The effect of role-playing model on students’ critical thinking skills and interest in learning chemical bonds concept

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Abstract. This study aims to determine the effect of using role-playing models on improving critical thinking skills (CTS) and students learning interest on chemical bonding material. The research method used was a quasi-experimental design with pretest posttest control group design. The number of samples used were 135 students majoring science at MAN Banda Aceh, who were selected using purposive sampling technique. The data of this study were obtained from reasoned multiple-choice test questions and student learning interest questionnaires. Data were analyzed using N-gain test, z test and t-test, the results of differences in the increase of CTS in research classes were calculated using \(Z_{\text{count}}>Z_{\text{table}}\) with a significant level of 0.05, while the results of students learning interest in the experimental class obtained \(t_{\text{count}}(5.845)>t_{\text{table}}(1.895)\) with a significant level of 0.05. Based on the results of the study, it can be concluded that the role-playing model implementation can improve the CTS and learning interest in chemical bond concept.

1. Introduction
Chemistry is a subject that many students complain about, especially during the national exam. Due to abstract concepts, memorising concepts and calculations that sometimes cannot be easily understood by students [1]. Based on the results of the National Examination on the indicators of chemical bond in MAN 3 Banda Aceh in 2016/2017 and 2017/2018 respectively, the results were unsatisfactory, where the students’ scores in the concept of chemical bonds scaled from 0.00 to 33.35, The students in MAN 2 Banda Aceh also faced similar problem who scored 0.00 and 61.11 and MAN 1 Banda Aceh 20.00 and 31.82 [2]. Based on these data it can be concluded that students’ concept understanding, especially in the concept of chemical bonds in 2017 and 2018 at MAN 3 Banda Aceh City was relatively low.

The students failed to answer national exam questions because the national exam questions were designed for a higher level of implementation, synthesis, analysis and evaluation [3]. Based on observations on a case study on November 12-24 2017 at MAN 3 Banda Aceh in the class X-IA1, X-IA3 and XI-IA1, several factors that could make students challenging to understand the chemical concepts, especially chemical bond. One of them was because, during the learning process, students
were only assigned to read chemical bond subject without teacher explaining in detail the chemical bond subject and its relation to daily life. As a result, students’ learning motivation and interest declined, which is indicated less activity, less concentration in learning, and even leaving the classroom during the learning process. One alternative problem-solving in understanding concepts requires student’s interests and critical thinking skills (CTS) [4].

CTS is an ability that requires relevant knowledge and can draw valid conclusions that implemented through the real world [5]. Creating CTS for students is the same as developing student’s personalities so that students need to learn in the learning process [6]. Students’ learning interest can be improved through several methods and learning models [7]. The practice outside the school further increases student’s interest in learning compared to practising at school, this is because the optimal implementation of learning strategies is used so that students tend not to be interested in practices at school [8].

The results of the distribution of chemistry learning interest questionnaires conducted on 13th August to 5th September 2018 in class X of MAN 3, MAN 2 and MAN 1 Banda Aceh showed that the average value of interest in MAN 3 and MAN 1 Banda Aceh was classified as low with consecutive values obtained were 36.16% and 39.30% while those in MAN 2 Banda Aceh were classified as high at 61.73%. This proved that the average MAN students in Banda Aceh City were less interested in chemical subjects. Therefore, it is necessary to have the right learning strategy to increase student’s interest in learning so that their CTS can increase because through CTS and learning interests of students the demands of the 2013 curriculum can be achieved [9].

One learning model that can improve the CTS is a role-playing model as published by [10] that learning using role-playing model provides better learning outcomes. The role-playing model is the process of developing imagination when playing roles, both as living and inanimate figures by mastering the concept of learning. This proves that the role-playing model belongs to the level of role-playing and performs simulations in the learning pyramid where the ability to remember is 90% [11]. In addition, the role-playing model can guide students to work together in groups that show positive social attitudes so that they can foster a sense of responsibility and care that will foster empathy for students in accordance with the expectations of core competencies 2 on the chemistry syllabus.

Research on role-playing had been carried out by [12] who said that the use of the role-playing model can increase the attractiveness of students in the learning process. This greatly helped to improve the quality of students such as knowledge, skills and experience. Similar research had also been conducted by [13] about the application of the role-playing model to learning motivation of students in learning chemical bonds. Interesting things had also been studied by [14] in his research combining several models to test whether role-playing models could improve CTS and the results showed that there was a close relationship between role-playing and CTS models so that they had good influence on students. Learning role-playing models could also improve student’s insight through role-playing scenes that had been compiled based on subject matter [15].

2. Methods
The research method used in this study was quasi-experimental. The research design used was pretest-posttest control group design. As for the population in the study were all students of class X of MAN in Banda Aceh in the academic year 2018/2019. Sampling in this study was conducted by purposive sampling in the form of sample targets that had been studied based on the similarity of the percentage value of the interest in learning chemistry subjects in MAN of Banda Aceh. The sample in this study was class X IPA1 and Class X IPA2 of MAN 1 Banda Aceh City and class X-MIA2 and X-MIA3 of MAN 3 Banda Aceh. The determination of the control group and the experimental group was done by random sampling. So that the experimental class was obtained from class X-MIA2 and X IPA1 with a total of 67 students and control class from class X IPA2 and X-MIA3 with a total of 68 students.

The instrument development process began with the analysis of items that had been through a validity test. Then proceed with the reliability test, the difficulty level of the question and the different power. The questions given were in the form of reasoned multiple choices by including 12 CTS indicators.
Besides going through the questions, the increase in CTS could also be seen from the skills of students in making drama scripts by the subject of a chemical bond.

In addition to the questions, the interest questionnaire was also validated by experts from the counsellor. The aspects used in the assessment of students’ interest in learning consisted of 4 aspects, namely feelings of pleasure, interest, attention and involvement of students developed into 11 statements. Questionnaires of student’s interests were disseminated before learning in all class X MAN of Banda Aceh and while it took place after learning in class X IPA1 of MAN 1 Banda Aceh and class X-MIA2 of MAN 3 in Banda Aceh.

The technique of analyzing learning outcomes data in this study used N-gain data obtained from the control and experimental classes. The results of the N-Gain data were tested for normality and homogeneous tests. Data that were normally distributed and homogeneous would be tested through t-test at a significant level of 0.05. The testing criteria are $H_0$ accepted because of $t_{count}>t_{table}$ and vice versa, but the N-gain data of the experimental group and the controls that will be compared were not normally distributed and homogeneous, then the test used was the Mann-Whitney test at a significant level of 0.05 with $H_0$ criteria accepted because of $Z_{count}>Z_{table}$ and vice versa. Meanwhile, the percentage formula was used for measuring the learning interest.

### 3. Result and Discussion

#### 3.1. Numbering

Based on the percentage value of the average N-gain each CTS indicator in the experimental class was in the high category while in the control class was in medium category. The highest CTS indicator in the control and the experimental class was making induction and considering the results of induction, while the lowest CTS indicator value in the control and experimental classes respectively was considering the credibility (criteria) of a source and defining the term and considering definition. In contrast to the results of [16] the highest indicator was in the indicator making a simple clarification of 60% while the lowest was the indicator of building strategy and tactics which was 43%.

Based on the results obtained, the data analysis was carried out aiming to test the hypothesis that the researcher had to determine the effect of using the role-playing model in learning in the experimental class with the control class that used the discussion method. Hypothesis test results of all CTS indicators can be seen in Table 1, the results obtained showed that there were significant differences between the control and experimental classes with a calculated $Z_{count}>Z_{table}$ on all indicators. This means that the use of role-playing models in the experimental class greatly influenced the increase in student’s CTS compared to the control class.

**Table 1. Normality Test, Homogeneity and z Test of the CTS N-gain Value**

| CTS Indicator                                      | Student Result (N-gain) | Normality | Homogeneity | Z Value | Meaning |
|----------------------------------------------------|-------------------------|-----------|-------------|---------|---------|
|                                                    | Control | Exp. | Control | Exp. | Not Normal (0.000) | Not Normal (0.000) | Not Homogeneity (0.001) | $Z_{count}$ | $Z_{table}$ |         |
| Making induction and considering the results of the induction (conclude) | 58.19  | 80.69 | Not Normal (0.000) | Not Normal (0.000) | Not Homogeneity (0.001) | 3.751 | 1.96 | Sig |
| Identifying assumptions (providing further explanation) | 49.75  | 77.45 | Normal (0.096) | Not Normal (0.000) | Homogeneity (0.173) | 4.650 | 1.96 | Sig |
| Focus on questions (giving a simple explanation)   | 57.01  | 79.02 | Normal (0.057) | Not Normal (0.000) | Homogeneity (0.074) | 3.673 | 1.96 | Sig |
The significant increase in CTS of students was not easily obtained because the rise in CTS must be associated with the right learning method used based on students’ characteristics, one of which by using the role-playing model. Learning that can improve CTS has the right planning and implementation, not only paying attention to the content of teaching material but must adjust it in advance with the learning process so that the development of student’s CTS is not limited [17]. The increase in student’s CTS in this study was not only seen from the test, but the increase in Student’s CTS can also be observed from the results of the worksheet which required students to answer questions and made drama scripts with chemical bonding subject. The results showed that each student was able to respond in detail every question in the worksheet and make the drama script well. This result indicates that the role-playing model can improve student’s CTS. The results of research by [18] also stated that learning by using role-playing models is very useful to be used in enhancing Student’s CTS.

One example of this was a covalent bond play with the theme "the kingdom of covalent" in the text of the contest announcement, students from the kingdom of metal could not become prince of the empress. This is evidenced by students from the metal kingdom realizing that they could not form covalent bonds with the prince. Student’s self-awareness proved that students were not just memorizing drama scripts, but understood in positioning themselves during role-playing because they had understood the material of covalent bonds. Likewise, with drama scripts on ionic bonds, students understood themselves as excess electron sodium atoms, so he looked for other students who needed electrons for joint stability. Therefore, the role-playing model is one of the models that can improve the CTS of students. Similar research had been carried out by [19] that the value of class posttest using scenario-based role-playing was higher than the teaching-based scenario.

The results of the hypothesis test on each CTS indicator showed significantly different. This was marked by an increase in the posttest value and the ability of students to make drama scripts, so role-

| Analyzing arguments (giving a simple explanation) | Not Normal (0.003) | Not Normal (0.000) | Homogenity (0.095) | Sig |
|----------------------------------------------------|--------------------|--------------------|--------------------|-----|
| Considering the credibility (criteria) of a source (Building basic skills) | Not Normal (0.017) | Not Normal (0.000) | Not Homogenity (0.024) | Sig |
| Defining terms and considering the definitions (provide further explanation) | Not Normal (0.002) | Normal (0.033) | Not Normal (0.000) | Sig |
| Making and considering decision values (conclude) | Normal (0.050) | Not Normal (0.002) | Not Homogenity (0.022) | Sig |
| Observing and considering observation reports (Building basic skills) | Normal (0.244) | Not Normal (0.000) | Normal (0.711) | Sig |
| Asking and answering questions (providing a simple explanation) | Not Normal (0.000) | Normal (0.012) | Not Normal (0.001) | Sig |
| Determining an action (set strategy and tactics) | Not Normal (0.009) | Not Normal (0.010) | Not Normal (0.003) | Sig |

The results of the hypothesis test on each CTS indicator showed significantly different.
playing models are very well used to improve the CTS of students. Similar research had also been carried out by [20] which compared the debate method and role-playing in improving the CTS, the results showed that role-playing was effectively used in the learning process in enhancing the CTS of students. A significant increase in CTS in the experimental class caused by the rise in student’s interest in learning in the learning process.

3.2. Student’s Interest Result

The students’ interest in learning was very supportive of active learning. Based on an indicator analysis of interest questionnaires the results of the scores before and after learning had increased, where the indicators of student’s pleasure in learning chemistry were in the moderate category and the other three indicators were in a low category. While after learning the value of the four indicators was in very high category. This indicated that there was an increase in interest in learning after the role-playing model was applied which is showed by the N-gain value on all four indicators. In addition to the N-gain value, significant differences depicted in Table 2 which shows the value of $t_{\text{count}} (5,845) > t_{\text{table}} (1,895)$ at a significant level of 0.05 indicating that there are substantial differences before and after learning by using role-playing models on students’ learning motivations.

| Learning Interest Result | Normality | Homogeneity | Hypothesis Test | Meaning |
|--------------------------|-----------|-------------|----------------|---------|
| Pretest                  | Posttest  | Pretest     | Posttest       |         |
| 37.73                    | 95.00     | Normal      | Normal         |         |
|                          |           | (0.994)     | (0.999)        |         |

Interest in learning is one way to improve the quality of education in schools, a similar study was conducted by [21] revealing that the higher the interest in learning of students, the greater the attention so that his desire to learn science was increasing, besides that with growing interest in students, it encouraged students to participate in the entire process of teaching and learning activities without exception. The role-playing model was beneficial for students in increasing interest in learning; this was characterized by the enthusiasm of students in making drama scripts and acting them out. Learners found out the understanding of various books they had to make drama scripts with the concept of chemical bonds. Besides, students were very active in asking and issuing opinions, so that through the role-playing model students were motivated to study chemistry seriously. The motivation of students was one form of strength that must be possessed by each student to encourage his interest in learning, in the sense that each student liked to follow chemical learning process without feeling pressured [22].

Increasing student’s interest in learning was caused by the role-playing model that involved students directly in the learning process. The role-playing model required students to look for learning topic material in the preparation of drama scripts that would be displayed in front of the class in the form of role-playing with the theme of chemical bonds. This result is in line with the results of the study of [23] which stated that a good situation in the learning process significantly influenced the increase in student’s interest in learning, in this study they invited students to an exhibition and taught them how to form geometric models directly.

The interest in learning greatly influences the improvement of student learning outcomes as a whole, both in the form of affective, psychomotor, and cognitive. These three forms are complicated to obtain if the learning process used has not been able to attract the attention of students to be active in learning. This is in accordance with [24] which revealed that students’ interest is very essential in improving learning outcomes, especially on cognitive learners, while the way to increase interest is to involve students in the learning process that will enhance student’s cognitive abilities that inline with the role-playing model that applied in the learning process, where students were directly involved in understanding chemical bond material. The results showed that 91.19% of students were very interested in using the role-playing model on chemical bonding material which was in the very high category. The
interest of students in the learning process had positive ethical impacts from the students listening well to the explanations and direction of the teacher to actively asking questions and wanting to know more about the material taught.

The increase in CTS and interest in learning has a strong correlation so that it cannot be separated, because both are necessarily important in supporting good learning outcomes for students. Therefore, by increasing interest in learning and CTS, the learning outcomes of students also increases. This finding agrees with the results of [25] study, which stated that learning interest is essential in creating effective discussion results so that students can improve their CTS which affects improving learning outcomes. Therefore, the overall results showed that the use of role-playing models was very useful in increasing the interest and CTS of students so that the learning outcomes of students were better than before. [10] argued that the role-playing model could make students become imaginative, have a broad interest, independent in thinking, curious, full of energy and self-confidence. But not all subjects can use the role-playing model as a solution to solving learning problems, such as in the concepts that require calculation, but the role-playing model is usually used on theoretical subjects on particular material such as economics, biology, language, health, physical education, chemistry in theoretical concepts and so on. Therefore the application of the role-playing model in learning must consider the characteristic of matter or subject.

4. Conclusion
The role-playing model can improve the CTS of students seen based on the N-gain value of each CTS indicator in the high category and strengthened by the Z test value on each CTS indicator which stated that there was an influence on the use of role-playing models to improve CTS. The role-playing model also influences student’s interest in learning on chemical bond subject which was characterized by the N-gain value of each interest indicator in the high category and strengthened by the t-test value which showed student’s interest in learning increased after the use of role-playing models, so the role-playing model has an effect on providing meaningful learning in improving CTS and interest in learning.

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