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ANALYSIS OF STUDENTS NEEDS FOR CHEMISTRY MODULE BASED ON GUIDED DISCOVERY TO IMPROVE CRITICAL THINKING ABILITY AND SCIENCE PROCESS SKILLS

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Abstract

This research aims to find out students 'needs for chemistry modules based on guided discovery for thermochemical material to improve students' critical thinking skills and science process skills. Ninety students from three Senior High School in Surakarta participated in this research. The research method used is qualitative. Sources of data obtained from open questionnaires and interviews. The results of the analysis show that 90% of students state that there is a need for chemistry modules based on guided discovery for thermochemical material because the guided discovery stage can guide them to learn systematically so that what is learned is easier to understand, students stated that the chemistry module based guided discovery can help them think more critically and improve their science process skills. Learning activities with the guided discovery learning model will run well if supported by appropriate modules.

Keywords: learning module, guided discovery, critical thinking skills, science process skills

Introduction

21st-century learning requires educators and students to be more independent in learning and develop according to the times. In 21st century learning, students are required to have 21st-century skills. 21st-century learning requires students to be more active and independent in the teaching and learning process, while the teacher acts as a facilitator who will guide students during the learning process. 21st-century learning requires students to have skills in problem-solving, critical thinking, collaboration, communication, and creativity [1]. One of the competencies in 21st-century learning is critical thinking.

Critical thinking is the ability to analyze and evaluate information, by collecting important questions and problems, formulating clearly, gathering and assessing relevant information, using abstract ideas, thinking openly, and communicating effectively with others [2]. According to Sezer in Malmir & Shoorcheh [3], critical thinking is a process of intellectual discipline that is active

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and skilled in conceptualizing, applying, analyzing, synthesizing, and evaluating information collected/generated through observation, experience, reasoning, or communication as a guide for belief and doing an action. Baron and Stemberg [4] state that critical thinking is a thought that is focused on deciding what to believe to do. This definition is a combination of five basic things in critical thinking, namely practical, reflective, reasonable, belief, and action. A similar opinion was also expressed by Ennis [5] which defines critical thinking as a process of using the ability to think rationally and reflectively to make decisions about what to believe or do. The important thing about critical thinking according to Ennis [6], namely critical thinking is focused on the notion of something that is done with full awareness and leads to a goal. Where one of the main and very important goals is to help someone make the right and best decisions in his life. Critical thinking can be done by identifying questions, formulating hypotheses, collecting relevant data, testing and evaluating hypotheses logically, and concluding based on results [7].

In addition to critical thinking skills, one of the skills students must have in learning is science process skills. Science process skills are abilities used to create knowledge, reflect on problems, and formulate results [8]. Wolfinger [9] states that process skills are techniques used by scientists to obtain information. Whyne [10] states that process skills are a procedure used to find and process information. Beyer [11] states that process skills can be used as a tool or tools to understand the material. Cain and Evans [12] state that learning success is determined by the development of science process skills. Science process skills are divided into two groups: basic science process skills and integrated science process skills. Chiappetta and Koballa classify scientific skills as basic science process skills (observing, measuring, inferring, classifying, predicting, communication) and integrated science process skills (controlling variables, hypothesizing, designing experiments, and interpreting data [13].

Efforts to develop students' 21st-century skills in chemistry learning can be done by applying the 2013 Curriculum [14]. The characteristics of learning in the 2013 curriculum are a scientific approach that is characterized by the development of abilities and skills in observing, asking, trying, reasoning, and communicating. One of the recommended scientific approach-based learning models is the guided discovery learning model [15]. Westwood [16] states that the advantage of the guided discovery learning model is that students are actively involved in the learning process and can be more intrinsically motivated, the activities used in the discovery process are often more meaningful than practice-based learning and textbooks, students acquire inquiry skills. and reflective that can be generalized to other contexts, this approach builds on students' previous knowledge and experience and enhances collaboration between students. The application of guided discovery learning can improve students' chemistry learning outcomes [17].

One of the materials in chemistry that is considered difficult and abstract is thermochemistry [18] because it requires several concepts such as chemical reaction

equations, stoichiometry, and hydrocarbons. The results of the study prove that the guided discovery learning model is more effective when compared to conventional learning models to improve student achievement in chemistry learning [19]. Scriven and Paul [20] explain that critical thinking is important to develop because it can improve the quality of thinking for an individual to be skilled at analyzing, assessing, and reconstructing what he thinks about solving problems.

Based on the explanation above, guided discovery can be applied to improve students' critical thinking skills and science process skills. The application of guided discovery in chemistry learning can be carried out well if it is supported by the competence of educators and the availability of teaching materials or modules. Through modules, teachers will find it easier to carry out learning, and students will be more assisted in learning. Module development is suitable as alternative teaching material to measure students' abilities through constructivist learning strategies [21]. Based on the explanation above, this study aims to make an initial analysis of student needs and the guided discovery-based thermochemical module.

Method

This research uses a descriptive qualitative method. The purpose of this study was to determine students' needs for the guided discovery-based chemistry module. The sample in this study was 90 students of class XI from three high schools in the city of Surakarta, Indonesia. Schools are selected based on several criteria. First, schools must be public high schools because they use the same curriculum. Second, schools were selected based on the level of achievement of the National Examination results to obtain sample heterogeneity. School A is the high group, School B is the medium group, and School C is the low group.

Data collection using non-test methods using open questionnaires and interviews. The questionnaire was used to determine the conditions of learning and textbooks used by students, while the interview was used to find out information on how students' learning activities had been in class, student constraints in understanding the subject matter, and to determine student needs. The statements in the questionnaire relate to the ability of textbooks used to improve students' critical thinking skills and students' science process skills, the guided discovery component in the textbooks used, and the types of teaching materials that are expected to help improve students' critical thinking skills and science process skills in learning. The results of the questionnaire were presented in the form of a percentage of students who answered yes and no to each statement in the questionnaire, then the answers from students were analyzed to determine students' needs for the guided discovery-based chemistry module.

Results and discussion

The questionnaire given to students aims to see students' needs for the guided discovery-based chemistry module. The questionnaire given is an open

questionnaire containing 21 questions that have been developed from several aspects as presented in table 1.

Table 1
Aspects that are asked in the questionnaire

Textbooks used by students
Limitations of textbooks used
The ability of textbooks to improve students' critical thinking
The guided discovery component in the textbook is used
Learning using the guided discovery module
The guided discovery module's ability to improve critical thinking
The ability of the guided discovery module to improve science process skills
Practicum activities in modules

Based on the data obtained from the results of the questionnaire given to students, it is known that 100% of students during learning use chemistry textbooks, from the results of the questionnaires given it is known that chemistry textbooks are used by students as a guide for learning. As many as 47.77% of students stated that they have handbooks in the form of Student Worksheets and books lent by schools. Other handbooks are used by students as additional learning resources that facilitate students in understanding the material and serve as guidelines for students when learning. The books used by students have deficiencies, based on the results of the questionnaire it is known that 86.66% stated that the deficiencies in the books they use include the books used by the explanation technique which are still difficult to understand, so students must use more than one book or seek explanations other learning resources. In addition, the books that students use when studying have not fully led them to think critically, this is in accordance with the results of the questionnaire obtained, where according to students the books they use only lead to critical thinking during question and practicum exercises.

As many as 78.88% of students experienced learning difficulties when using the chemistry handling books they used today because the explanations were still not able to be understood by themselves when they studied. Students stated that the chemistry textbooks they used had not fully trained them in identifying problems, facts, or events and trained them to explore knowledge, collect data, process data, formulate hypotheses, prove hypotheses, analyze information or data. This is because there are practice questions or questions during the practicum that require them to find information outside the handbook. Students expect a complete textbook so that it is easier for them to do practice questions and practicum.

Students are able to make conclusions based on theory because when doing practice questions or practicum students are always asked to make conclusions. These results indicate that what students often do is to make conclusions based on theory but not maximally able to process data, formulate hypotheses, prove hypotheses, analyze data or information. The existence of a module that includes these stages can train students' critical thinking skills and science process skills.

Based on the results of the questionnaire, 90% of students stated that learning using modules will be easier if they use a chemistry module that guides you to understand the material gradually. The module which includes the guided discovery stage can guide students to understand the material gradually and train students' critical thinking skills and science process skills. This is because students will find out for themselves in concept discovery during learning. The module will further empower students' critical thinking skills and science process skills if the module is equipped with a practicum in the laboratory because students will be more active and experience directly during practicum to help students remember the material longer. The guided discovery module, which is equipped with practicum, can help students' difficulties and can support the deficiencies of learning carried out in class on chemical materials such as thermochemistry because some concepts in thermochemistry will be easier for students to understand with a practicum in the laboratory.

The data obtained from filling out the questionnaire was strengthened by the results of interviews with several students. A total of 18 students were randomly selected from the three schools above for interviews. Based on the results of the interviews, 83% of students had difficulty understanding thermochemistry because in the learning activities they only listened, took notes, and did the exercises. Students are not guided to develop concepts through learning activities. learning activities are more teacher-centered. Students listen to explanations of the material and are occasionally asked to express their opinions or arguments. Activities that involve student activities such as practicing are also very rarely done. In one semester, on average students only do practical activities once or twice.

To improve students' critical thinking skills and science process skills, innovation in learning activities is needed, one of which can be done by applying the learning model suggested in the 2013 Curriculum, for example, the guided discovery learning model. By applying the guided discovery learning model it is expected that student-centered learning activities, where the teacher acts as a guide and becomes a facilitator in learning activities, not dominating. The application of the guided discovery learning model in the classroom will be more optimal if there are teaching materials or modules that are in accordance with the guided discovery learning syntax so that it can support students' critical thinking abilities and science process skills.

Conclusion

Textbooks that have been used by students in learning activities have not been maximized in improving students' critical thinking skills and science process skills. It is necessary to develop teaching materials in the form of modules. The module will have a more positive influence on student understanding if it is equipped with practicum activities in the learning process. The guided discovery-based module is expected to be able to train students' critical thinking skills and

science process skills because the concept of material is not directly conveyed to students, but in the learning process students find it independently gradually. The results of the analysis show that 90% of students state that there is a need for a guided discovery-based thermochemical module because the guided discovery stage can guide them to learn systematically and discover the concepts that are being studied. The development of a guided discovery-based chemistry module is one way to make students learn chemistry better. This guided discovery-based module is expected to improve students' critical thinking skills and science process skills.

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