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THE PROFILE OF STUDENT ANALYTICAL SKILLS THROUGH HYPOTHETICAL LEARNING TRAJECTORY ON COLLIGATIVE PROPERTIES LESSON

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Abstract

Students often have difficulty in understanding chemistry lessons, especially Colligative Properties. Teachers should have systematic learning plans so that students understand the content of learning well. Hypothetical Learning Trajectory (HLT) is effective to be used in the learning process because it becomes an idea in designing detailed learning paths. Besides that, learning outcomes can be achieved well and optimally. This study uses qualitative and quantitative approaches. Data processing is carried out based on four assessment criteria. First, student responses that appear based on response predictions, second, student ability test scores, third, analysis of learning activities, and finally science process skills (SPS). The results showed that the didactic presented by the teacher as a student learning path was good enough. Only 12% of student responses are beyond predictions. Furthermore, student SPS through the use of HLT shows that classification and communication skills have a high value, respectively 82% and 81%. Meanwhile, based on Piaget's approach, students' conceptual abilities are better (56%), compared to other abilities. Therefore, the application of HLT to the material of colligative properties towards students is very good.

Keywords: *Hypothetical Learning Trajectory, Colligative Properties, Science Process Skills*

A. Introduction

Teacher as educator is like a second parent for students, who passionately teach new things and developed potential. However, learning obstacle will lead to a situation which students cannot learn properly, so they have low learning achievement. This learning difficulty can even lead to a difficult situation and may lead to a desperation that forces a student to stop on the middle of the road. For that matter, teachers should plan a lesson that can help learners understand the lesson well (Sheehan, 2010; Akbar, 2016).

The topic about colligative properties is the subject of chemistry that studies of some abstract concept. Many students have difficulty to understand its concept, as evidenced by repeated results that do not reach the value of passing standard (KKM) (Mairisiska *et al.*, 2014). The result of the research of Luoga et al. (2013) indicates that there are still many high school students who have misconceptions on the concept of the colligative properties. Some misconceptions encountered include students assuming that a higher density of hearing leads to a high boiling point, that the presence of salt in solution can increase the boiling point because it prevents evaporation. This is also in line with the results of the Talanquer (2009) study which found that students consider the presence of salt to prevent evaporation and increase the boiling point of the solution. Other findings indicate that students consider the bonds to salt strong enough and it takes a great deal of energy to break it so that the salt bleeding point is higher than the boiling point of water. Another problem that arises is the implementation of demonstrations or practicum on the material colligative properties. This is due to several factors, namely due to lack of time, not all schools have complete laboratory equipment and operational implementation of the lab requires a high cost. Other factors presented by Argandi *et al.* (2013) which states students tend to feel afraid to hold tools and chemicals so that students are less focused on the material.

Hypothetical Learning Trajectory (HLT) is one of the learning paths provided by teachers based on the idea of choosing a specific

learning design, so that the best learning outcomes are possible to characterize the reflexive nature of the learning design and the consideration of learning difficulties (Sari, 2011; Clements *et al*. 2004; Daro *et al*., 2011). HLT is structured based on three components: direct learning objectives, learning activities, and learning hypotheses about predictions of thought or student responses (Trya, 2014; Sztajn, *et al.*, 2012). The three components of HLT are flexible; teachers can change the direction of the learning objectives and adapt the planned learning activities in accordance with the student responses that appear during the learning activities. For that Hypothetical Learning Trajectory can help teachers to achieve learning objectives with a better way (Pöhler, 2014; Putri, 2012).

Based on this, the authors are interested in using HLT in designing a learning design on the material of the colligative properties. As a guideline for the implementation of learning in the classroom, HLT can also be used as well as an anticipatory action against problems arising by students in following the learning process. Preparation of HLT implementation on the topic of the material, it is expected that teachers and prospective teachers can know the various abilities of students who formed when applied. Therefore, through this research, it is hoped that the response profiles and varied ability of students on chemical learning for the HLT-based colligative properties of the material can be identified and analyzed by prospective teachers, to then map the profile of the prospective teacher's ability as an important capability profile to be possessed by a teacher.

B. Method

This research was conducted at SMAN 10 Fajar Harapan at Banda Aceh. This research uses qualitative and quantitative approach. HLT is used as an instrument of learning and developing diverse student abilities. Data were processed through two types of analysis, namely: qualitative analysis by looking at student responses that emerged based on the predictions of responses that have been provided, and analysis of student ability test scores,

for learning activity analysis applications, as well as science process skills (SPS). The research design is presented in Fig 1.

Table 1. Student Participants Information

Treatment	Information
Participant	30
Grade	12
Age	16-17
Sub Topic	1. Concentration use in colligative properties 2. Decrease in vapors pressure 3. Increase in boiling point 4. Decrease in freezing point 5. Osmotic Pressure 6. Colligative properties on electrolyte solution

HLT is structured on the basis of an analysis of the Learning Obstacle, the student's thinking stage, and the analysis of the curriculum by maintaining the concept of the material (Wijaya, 2015). Which students must understand. Present LO, researchers found some epistemological constraints experienced by students, such as understanding the P-T diagram, calculations in the colligative properties, and so forth. HLT is designed based on the learning objectives to be achieved, activities that support the objectives, and mathematical hypothesis in the form of conjecture expected to occur in students according to their ability to think. Therefore HLT is prepared by taking into account the stage of the student's thought flow and the concept of material that students must construct.

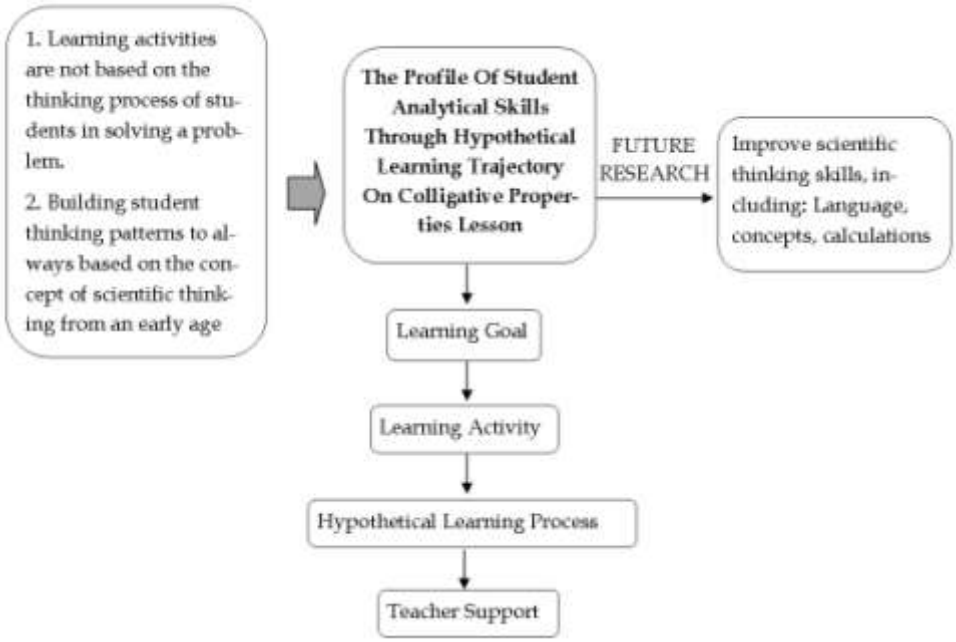

Figure 1. Research framework

Both of these things must be synergized to the activities designed in line with the two so as to obtain a design of learning in accordance with the learning needs and characteristics of students. Stages conducted by researchers in compiling HLT as follows:

1. Theoretical study of students' thinking characteristics within the age range 16-17 years (grade 12 at Table 1).
2. Studying the history and in-depth study of theories about the concept of the colligative properties and the research that has been done about the colligative properties.
3. Reviewing the curriculum and syllabus of chemical textbooks used by grade XII students. Included in this activity is examining the methods, approaches, or methods used to convey the concept of the colligative properties.
4. Reviewing aspects of learning obstacles that occur in the learning process. This needs to be done so that later didactic situation created to minimize learning obstacles both from the aspect of students and teachers (Suryadi, 2013).

Assessing what didactic situations will be built, predicting possible student responses to the created situation, and determining the didactic and pedagogical anticipation of the response.

C. Research Finding

Analysis of student response through HLT consists of 6 sub-subjects coverage on colligative properties topic. Seen on Fig 2, for each sub-material coverage, more than 50% of responses appear to correspond with predictions of the initial response. There are 3 sub-materials that generate a response beyond the prediction. In sub-materials 2, 4 and 6 all there are only 1 OPR. In Sub 4 and 6, 4 appropriate prediction characters.

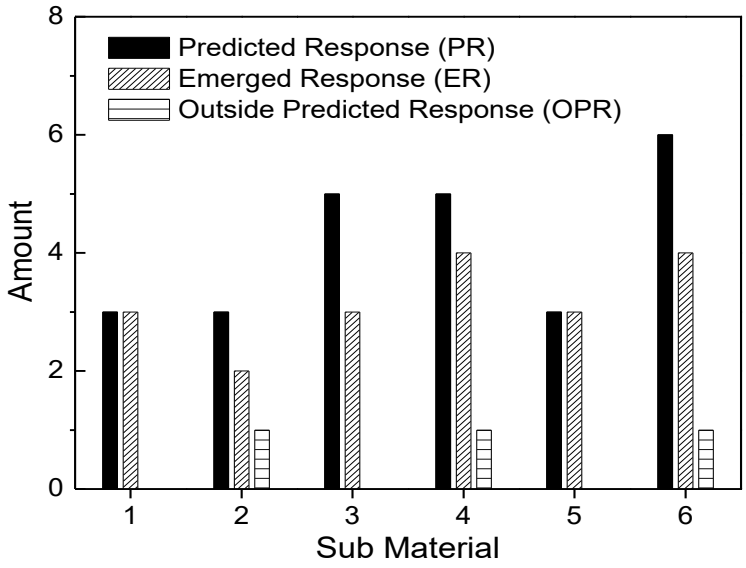

Figure 2. Response Type Analysis in Learning Process.

Furthermore, Figure 3 describes the interrelationship of analytical capabilities with Piaget's theory. It can be seen that the conceptual ability shows the highest percentage of 56%, compared to the procedural which is only 28% and principle 16%. Even factual abilities do not show any influence. When dealing with the type of knowledge in the form of principles and concepts, students tend to put forward the way of thinking at the operational stage of the Congress. In this case, on the type of

knowledge of principles and concepts, students tend to think concretely. But on the other hand, students put forward the formal thinking ability when dealing with the type of knowledge in the form of procedure.

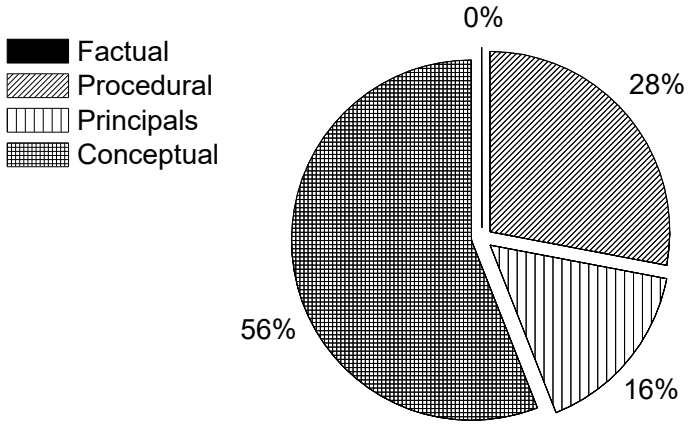

Figure 3. Types of ability that appeared in Piaget's theory on student response

The profile of the science process skills (SPS) is shown in figure 4. It can be seen that aspects of classify (82%) and Communicate (81%) show a higher percentage than Interpret and Implement. This proves that the process of student analysis is based primarily on classification and communication. Teachers must be able to classify and communicate with students.

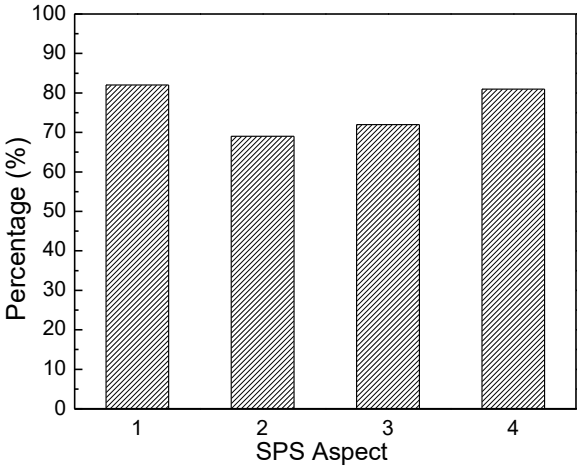

Figure 4. Profile of Student SPS Aspect; 1. Classify, 2. Interpret, 3. Implement, 4. Communicate.

Finally, based on student learning activities, studies are also conducted to see the relationship between students' analysis profiles. Figure 5 shows that the most dominant learning activities are influenced by visual and motor aspects, namely 90% and 80%. While the oral aspect only shows a value of 78%.

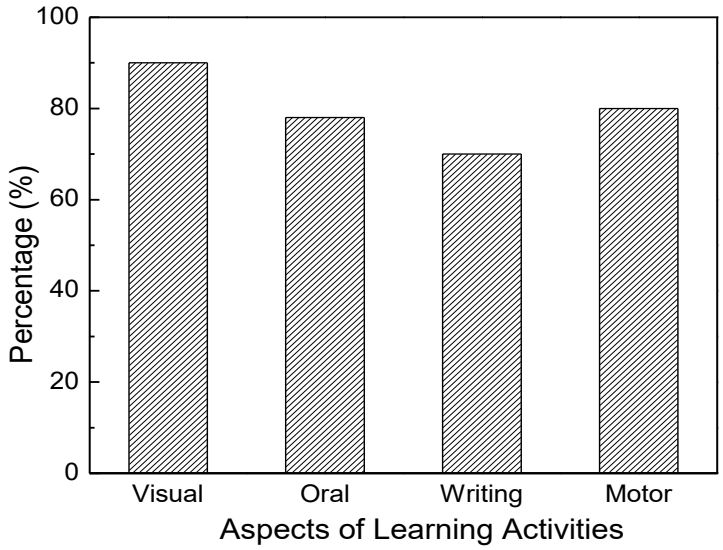

Figure 5. Profile aspects of student learning activities.

D. Discussion

This study does not demand to increase the value of the KKM, because the selected sample is a superior school. Therefore, it is not expected to increase learning outcomes through the HLT approach. On the other hand, through this HLT the team wanted to observe student profiles in response to the material of colligative properties. This is done to get future learning references related to the topics that are used now to avoid misconceptions and learning effectiveness. Based on the result of the research, it is found that the chemistry learning process about the colligative properties is oriented Hypothetical Learning Trajectory has been able to encourage prospective teachers to be able to present effective learning for students who have trouble learning in the classroom and can develop students' learning ability. The students' skilled criteria for

classifying and communicating skills cannot be separated from how the teacher presents the lesson by considering the possibility of a student-oriented response to guide the students on the learning objectives as the chosen learning pathway has encouraged the students to be more courageous in expressing their classification process well. However, the students' skills in interpreting and applying the concept have not been optimally developed, it is related to not yet optimal planning and implementation of learning made on the basis of individual needs and specialization in the form of effective learning.

Referring to Figure 2, there are 4 sub-materials that show differences in students' analysis responses. In fact, there are 3 sub-materials that show a response beyond predictions. Substances 1 and 5 show the perfection of responses from students. In sub material 2, it is seen that 66.67% of responses are in accordance with student analysis. In general ER shows a percentage of > 50%. Furthermore, the comparison of response types to total response predictions indicated 12% of student responses that emerged out of response. In addition, the corresponding response corresponds to a total of 76% predictions (Figure 2). Based on these results, the didactic presented by the teacher as a student learning path has been quite good.

Analysis of the type of knowledge of students using Piaget's theory is based on the hypothetical components of student learning process that appears in the learning, the following analysis of student responses is presented in Fig 3. It appears that conceptual knowledge is widely used by students by 56%, and none use knowledge factual. The tendency of the operational stage of thinking of high school students based on the data obtained shows that in general when dealing with the type of knowledge in the form of procedures, they are more able to put forward their thinking ability at the stage of formal operational thinking (Haryani, 2012; Ichsan, 2009; Intan, 2014).

The students SPS score searched through the use of HLT is found that the skills of clashing and communicating aspects showed a high

enough value of 82% and 81% (Figure 4). In this case, the two aspects are not separated from the readiness of teachers in presenting learning. On the other hand, teachers have considered the possibility of a student-oriented response, so both skills develop optimally. Meanwhile, the students' skills in interpreting and applying the concept show slightly lower grades at 69% and 72%. This can be due to ineffective planning, so this skill is considered not optimally developed (Sartika, 2015).

The profile of student learning activities has been summarized in Figure 5. This activity is conducted in groups. The result, the activity visually, orally, and motor showed a fairly optimal value of 90%, 78%, and 80%. Efficient activity from the visual and oral is driven by the effective help attention of teachers when responding to and responding to the emerging student responses. However, motor activity is not entirely influenced by the media used, in which case, the experimental process in groups simply contributes. Because it is generally helped by Next need to have individual activities to optimize writing activity. While the writing activity is relatively smaller achievement than other aspects indicate that this learning has not been directed to be prepared individually for students, in other words activities in the form of groups still cannot optimally encourage the ability of individuals in writing activities (Mardhia and Akbar, 2018; Pöhler and Prediger, 2014)

As a professional in their field, each teacher in the educational unit is obliged to develop a complete and systematic RPP for learning to be interactive, inspirational, fun, challenging, motivate learners to participate actively, and provide sufficient space for initiative, creativity, and independence according to talent, interest, and physical and psychological development of learners. Thus, in the preparation of the RPP, it is necessary to consider individual differences of learners, based on gender differences, initial ability, intellectual level, interest, motivation, talent, potential, social skills, emotions, learning styles, special needs, learning speed, , the norm, value, and environment of the learners (Putri, 2012). This indicates that the thinking ability of each individual is different. The

thinking process of students is influenced by the level of intellectual development. The level of intellectual development according to Piaget, divides into four, namely sensory motor, preoperational, concrete operations, and formal operations.

E. Conclusion

Based on this research, the various profiles, that have been obtained through the process of chemistry learning with the topic of colligative properties assigned HLT, can encourage prospective teachers and educators to be able to prepare more effective learning for learners. Generally, ER showed a percentage of > 50%. So, the didactic presented by the teacher as a student learning path has been quite good. On the other hand, the Piaget's theory displayed that the conceptual was the main knowledge which is very influential. The SPS analysis showed the students' skills in interpreting and applying the concept revealed slightly lower grades at 69% and 72%. This can be due to ineffective planning, so this skill is considered not optimally developed. Finally, the visual and motor become the principal activities to increase the ability student.

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