IMPLEMENTING GUIDED DISCOVERY LEARNING IN SCIENCE CLASSROOM

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Vygotsky believed that students learn complex problems that are tasks in the Zone of Proximal Development. Here, students get a chance to uncover existing knowledge and create new knowledge. If teachers are eager for students to get such delightful experiences in their science classroom, in such an environment, students get a chance to uncover existing knowledge and create new knowledge. If we want students to get such wonderful experiences in their science classroom, we need to implement Guided Discovery Learning that will be appropriate learning methods for students. Guided Discovery Learning is based on a constructivist approach that gives full autonomy to students to manipulate, modify and explore new things in their own way. It emphasises to foster learners' ability to uncover the things, exploration, problem-solving and independent thinking. Guided discovery also provides an opportunity for students to create and discover things through creative learning. Present paper throws light on how Guided Discovery Learning is implemented in science classroom with appropriate examples and also discusses basic concept of Guided Discovery Learning, role of teacher and rules that must be kept in mind, while implementing this learning in classroom.

Keywords: Guided Discovery Learning, Science Classroom, Traditional Learning, Discovery Learning

Guided Discovery Learning: Creation of Knowledge

Students of the 21st century prefer to learn things through active participation rather than as spectators (Leadbeater, 2010). Now it is a big challenge for teachers to implement new pedagogy for the 21st century that can develop new competencies that today's learners need. Conventional teaching-learning methods focused on rote learning, thus such teaching methods will not foster learners' critical thinking skills or autonomy. If we want to develop higher order thinking skills among students, then we must engage individuals in meaningful enquiry-based learning. It will be relevant for them personally and their communities too. Real-world and first-hand experiences provide opportunities for learners to construct and organise knowledge; engage in detailed research, enquiry, writing and analysis; and communicate effectively to audiences (Scott, 2015). Simamora, Saragih and Hasratuddin (2019) emphasised that Discovery Learning was based on enquiry-based constructivist learning theory. In such types of environment, learners use their previous knowledge and experience to find facts and relationships with the new material being studied (Bruner, 1961). Through Discovery Learning, the teacher provides opportunities for the students to become problem solvers, scientists, historians or mathematicians (Simamora, Saragih and Hasratuddin, 2019). Amin (1998)

said that students can uncover the facts, concepts and principles through their own mental processes by active participation in the teaching-learning process, which is designed by teachers. Guided Discovery Learning is one of the innovative teaching methods that is focused on the philosophical belief of constructivist approach. In the constructivism, people construct their own understanding of reality rather than assimilate a body of knowledge about one's world and environment. Constructivists believe we construct meaning based upon our interactions with our surroundings. It gives importance to students' experiences and their socio-cultural background. In the guided discovery teaching and learning environment, students are enthusiastic and interested, and actively participate in uncovering or discovering knowledge. The main aim of it is to provide a situation, where students get opportunities for deep learning and viewing a problem from multiple perspectives. The instructional belief is that, if the students are able to create new knowledge, they would in the process, create and add to their own understanding. They will have formulated and evaluated hypotheses, rejected those that do not seem to explain observations, confronted misconceptions, encountered surprises and finally come to an understanding that comports with experiment (Simamora, Saragih and Hasratuddin, 2019). By reproducing or uncovering the knowledge which already exists but is, heretofore, unknown to them, students will also understand how to create new knowledge and they will get training in inductive reasoning—the method used to construct most human knowledge.

Guided Discovery Learning is student-centred, with the role of a teacher as a guide or facilitator. Guidance given by the teacher is limited because if there are too many guidelines for discovery, then learning will be similar to direct learning and thus, learning loses its benefits (Yang et al., 2010). Students enquire about the given situations. Suchman (1962) emphasised that enquiry-based teaching-learning is based on the assumption that enquiry is a natural way of learning and it helps human beings to learn about their environment. In a guided discovery learning environment, fundamental understanding of the learner develops. Such a conducive and healthy teaching-learning atmosphere provides the learner an opportunity to view problems from multiple perspectives.

Discovery, exploration, problem-solving and independent thinking — these abilities can be fostered in guided discovery learning environment, as such an environment motivates the students to engage in creative thinking. In Guided Discovery Learning, students engage with full energy and have the opportunity to construct their own knowledge (Shieh and Yu, 2016). They also found that guided discovery instruction would positively affect students' performance as well as influence learning retention. Guided Discovery Learning is the learning based on the pattern of the scientific method to find problem-solving by students in groups. The various steps of this learning such as stimulation, problem statement or identification, data collection, data processing and verification to drawing conclusions (Yerizon, Putra and Subhan, 2018). Alfieri et al. (2011) conducted a comparative study between unassisted discovery learning, direct instruction or explicit learning and guided discovery

learning. He suggested that unassisted discovery does not benefit learners, whereas feedback, worked examples, scaffolding and elicited explanations do. Herdiana, Wahyudin and Sispiyati (2017) reported that guided discovery learning is an effective way for improving mathematical problem solving ability among students.

Discovery vs Traditional Learning

In Discovery Learning, teachers focus more on students' participation in hands-on and problem-solving activities whereas in traditional classroom, teachers simply transfer their knowledge through lecturing. In such an atmosphere, the teachers are the transmitter and students are the recipient of bits of information (knowledge). In traditional classrooms, students have no chance to learn, manipulate or create new knowledge with their own pace and speed. In Discovery Learning, students have a chance to identify the content that they want to know. Here, teachers provide appropriate environment to them for learning. As guidance, teachers can use scaffolding or give certain tasks in the form of students' worksheets (Yerizon, Putra and Subhan, 2018). In Discovery Learning, the students can find something more, if the teacher is engaged in preparing a variety of material to be delivered in advance. Students are encouraged to primarily study themselves through active involvement by finding principles in understanding concepts (Wardani, Leo and Yunianto, 2015). In conventional classrooms, teachers focus more on students' results rather than the process of understanding the content. Science is a process as well as a product, so there is a need to give importance on science process skills so that, students learn how to create knowledge. Students get such opportunities in Discovery Learning classrooms. If students fail to find an end product or new knowledge in a Discovery Learning environment, then it gives encouragement to students to contribute to search the solution of the given problems. Such opportunities are missing in traditional teaching.

In Discovery Learning, students are actively involved in thought-processes resulting to change experience to bits of knowledge. When we interact with an object or situation, many questions arise in our mind about that object. To find out the answers, we examine the object, carry out some tests and compare it with other familiar objects. Observing, theorising, experimenting and theory testing — these activities are essential processes of discovery. Such a process also gives training for inductive reasoning.

Suyanti and Purba (2017) found that the student's achievement when taught by Discovery Learning model is better than the student's achievement when taught by direct instructional method. Discovery Learning is a learning process that focuses on developing the student's intellectual mindset to solve various problems, discover concepts and generalise them for real life applications (Illahi, 2012).

Rules to Conduct Sessions in Guided Discovery Classroom

1. Questions to be posed by students
2. Freedom to ask questions and teachers help to formulate a theory
3. Teacher's response (yes, no or may be) should be non-judgmental to the theory or hypothesis framed by students

4. Testing theories or hypotheses
5. Cooperation by encouraging students to work in groups
6. Experimenting by giving access to books and laboratory so that students can explore at will within limits

Steps

1. Exploration—Teacher presents divergent questions.
2. Invention—With the help of teachers, students find meaning.
3. Discovery—Students apply the learning experiences to new situations that they learned in exploration and invention.

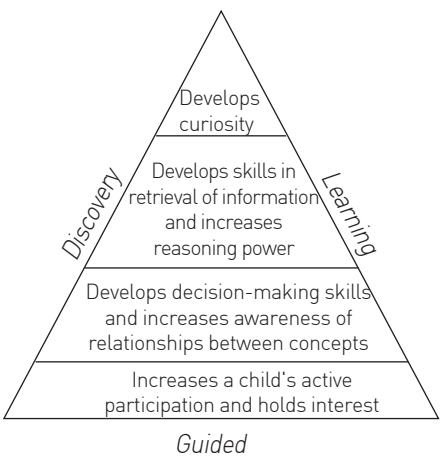

Fig. 1. Learning pyramid for guided discovery learning

Role of Teacher

As Guided Discovery Learning is based on a constructivist approach, teachers play a role as a facilitator in science classrooms. Teacher's role is shifted towards a mentor or guide. Here, students actively participate in constructing and reconstructing the meaning-making (acquiring knowledge) process progressively on their own, under the proper guidance of teachers and interaction with peers. Teachers think about various situations and experiments or activities, which generate curiosity and questions among learners. If students divert from content, teachers provide some signals or clues rather than solving the problems. Teachers always motivate the students to ask questions, and appreciate and respect their responses. It is observed that questions generally begin with why. Teachers match sophistication of the problem to the level of students by selecting a problem and choosing a media to match students' background. Teachers give full freedom to students in creating new knowledge. They play the role of silent observers. They stay alert and actively observe the class activities done by students. Learning is interactive and based on previous knowledge. So, there is a major scope for development of higher cognitive faculties like problem-solving abilities, critical thinking and reflective thinking.

Procedures to Implement Guided Discovery in Teaching and Learning Activities

Yerizon, Putra and Subhan (2018) suggested the following procedures that must be implemented in general teaching and learning activities in science classrooms:

1. **Stimulation:** At this stage, the students are confronted with problems related to the subject. The purpose is to create confusion so as to arouse the students' desire to explore on their own. In this

part, teachers can start conducting learning activities by asking questions or asking students to read some books.

2. **Problem Statement:** Now, teachers identify as many possible agenda or issues as relevant to the lesson material. Then, one of them is selected to formulate a temporary answer to the problem question, that is, hypothesis. At this stage, the teacher provides opportunities to students to interact with problems they face, and identify and analyse it in detail. This technique is useful in building the mindset of the students to get them accustomed to finding a problem.
3. **Data Collection:** Students gather as much data and relevant information as possible about the given problems or situations and try to find solutions or to prove their hypothesis. For this purpose, relevant data can be collected in various ways such as reading literature, observing objects, interviewing respondents, experimenting by themselves, and so forth.
4. **Data Processing:** At this stage, students try to get a valid conclusion from the relevant data collected at the previous stage. They compare data with the related theory and analyse their connection in order to solve the problems. In this way, students gain new knowledge about alternative solutions to the problems.
5. **Verification:** Learners attempt to prove whether the tentative solution or, we can say, hypothesis has been established or not. The statements or hypotheses

Table 1: Implementation in Science Classroom
Topic: Metal and Non-metal

Steps	Teacher's activity	Students' Activities
Exploration	Teacher indicates or shows some objects with that teacher coming in class and then present divergent questions like what objects you observed in your surroundings, how they differ from each other, etc. Present the problem and ask students to either hypothesise possible explanations or begin gathering data. Facilitate the students to collect different small objects that are available in their surroundings like chalk, pencil, spoon, ball, keyring, plastic lunch box, etc.	Students observe their surroundings and collect objects and try to find answers. Students try to make a list of materials from which the objects were made. Data gathering and hypothesising continue in a cycle with hypothesis being eliminated or revised on the basis of data gathered that may further data gathering and the cycle continues and hypotheses for all data is developed.

Invention	Teacher plays a role as a facilitator for students in identifying the physical properties of the objects.	Students write physical properties of available objects while discussing them with their group members and make a table as shown in Table 2. Accepting and rejecting hypothesis after testing.
Discovery (Creation of new knowledge)	Teacher did not tell them which are metal and which are non-metals. They only facilitated the students to categorise the given materials on the basis of their physical properties like production of ringing sound, can be drawn into wire, can be beaten into sheets and have lustre. Teacher helped them by asking questions.	Students record their observation under the category of metal, which have properties like ringing sound, lustre, etc., and the object not having these properties as non-metal*. *Categorise objects into metal and non-metal

Table 2: Students draw table of physical properties of objects

Objects	Changes its shape	Breaks into pieces	Conducts electricity	Produces ringing sound or not	Appearance (Shiny or dull)	Ductility (can be made into wire or not)
Iron nail	Yes	Yes	Yes	Yes	Shiny	Yes
Eraser	Yes	Yes	No	No	Dull	No
Ball						
Keyring						

formulated earlier are checked, whether answered or not, whether proven or not

6. **Generalisation:** Students draw a conclusion that is based on the result of the verification process, which is a general principle that can be applied to all similar events or problems.

Object	Materials	Metal	Non-metal
Nail	Iron	Yes	—
Eraser	Rubber	—	Yes

Conclusion

In the present century, educationists emphasised that science education is an essential element of the curriculum.

Students of modern times are more curious to know their surroundings but the traditional methods used for teaching science in contemporary Indian science classrooms do not provide students hands-on experiences. Teachers only transact knowledge in a very

passive manner. We all know that science is a process as well as a product but we focus more on the body of knowledge rather than the process aspect of science. Such teaching-learning processes do not have the option to involve students in the processing of content and prove futile exercises to inculcate higher mental activities like problem-solving abilities, critical and reflective thinking among the children. Therefore, there is an urgent need to transform our teaching practices in the light of recommendations of NCF–2005. In this framework, a child is viewed as a discoverer, who actively constructs his knowledge and builds his understanding by meaning making process. Hence, the framework advocates the use of constructivist approaches at every stage of science teaching. Guided Discovery Learning is based on the tenet of constructivism. Here, students have freedom to check their knowledge through various experimentations and activities or you can say with their own ways. In this learning process, teachers play the role of a facilitator and they respect the students' responses and thoughts and focus on developing independent learning. Guided discovery encourages learners to reflect and question their own understanding via an active meaning making process. Thus, Guided Discovery Learning is helpful in learning science in a true sense, that is, not only as a body of knowledge but also as a process for making sense of surroundings. Students are active learners, who themselves construct knowledge through experience, observation, documentation, analysis and reflection. A lesson plan on 'Metals and Non-metals' has been framed by the authors to make an effort towards design learning procedures. This science lesson plan may be helpful in achieving the primary goal of constructivism, that is, to help students construct knowledge at their own pace and learn science both inside and outside the class.

References

Alfieri, L., P. J. Brooks, N. J. Aldrich and H. R. Tenenbaum. 2011. Does Discovery-Based Instruction Enhance Learning? *Journal of Educational Psychology.* Vol. 103, No. 1. pp. 1–18. https://doi.org/10.1037/a0021017

Amin, M. 1998. *Teaches Natural Science by Using Discovery and Inquiry Methods* (Depdikbud, Jakarta, 1998), p. 97.

Bruner, J. S. 1961. The Act of Discovery. *Harvard Educational Review.* Vol. 3, No. 1. pp. 21 – 32.

Herdiana, Y., Wahyudin and R. Sispiyati. 2017. Effectiveness of Discovery Learning Model on Mathematical Problem Solving. *AIP Conference Proceedings.* https://doi.org/10.1063/1.4995155

Illahi, M. T. 2012. *Pembelajaran Discovery Strategy dan Mental Vocational Skill*. Yogyakarta: DIVA Press.

Leadbeater, C. 2010. *What's Next? 21 Ideas for 21st Century Education.* https://charlesleadbeater.net/2010/01/whats-next-21-ideas-for-21st-century-education

National Curriculum Framework. 2005. *Position Paper National Focus Group on Teaching of Science*. NCERT, New Delhi.

Scott, C. L. 2015. *The Futures of Learning 3: What Kind of Pedagogies for the 21st Century?* Retrieved on 15 June 2021. http://pichet-pinit.in.th/wp-content/uploads/2017/01/What-kind-of-pedagogies-for-the-21st-century.pdf

Shieh, C.J. and L. Yu. 2016. A Study on Information Technology Integrated Guided Discovery Instruction towards Students' Learning Achievement and Learning Retention. *Eurasia Journal of Mathematics, Science and Technology Education.* Vol. 12, No. 4. pp. 833–842. https://doi.org/10.12973/eurasia.2015.1554a

Simamora, R. E., S. Saragih and Hasratuddin. 2019. Improving Students' Mathematical Problem Solving Ability and Self-Efficacy through Guided Discovery Learning in Local Culture Context. *International Electronic Journal of Mathematics Education.* Vol. 14, No. 1. pp. 61–72. e-ISSN: 1306-3030. https://doi.org/10.12973/iejme/3966

Suchman, J.R. 1962. Creative Thinking and Conceptual Growth. *Gifted Child Quarterly*. Vol. 6(3). pp. 95–99. https://doi.org/10.1177/001698626200600309

Suyanti, D. R. and D. M. Purba. 2017. The Implementation of Discovery Learning Model Based on Lesson Study to Increase Student's Achievement in Colloid. *AIP Conference Proceedings. 1823,* 0200090. https://doi.org/10.1063/1.4978163

Taylor, L. 1993. Vygotskyan Scientific Concepts: Implications for Mathematics Education. *Focus on Learning Problems in Mathematics.* Vol. 15. pp. 2–3.

Wardani, H.T., Agung Leo and Tri Yunianto. 2015. *Materi Pelatihan Guru Implementasi Kurikulum 2013*. Yogyakarta: Kemendikbud.

Yang, E.F.Y., C.C.Y. Liao, E. Ching, T. Chang and T.W. Chan. 2010. The Effectiveness of Inductive Discovery Learning in 1:1 Mathematics Classroom. *Proceedings of the 18th International Conference on Computers in Education.* Putrajaya, Malaysia: Asia-Pacific Society for Computers in Education. pp. 743–747.

Yerizon, A.A. Putra and M. Subhan. 2018. Mathematics Learning Instructional Development based on Discovery Learning for Students with Intrapersonal and Interpersonal Intelligence (Preliminary Research Stage). *International Electronic Journal of Mathematics Education*. Vol. 13, No. 3. pp. 97–101. https://doi.org/10.12973/iejme/2701