

## Impact of Constructivist Teaching Strategies on the Development of Basic Science Process Skills

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### ABSTRACT

*Scientific literacy in the contemporary knowledge-based society ought to be realized by equipping the students with the underlying skills and abilities, such as Basic Science Process Skills (BSPS), which are observation, classification, inference, measurement, prediction, and communication. The traditional education system is not likely to have the capacity to foster such crucial skills because the teaching system dwells on memorization and passive learning. The current study discusses how the constructivist teaching methods, founded on the principles of active engagement, inquiry, and experiential learning, can be applied to the development of BSPS in learners. This discussion aims to explore how constructivist practices foster a learner-centred environment that facilitates the development of learning skills and cognitive abilities. The paper is qualitative theoretical research that integrates theoretical knowledge with observational expertise of the classroom practices connected with inquiry-based learning, problem-solving tasks, collaborative work, and practical experiments. The findings reveal that the constructivist strategies are very influential in the engagement, critical thinking, and retention and application of scientific knowledge among students. These methods promote a scientific attitude, metacognitive awareness, and internal motivation as well. Despite such problems of the field as rigid curricula, limited resources, and assessment challenges, the research establishes that constructivist designs are an effective way of developing scientific inquiry. It recommends the revision of curricula, enhancement of teacher preparation, and sustaining institutional assistance to establish rich and inquiry-driven science learning environments.*

## 1. Introduction

In a rapidly evolving world, science education enables individuals to think critically, problem solve and make contributions to the society. The skills of seeing, classifying, measuring, predicting, inferring, and communicating are Basic Science Process Skills or BSPS that play a key role in science learning (Abungu et al. 2014). The skills are the foundation of academic success, scientific literacy, and lifelong interest in nature. Passive and routine ways of learning do not contribute to the development of BSPS. Nevertheless, constructivist approaches are more useful as they focus on active learning and doing. The constructivist classroom promotes inquiry and problem solving in science by discovery, collaboration, and critical thinking (Adie et al. 2020).

The move towards constructivist pedagogy has been advocated by educational theorists such as Piaget, Vygotsky and Bruner that contended that effective learning occurs when students are allowed to build their own knowledge. When applied to science, this implies that students should be encouraged to pose questions, explore, make conclusions, and share the findings just as real scientists do (Milena and Petra, 2021). These types of environments do not only develop cognitive and practical skills but also foster creativity, curiosity, and scientific mindset.

### 1a. Objectives of the Study

- To examine the theoretical foundation of constructivist teaching strategies and their alignment with Basic Science Process Skills (BSPS).
- To analyze the role of teachers and pedagogical approaches in fostering BSPS through constructivist methods.
- To evaluate the overall impact, and challenges of applying constructivist strategies in science education.

## 2. Literature Review

**Reyes (2013)** applied constructivism to chemistry labs. The results supported Outcome-Based Education (OBE), which required students to demonstrate learning. Reyes designed critical thinking, practical experimentation, and cooperative learning exercises. This method encouraged students to actively study science. Constructivism training enhanced lab performance, conceptual understanding, and science tool confidence. A study found that constructivist pedagogy promoted deep and transferable scientific knowledge and was consistent with OBE (Reyes, 2013).

**Büyüktaskapu, et al. (2012)** tested 6-year-olds' scientific processing ability after constructivist science instruction. For young learners, the program promotes informal learning, play-based discovery, and directed learning. Science process skills (BSPS) such observation, classification, measurement, prediction, and inference improved significantly. Children gain inquiry skills early on in constructivist instruction because they are curious and interact (Büyüktaskapu et al., 2012).

**Libata, et al. (2023)** investigated how a constructivist module improved science process skill in Form Two children of different cognitive capacities. Science was taught through scaffolded, interactive, and problem-solving experience and reflection. Pre- and post-tests

showed that the program improved students' hypothesizing, experimentation, data analysis, and scientific conclusions. This constructivist flexibility was seen in kids of varied intelligences. Science skills development involves individualized and student-centered learning, says the study (Libata et al., 2023).

### 3. Research Methodology

The qualitative theoretical research design of the proposed study synthesizes literature and theoretical views on constructivist teaching strategies and their effects on Basic Science Process Skills (BSPS). The sources of data were peer-reviewed journals, books, and other reliable academic sources published in 2010-2024 both on the foundational theories (Piaget, Vygotsky, Bruner) and recent empirical results. Sources were chosen based on their relevance to constructivist science education, attention to at least one BSPS, and their contribution to the discourse of instructional strategy. The identification of recurring pattern and pedagogical strategies were identified through a thematic content analysis and the major themes were inquiry-based learning, collaborative learning, problem-based learning, hands-on activities, and scaffolding, which are the foundations of the analysis of the study.

#### 3a. Research Questions

1. How do constructivist teaching strategies align with the development of Basic Science Process Skills (BSPS) in learners?
2. What role do teachers and specific pedagogical approaches play in fostering BSPS through constructivist methods?
3. What are the key impacts and challenges of applying constructivist strategies in science education?

### 4. Theoretical Framework

#### 4a. Constructivist Learning Theory

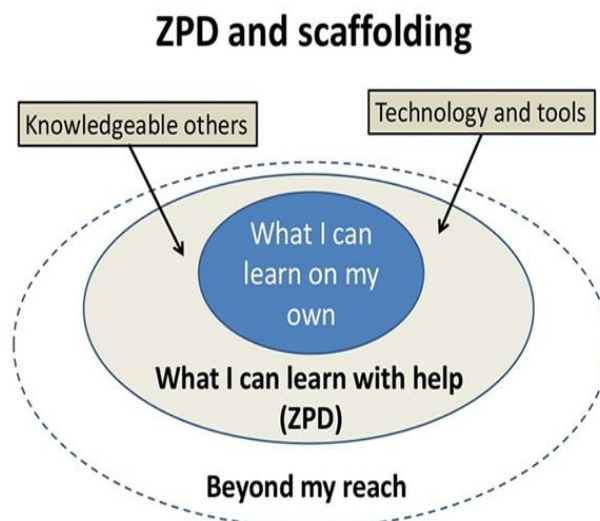
The cognitive constructivism proposed by Jean Piaget stresses the fact that learners go through their stages of cognitive development, developing knowledge by means of assimilation and accommodation (Cobern, 2012). In science learning, it implies that students develop new knowledge in practice-oriented, discovery learning experiences.



**Figure 1:** Jean Piaget's cognitive constructivism theory

(Source: <https://www.simplypsychology.org/piaget.html>)

Social constructivism by Lev Vygotsky emphasizes culture and social interaction in learning. His approach to the Zone of Proximal Development (ZPD) shows how kids can do more with assistance, therefore science classrooms need collaborative learning and guided inquiry.



**Figure 2:** Lev Vygotsky's social constructivism learning theory  
(Source: <https://www.simplypsychology.org/vygotsky.html>)

The theory of discovery learning developed by Jerome Bruner is an argument that students learn more when they discover and investigate. His spiral curriculum method of learning strengthens the process of learning by re-learning at a more advanced level through active participation.

#### **4b. Basic Science Process Skills (BSPS)**

Basic Science Process Skills (BSPS) are the elements of scientific research and are normally taught in early science to facilitate thought and experimentation (Akanwa & Ovute, 2014). These are observation, classification, measurement, inference, prediction, and communication, which help the learners collect and analyze information, make rational conclusions, predict possibilities, and communicate the results. These competencies are in line with constructivist teaching that focuses on learning through inquiry and practice in which students are made to think and behave like scientists.

### **5. Constructivist Teaching Strategies Aligned with BSPS**

Constructivist teaching strategies enable students to actively construct knowledge through engagement, inquiry, and reflection.

#### **5a. Inquiry-Based Learning**

This enables the students to ask questions, set up experiments, gather data and make conclusions, thus acquiring the skills of observation, measurement and inference (Ekon et al., 2014). As an example, the process of plant growth in the light of various intensity will enable students to make observations and interpret findings critically.



offer reflective feedback to facilitate metacognition, where students can evaluate their understanding, refine their ideas and look into alternative options (Qarareh, 2016).

## 7. Impact on Learner Development

The constructivist methods of teaching introduce revolutionary changes in the development of a learner- cognitively, affectively, and behaviorally, in particular, in the development of Basic Science Process Skills (BSPS).

### a) Cognitive Development

Constructivist approaches move learning to a level beyond memorization- to hypothesis, analysis and conclusion. This improves BSPS, including inference and prediction and develops metacognitive awareness (Idris, 2022).

### b) Formation of Scientific Attitude

A scientific attitude is fostered by constructivist teaching by stimulating curiosity, critical inquiry, and evidence openness. The students start to recognize science as a process of discovery and not as a collection of facts.



**Figure 4: Scientific Attitude**

(Source: <https://www.allresearchjournal.com/archives/2022/vol8issue7/PartA/8-7-25-667.pdf>)

### c) Enhanced Retention and Transfer of Learning

By being relevant in the real world and engaging in active problem-solving, the learners more easily memorize the concepts and use them in different situations. This long-term learning is more than rote learning with the help of this deep learning.

### d) Participation and Inspiration

Constructivist classrooms will further the intrinsic motivation because the learning process is based on student inquiry, choice, and collaboration. This is a student-centered model, which maintains interest and confidence.

## 8. Challenges and Considerations

Although constructivist strategies have been found to be useful in improving Basic Science Process Skills (BSPS), there are a number of obstacles in the implementation. Strict curriculum that emphasizes rote learning does not leave much space to inquiry-based learning (Kruea-In and Buaraphan, 2014). The standardized tests cannot measure important BSPS such as observation or inference and therefore skills are underestimated. Moreover, most teachers are not well trained in constructivist approach and have a poor understanding of their role in the learning process. Shortage of resources and crowded classrooms also reduce practical student-based activities (Iofciu et al., 2012).

## 9. Conclusion and Suggestions

### 9a. Conclusion

This research concludes that constructivist pedagogical methods are central towards promoting the acquisition of Basic Science Process Skills (BSPS) in learners. These strategies also help establish a positive learning experience by moving away the rote learning experience to active discovery, exploration, and thinking. Not only does the students learn scientific concepts more efficiently, but also learn to be critical in their means of observation, inference, measurement and communication. The teacher as facilitator, contextual tasks, and practical activities altogether bring about more profound knowledge and scientific thinking. Amidst the issues associated with the rigidity of curriculum, assessment constraints, and resource shortage, the results support that constructivist strategies are very useful in facilitating scientific literacy. Thus, educational stakeholders have to focus on constructivist pedagogy by means of curriculum reformation, teacher education, and institutional assistance to realize its potential in science education in full.

### 9b. Suggestions

- 1. Teacher Professional Development:** Training sessions ought to be scheduled on a routine basis in order to prepare the teachers with practical skills on how to apply inquiry and student-centered pedagogies.
- 2. Resource Allocation:** Schools are to be equipped with sufficient laboratory equipment, teaching aids and ICT tools to facilitate experiential and hands on learning.
- 3. Collaborative Learning Culture:** Educational institutions should encourage collaborative projects and peer-learning to improve students' communication, teamwork, and scientific thinking.
- 4. Future Research:** Future research should employ longitudinal and experimental methods to assess constructivist tactics' effects on BSPS growth in different learning settings.

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