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DISCOVERING ONE'S OWN KNOWLEDGE: A CRITICAL REVIEW AND OPPORTUNITIES FOR IMPLEMENTING DISCOVERY LEARNING IN THE DIGITAL ERA

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Abstrak

Pendidikan abad ke-21 menuntut pendekatan pembelajaran yang tidak hanya mentransmisikan pengetahuan, tetapi juga mendorong siswa untuk aktif membangun pemahamannya sendiri melalui keterlibatan langsung dan berpikir kritis. Dalam konteks ini, pendekatan discovery learning atau pembelajaran penemuan menjadi semakin relevan. Discovery learning pertama kali dipopulerkan oleh Jerome S. Bruner pada tahun 1960-an sebagai sebuah pendekatan belajar yang menekankan proses aktif menemukan konsep dan prinsip melalui eksplorasi dan pengalaman langsung. Pendekatan ini berakar pada teori konstruktivisme yang meyakini bahwa pengetahuan dibangun melalui interaksi aktif dengan lingkungan dan keterlibatan kognitif peserta didik. Penelitian ini mengadopsi pendekatan kualitatif dengan jenis studi pustaka (library research). Tujuan utama penelitian ini adalah mengkaji secara mendalam prinsip-prinsip discovery learning, menelusuri kemungkinan penerapannya di era digital, dan menelusuri tantangan dan keterbatasan dalam penerapannya.

Kata kunci : discovery learning; era digital; model pembelajaran.

Abstract

21st century education demands a learning approach that not only transmits knowledge but also encourages students to actively construct their own understanding through direct involvement and critical thinking. In this context, the discovery learning approach becomes increasingly relevant. Discovery learning was first popularized by Jerome S. Bruner in the 1960s as a learning approach that emphasizes the active process of discovering concepts and principles through exploration and direct experience. This approach is rooted in the theory of constructivism which believes that knowledge is constructed through active interaction with the environment and the cognitive involvement of learners. This study adopts a qualitative approach with a library research type. The main objectives of this study are to examine in depth the principles of discovery learning, explore the possibilities of its application in the digital era, and explore the challenges and limitations in its application.

Keywords*: discovery learning; digital era; instructional model.*

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I. Introduction

In his book The Process of Education (1960), Jerome S. Bruner dedicated a chapter to learning through discovery, expressing the idea that knowledge, cannot simply be learned but must be discovered. Discovery ensures understanding, whereas learning alone may be verbal, superficial, non-transferable, and soon forgotten. Discovery, on the other hand, is possible only by building understanding on the basis of extension, elaboration, or reformulation of current or previous understanding. Starting from a chapter in this book, "discovery learning" has become a kind of official pedagogy in the last three decades (Bakhurst & Shanker, 2001).

According to Bruner, scientific knowledge is the result of 'making' and that children's learning is also a matter of making and discovering. Bruner said that:

> *Science is not something that exists out there in nature, but ... a tool in the mind of the knower ... and you don't really ever get there unless you do it, as a learner, on your own terms. All one can do for a learner en route to her forming a view of her own is to aid and abet her on her own voyage.*
>
> *— Bruner, J. S. (1966). The Culture of Education. Harvard University Press, p. 115.*

Bruner (1960) developed the concept of discovery learning by stating that students should "not be presented with the subject matter in its final form, but instead be asked to organize it themselves. Students are required to discover for themselves the relationships that exist among items of information."

Bruner (1961) proposed that learners construct their own knowledge and do this by organizing and categorizing information using a coding system. Bruner believed that the most effective way to develop a coding system is to discover it rather than have it told to them by the teacher. The concept of discovery learning implies that students construct their own knowledge for themselves (also known as the constructivist approach).

> *The best way to learn a subject is to discover it for yourself.*
>
> *– Bruner, J. S. (1961). The Act of Discovery. Harvard Educational Review.*

The result is a highly active form of learning, where students are always engaged in tasks, finding patterns or solving puzzles, and where students constantly need to exercise existing schemas, rearrange and transform these concepts to meet the challenges of the task at hand.

The rapid development of digital technology has changed the face of global education. Conventional face-to-face learning models are shifting towards technology-based learning, whether in the form of blended learning, virtual learning environments (VLEs), or massive open online courses (MOOCs). This transformation provides new opportunities for the implementation of discovery learning, but at the same time raises

challenges in terms of learning design, teacher readiness, and the increasingly diverse characteristics of students.

Although discovery learning is theoretically able to equip students with critical thinking skills, problem solving, and independent learning—important attributes in facing the 21st century world of work—its application in the context of digital learning still requires methodological and pedagogical adjustments. Several important questions arise: *To what extent can discovery learning be adapted in a digital context? and what are the challenges and limitations?*

II. Methods

This study adopts a qualitative approach with a library research type. The qualitative approach is descriptive and tends to rely on analysis in its process. In this study, attention is more directed at the process and meaning contained in a phenomenon. This approach is used to analyze and interpret facts, symptoms, and events based on actual events, so that they can be used as a basis for further study (Nasution, 2023).

The data sources used in this study come from literature such as journal articles, proceedings, and books that discuss the theory of discovery learning. The main objective of this study is to examine in depth the principles of discovery learning, explore the possibility of its application in the digital era, and explore the challenges and limitations in its application.

III. Discussion

A. Background of the birth of Discovery Learning

Discovery learning is rooted in the thoughts of Jerome S. Bruner in his book The Process of Education (1960). This model was born as a response to the traditional education system that emphasizes memorization of facts without deep understanding. Bruner emphasized the need for educational reform to be in line with the development of science and the needs of students. Several main points that underlie the birth of discovery learning (Bruner, 1960)(Bruner, 1961)(Bruner, 1966):

1. Educational Reform: Bruner highlighted the importance of learning based on understanding the structure of science, not just rote memorization, for effective knowledge transfer.
2. Knowledge Structure: Understanding the basic structure of scientific disciplines is considered important to help students remember and apply knowledge in various contexts.
3. Readiness to Learn: Bruner rejected the view that difficult concepts can only be taught at a certain age. He introduced a spiral curriculum, where basic concepts are introduced early and developed gradually.
4. Intuitive and Analytical Thinking: Education must foster both types of thinking in a balanced way to improve students' problem-solving abilities.

5. Motivation to Learn: Intrinsic motivation such as curiosity is considered a key factor in effective learning. Bruner encouraged a learning environment that fosters interest and a positive attitude towards knowledge.
6. Teaching Aids: Teaching media such as audio-visuals and technology can enrich learning, as long as they are used appropriately by teachers to support understanding, not just entertainment.

According to Bruner (1961), there are four benefits that can be obtained from the experience of learning through self-discovery: (1) Increased intellectual potential, (2) shifting from extrinsic to intrinsic rewards, (3) learning discovery heuristics, and (4) assistance for memory processing. Overall, discovery learning is born from the belief that students will learn better if they actively discover concepts through a meaningful thinking process, with the right teacher guidance.

B. Theories Underlying Discovery Learning

Bruner developed several theories that are interrelated with each other and applied in the discovery learning model, some call it Bruner's Theory of Instruction, some call it Bruner's Child Development. These theories can be described as follows (Bruner, 1960).

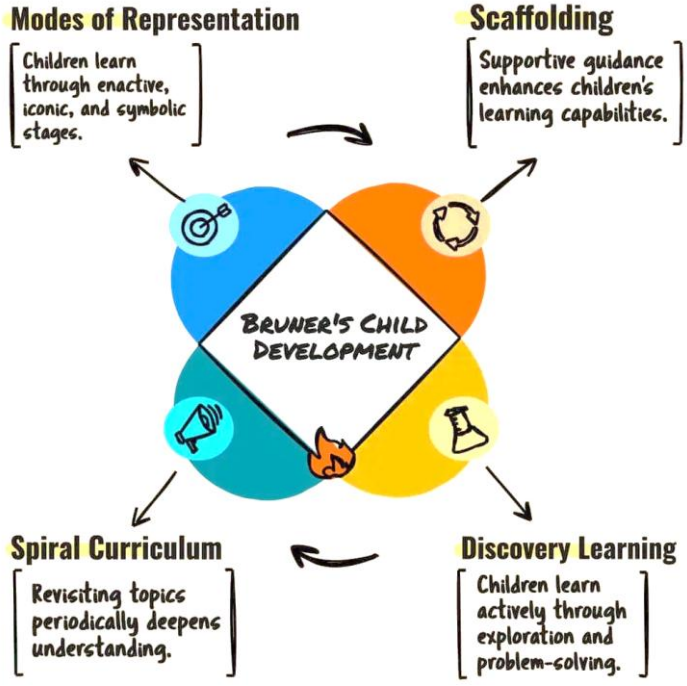

Figure 1. Bruner's Child Development
Sumber: https://www.earlyyears.tv/

The theories developed by Bruner are the basis for the development of the discovery learning model in addition to other theories that are indeed used as a basis such as the cognitive constructivism theory and the zone of proximal development (ZPD) theory. The learning theory that is the basis for the development of the discovery

learning model is explained as follows (Bruner, 1960)(Bruner, 1966)(Wood et al., 1976).

1. Cognitive Constructivism Theory

Jerome Bruner stated that learning is an active process in which students construct knowledge through interaction with the environment. Students do not passively receive information, but rather discover their own meaning. This is the basis of discovery learning, which emphasizes the active role of students in exploration and independent learning.

2. Cognitive Representation Theory

Bruner developed the theory that intellectual development proceeds through three stages of representation:

- Enactive (0–3 years): Knowledge through action.
- Iconic (3–6 years): Image-based knowledge.
- Symbolic (7 years and above): Knowledge in the form of symbols, language, and numbers.

Effective learning must be adapted to this representation stage so that students are able to build understanding gradually.

3. Spiral Curriculum Theory

Bruner suggests that concepts can be taught early and repeated in increasingly complex forms as students age. The spiral curriculum allows revisiting of key ideas to deepen and deepen understanding. This is in line with the discovery learning approach which allows for gradual and iterative learning.

4. Scaffolding Theory

Scaffolding is temporary support from teachers so that students can complete tasks that are within their reach. Teachers must actively provide assistance such as: attracting attention, simplifying tasks, maintaining focus, pointing out errors, controlling frustration, and providing examples. This concept is important in discovery learning, where students are helped to discover knowledge on their own.

5. Zone of Proximal Development (ZPD) Theory

Developed by Vygotsky and adapted by Bruner, the ZPD is the range of abilities that students can achieve with assistance. This shows the importance of guidance from more experts to develop skills that students have not yet fully mastered, which is the core of the discovery learning process.

C. Is Discovery Learning a Model?

Joyce et al. (2015) provide characteristics of the learning model, namely having model parts in implementation, consisting of learning steps (syntax), social system, the existence of reaction principles, and support systems. If an analysis is carried out on discovery learning, then discovery learning can be said to be a learning model because it meets the 4 (four) characteristics.

1. *Syntax*

Although Bruner did not explicitly develop the syntax for discovery learning, this model has many syntaxes developed by experts, one example of which is the 6 stages developed by the Indonesian Ministry of Education and Culture (Kharismawati et al., 2020), namely stimulation, problem statement (problem identification), data collection, data processing, verification (proof), and generalization (drawing conclusions).

2. *Social System*

In discovery learning, there are roles of teachers and students in classroom interactions:

- The teacher acts as a facilitator and scaffolder when needed.
- Students are active, independent, and collaborative, discussing and sharing data and findings.
- There is an open, dialogic learning environment that encourages critical thinking.

3. *Principles of Reaction*

In discovery learning, there are principles of reaction such as:

- Teachers provide support as needed, do not immediately provide answers.
- Teachers respond to students' ideas positively and openly, so that students are encouraged to continue thinking and finding out.
- Teachers provide open questions to challenge students' ways of thinking.
- Teachers facilitate the process of reflection on students' findings.

4. *Support System*

Discovery learning has a support system, and this is one of the important things emphasized by Bruner in the background of the birth of discovery learning, namely teaching aids. Bruner said that:

> *There exist devices to aid the teacher in extending the student's range of experience, in helping him to understand the underlying structure of the material he is learning, and in dramatizing the significance of what he is learning.*
>
> *— Bruner, J. S. (1960). The Process of Education. Harvard University Press, p. 84*

In the application of discovery learning, facilities and resources are needed such as:

- Various learning resources: books, articles, digital media, experiments, case studies.
- Exploration-rich learning environments, such as flexible classrooms, laboratories, or internet access.
- Support from learning technology for data collection and analysis.
- Evaluation tools that focus on the thinking process, not just the end result.

Furthermore, if we look at the classification of learning models carried out by Joyce, Weil, and Calhoun in the book Models of Teaching (2015), this discovery learning model can be included in the group "The Information-Processing Family of Models", because this group includes learning models that focus on how individuals process information, develop thinking skills, analyze, solve problems, and understand concepts, and encourage the formation of cognitive structures and intellectual skills.

The models in the Information-Processing Family of Models group are based on cognitive theory and this is in accordance with the discovery learning model. The discovery learning model is oriented towards the development of thinking skills and information processing by students actively and independently, in line with cognitive theory.

The discovery learning model involves high-level thinking skills such as analysis, synthesis, evaluation, and drawing conclusions, focuses on processing information through exploratory learning experiences, and requires students to organize and reorganize information, not just passively receive facts.

D. Implementation of Discovery Learning in the Digital Era

The rapid development of digital technology has changed the face of global education. Conventional face-to-face learning models are shifting towards technology-based learning, whether in the form of blended learning, virtual learning environments (VLEs), or massive open online courses (MOOCs). This transformation provides new opportunities for the implementation of discovery learning, but at the same time raises challenges in terms of learning design, teacher readiness, and the increasingly diverse characteristics of students.

To what extent can discovery learning be adapted in a digital context?

Discovery Learning is highly adaptable in a digital context and can even be extended through technology. In a digital environment, this approach allows for more interactive, self-directed, and exploration-based learning. Discovery Learning is highly possible and effective to be adapted in a digital context, with technology expanding opportunities for exploration, interactivity, and personalization in learning. Here are some examples of aspects of adaptation.

1. **Simulations and Virtual Labs**
   Digitization allows students to experiment in simulated environments without real risks. Interactive simulations, such as those developed in the PhET (Physics Education Technology) project, can significantly improve students' understanding of scientific concepts. These simulations enable discovery learning by providing an interactive and dynamic environment, facilitating active exploration, reducing cognitive load, and increasing engagement (Wieman et al., 2008).

2. **Game-Based Learning dan Edutainment**
   Educational games provide challenges and puzzles that encourage students to discover concepts independently, in line with the principle of discovery (Gee, 2003).

3. **Adaptive Learning Platforms**
   Platforms such as Khan Academy, Duolingo, and Coursera provide learning paths that are tailored to students' progress, allowing them to explore material at their own pace (Shah, 2023).

4. **Augmented Reality (AR) and Virtual Reality (VR)**
   AR and VR allow for direct exploration of complex or physically inaccessible learning environments, such as space or human anatomy (Radianti et al., 2020).

5. **Chatbots & AI Tutors**
   Chatbots and AI Tutors are a perfect fit for Discovery Learning as they provide self-directed exploration, adaptive scaffolding, and dialogue-based learning as well as personalization, all of which are in line with Bruner and Vygotsky's theories (Luckin, 2018)(Holmes et al., 2019)(DNE-TN2, 2024).

6. **Online Collaborative Discovery**
   Discovery learning in blended learning or virtual classrooms. Tools such as Google Workspace, Padlet, and Miro facilitate collaboration and exploration of ideas between students in digital project-based learning (DNE-TN2, 2024).

What are the challenges and limitations?

Although it has various advantages and can be applied in learning in the digital era, the discovery learning model also has challenges in its application in the digital era.

1. **Technology Access Gap (Digital Divide)**
   Not all students have access to devices, internet connections, or supportive learning environments. This hinders the implementation of digital discovery learning that relies on independent exploration and online resources.

2. Need for Digital Literacy Skills

Digital discovery learning requires students to have digital literacy, platform navigation skills, and critical thinking skills. Students who are not yet trained can feel overwhelmed or confused in independent exploration.

3. High Cognitive Load

In an information-rich digital environment, students can experience information overload. Without sufficient guidance or scaffolding, they may not be able to distinguish relevant and important information.

4. A More Complex Role of Teachers

Teachers must be active facilitators, content designers, and technology advocates. This requires additional training and pedagogical-technological readiness that is not always available.

5. Difficult Learning Evaluation

Assessment of learning outcomes in discovery learning—especially in the form of digital exploration—is not always easy to measure quantitatively. More complex, authentic evaluation tools are needed.

6. Risk of Lack of Structure

Discovery learning that is too free in a digital context can cause confusion if there is no clear framework or instructions.

IV. Conclusion

The Discovery Learning learning model is an approach that emphasizes the active role of students in the process of finding knowledge independently. Through stages such as stimulation, problem formulation, data collection, data processing, proof, and drawing conclusions, students are encouraged to think critically, creatively, and analytically. Although discovery learning is a model that has been created for a long time, discovery learning remains relevant and has great potential for use in learning in the digital era. Adaptation with technological support is the key to its successful use. This approach requires the active role of teachers as facilitators and designers of learning experiences.

Although discovery learning in the digital era promises great opportunities for active and independent learning, its implementation faces challenges in the form of technology access, teacher and student readiness, cognitive load, and evaluation difficulties. This approach must be designed with the right scaffolding, structure, and technology support.

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