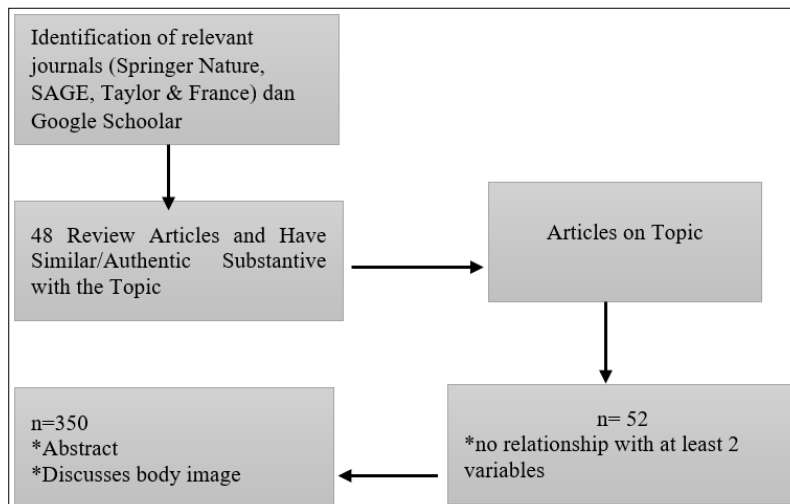
In the process of constructing knowledge, learners are not only active internally but also in a social context with social constructivism learning materials viewing each learner as a unique individual with unique needs and background. Lev Vygotsky is the most important representative of social constructivism Knowledge is not transferred from teacher to student but is constructed in the mind of the student. What is transferred is a set of cultural and linguistic knowledge (Stoltz *et al.*, 2015) [42]

Based on existing theory, the assumption is that the constructivist approach has a role in building online learning models. The constructivist approach emphasizes independence, in line with the online learning model which gives students the freedom to choose what they want to do. When students carry out practical activities with planned products, they demonstrate independence in online learning. One of the advantages of the constructivist process is the concrete experience of lecturers and students in carrying out projects, and the active participation of both in completing the stages of the project process. The aim of the research is to explain how online learning can help students master procedural skills using constructivist methods or perspectives. Basic theories and principles of online learning, procedural abilities, and constructivism are discussed. Constructivist theories and principles are essential to online learning models. The learning process part of the constructivist perspective is applied in the steps of the online learning model.

**Research methods**

This research uses a scoping review. The method used to evaluate existing literature in a research field is known as a scoping review. Scoping review is a literature review method that consists of five steps, including (a) finding research questions; (b) find relevant research; (c) selecting research; (d) displaying data; and (e) finally make conclusions and report results (Titus & Muttungal, 2023) [45]. To conduct a scoping review, researchers used a Scopus database search, which is the largest database of peer-reviewed literature abstracts and citations. The key words are: online learning, procedural ability, and constructivist to find research that discusses the impact of online learning. (Basori *et al.*, 2023) [6]. Reference resources such as, Springer Nature, SAGE, Taylor & Francis and Google Scholar can be accessed via the internet. There were two types of articles searched: full text or open access that focused on online learning variables, procedural and constructivist abilities. Journals that have been collected and selected are in accordance with needs and become research results to be discussed at the next stage. The end of the process results in conclusions regarding discussions and deliberations.

**Data Collection and Analysis**



**Fig 1:** Steps in the article review process

From Figure 1, In the first stage, researchers identify journals that relevant to research topics sourced from springer, SAGE, Google Scholar and so on After obtaining the appropriate journal, the researcher reviews the article according to the substance of the topic then produced articles that fit the topic, for irrelevant articles the researcher did not cite it, and the results of the literature review include abstracts and discussions.

**Table 1:** Mapping of article reviews

No	Variable	Collected			
		Articles	Connected	Selected	Reviews
1	Online Learning	136	89	20	20
2	Procedural Skills	86	46	13	13
3	Constructivist Approach	130	76	15	15
Total		350	211	48	48

These data come from information collected on three variables: "Online Learning," "Procedural Ability," and "Constructive Approach." This data includes the number of articles collected, the number of articles related to the relevant topic, the number of articles selected for review, and the number of articles that have been reviewed. Table 1 explains that articles that discuss online learning A total of 136 articles, and related there are 89 articles and those selected are 20 articles, then For articles that discuss procedural capabilities there are 86 articles, and related 46 articles and selected there are 13 articles And articles that discuss the variables of the constructivist approach there are 130 articles, of which 211 relevant articles and selected 15 articles. hence the results of the article The selected are 48 articles that are relevant according to the topic

**Results and Discussion**

The impact of students' persistence in online learning is that they can be more independent in creating and innovating, lecturers act as instructors only, the university must proactively create and implement interventions to prepare students in the online learning environment and to help them become student agents of change (Stephen & Rockinson-Szapkiw, 2021) [41]. As research has shown that initiatives aimed at student success can increase student persistence and achievement levels in undergraduate students, universities are starting to develop high-impact practices for students in online learning settings. (Seo *et al.*, 2021) [40]. In line with constructivist characteristics, it was found that some lecturers might create error patterns deliberately which seemed to produce many error patterns from memory, which made it difficult to follow standard procedures that they had previously learned. Students knew procedural understanding beforehand. (Putra, 2019) [34]. Providing an explanation of how problem solving procedures in such learning is a challenge for lecturers who act as teachers (Sembiring *et al.*, 2008) [39]

We use a constructivist theoretical approach in this research to see how online learning can improve procedural abilities. We believe that engaging with students or learners empathetically and capturing their subjective experiences is important to understanding their reality. We believe that a constructivist theoretical approach is best for this research. This method helped us discover students' perspectives on unexpected elements of technology in education. (Deepa *et al.*, 2022) [14] Many studies show that the use of information and communication technology in education is beneficial.

These include encouraging creativity, encouraging collaborative learning, increasing student motivation and engagement, supporting independent learning, improving problem-solving abilities, and improving procedural skills (Kwok & Yang, 2017) [23].

All the knowledge we obtain comes from our own reconstruction, it is impossible for knowledge to be transferred from one person to another. Knowledge cannot be transferred from people who already know to people who don't know. If a lecturer or teacher wants to impart knowledge to students, knowledge must be constructed, interpreted and transformed by the students themselves through their own experiences. Many students misunderstand (misconceive) what their teachers teach, indicating that knowledge cannot simply be transferred, on the contrary, students must do it themselves. Constructivism in learning states that, 1) knowledge is built by students themselves, both personally and socially, 2) knowledge cannot be transferred from teacher to student except through students' reasoning activities, 3) students actively construct continuously, so that concepts always develop be more detailed, complete, and in accordance with scientific concepts, and 4) teachers only help provide the environment and environment for learning (Martini, 2017) [27].

Constructivism is applied in online learning so that students are more active and lecturers only help. During learning, lecturers interact directly with students and make plans to evaluate activities. Lecturers have many responsibilities in the classroom, one of which is helping students. To make classes more lively and enthusiastic, the emphasis is that lecturers now play more of a role as facilitators (Rahmawati & Suryadi, 2019) [36]. Initial activity components include relating current lesson material to student experiences or previous learning (apperception), providing motivation, conveying lesson objectives, and conveying the abilities to be achieved. Apperception is an activity that will motivate students' enthusiasm for learning and help lecturers attract student interest by displaying enthusiasm. (Budyastuti & Fauziati, 2021) [11]. Procedural ability or procedural knowledge is the ability to do something involving knowledge of skills and algorithms, method techniques, knowledge criteria, and justification "when to do what" in a particular field or topic (Kusnawa, 2012).

A specific set of actions, operations or actions that must be performed or carried out in a certain way to always obtain the same result under the same circumstances is called a procedure. Many educational experts have discussed constructivist approaches in developing students' procedural abilities. However, it is important to remember that each person may have a different perspective. The following are the opinions of well-known experts on how the constructivist approach affects students' procedural abilities: (a) Jean Piaget: a famous developmental psychologist known as Jean Piaget is one of the important figures in the theory of constructivism. According to Piaget's theory, children build their knowledge actively through interaction with the world around them. In terms of procedural abilities, Piaget would emphasize how important it is to gain practical skills through practice and direct experience (Mukrimaa *et al.*, 2016) [29], (b) A Russian psychologist named Lev Vygotsky created the concept of the zone of proximal development, which states that peers or adults those with more experience can help students learn better. Vygotsky would highlight how important it is to build skills through instruction and

teamwork in the context of procedural abilities. (Newman & Holzman, 2013) <sup>[30]</sup>, (c) A cognitive psychologist, Jerome Bruner emphasizes the importance of a constructivist approach to problem-based learning. He argues that students' procedural abilities can be improved through learning that involves practical problem solving (Bruner, 2006) <sup>[10]</sup>, (Morris, 1975) <sup>[28]</sup>, (d) Seymour Papert advocates a strong constructivist approach through the use of technology in education. He is best known for working with the Logo programming language, which is used to educate children about computer concepts. This method encourages various efforts to teach students programming and computing (Morris, 1975) <sup>[28]</sup> (Wooster & Papert, 1982) <sup>[46]</sup>, (e) David Jonassen is adept at using technology for constructivist learning. He has conducted extensive research on simulation and problem-based learning to improve procedural abilities in various fields, such as engineering and computer science. All of these experts provide useful perspectives on how constructivist approaches can influence students' procedural abilities. (Howland *et al.*, 2013) <sup>[20]</sup> However, it is important to remember that education is an ever-changing field, and our understanding of constructivism and procedural skills may change with time and further research.

A person's ability to perform certain tasks or activities with appropriate skills in a practical or laboratory environment is called procedural ability in the practicum. Procedural abilities in practicum include understanding theoretical and practical concepts and the ability to apply them in real life. Experts from various fields of education and science have given their opinions about how important it is to have the ability to apply procedures in practicum:

(a) David Kolb, created Experiential Learning Theory, which emphasizes the importance of direct experience in learning. According to Kolb, practicum is the best method for improving procedural skills because it involves reflection on experiences, understanding concepts, and applying concepts in real-world contexts. (Kolb, 2015) <sup>[22]</sup>, (b) Lev Vygotsky emphasized how important it is to get guidance when building procedural abilities. By providing direction, support, and feedback, advisors or instructors can play an important role in helping students develop practical skills in practicums. (Newman & Holzman, 2013) <sup>[30]</sup>. (c) John Dewey: was an educator and philosopher who argued that learning is a social experience rooted in action. Practicums allow students to learn through active interaction with material and other people. Real actions supported by reflection and discussion improve procedural abilities. (Dewey, 1938; Kolb, 2015) <sup>[22]</sup>, (d) Charles M. Reigeluth has extensive experience in instructional design. He emphasized that practicums must be designed with clear objectives and tasks that are appropriate to students' abilities. Procedural capabilities can be built with good design. (Prensky, 2016) <sup>[32]</sup>. Donald A. Schön is an educational scientist who studies practitioner reflection, namely a person's ability to think about and understand practical actions. In practicums, students can gain procedural skills by thinking about their practical experiences, finding errors, and planning improvements. (Su, 1996) <sup>[43]</sup>. Overall, an important concept in education and practical skills development is procedural ability in practicum. Experts in various fields have provided valuable perspectives on how practicums can be used to improve

procedural skills and how appropriate learning methods can be used to achieve this goal.

## Conclusion

A constructivist approach to online learning helps students' procedural abilities. The conclusion that can be drawn from the sources that have been collected and processed is that this method can provide an effective environment for students to develop their practical skills. In conclusion, some important points follow:

1. **Active Learning** Students in constructivist-based online learning are actively involved in improving their own knowledge and skills. They not only receive information, but also participate in tasks and activities related to practical applications.
2. **Personal Experience:** The constructivist approach recognizes that personal experience is essential to learning. Students can incorporate their own experiences into online learning, which can help them relate theoretical ideas to situations that occur in the real world.
3. **Collaboration and Interaction:** Constructivist-based online learning often involves teamwork and social interaction. Students can increase their understanding of procedural skills by learning from each other, talking, and sharing experiences
4. **Reflection:** Constructivism encourages us to reflect on what we learn. One important aspect of developing procedural abilities is students' ability to reflect on the tasks and activities they complete, spot errors, and plan improvements.
5. **Significant context:** Online learning must be connected to a context that is significant for students. This may include tasks related to their academic or professional goals.
6. **Use of Technology:** Constructivist approaches often use technology for online learning. Technology such as online learning platforms, simulations, and interactive tools enable students to actively learn and acquire procedural skills virtually.

However, it is important to remember that the success of constructivist-based online learning depends on good design, teacher support, and student participation. Therefore, the constructivist approach must be applied wisely and according to the context and learning objectives because online learning is not suitable for all types of procedural skills.

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