Analysis of student perceptions in the learning environment chemical laboratory

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Abstract. This study aims to analyze the perceptions of chemistry students towards the chemistry laboratory learning environment at Universitas Negeri Jakarta, by using instrument the Chemistry Laboratory Environment Inventory (CLEI). The sample used was 400 students of the Depart of Chemistry and Chemistry Education Universitas Negeri Jakarta. The research method used is a survey method using a questionaerie, laboratory observations and interviews with students. The survey results show the dimensions of student cohesiveness, open-endedness, integration, and students' perception rule clarity is very good, only in the open-ended dimension and environment material resulting in a multitude of answers dominance never, rarely, and sometimes

1.Introduction
The laboratory is an important part of science teaching and has a unique learning environment [1]. Laboratories in the world of education are places where the teaching and learning process through demonstration or practical methods can produce learning experiences where students interact with various tools and materials to observe changes that occur due to chemical reactions. In doing practicum, students can work individually or in group.

Laboratory is also defined as a place where teachers and students carry out experimental or research activities, so that a laboratory does not always mean a laboratory building but can be in the form of gardens, fields and others that are used for these activities [2]

The results showed that laboratory experiments influenced student attitudes and learning outcomes towards science[3]. Laboratory activities can improve meaningful learning, conceptual understanding, and understand the nature of science for students[4], so that students are motivated to explore material related to topics in the classroom. According to Diaz et al [5] in their research, it shows that learning in the laboratory helps students to understand chemical concepts, increases interest in research, improves higher thinking skills.

According to Neji et al [6] the success of learning in a chemical laboratory is influenced by the laboratory environment such as the availability of the necessary chemical equipment and materials. The results of Joaquin et al's [7] research show that (1) students positively assess the learning environment provided for biology practice, (2) the SLEI instrument can be used to evaluate student satisfaction, laboratory activities, the level of cooperation between students and teachers, and laboratory management. (3) the questionnaire can detect differences in perceptions of the learning environment based on gender and program.
Research conducted by Iyad et al [8] shows that there are differences in perceptions regarding the laboratory environment between Arabic teachers and students and Jewish teachers and students. Research conducted by Ping [9] on the perceptions of grade 8 students (Junior school) towards Science laboratory learning environments, showing the dimensions (1) students do not have basic laboratory skills and knowledge to do open investigation work, (2) the integration between laboratory activities and classroom theory is in the category "Sometimes" or "Often", (3) The rule clarity dimensions are in the "Often" rather than "Occasionally" category. (5) facility dimensions indicate laboratory equipment and materials rated adequate closer to "Often" than "Occasionally" in actual and preferred environments. Students expect a better environment than they have today. Che et al [10] determine teachers 'and students' perception of science laboratory learning environments schools in Malaysia. Analysis of findings that significant differences between teachers 'and students' perception of physical and psychosocial laboratory learning environment.

A positive learning environment in the laboratory will help lecturers and students to achieve the best performance in the learning process. Therefore, it is important to evaluate the learning environment in the laboratory. Not only that, to assess student perceptions, but also to investigate the impact of laboratory classes on learning outcomes [1]. One example of a science laboratory learning environment instrument is the SLEI (Science Laboratory Environment Inventory) developed to assess student perceptions of the learning environment in laboratory classrooms [1]. Subsequently, SLEI was modified by turning science into chemistry and adapted its name to the Chemistry Laboratory Environment Inventory (CLEI) in Singapore [11].

The CLEI instrument has been used to analyze the chemistry laboratory learning environment, the interaction between lecturers and students and student attitudes towards chemistry learning in 497 public and private secondary schools in Singapore (Lang, et al 2005). In this study, the CLEI instrument was modified to be used to measure the perceptions of chemistry students about the laboratory environment at the Department of Chemistry, Universitas Negeri Jakarta.

2. Methodology
This study tries to explore students' perception on phischosocial, safety, environment, topic and activity practical work of the chemistry laboratory. The study used survey methods and all data were collected using questionnaires. A total of 400 students from department of chemistry Universitas Negeri Jakarta participated in this study. Students’ perception on learning environment laboratory were measured by using Chemistry Laboratory Environment Inventory (CLEI), to measure: (i) student cohesiveness, which measures the extent to which students know, help and support each other., (2) open-endedness, which measures the extent to which laboratory activities emphasize an open and different experimental approach. (3) Integration, namely measuring the extent of laboratory activities that are integrated with the theory taught in class, (4) Rule Clarity, namely measuring activities in the laboratory guided by rules, and (5) Material Environment, which is measuring tools and materials in the laboratory.

The CLEI questionnaire was modification consisted of 35 statements. For each statement, a Likert scale was used where 5=always, 4=often, 3=sometimes, 2=rarely, and 1=never. Instruments have been validated by two experts in chemistry education as well as supervisors. Reliability and validity is also obtained through a pilot study.

3. Result and Discussion
3.1 Validity and reliability instrument
Reliability is the degree to which an assessment tool produces stable and consistent results. Internal consistency and the test-retest reliability are defined as two of the main types of reliability evidence and include parallel forms reliability and, inter-rater reliability. Internal consistency reliability is a measure of reliability used to evaluate the degree to which different test items that probe the same construct produce similar results and is usually measured with Cronbach’s alpha. The internal
consistency reliability (coefficient alpha) ranged from 0.79 to 0.91 for the five CLEI scales. This range is considered acceptable to good, since the closer the alpha is to 1, the greater the internal consistency of the items.

Content validity refers to how accurately a measurement tool taps into the various aspects of the specific construct in question, and this validity is most often measured by relying on the knowledge of people who are familiar with the construct being measured. Item analyses were undertaken to determine which items should be retained for factor analysis (n=40) with <4 missing data. Items means ranged from 2.90 to 3.85 on the 15 item, connectedness scale, from 2.0 to 3.98 on the 10 item transcendence scale and 3.10 to 4.28 on the 10 item meaning life scale. Five items were removed from the initial 40 item instrument.

3.2 Students’ perceptions of the chemistry laboratory environment

The results of research on students’ perceptions of the learning environment in the chemistry laboratory in various dimensions, can be seen in Table 1.

| Dimension         | Mean | SD  |
|-------------------|------|-----|
| Student cohesiveness | 4.25 | 0.56 |
| open-endedness    | 2.45 | 0.54 |
| Integration,      | 4.18 | 0.55 |
| Rule Clarity      | 4.56 | 0.35 |
| Material Environment | 3.48 | 0.42 |

Activities in a chemical laboratory are activities that need to be carried out because chemistry learning emphasizes scientific skills, scientific attitudes and scientific products. Through chemistry practicum, skilled students use tools, instruments, can prove a cause and effect relationship, are able to explain a natural phenomenon. Of course, every student has a different experience, as long as they interact with the chemical laboratory environment. This student experience can be used as information to find out their perceptions of the chemical laboratory environment.

a. Student cohesiveness

Based on the results of the research in Table 1, the student answer score for student cohesiveness is 4.25. These results indicate that: (1) they know and get along well with one (2) they work well together in the laboratory. According to Perry & Miller (2019) collaborative activities between fellow students can affect their learning performance, the more positive their interactions, the better their learning performance. Likewise with Dornyei (1994) in their research, they claim that student cohesiveness is an important aspect of the learning environment because it can foster motivation and self-confidence in learning.

b. open-endedness

Open-endedness is a dimension that describes whether students are given the freedom to develop their own experiments. The results showed that the student’s answer score was 2.45, which illustrates that they are rarely given the opportunity to do their own experiments. This also happened to students in Hong Kong, Taiwan, Korea and Singapore (Kwok 2015; Tsai, 2003s; Lee & Fraser 2002; Wong & Fraser 1996). This situation is due to the learning system in the laboratory which still traditionally applies the cook-book model, where students conduct experiments according to the procedures contained in the practicum book, so it is not possible to carry out open experiments. In addition, it is also not possible to conduct open experiments because students do not have basic skills and knowledge of laboratory work.
Integration is a dimension to see the extent to which the theory that has been learned in the classroom is integrated with laboratory activities. The laboratory is a place designed for improve student understanding, build student knowledge and be able to work scientifically. Based on the data in Table 1, the integration value is 4.18, which means that practicum activities are integrated with the theoretical theory learned in the classroom. According to Decaprio (2013: 17) that the laboratory is a place to balance theory and practice, theory is the foundation (base) while practice will strengthen theoretical arguments, the two must be related to each other. This integration is also important so that there is continuity and connection of what students have learned in class with what has been learned in the laboratory environment.

d. Ruleclarity
Rule clarity is a dimension to see the extent of regulations that run during laboratory activities. In the laboratory, regulations are needed to regulate the workings of the tools and instruments, because the laboratory as a place for experiments is a place that is prone to an accident. In a chemical laboratory there are hazardous and flammable materials. With clear rules, it is hoped that there will be no accidents, either administrative or physical. Therefore regulations become a tool to create safe conditions in the laboratory. In the rule clarity, there are 7 statements with 1 negative statement. The value of students' perceptions of the rule clarity dimension is 4.56, this shows that the rules applied and clarity in the laboratory environment work well. According to Kwok (2015), in his research, there is a correlation between the open-ended dimension and the clarity rule, according to him, if open-endedness is applied, it means that the clarity rule becomes looser, allowing students to apply the freedom of the method in their practicum. However, in this case it is quite risky because the lack of rules can increase the risk of accident, therefore teachers generally tend to be rather strict in enforcing safety regulations to anticipate laboratory accidents.

e. Material Environment
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4. Conclusion
Based on the results of the research that has been done, it can be concluded that the students' perceptions of the laboratory learning environment based on each dimension are in good condition. During the practicum activities in the chemistry laboratory, students work together well, students follow the applicable regulations, and all chemistry practicum material is integrated with the theory learned in class.

Given the risk of accidents in the laboratory, students are limited to doing experiments outside what has been determined, so that the scores for the open-ended dimensions are lower than for the other dimensions. This research needs to be continued to develop an environmentally friendly practicum method, so that students can do their own experiments.
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