Profile of evaluative thinking skills of chemistry education pre-service teachers on theme of carbohydrates in food chemistry lectures

Sofia¹*, A Permanasari²*, H Sholihin², and FMT Supriyanti²

¹Pendidikan IPA, PP, Universitas Pendidikan Indonesia. ²Departemen Pendidikan Kimia, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No. 229, Bandung 40154, Indonesia.

*sofia@fkip.unsri.ac.id, anna.permanasari@upi.edu

Abstract. This study aims to determine the profile of evaluative thinking skills (ETs) of Chemical education pre-service teacher on the theme of carbohydrates in food chemistry (FC). The research method used was descriptive qualitative with a research sample of 31 students from 2013, 2014 and 2015 who have attended FC lectures in one of the Chemical Education department in South Sumatra. The instrument used was a test of ET totaling 4 questions that had been validated. Indicators of ETs to be achieved include 1) Asking questions. 2) Seek deeper understanding through reflection and perspective, and 3) Making informed decisions in preparation for action. The results showed the profile of students’ ETs on theme carbohydrates in FC lectures showed that the average student ETs were classified as low. Generally, students have demonstrated skills in asking questions adequately, but still show weaknesses in reflecting and perspective thinking. Likewise decision-making skills also need to be improved. ETs are needed so that students are able to do self-evaluation and introspect their own weaknesses to be able to think more forward.

1. Introduction

The development of the world requires the learning process to produce human resources capable of solving problems or finding alternative solutions to problem solving independently. Evaluative thinking (ET) is indispensable in life because ET is an overlapping skill and is integrated with other skills such as critical thinking, system thinking, asking questions, evaluative thinking, decision making and solving for transfers [1,2]. ET is needed in critical thinking [3], problem solving [4,5], and decision making [2,6,7], building evaluation capabilities [5].

ET is a skill expected to be achieved in learning outcomes set by the Indonesian National Qualifications Framework (INQF). One of the nine general skills expected for the bachelor level is to be able to apply logical, critical, systematic and innovative thinking in the context of the development or implementation of science and technology that pays attention to and applies humanities in accordance with their fields of expertise [8]. This learning achievement must also be achieved in the FC lecture. Evaluation of learning Chemistry food so far has emphasized knowledge and has not yet measured students' thinking skills including ET [9].

ET is the core thinking skill for critical thinking [3]. ET involves exploring ways to make promising choices into the best solutions and prepare for successful implementation. Evaluation of ideas is
important when problems are presented and individuals must develop problems and make solutions that are appropriate, useful, or possibly applicable [10]. ET is questioning, reflecting, learning, and modifying but is done all the time [11]. ET is critical thinking applied in the context of evaluation, motivated by an attitude of curiosity and belief in the value of evidence, which involves identifying assumptions, asking wise questions, seeking deeper understanding through reflection and perspective taking, and informing decisions in preparation for action [12]. ET is critical thinking applied in the context of evaluation, motivated by an attitude of curiosity and belief in the value of evidence, which involves identifying assumptions, posing thoughtful questions, pursuing deeper understanding through reflection and perspective taking, and informing decisions in preparation for action [13]. Another indicator of ET are 1). Asking substance questions, 2). Determining the data needed to answer the question, 3). Collecting data in a systematic way, 4). Analyzing data and share results. 5). Developing strategies for acting on findings [14].

Based on the background and theories supporting ETs are skills that should be possessed by pre-service teachers. So far there has been no research report on the evaluative thinking skills of prospective teacher students, especially at the college class in FC. The purpose of this study was to determine the ETs of prospective teacher students on the theme of carbohydrates in FC.

2. Method
The research method used is descriptive qualitative research with 31 research samples in 2013, 2014 and 2015 who have attended the FC lecture in one of the departments of Chemical Education in South Sumatra. The research instrument was in the form of a matter of ETs on the theme of carbohydrate in the lectures of food chemistry 4 questions and each question consisted of 3 indicators. The test results obtained were scored and interpreted to get the profile of ETs of Chemical education pre-service teacher on the theme of carbohydrates in FC.

3. Result and Discussion
The study of students' ETs profile was obtained from the description test given to 31 students. Indicators of ETs to be achieved are 1) asking questions, 2) pursuing deeper understanding through reflection and perspective, and 3) making informed decisions in the form of an action plan. The results of the preliminary study profile of students' ETs on carbohydrate topics in FC can be seen in Figure 1.

![Figure 1. ETs Profile of Chemistry Education Pre-service Teachers](image-url)

Student ETs test results for the theme of carbohydrate are 46.33 in the low category. These students' ETs have not yet reached the learning outcomes determined by Indonesian National Qualification Framework (INQF). The low ETs as the general for the evaluation of learning more on knowledge and not measure students' thinking skills [9]. Evaluation of learning that does not require students to think, the lecturers and students do not have the skills they need to grow students' thinking skills such as ET. This can be overcome by conducting learning and discussions that encourage the development of students' thinking skills. The shift in focus on nurturing ET in students has profound implications for the way in which teachers support learning and organise assessments [15].
The results of ETs test indicators asking questions were 54.55. The skills to ask students questions above the class average of 68% and 19.4% get excellent grades, 16.1% are good and 6.5% are sufficient. The skills of asking students questions are quite good but they still need to be improved, because the skills of asking questions are needed in the learning process. The skill of asking questions identifying problem solving is at the core of inquiry [16]. The ETs such as asking questions can improve critical thinking skills. Asking questions plays an important role in discussing habits of thought and scientific understanding of scientific knowledge [17]. asking evaluative questions that are often in the classroom helps critical thinking [17].

The results of ETs test indicators that pursuing deeper understanding through reflection and perspective are 46.49. The skills to seek deeper understanding through reflection and perspective of the average class students namely 46.6 and 12.9% get good grades and 25.8% are sufficient. The skills to pursuing deeper understanding through reflection and perspective are still low. Indicators of this understanding consists of sub-indicators determining what data is needed, collecting data according to systematic ways, analyzing data and sharing results. These ETs are needed in gathering the required data. ET provides evidence to record, map and monitor progress, successes, failures and obstacles in innovation. This involves thinking about what evidence will be useful, setting various goals and targets to determine their progress, and building knowledge and developing practical uses for new information in innovation. This activity is a continuous cycle of generating hypotheses, gathering evidence, and reflecting on progress, experimenting, making mistakes and considering what works right and what is wrong with learning the effects of innovation [5]. Routine ET allows everyone to get a better understanding of the progress of innovation, to clarify goals, recognize progress, and negotiate the nature of evidence that is acceptable, better understand the process and be a supporter for innovation and evaluative thinking that is happening. The schedule for gathering evidence will continue to be flexible, with all parties involved in deciding what they want (and need) to know, what they will receive as evidence, and when it is appropriate and possible to try to fulfil their objectives [5].

The results of ETs test indicators for making informed decisions in preparation for action are 37.84. This result is still below the class average of 37.8 and 12.9% of students who get good and 12.9% enough. Decision-making skills that are informed in the form of action plans need to be increased again. Decisions making is a necessary evaluative thinking skill. Complex life requires us to make rational decisions based on evaluative / critical thinking rather than accepting authority, students must be prepared to question, deny, raise doubts, investigate situations, and investigate alternatives in the context of school and everyday life [6]. ET has inherent value for the development of innovation, with the main objective being to bring a basis of ongoing evidence for feedback, reflection and decision-making processes because successive iterations of innovation are planned, implemented, and reviewed [5].

The distribution of the average value of ETs and each student indicator on the theme of carbohydrates in FC can be seen in Figure 2.

![Figure 2. Distribution of average scores and each indicator of students' ETs on the theme of Carbohydrates in FC](image-url)
The lack of students' ETs will influence their ability to learn and after they are in the work and social environment. Evaluative thinking skills can produce innovation. ET can describe in detail and comprehensively what the developer wants and does, defining the basis, goals, theoretical foundation and philosophy of efficient and applicable innovation. The evaluation approach contributes to ongoing decisions about innovation and meeting accountability requirements. This process is the basis for developing, determining progress, and deciding what evidence is important to support and assess the success of innovation [5]. ET has inherent value for the development of innovation, with the main objective being to bring a basis of ongoing evidence for feedback, reflection and decision making processes because successive iterations of innovation are planned, implemented, and reviewed [5].

ETs are also an important leadership skill, especially when evaluating new ideas for possible implementation. Evaluative and contextual thinking skills are valuable leadership skills to produce creative change and leaders must learn to work well in their social context. [Puccio, Murdock, & Mance, 2011, cite in [18]].

Based on the description above ETs are skills that need to be developed in the learning process. ET processes start from project planning and intervention, implementing activities and ideas, creating data and results, then learning, adapting, improving, managing data and information, converting data into lessons and knowledge, reflecting on lessons, rethinking core activities and returning planning again and so on [11]. This activity is carried out continuously so that we become activities that are carried out continuously. The process of ET can be seen in Figure 3.

In Figure 3 it can be seen that learning is at the heart of ET processes and each of our activities is the ability to recognize failure and success enables us to take steps to improve, modify, or strengthen our actions [11]. Thus, the evaluational skills in the process of courtship are inseparable. ET is the skill needed to think sustainably. This is in accordance with the opinion of Zoller which states skills such as asking questions, systems, critical-evaluative thinking, problem solving, decision making as well as moral thinking, creative thinking and transfer are needed for sustainable thinking [5]. Because a more principle view of sustainability has emerged, along with a more developed view of evaluation,
evative thinking has become an integral part of identifying big ideas in innovation and linking them with evidence of how they have played and what may or may not contribute to the sustainability of processes and outcomes that can contribute to capacity system [5].

This learning process is good for yourself and the organization. Learning and building evaluative thinking in an organization is an action in the organization that can make the expected changes in the future [5]. Besides, it is also important to allocate sufficient resources to involve evaluators to think evaluatively, to share in leading specific processes related to evaluative activities, to provide evaluative expertise and build evaluative capacity [5].

4. Conclusion
Results of a profile of ETs of chemistry education pre-service teachers on carbohydrate themes in FC lectures in one of the Chemical Education Department in South Sumatra was 44.4 in the low category. The results of ETs test on indicators asking questions are medium, indicators of pursuing deeper understanding through reflection and perspective are lows, and indicators of decisions making informed in the form of an action plan of students in the medium and low categories on several indicators. ETs are needed so that students are able to do self-evaluation and introspect their own weaknesses so that they are able to think more forward. ETs are needed so that students are able to do self-evaluation and introspect their own weaknesses to be able to think more forward. These students' ETs need to be trained and improved.

5. References
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Acknowledgments

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