The effectiveness chemistry module based on search, solve, create, and share (SSCS) to increase science generic skill

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Abstract. This study aimed to determine the effectiveness of chemical module based on Search, Solve, Create, and Share (SSCS) to increase science generic skills. This study was conducted at one of Senior High School in Surakarta academic year 2017/2018 with used quasi-experiment with pre- and post-test design. There were control and experimental class while the control class taught by using an instructional material that teachers’ developed in this school and the experimental class was used module based on SSCS. As the concluded, module based on SSCS was effective to increase science generic skills in the learning process.

1. Introduction
The skill need of future is a variety of science generic skill [1]. Science generic skill is an intellectual skill that results in a complex mixture of interactions between science and skill knowledge [2]. According to Brotosiswoyo in Tawil [2] there are nine indicators of science generic skill i.e. (1) direct observation; (2) indirect observation; (3) scale awareness; (4) the symbolic language; (5) logical frame; (6) logical consistency; (7) the law of cause and effect; (8) mathematical modelling; (9) concept construction.

Generic skill and attitude are now widely accepted as important outcomes of an education and are being written into virtually every curriculum [3]. A properly aligned curriculum helps learners master these generic skills in the most balanced, efficient, and effective manner through the acquisition of knowledge and concepts (expressed in the form of learning targets) [4]. Science generic skill is one of skills and abilities that must be increased in the learning process and this skill is very important for the student to solve every problem in the learning process and daily life, so to increase science generic skill for the student is an important issue in education. Generic skills are also conceptualized as skills that help them understand their strengths and weaknesses and to help them learn on their own [5]. The generic skills should be taught as an integral part of the learning activities students [6].

Based on interviews and questionnaires on seven chemistry teachers known that the chemistry teachers still lack to increase science generic skill to the students, because the chemistry teachers’ skill was still included in the medium category even though the chemistry teachers have performed their duty as a learning agent. The chemistry teachers only trained some aspect of science generic skill in the learning process, such as direct observation, indirect observation, awareness of scale, and symbolic language. The science subjects as contexts for developing generic skills and attributes. Studying chemistry can support the development of thinking skills, teamwork, communication skills, creativity,
and metacognition [7]. Science generic skill does not practice by the student can cause student’s learning outcomes not effective.

The research literature is clear that many students complete general chemistry but still lack the conceptual understanding of several fundamental topic [8, 9]. The result of questionnaires student known that 82.35% students stated that they are felt difficult to understand chemistry subject with learning material and learning method from their teacher (teacher still used discussion method, even though used discourse method), 61.76% student stated that the atomic structure and the periodic table of elements belonged on difficult subject, and 88.23% student need a alternative material teaching for make this subject more easy to understand and more interested to learn. The atomic and molecular structure is the material that is too difficult and is uninteresting [10]. Learners may have difficulty differentiating between key aspects of different atomic models, for example confusing electron shells and clouds [11].

Based on data National Examination analysis in one of Senior High Schools at Surakarta shown that percentage score of atomic structure and the periodic table of elements during the last 3 academic years (2014 until 2016), which amounted to 55.73% in 2014; 57.93% in 2015; 65.94% in 2016 [12]. This is showed that the average percentage score in this school has not been able to achieve the level of the city and nation. The difficulties of learning science are related to the nature of science itself and to the methods by which science is customarily taught without regard to what is known about children’s learning [13].

The module is one of the types of teaching materials that the user can learn the subject easier to understand. The learning by using module allows students who have a high ability to learn would be faster in completing a basic competence than other students [14]. Research from Lie & Osman [15] indicated that students who were given the module had a high posttest score compared to students who did not use the module in the lesson. In this research, the teachers have developed a module on the atomic structure and the periodic table of elements, but the results of the analysis showed that teachers’ modules do not integrated with a learning model and do not increase students' skills. Teaching methods and teaching materials that can’t increase students' skills affect students' learning outcomes.

To overcome the teaching methods and teaching materials that can’t increase students' skills, the development of module based on Search, Solve, Create, and Share (SSCS) learning model. The using SSCS model in the learning process increase students’ active, interest, creative, communicative, and affect their science generic skill. This study aimed to determine the effectiveness of chemical module based on Search, Solve, Create, and Share (SSCS) to increase science generic skills.

2. Method

2.1. Participant
The research involved two classes (10th grade) in one of the Senior High Schools at Surakarta academic year 2017/2018 that consisted of 31 and 32 students in each class. The research method was used quasi-experimental with pre- and post-test design [16]. The control and experimental class group were given science generic skills test before (pre-test) and after learning (post-test). The control class was used instructional material that teacher developed in school while the experimental class by using module based on SSCS.

2.2. Science generic skill test
The validity science generic skill test was used the Aiken’s formula [17] which gets score 0.87 that can interpret content validity is good for seven validators. The science generic skill test gets scored of coefficient reliability (α) 0.73 with Anates 4.0 software, which means the content of this test was good. Twenty multiple-choice questions to determine student’s science generic skills involves questions assessing science generic skill aspects developed by Brotosiswoyo in Tawil [2] was conducted six aspects. There were indirect observations, scale awareness, symbolic language, logical frame, logical
consistency, and concept constructing. For evaluation, the correct answer has been scored 1 and the wrong answer has been scored 0.

Another assessment of science generic skill was used observation sheet with four Likert’s scale. The validity of the observation sheet was used the Aiken's formula and gets score 0.86 which means the content of observation sheet was good and can be applied to assessment.

2.3. Module based on Search, Solve, Create, and Share (SSCS)
Module based on SSCS to increase science generic skills have conducted the activities used SSCS stage by Pizzini [18]. The validity of the module gets score 0.91 that can be interpreted as valid for nine experts. It showed that module SSCS on atomic structure and the periodic table of elements subject can be implemented to increase science generic skills in the experimental class.

2.4. Data analysis
The analysis was performed on the pre- and post-test values of the control and experimental classes. The pre- and post-test value were used to determine the n-Gain of each class. The n-Gain formula [19]:

\[
n - Gain = \frac{\text{post test score} - \text{pretest score}}{\text{maximum possible score} - \text{pretest score}}
\]

(1)

Furthermore, the n-Gain score was used SPSS 18 to prerequisite test (normality and homogeneity test) for effectiveness test. The effectiveness test aimed to found out whether the effectiveness of the learning process with using module based on SSCS to increase science generic skill.

3. Result and discussion

3.1. Result
The module based on SSCS was which divided into six chapters of atomic structure and the periodic table of elements. The reached percentage score of science generic skill in every chapter at both classes presented in figure 1.

![Figure 1. The reached percentage score of science generic skill in every chapter in control and experimental class group.](image)

Based on figure I show that in chapter I (atomic structure), chapter II (atomic number and mass number), chapter III (Bohr's atomic theory), chapter IV (theory of quantum mechanics), chapter V (electron configuration), and chapter VI (the periodic table of elements) gets score science generic skill has a score that tends to increase. The result of pre- and post-test score in control and experimental class showed in figure 2.

![Figure 2. The result of pre-test, post-test, and n-Gain.](image)
Table 1. The result of normality test.

| Significance Different Criteria Test                  | Result          |
|------------------------------------------------------|-----------------|
| Control Class                                       | 0.195           |
| Experimental Class                                  | 0.200           |
| Sig. Different > 0.05                                | Normal          |

Based on table 1, the result of normality test showed that the control and experimental class gets significance level were respectively 0.195 and 0.200. It means that the data was normally distributed cause level of significance is more than 0.05.

Table 2. The result of homogeneity test.

| Significance Score | Criteria Test      | Decision Test |
|--------------------|--------------------|---------------|
| 0.157              | Sig. Score > 0.05  | Homogeneous   |

The level of significance homogeneity test obtained 0.157, it means the sample has a homogeneous cause that the significance level is more than 0.05. The effectiveness test used parametric test, that was t-test because the data have been a normal distribution and homogeneous. The result of effectiveness test showed in table 3.

Table 3. The result of effectiveness test.

| t_count | t_table | Criteria Test                  | Decision Test |
|---------|---------|--------------------------------|---------------|
| 2.028   | 0.047   | t_count > t_table              | Accept H1     |

Based on table 3, the effectiveness test obtained $t_{\text{count}}$ is more than $t_{\text{table}}$ that means the learning process with using module based on SSCS is better than the learning process without used module based on SSCS.

3.2. Discussion

Search, Solve, Create, and Share (SSCS) model is a model that can train student’s skills, especially science generic skill of students. Some research indicated that there is an improvement to skills and students’ conceptual understanding after application of Search, Solve, Create, and Share (SSCS) model [20, 21, 22]. That be inspired the researchers to develop a module based on SSCS was integrated with science generic skill aspect. SSCS model has four stages, there are search, solve, create, and share.

In the implementation handbook by Pizzini [23] described the sense of the four stages of SSCS. The search is a fact-finding process in discovering who, what, where, and how. Then solve is finding the alternative sorting out the will used in solving the problem as well plan the steps in the finish the problem. Next, create means the application from planning in the solving process i.e. use creative thinking and analytical skills. The last stage is share, communicate solutions solving the problem to his friends.

The search stage in this module integrated with aspect indirect observation and scale awareness. In the chapter activity, students have observed the experimental results showing the existence of electrons, protons, nucleus, and neutron. In the second chapter activity, the students have done research on atomic number, mass number, isotope, isobar, and isoton. In the third chapter activity, the students have investigated the results of Bohr's observations on the spectrum of hydrogen atoms and Bohr's atomic theory. In the fourth chapter activity, the students have traced the de Broglie hypothesis and Heisenberg's principle of uncertainty which underlies the theory of quantum mechanics. In the five chapter’s activity, students have done a search on the electron configuration. The sixth chapter activity, the students have traced the periodic table of elements. In addition to collecting information from the module (who, what, where, and how), students have also searched for additional sources of information through the website. In this stage, aspects of generic science skill such as indirect observation and awareness of the scale of students have increased by observing scientific phenomena and the information retrieval process.
stage make the students become very active in exchanging opinions and asking questions about the unknown [24].

Furthermore, the aspect of science generic skill that has been trained was logical frame and symbolic language in solve stage. In this stage, students will be directed for group discussion to collect data for finish the problem and completing the student worksheet. In some study on motivation and student’s generic skills development, found that individual’s motivation can be enhanced by working in a group because they have sources of reference [25, 26]. In the create stage, the science generic skill aspect that has been trained were logical consistency and concept constructing. At this stage, students made a conclusion to obtain a simpler level of explanation so that students can generalize their findings. The last student’s activity in SSCS stages (share stage) was the students present the results of their group discussion in order to obtain feedback. Science generic skill was expected to increase by arguing with the rules. The science generic skill aspect has been trained in the share stage was logical consistency and concept building.

The used of the SSCS model has made generic science skills of students increasing in every chapter’s activity. Based on figure 1, it is known that the increase of generic science skills of students in experiment class is higher than in the control class. The experimental class used module based on SSCS made students more interested in learning activities, more active, and more creative, while in the control class, the role of teacher still dominant so made the student be passive. The result of the parametric test (t-test) showed that the control class was used module based on SSCS is better than the experimental class without used module based on SSCS. It means that the module based on SSCS was effective to increase science generic skill significantly.

Generic skills define the set of skills or abilities essential to fulfilling the three potential outcomes of higher education, namely, the needs and requirements of employers in the marketplace, lifelong learning, and good citizenship [27]. The used of SSCS model gave positive responses to the students in the learning process and can increase student's skills [28]. SSCS model can make the teaching and learning to be student-centered, in that students can build their science generic skills through various in classroom activities.

4. Conclusion
Science generic skill must train to the students because this skill need for student’s future. The module based on SSCS in the learning process can be one of the alternative materials teaching for the chemistry teacher to increase student's science generic skills. This module was integrated with six aspects of science generic skill, i.e. indirect observations, symbolic language, scale awareness, logical consistency, logical frame, and concept constructing.

In the used of module based on SSCS, the role of teachers is needed to guide students following every stage in SSCS model. Teachers should be able to manage the time of learning activities, especially in the create stage. This research was conducted in Surakarta so the result could be different if done elsewhere.

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