Jurnal Pengajaran MIPA
Vol. 23, No. 1, April 2018, 76-80
ISSN 1412-0917 (print)/ 2443-3616 (online)

DOI: 10.18269/jpmipa.v23i1.13909

THE PROMISE AND CAVEATS OF IMPLEMENTING DISCOVERY-INQUIRY LEARNING

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ABSTRACT

Discovery learning is arguably the most debated learning approach because even after more than 58 years since Brunner suggested it in 1961, it continued to be a center of heated debate. The main concern for numerous educational experts was the degree of teacher involvement in discovery learning. One of the discovery learning variants which addressed this issue is discovery-inquiry learning, a learning model currently endorsed by the Indonesian Government to be implemented in the classroom. This study explored the potency and caveats of discovery-inquiry learning model and discussed improvement suggestions when implementing the model.

Keywords: discovery learning; inquiry learning; learning model

ABSTRAK

Pembelajaran penemuan atau *discovery learning* bisa dikatakan sebagai pendekatan pembelajaran yang paling diperdebatkan karena bahkan setelah lebih dari 58 tahun sejak Brunner menyarankan penggunaannya di tahun 1961, pembelajaran ini terus menjadi fokus perdebatan sengit. Kekhawatiran utama banyak pakar pendidikan adalah tentang tingkat keterlibatan guru dalam *discovery learning*. Salah satu varian *discovery learning* yang mencoba menjawab kekhawatiran tersebut adalah *discovery-inquiry*, sebuah pembelajaran yang saat ini mendapat dukungan Pemerintah Indonesia untuk diimplementasikan di dalam kelas. Penelitian ini menggali potensi maupun hal-hal yang perlu diingat dalam menerapkan model pembelajaran *discovery-inquiry* serta membahas saran-saran perbaikan ketika mengimplementasikan model pembelajaran ini.

Kata kunci: pembelajaran penemuan; pembelajaran inkuiri; model pembelajaran

How to cite: Nurdin, E.A. (2018). The Promise and Caveats of Implementing Discovery-Inquiry Learning. *Jurnal Pengajaran MIPA*, 23(1), 76-80.

INTRODUCTION

Discovery learning has taken on a range of meanings, but most often it refers to a form of curriculum in which students are exposed to particular questions and experiences in such a way that they “discover” for themselves the intended concepts (Hammer, 1997, p. 489). The term discovery learning is rooted in the work of Brunner (1961) and in his paper considered as classic for discovery learning approach, Bruner (1961) stated that the teachers’ goals in learning is to give students a firm grasp of concept and to make them become an autonomous and self-propelled thinker. Because learners ‘discover’ the concepts by themselves, learners could increase their learning potency, change in how they view rewards in learning: the shift from extrinsic to intrinsic rewards, develop their ability in the arts of inquiry, and aiding their memory processing (Brunner, 1961).

Since its early days, discovery learning has been transformed into numerous discovery learning variants (Tuovinen and Sweller, 1999) and the degree of educators involvement in discovery learning (Klarhl and Nigam, 2004; Mayer, 2004; Kirschner, Sweller, and Clark, 2006) has been the main concerns in the evolution of discovery learning. Klarhl and Nigam (2004) study, for example, proved that there should be a balanced distribution of learning approaches when utilizing direct or indirect ones. Further, Mayer (2004) stated that active learning should not be equated with active teaching, and constructivist teaching should not be restricted to pure discovery methods because a variety of instructional strategies can lead to constructivist learning. A meta-analysis by Kirschner et al. (2006) also suggested that unguided instruction is typically less effective: it may even have negative results when students acquire misconceptions, incomplete, or disorganized knowledge. Further, Alfieri, Brooks, Aldrich, and Tenenbaum (2011) meta-analysis of 108 studies showed that unassisted discovery does not benefit learners, but

Received: 11 January 2018
Accepted for publication: 31 March 2018
Final version: 5 January 2019

discovery learning with feedback, worked examples, scaffolding, and elicited explanations do.

The promise and caveats of discovery learning have been the source of inspiration for education stakeholders, such as Indonesia's curriculum reform case. To improve Indonesian students' competitiveness at a global level, Indonesian curriculum changes in 2013 marked the shift in learning direction in which learning should provide sufficient space for students' initiative, creativity, and independence (Ministry of Education and Culture Regulation No. 103, 2014). In terms of specific types of discovery learning, discovery learning encourages by the ministry is a discovery-inquiry model (Ministry of Education and Culture Regulation No. 22, 2016), in which in a discovery-inquiry model, teachers actively involved in students' learning in a rather specific sequence (Syah, 2014).

In discovery-inquiry model, teachers guide the students in a series of steps: stimulation, problem statement, data collection, data processing, verification, and generalization (Syah, 2014). With this syntax, the degree of teachers' involvement problems can be addressed, and students' progress in discovering the concept can be monitored. Studies have also investigated the implementation of discovery learning in Indonesia (for example, Maarif, 2016; Dewi, Nurmilawati, and Budiretnani, 2017; In'am and Hajar, 2017; Khabibah, Masykuri, and Maridi, 2017; Ratnaningsih, 2017; Yurniwati and Hanum, 2017), but study evaluating the implementation of the specific syntax of the discovery-inquiry model is still limited. It is then vital to evaluate the discovery-inquiry model implementation in the actual classroom.

METHOD

The Discovery-inquiry model was implemented for learning computer network topology as science and technology sub-subjects in one of the vocational highschool in Bandung-Indonesia. The model was implemented based on a syntax of Syah (2014, Table 1). Thirty students served as the sample in which their understanding before and after model implementation was evaluated with a written test (the instrument was valid and reliable, r= 0.82). Improvement in understanding was recorded as average normalized gain (N-gain or g) based on Hake's classification: $g > 0.7$ considered as high, $0.3 > g < 0.7$ considered as medium or moderate, while $g < 0.3$ categorized as a low improvement (Hake, 1998). Learning Achievement Threshold (LAT) score was set at 65.

Table 1. Discovery-Inquiry Learning Steps

Steps	Description	Activity
Stimulation	Giving psychological stimulus which will direct the students to problem solving activity	Teacher gives questions that will elicit students' curiosity. No generalization is given so that students' desire to investigate on their own arises.
Problem Statement	Identifying problem(s) and making problem statement for a problem considered as the most important or urgent or interesting in a form of hypothesis	Teacher provides the students with the opportunity to identify as many relevant problems as possible, one of them is then selected and formulated in a form of problem's hypothesis.
Data Collecting	Collecting relevant data to confirm or refute the hypothesis	Teacher provides the students with the opportunity to collect relevant information from multiple source or literature.
Data Processing	Processing all relevant data and information	Teacher guides the students in processing the collected data or information
Verification	Checking data and information congruency with problem's hypothesis	Teacher guides the students to check and verify problem's hypothesis based on data processing results.
Generalization	Drawing conclusion and making generalization	In consideration with verification results, teacher invites the students to draw a conclusion that can be used as a general principle and applies to similar events or problems.

Table 2. Students' Learning Achivement Before and After the Implementation of Discovery-Inquiry Learning

Students' Understanding	Pretest	Posttest
Score range (min-max)	40-80	65-90
Average score ± Standar Deviation	59.47 ± 13.02	82.53 ± 9.15
Number of Students with score below Learning Achievement Threshold (LAT)	16	0
Number of Students with score reaching or above LAT	14	30
Students' average gain (G)	23.07 ± 15.98	
Students' average normalized gain (Ngain or g)	**0.53 (moderate improvement)**	

RESULTS AND DISCUSSION

Posttest results marked students' improvement after discovery-inquiry implementation (see Table 2). The number of students who failed to reach the Learning Achievement Threshold (LAT) of 65 was decreased by 100% after learning with the discovery-inquiry model. Out of thirty students, only one got the LAT score, while the remaining 29 students scored more than the LAT score. Compared to the pretest, the number of students with scores reaching or above LAT increased by more than 50%, and the average score increased by 23 points or 39% at posttest. Overall, students' improvement was 0.53 or can be considered as a moderate improvement. Similar results were found in Maarif (2016) and Khabibah et al. (2017), which also found a moderate improvement after discovery learning implementation. Hake (1998) pointed out that moderate normalized gain indicated implementation problems. Dissecting implementation problems is then crucial to gain insight into what went wrong and how to make meaningful improvements in the model implementation.

The Discovery-inquiry model implemented in this study was a model suggested by Syah (2014), which is currently encouraged by the Ministry of Education and Culture to be implemented in the classroom throughout Indonesia. In his book, Syah (2014) stated that one of the main disadvantages of implementing the model is limited guidance can bring learning into disarray. In terms of guidance, experts agreed that educators or facilitator involvement are a vital recipe for learning success (Reid, Zhang, and Chen, 2003; Klarhl and Nigam, 2004; Mayer, 2004; Kirschner et al., 2006; Alfieri et al., 2011). De Jong and van Joolingen (1998) stated that successful discovery learning is related to applying a systematic and planned discovery process. Alfieri et al. (2011) further suggested that optimal approaches should at least include one of the following: (a) guided task with scaffolding, (b) timely feedback to probe students' ideas and its accuracy, and (c) worked examples of how to succeed in completing the task. Throughout the learning activity in this present study, those suggestions were addressed. First, by giving the students initial knowledge about computer networks and topology to guide and readied them in entering the simulation step. Secondly, by giving necessary scaffolding, feedback, and worked examples along simulation until generalization steps. These indicated that the implemented model has met optimal results requirements, but unfortunately improvement can only be considered as moderate.

Hmelo-Silver, Duncan, and Chinn (2007) wisely suggested that instead of asking whether guided inquiry instruction is working or not, the more important question is under what circumstances does it work and what kinds of supports are needed for different learning goals and population. As indicated by students' score in Table 2, students initial understanding were varied, and even after model implementation, the understanding gap between students still nearly double digits (9.15). Brunner (1961) stated that discovery learning favors the well-prepared mind and that certain child-rearing and or home atmosphere leads some children to be more discoverer than their peers. This notion has been proven by Roll et al. (2018) study that prior knowledge is vital for students to make sense of the inquiry process. Thus, factors within students themselves influence learning outcomes in discovery and inquiry learning.

Bakker (2018) suggested that when implementing learning designed to make students as autonomous as possible, such as in discovery learning, teacher should design learning to be in line with the goal by considering causality and the attributable change as well as the unique characteristics of the students. The students in this present study came from different socioeconomics backgrounds in which studies showed that socio-economics background is affecting achievement (Acar, Buber, and Tola, 2015; Thomson, 2018). The gathering of students from different socio-economics backgrounds in a classroom is a reality of a public school, and in Indonesia, the government policy of schooling based on home radius further substantiates presumed knowledge discrepancy. Fortunately, Roll et al. (2018) study showed that even when initial knowledge discrepancy was found, if students come into the classroom with a positive attitude towards the inquiry process, they can improve their knowledge and catch up with their higher knowledge peers. Gijlers and de Jong (2005) study further showed that collaborative discovery learning could help students with alternative conceptions to refine their knowledge, leading to cognitive change.

As this current study has shown and discussed, the implementation of discovery-inquiry learning models could improve learning, but several aspects of learning, such as students' initial understanding and behavior when learning, should be considered. Trninic (2018) aptly summarizes this notion: instruction and guidance should provide both discovery-in context-activity and the guidance that supports and leads to discovery.

CONCLUSION

Implementing the discovery-inquiry learning model could improve learning because of necessary supports embedded in the model syntax guide the students in the process of discovering and acquiring knowledge. Several learning aspects such as students' initial understanding and behavior when learning, should be considered in designing discovery-inquiry learning to reach the desired optimum results.

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