

A Critical Examination of the Prince Edward Island Grade 2 Science Curriculum: Alignment with Constructivist and Inquiry-Based Learning Approaches

Noman Tahir^{1*}, Waheed Ur Rehman², Syed Salman Mahmood³, Mushtaq Haider Malik³

¹Department of Computing Sciences, Gulf College, Muscat, Sultanate of Oman

²Department of Business & Accounting, Muscat College, Muscat, Sultanate of Oman

³Department of Mathematics & Statistics, Abu Dhabi University, Abu Dhabi, United Arab Emirates

*Corresponding author: Noman Tahir, noman@gulfcollege.edu.om

Abstract

This paper presents a critical examination of the Prince Edward Island (PEI) Grade 2 Science Curriculum, evaluating its alignment with established constructivist and inquiry-based learning (IBL) models. Through a curriculum theory lens, the analysis explores how the curriculum's structure, pedagogical approaches, and assessment strategies reflect the principles of theorists like Tyler, Taba, Stenhouse, and Freire. The findings indicate that the curriculum demonstrates significant strengths, including a strong emphasis on hands-on, student-centered inquiry, Science-Technology-Society-Environment (STSE) connections, and diverse, formative assessment methods that foster scientific literacy. However, the analysis also identifies areas for improvement, such as the limited integration of equity, Indigenous perspectives, and critical pedagogy, potential teacher workload challenges, and a need for more standardized assessment rubrics. The paper concludes with recommendations to enhance equity integration, provide targeted teacher support, develop clearer assessment guidelines, and expand socio-scientific debates to further strengthen the curriculum's effectiveness and inclusivity in preparing students for the complexities of the modern world.

Keywords

Science Curriculum, Inquiry-Based Learning, Constructivism, Curriculum Analysis, Equity in Education

1. Introduction

The paper discusses the Prince Edward Island (PEI) Grade 2 Science Curriculum, published by the Department of Education through the English Programs division. This analysis rests on curriculum theory, with a focus on seeing to what extent the curriculum is congruent with constructivist and inquiry-based learning models, considered effective in science education. Constructivism as espoused by Piaget and Vygotsky holds that learners actively construct their own knowledge via exploration and reflection, while inquiry teaching develops scientific thought by encouraging students to raise questions, investigate phenomena, and draw conclusions from evidence [1].

The PEI Grade 2 Science Curriculum is a stipulated framework for implementing the science program in Atlantic Canada, which specifies learning outcomes, instructional strategies, and assessment methods. One of the curriculum's major strengths lies in fostering scientific literacy, which entails both core knowledge of scientific concepts and processes of thinking, problem-solving, and forming views of what constitutes science. The curriculum then goes ahead to emphasize the hands-on process of learning—a feature of inquiry-based pedagogy—in which students themselves conduct experiments, make observations, or undertake other group activities that constitute real-world scientific endeavors [2].

In addition, the curriculum embodies a student-centered approach, with the teacher serving merely as a facilitator rather than the lone authority, thereby giving students the chance to engage themselves in the learning process. This bears out current educational research that argues for learner autonomy and differentiated instruction. Yet the paper also looks at any possible gaps or weaknesses that might be in the curriculum, including to what extent it accommodates within its framework various learning styles; embraces Indigenous knowledge systems; or employs technologies that could augment inquiry-based learning. Through this discourse set in the parameters of curriculum theory, we aim to inform about the strengths of the PEI Grade 2 Science Curriculum, point out some weak points, and generally contribute to the collective dialogue on good science education in early elementary school [3].

1.1 Professional and National Context

There is a decentralized system in Canada for Science education on behalf of what the education is regulated, and provinces and territories establish their own curriculum while keeping the things maintained to national standards. Its primary framework is the Common Framework of Science Learning Outcomes K to 12, which was developed in 1997 by the Council of Ministers of Education, Canada (CMEC) to unify and uphold standards in science education throughout the country. The pan-Canadian framework highlights several key learning areas such as basic scientific knowledge, inquiry skills, and linkages between science, technology, society, and the environment (STSE). With these key principles embedded into it, the science curriculum of Prince Edward Island (PEI) closely follows this framework while further adapting content with respect to regional educational concerns [4].

There is a certain approach adopted by STSE that forms the major component of primary education institution's science curriculum and most of the Canadian science curriculum is designed with this approach. According to this approach, students are required to examine the relationship between scientific advancement, societal needs and technical breakthroughs and keeping the environment in a well and healthy shape. This broader point of view helps the students to see science as a good discipline that is connected to the actual problems, and it is just not a single idea or a theme considered as a separate topic. The main emphasis of this curriculum is to develop skills, and these involve developing ideas and designing different studies that may examine different ideas and can develop a specific thinking style for science. This guarantees that students not only acquire information but also develop the abilities necessary for scientific inquiry. Curricula are under more pressure to get students prepared for a rapidly changing, tech-heavy world as the globe puts more stress on STEM education. Policy makers and educators contend that excellent STEM instruction should go beyond rote memorization. Rather than concentrating on critical thinking, creativity, teamwork, and problem-solving. They consider these abilities essential for being an informed citizen and holding future jobs. This calls for investigation of whether science curricula, including PEI's contribution, develop these abilities and motivate pupils to keep learning all their lives. Still, difficulties remain in guaranteeing equal access to top-level STEM education, especially in underserved or rural schools, and in including Indigenous knowledge systems that provide insightful alternative viewpoints on science and sustainability. Moreover, curricula have to always evolve to guarantee relevance as artificial intelligence and digital technology transform the labor. This essay evaluates how well the PEI science curriculum prepares students for the complexities of the 21st century by critically analyzing it within this wider context and determines its efficacy in satisfying current educational needs [4].

1.2 Research Aim and Significance

This paper tries to find answers as given below:

- How does the PEI Grade 2 Science Curriculum reflect constructivist and inquiry-based learning principles?
- What are the strengths and limitations of its pedagogical and assessment approaches?

The significance of this analysis lies in its implications for curriculum design, teacher training, and policy development. If the curriculum successfully integrates student-centered, experiential learning, it can serve as a model for other regions. Conversely, if gaps exist, recommendations can be made to enhance its effectiveness.

2. Literature Review

2.1 Curriculum Theories and Models in Science Education

Curriculum theories and models are very important in which the foundation of any educational program is based and built and if we talk about the field of science education, there are number of influential curriculum models that have shaped how learning objectives are framed, pedagogical strategies are launched, and outcomes of the students are assessed through different assessment methods. To cope with such factors, there are different models like Tyler's Rationale, Taba's Indicative Model, Stenhouse's Process Model and Freire's Critical Pedagogy are bench marked for any type of educational curriculum settings. Let's have a review of these models one by one and see how these models support Prince Edward Island science curriculum for Primary Education Institutions by highlighting its practical applications and philosophical means.

2.1.1 Tyler's Rationale (1949)

Ralph Taylor introduced a model in 1949 that is labeled as "Basic Principles of Curriculum and Instructions" and this model is considered one of the most basic and influential models in the field of education [5]. The model explains a linear and systematic approach to keep the educational process simple and straight forward. There are some basic questions related to curriculum development around which Taylor's model moves:

1. What educational purposes should the school seek to attain?
2. What educational experiences can be provided to attain these purposes?
3. How can these educational experiences be effectively organized?
4. How can we determine whether these purposes are being achieved?

The above questions not only provide practical and realistic details but also give the idea of a framework that emphasizes the alignment between learning outcomes, instructional methods and assessments as well and if we talk about the context of PEI science curriculum, Taylor's influence is particularly evident and clear. According to this, a curriculum should specify general curriculum outcomes (GCO) and specific curriculum outcomes (SCO) which should be coherent to the educational aims. These are supported by suggested learning activities and strategies for organizing content and assessing student understanding. If we talk about elementary science units where students are guided to explore biological processes and physical phenomena and earth sciences through planned activities that are clearly tied to the stated outcomes and assessment is also an integral part of the process, with tools such as performance tasks, science journals, and observation checklists employed to evaluate students' achievement of learning goals. Thus, the PEI curriculum exemplifies Tyler's rationale by ensuring that educational objectives drive both instruction and evaluation.

2.1.2 Taba's Inductive Model (1962)

There is an advancement found in 1962 when Hilda Taba's advanced and alternative model was introduced to support more inductive, teacher-led approach for curriculum development. Taba posted in her book which is named "Curriculum Development: Theory and Practice" that curriculum should be developed from the grounds and it should be having a beginning with specific teaching-learning experiences before forming generalized aims. This model places a strong emphasis on the role of teachers as curriculum designers and on the use of empirical classroom evidence to shape broader educational goals. According to Taba's model and its philosophy, PEI curriculum should focus on experiential and hands on learning process. As far as science education is concerned, students should be encouraged to start with the tangible and concrete observations and activities and should be experienced to follow these activities with the passage of time. These activities and experiments may include examining life cycles through real specimens or testing the properties of different materials etc. [6]. These activities allow students to draw conclusions and develop general scientific principles inductively. Rather than starting with abstract theories, students construct knowledge based on their experiences, which aligns with Taba's model of progressing from the particular to the general. Besides all above, the PEI curriculum also inspires teacher compliance and responsiveness by enabling educators to modify and design instruction based on students' interests and needs. So, we can say that this flexibility supports Taba's vision of curriculum as an evolving, dynamic process shaped by the classroom environment and informed by student feedback.

2.1.3 Stenhouse's Process Model (1975)

Stenhouse criticized the seemingly set prescriptive nature of objectives-based models in his influential work, *An Introduction to Curriculum Research and Development* (1975). The learned scholar thus favored inquiry, critical thinking, and student autonomy over fixed objectives. His belief was that education ought to provide students with the freedom to ask questions, explore options, and not merely learn pre-established knowledge. The PEI curriculum stays true to this process-oriented philosophy by assisting student-driven inquiry and open-ended investigation. As one example, students inquire into the effects of forces on the motion of an object, where they establish hypotheses, carry out different tests to question their hypotheses, and reflect on what they discovered. This will foster a scientific mindset and promote the idea of students learning through their interpretations as opposed to learning a set body of scientific theory. Stenhouse went on to advocate the professional autonomy of teachers as he felt teachers must be researchers within their own classrooms [7]. The PEI science curriculum echoes this by encouraging teachers to engage in reflective practice, to adapt lessons in response to the needs of students, and to co-construct knowledge with their learners. Therefore, while the curriculum supports student-centered learning, it equally affirms a teacher-centered perspective that sees the teacher as central to facilitating intellectual exploration.

2.1.4 Freire's Critical Pedagogy (1970)

Paulo Freire's Pedagogy of the oppressed revolutionized educational thought, concentrating on dialogue, critical consciousness, and social justice. Freire expounded on how the "banking model" was an undesirable model of education in which knowledge was simply deposited into the passive learners, basing himself on education through dialogue and co-learning [8]. To Freire, education was a political act; the classroom was an arena where inequities were confronted and emancipated thinking was cultivated.

While faced with the fact that the science curriculum of PEI does not directly associate itself with the revolutionary tone of Freire, similar traits of critical pedagogy linger in it via its Science-Technology-Society-Environment (STSE) outcomes. These outcomes require students to consider the ethical, environmental, and societal implications of scientific issues. For cases of water conservation, students are learning not merely the science behind water cycles but also investigating human responsibilities regarding environmental decisions and impacts on communities.

Therefore, through empowerment for critical thought upon real-life issues, the curriculum engenders a sense of social responsibility and the development of active and knowledgeable citizens. While this is not overtly politicized, the takeaway commitment to equity, environmental stewardship, and global awareness certainly bears resemblance to Freirean ideals.

2.2 Contemporary Debates in Science Education

Beyond classical curriculum theories, contemporary discourse in science education is shaped by ongoing debates

around inquiry-based learning, constructivism, and assessment practices. These frameworks reflect evolving understandings of how students learn best and how educational systems can respond to diverse learners and changing societal needs.

2.3 Inquiry-Based Learning (IBL)

Currently, active research in science education changes much of the way teachers taught in previous times. Questioning is a major element of IBL. Hence, rather than emphasizing memory and parrot-like answers, learning in IBL puts an emphasis on questioning skills, critical thinking, and scientific reasoning [9].

The PEI curriculum applies the principles of inquiry learning by aligning questions with lessons and allowing students to undertake their own scientific investigations. Students make predictions, set up and carry out investigations, observe, gather data, and draw conclusions-the standard features of scientific inquiry. For example, if students study magnetism or ecosystems, they may only design experiments on their own or explore how variations change the results.

The experiences impart both content knowledge and a deeper understanding of the nature of science. Students learn that science is exploration and discovery and not a static arrangement of facts. This fosters engagement, motivation, and ownership toward their own learning.

Constructivism: Piaget and Vygotsky

There are constructivist theories of learning especially formulated by Piaget and Vygotsky and these theories are considered the core of theoretical foundation of IBL. There are stages of cognitive development and Piaget's theory emphasizes this with the importance of hands-on experiences in constructing knowledge. If we talk about Vygotsky who meanwhile highlighted the role of social interaction and cultural tools in learning that may be motivation to the learners. Vygotsky also introduced scaffolding in the field of education [10]. If we talk about Constructivism, in fact this suggests that learners actively build knowledge through interaction with their environment and with others. And the PEI curriculum reflects these principles by integrating combined learning opportunities such as group investigations, peer discussions, and projects that connect science to students' lives. Like, we can say that students might explore the properties of materials by working in teams to test different substances or investigate the environmental impact of waste through community-based projects. Such type of social and experiential dimension of learning aligns closely with Vygotsky's emphasis on mediated learning and underscores the importance of context, language, and collaboration in science education which was something totally new. Teachers are encouraged to facilitate learning rather than transmit knowledge, supporting students as they make meaning from their experiences.

2.4 Assessment for Learning (AfL)

If we review some of the previous history related to education, we may find that assessment procedures have changed significantly. There are now standardized tests and different traditional summative evaluations used appropriately for student learning processes. On the other hand, the idea of Assessment for Learning (AfL), which was made popular by Black and Wiliam (1998) emphasizes formative assessment techniques that enhance student development and improve instruction [11].

Nowadays, we can see that assessments are used not only for AfL but also to encourage learning process. Self-assessments, questioning, observations, learning diaries and feedback like processes a have developed continuous insights into students' comprehension. This strategy is supported by the PEI science curriculum, which encourages instructors to use assessment data to inform instruction and suggests a range of formative assessment options.

Students can be evaluated by teachers through science diaries in order to figure out misconceptions and also to find out unreliable records which can be formulated through group projects or to pose open-ended questions to elicit deeper and detailed thinking. By using these strategies, teachers may adapt to the unique learning requirements of each student and create a more responsive, inclusive learning environment. AfL also promotes a method to assessment that is more efficient and equitable by reorienting the emphasis from grading to growth.

There is an extensive background of curriculum theories and models which range from Tyler's systematic goals-based approach to Stenhouse's process oriented inquiry model and Freire's critical pedagogy. We see that these theories have greatly shaped the PEI scientific curriculum. Also, by including constructivist principles, inquiry based learning, and formative assessment we see the curriculum put into practice current best pedagogic and assessment practices. Through this we have a dynamic, student-centered curriculum which includes community engagement, critical thinking, and team work as well as scientific literacy. Science curricula like PEI's show the continuing relevance of fundamental curriculum theories while concurrently accepting cutting-edge practices that equip students for the complexity of the modern world as educational priorities continue to shift in response to societal, environmental, and technological changes. And future studies could examine how these models are applied in various classroom settings and how they affect student participation and performance, particularly for marginalized or underrepresented groups [12].

2.5 Gaps in Literature

While many studies support IBL, critics argue:

- Time constraints may limit deep inquiry [13].

- Teacher preparedness affects implementation [14].
- Assessment validity - Can open-ended tasks reliably measure learning?

This paper positions itself within these debates by evaluating the practicality and theoretical grounding of the PEI curriculum.

3. Analysis of the Curriculum Artefact

3.1 Curriculum Aims and Underlying Philosophy

The curriculum's General Curriculum Outcomes (GCOs) emphasize:

3.1.1 STSE (Science-Technology-Society-Environment Connections)

There are four major GCOs that serve as the foundation for Prince Edward Island Grade 2 Science Curriculum where GCO stands for General Curriculum outcomes and these offer a complete framework for teaching sciences. At first, students are encouraged to find out and properly investigate the links amongst different factors like scientific ideas, technological application and social demand and environmental effects with STSE. This is a kind of interdisciplinary approach that is promoting critical thinking for topics which are aligned with the sustainability and effects of humans on ecosystems while helping the students to see science as a dynamic and logical profession.

3.1.2 Skills (Inquiry, Problem-Solving, Decision-Making)

In this area of concern, the curriculum offers and emphasizes the development of different critical abilities like decision making, problem solving and other scientific research that might be helpful to develop different skills and expertise. In this area of expertise, students may improve their abilities so that they can formulate questions and can also make predictions. They will also be able to collect and analyze different types of data and can finalize conclusion based on evidence. There is an emphasis on practical assessment as well to equip the student to solve more difficult STEM problems.

3.1.3 Knowledge (Life, Physical, Earth Sciences)

The focus of the third general curriculum outcome is to acquire knowledge in three fundamental scientific fields that are Earth sciences which include weather, natural resources and other related patterns, physical sciences that also related different state of matters and their transformation and biological sciences that provides an understanding of life cycles of plants and animals. This is the basis of further scientific topics and give fundamental comprehension to the students.

3.1.4 Attitudes (Curiosity, Collaboration, Safety)

This factor is responsible for improving the critical attitude towards science in such a way that all learners should be aware of safety and security. They should be curious and logical and should know how to work in team while supporting team members. The purpose of this factor of curriculum is to seek and build both scientific competency as well as positive attitudes towards science.

Above detailed four GCOS work together to provide an appropriate, well-structured approach to scientific education that may improve positive learning and practical skills. These factors also help to understand real-world applicability and insight.

3.2 Pedagogical Principles and Teaching Approaches

The curriculum advocates:

- Hands-on experiments
- Collaborative learning
- Student questioning

These strategies align with constructivism and Taba's inductive model. However, the teacher's role is sometimes directive (e.g., predefined experiments), which may limit Stenhouse's open-ended inquiry.

3.3 Content Structure and Sequence

The curriculum is organized into four units:

1. Animal Growth & Changes (Life Science)
2. Air & Water in the Environment (Earth Science)
3. Liquids & Solids (Physical Science)
4. Relative Position & Motion (Physical Science)

Each unit follows a four-column spread:

1. Outcomes (What students should learn)
2. Elaborations (Teaching strategies)
3. Assessment Tasks (Performance, journals, interviews)
4. Resources (Books, activities)

This structure ensures alignment between objectives, pedagogy, and assessment (Tyler's rationale).

3.4 Assessment Alignment and Learner Relevance

The curriculum uses diverse assessments:

- Performance tasks (e.g., designing a floating device).
- Journals (Reflecting on observations).
- Interviews (Verbal explanations).

This aligns with AfL but may lack standardized benchmarks, raising questions about consistency in evaluation.

4. Discussion

4.1 Strengths

There are multiple strengths that are shown by the demonstrated curriculum, and these strengths are aligned with contemporary best practices for science education. For example, we talk about IBL approaches that support the students to be active participants in their learning process by involving them in different experiences, problem solving tasks and open-ended investigations. Students are simply encouraged to find out and explore further concepts rather than receiving just information. This sort of approach gives a deeper understanding and engagement for the students to keep their knowledge up to date because this is completely reflected by direct experience and reflection.

Supporting the students to understand real-world issues is also one of the key strengths of the mentioned curriculum integrated by STSE. For example, understanding the units on water conservation and material properties encourage students to find out the interaction of environmental sustainability and our social needs. Additionally, the curriculum supports flexible assessment strategies, allowing students to demonstrate their understanding in multiple ways. Rather than relying solely on traditional tests, teachers can use observational checklists, student journals, project-based assessments, and peer evaluations. This approach accommodates diverse learning styles and provides a more holistic view of student progress, aligning with principles of differentiated instruction and Assessment for Learning (AfL).

Weaknesses & Areas of Improvement

Despite its strengths, the curriculum has some limitations that warrant consideration. One notable weakness is the limited emphasis on equity and social justice, with Freire's critical pedagogy remaining underdeveloped. While the STSE framework encourages discussions about societal impacts, there is minimal explicit focus on systemic inequities, Indigenous perspectives, or culturally responsive teaching. Strengthening these elements could make the curriculum more inclusive and socially transformative.

Another challenge is the potential increase in teacher workload, as designing and facilitating hands-on, inquiry-based activities require significant preparation time and access to materials. Schools with limited resources may struggle to implement these components effectively, potentially creating disparities in science education quality across different learning environments. Providing teachers with structured lesson supports, digital resources, and professional development could help mitigate this issue.

Finally, while flexible assessment is a strength, it may also introduce subjectivity in evaluating student performance. Without clear rubrics, exemplars, or moderation processes, assessments could lack consistency across classrooms. Developing standardized assessment guidelines while maintaining flexibility could enhance reliability while still accommodating diverse demonstrations of learning. Addressing these weaknesses would further strengthen the curriculum's effectiveness and equity in science education.

5. Conclusion and Recommendations

5.1 Key Findings

- The PEI curriculum effectively integrates inquiry-based and constructivist approaches.
- STSE outcomes promote real-world relevance but could better address equity.
- Assessment diversity supports differentiated learning but may need standardization.

5.2 Recommendations

5.2.1 Enhance Equity Integration

To strengthen the PEI Grade 2 Science Curriculum, several key enhancements should be considered. First, the curriculum would benefit from deeper equity integration, particularly through expanded discussions on environmental justice. This could involve lessons examining pollution, resource access, and climate change disproportionately affect marginalized communities. By introducing age-appropriate case studies (e.g., clean water disparities in Indigenous communities), students can begin understanding science as both a technical and social endeavor, aligning with critical pedagogy principles while fostering empathy and civic awareness.

5.2.2 Providing Teacher Support

Second, targeted teacher support should be provided through ongoing professional development focused on inquiry-based learning (IBL). Many educators need training to effectively facilitate open-ended investigations while managing classroom logistics. Workshops could model scaffolded inquiry techniques-such as gradual release of responsibility in student-led experiments-and share strategies for adapting activities to diverse learners. Additionally, creating a shared online repository of lesson plans and low-cost material alternatives could reduce implementation barriers for resource-constrained schools.

5.2.3 Develop Assessment of Rubrics

Third, the curriculum requires developed assessment rubrics to maintain rigor in evaluating open-ended tasks. While flexibility in student demonstrations of learning is valuable, standardized rubrics with criteria for scientific reasoning (e.g., hypothesis formulation, data accuracy) and communication (e.g., clarity of explanations) would improve grading consistency. Annotated exemplars of student work at varying proficiency levels could further clarify expectations for both teachers and learners.

5.2.4 Expand Socio-Scientific Debates

Lastly, the curriculum should expand socio-scientific debates by incorporating ethical dilemmas that intersect with science content. For instance, units on materials science could debate plastic use trade-offs (convenience vs. ocean pollution), while life science lessons might discuss habitat destruction from urban development. Structured "science talks" with role-playing activities would help students articulate evidence-based positions, weighing scientific facts against societal values-a key skill for future STEM-literate citizens. These additions would elevate the curriculum's relevance while nurturing critical thinking beyond textbook knowledge.

References

- [1] B. Pei, W. Xing, G. Zhu, K. Antonyan, and C. Xie, "Integrating infrared technologies in science learning: An evidence-based reasoning perspective," *Educ. Inf. Technol.*, vol. 28, no. 7, pp. 8423-8443, 2023.
- [2] W. Pei, "Curriculum reform of science in elementary schools in China," *Beijing Int. Rev. Educ.*, vol. 1, no. 2-3, pp. 573-578, 2019.
- [3] P.-Y. Lin, C. S. Chai, W. Di, and X. Wang, "Modeling Chinese teachers' efficacies for the teaching of integrated STEM with interdisciplinary communication and epistemic fluency," *Front. Psychol.*, vol. 13, p. 908421, 2022.
- [4] O. F. M. O. F. E. COUNCIL, "CANADÁ. Common framework of science learning outcomes," Toronto C. Secr., 1997.
- [5] U. Läänemets and K. Kalamees-Ruubel, "The taba-tyler rationales," *J. Am. Assoc. Adv. Curric. Stud.*, vol. 9, no. 2, 2013.
- [6] F. C. Lunenburg, "Curriculum development: Inductive models," *Schooling*, vol. 2, no. 1, pp. 1-8, 2011.
- [7] M. James, "An alternative to the objectives model: the process model for the design and development of curriculum," in *Curriculum, Pedagogy and Educational Research*, Routledge, 2012, pp. 61-83.
- [8] I. Shor, "Paulo Freire's critical pedagogy," *Paulo Freire A Crit. Encount.*, vol. 23, 1993.
- [9] J. L. Bybee, "From usage to grammar: The mind's response to repetition," *Language (Baltim.)*, vol. 82, no. 4, pp. 711-733, 2006.
- [10] K. Khadidja, "Constructivist theories of Piaget and Vygotsky: Implications for pedagogical practices," 2020.
- [11] P. Black and D. Wiliam, "Assessment and classroom learning," *Assess. Educ. Princ. policy Pract.*, vol. 5, no. 1, pp. 7-74, 1998.
- [12] M. T. Flórez and P. Sammons, *Assessment for Learning: Effects and Impact*. ERIC, 2013.
- [13] P. A. Kirschner, J. Sweller, and R. E. Clark, "Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching," *Educ. Psychol.*, vol. 41, no. 2, pp. 75-86, 2006.
- [14] B. A. Crawford, "Embracing the essence of inquiry: New roles for science teachers," *J. Res. Sci. Teach. Off. J. Natl. Assoc. Res. Sci. Teach.*, vol. 37, no. 9, pp. 916-937, 2000.