

Theoretical Foundation of Constructivist Teaching Strategies and Their Alignment with Basic Science Process Skills (BSPS)

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Article Info	ABSTRACT
<p>Article History: Received: 27th July 2025 Accepted: 30th July 2025 Published: 04th August 2025</p>	<p>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 is aimed at discussing how constructivist practices create a learner-centred environment which aids in learning skills and developing cognition. 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 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.</p>
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Introduction

In a world that is changing quickly, science education is crucial because it creates people who can think critically, solve issues, and contribute significantly to society. Among the most crucial components of effective science learning are Basic Science Process Skills (BSPS), which include observing, classifying, measuring, predicting, inferring, and communicating (Abungu et al. 2014). Academic success, the growth of scientific literacy, and a lifetime interest in the natural world all depend on these abilities.

The building of BSPS is not sufficiently made possible by traditional, frequently rote-centered, and passive learning teaching approaches. Conversely, constructivist methods are more successful since they emphasise learning by doing and active learning. Exploration, teamwork, and critical thinking—qualities of scientific inquiry and problem-solving—are made possible in the constructivist classroom (Adie et al. 2020).

Educational theorists like Piaget, Vygotsky, and Bruner have pushed for the shift to constructivist teaching, arguing that when students are allowed to expand their knowledge, they learn more effectively. This suggests that, like actual scientists, kids should be encouraged to ask questions, do research, draw conclusions, and communicate their findings (Milena and Petra, 2021). These kinds of settings encourage creativity, curiosity, and a scientific mentality in addition to the development of cognitive and practical skills.

Objectives of the Study

- To investigate how constructivist teaching methods relate to Basic Science Process Skills (BSPS) and their theoretical underpinnings.

Literature Review

Hilal Aklamis & Omer Ergin (2008) conducted a study on the effect of science process Skills in education on students' scientific creativity, science attitude, and academic achievements. The study aimed to investigate the effect of teaching scientific process skills on students to promote scientific creativity, attitude towards science and achievement in science. The subject of research consisted of 40 students of seventh grade of an elementary school in Buca district of Izmir province in Turkey. The result of research concluded that the Scientific Process skills in education increased the student's achievement and scientific creativity; however, no meaningful progress was made on their attitude towards science when compared to teacher teacher-centered method.

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 as observation, classification, measurement, prediction, and inference improved significantly. Children gain inquiry skills early on in constructivist instruction because they are curious and interact. Constructionist approaches may assist young individuals in developing basic scientific abilities and a positive science mindset, according to the study (Büyüktaskapu et al., 2012).

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).

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 experiences 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).

Theoretical Framework

Constructivist Learning Theory

According to Jean Piaget's cognitive constructivism, knowledge is acquired through assimilation and accommodation as students progress through their cognitive development stages (Cobern, 2012). It suggests that in science education, students get new information through hands-on, discovery-based learning experiences.

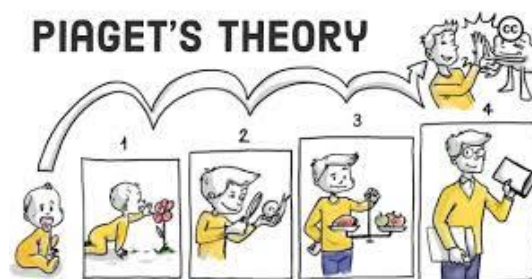


Figure 1: Jean Piaget's cognitive constructivism theory
(Source: <https://www.simplypsychology.org/piaget.html>)

Lev Vygotsky's social constructivism emphasises culture and social interaction as components of education. His theory of the Zone of Proximal Development (ZPD) shows how children can do more with direction; as a result, directed inquiry and collaborative learning are crucial in scientific classrooms.

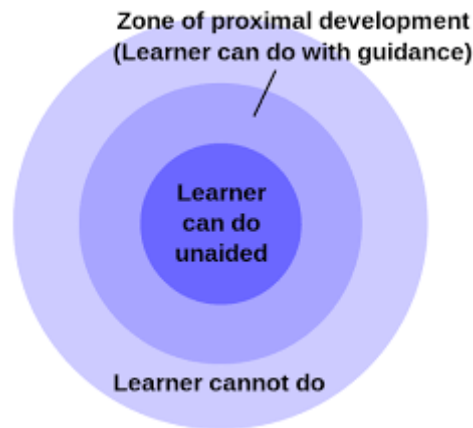


Figure 2: Lev Vygotsky's social constructivism learning theory
(Source: <https://www.simplypsychology.org/vygotsky.html>)

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.

Basic Science Process Skills (BSPS)

The skills of basic science process (BSPS) are the backbones of scientific inquiry and are essential in how students learn science and their participation in the science (Akanwa and Ovute, 2014). These are skills that are usually taught at the early stages of science learning and they aid in thinking and experimentation.

- **Observation:** The use of senses in order to determine and explain changes or characteristics of objects or events.
- **Classification:** To place items together depending on common characteristics so as to improve analytical skills.
- **Measurement:** The quantification of attributes with the help of standard tools in order to make it accurate.
- **Inference:** Making sense out of observations and previous knowledge through logical conclusions.
- **Prediction:** To foresee some outcomes based on what has been observed or what evidence has been seen.

- **Communication:** Presenting scientific thoughts and findings in an intelligible fashion, either in writing, pictures, or orally.

Such skills are consistent with constructivist instruction, which focuses on inquiry-based and practical learning in which students learn to think and act like scientists.

Constructivist Teaching Strategies Aligned with BSPS

Students can actively create knowledge through engagement, inquiry, and reflection while using constructivist teaching methods.

Learning through Inquiry

This helps students learn how to observe, measure, and draw conclusions by allowing them to pose questions, conduct experiments, collect data, and draw conclusions (Ekon et al., 2014). Students will be able to observe and critically analyse results, for instance, by following the growth of plants under different levels of light.

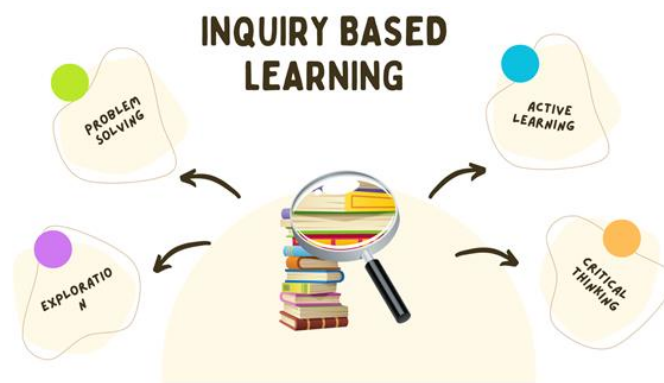


Figure 3: Inquiry-Based Learning

(Source: <https://prepwithharshita.com/inquiry-learning-model/>)

Collaborative Learning

Based on the theory of Vygotsky's social constructivism, collaborative learning promotes the sharing of knowledge among groups. Such activities as sorting rocks by texture encourage communication and classification, which are important in scientific collaboration and teamwork, and interpersonal skills.

Problem-Based Learning (PBL)

PBL exposes students to real-world issues that need investigation and reasoning. An issue such as how to clean up the river fosters analytical thinking, inference, and prediction while enhancing scientific literacy and self-reliance (Ukozor, 2011).

Hands-On and Experiential Activities

Examples include assisting BSPS with observation, measurement, and classification; working with materials and scientific tools; and giving concrete form to abstract notions. These

techniques increase engagement and retention through learning by doing. The materials, practical tasks, and Basic Science Process Skills they generate are listed in the table below.

Table 1: Hands-On and Experiential Activities for Enhancing BSPS

Activity	Materials/Tools	BSPS Developed
Chemical reactions	Beakers, reagents, Bunsen burner	Observation, Measurement, Inference
Electrical circuit building	Wires, batteries, bulbs, switches	Classification, Prediction
Measuring temperature change	Thermometer, water, various materials	Measurement, Inference
Leaf classification	Plant samples, hand lenses	Classification, Observation
Solubility testing	Salt, sugar, sand, beakers	Measurement, Observation

(Source: Self-Generated)

Scaffolding

The idea of scaffolding is to provide pupils with temporary educational support so they can pick up new skills. For example, a teacher can demonstrate density calculation to their students and then gradually reduce assistance as they gain independence. It improves metacognitive awareness, prediction, and inference.

Conclusion

According to the study's findings, constructivist teaching strategies are essential for helping students develop their Basic Science Process Skills (BSPS). By switching from rote learning to active discovery, exploration, and thinking, these techniques also aid in creating a good learning environment. Students not only acquire scientific topics more quickly, but they also develop critical thinking skills in their communication, measurement, inference, and observational methods.

Contextual tasks, practical activities, and the teacher's role as a facilitator all contribute to deeper understanding and scientific thinking. Notwithstanding the problems with curriculum rigidity, assessment limitations, and resource scarcity, the findings demonstrate the great value of constructivist approaches in promoting scientific literacy. To fully realise constructivist pedagogy's promise in science education, educational stakeholders must concentrate on it through curriculum reformation, teacher training, and institutional support.

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