Unesa Journal of Chemical Education *ISSN: 2252-9454*
Vol. 8, No. 3, pp.369-379 September 2019

THE DEVELOPMENT OF STUDENT MISCONCEPTIONS DETECTION AND REDUCTION SOFTWARE IN REACTION RATE MATERIAL WITH CONCEPTUAL CHANGE TEXT STRATEGY

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Abstract

This Study aimed to get a feasible software in detect and reduce students' misconceptions on reaction rate topic. This feasibility was viewed from the validity, practicality, and effectiveness of the software. Method of the research used research and development (R&D). The subjects in the research were 12 students of XI MIPA in SMAN Jogoroto, who had receive the reaction rate material. The method which is used to detect students' misconceptions is a three-tier test, while the strategy used to reduce misconceptions is conceptual change text strategy. Based on the results of validation by 3 validators, the content validity of the software was 89.92% in very valid category, while the construct software validity in linguistic, presentation, graphic, and software requirements as ICT media criteria be successive were 81.67%, 85.56%, 87.33%, and 82.22%, so four criteria for construct validity of software can be categorized as very valid. The practicality of software based on the response questionnaire supported by the student activity observation were 95.16% and 91% in very practical categories. Based on shifting students' conceptions from misconceptions to know concepts in preliminary field testing, the effectiveness of software was 82.13% in very effective category. This shows that the software fulfills 3 feasibility criteria, so the software is appropriate used to detect and reduce students' misconceptions in the reaction rate material, that is the effect of surface area, catalyst, temperature, and concentration on the reaction rate concept.
Keywords: Software, misconception, reaction rate, conceptual change text.

INTRODUCTION

Education in Indonesia has experienced significant changes. This can be seen from several learning principles which are determined based on regulation of the minister of education and culture number 22 of 2016 concerning the standards of primary and secondary education processes. It state that teachers are not only as source of learning, changes from students being told to students seeking out and the learning emphasized in multi-dimensional answers also several other principles. These principles certainly apply to various scientific disciplines including chemistry [1].

Chemistry is a branch of natural science that studies various things (composition, structure, properties, changes of matter and the energy that accompanies the material changes) was developed with scientific methods and accompanied by a scientific attitude. While the products of science itself are facts, concepts, principles, laws, and theories. Two things related to chemistry, the first is chemistry as a product in the form of facts, concepts, principles, laws, and theories and the second chemistry as a process of scientific work [2].

As a branch of science, chemistry is taught by connecting interrelated concepts. Understanding a particular concept influences the understanding of other concepts. The process of learning in chemistry becomes complicated because each concept must be understood correctly before understanding the other concepts. When students build their own understanding through an assimilation process that is connecting old concepts with new concepts in cognitive structures, students often experience difficulties or even failures. This raises a variety of different understandings about a concept and misconception potentially arise [3].

One of subjects in chemistry that contain many concepts that are interconnected one another so it has the potential to be able to cause misconceptions in students is the reaction rate. This is supported by pre-research results in three different senior high schools (SMA/MA) are selected randomly. The results show that in SMAN Jogoroto the percentage of students who experience misconceptions on the surface area factor is 68%, 50% on the catalyst factor, and 49% on the temperature factor. The students' misconceptions in MAN 1 Gresik are 53% on the factor of surface area, 49% on catalyst factors, and 48% on temperature factor. While in SMAN 1 Pandaan, 51% of students experienced a

misconception on the surface area factor, 48% on the catalyst factor, and 41% on the temperature factor. In line with the pre-research results, based on previous research 13.16% of students experience a misconception on factors that influence the rate of reaction, namely the factor of surface area and more than 50% of students experience misconceptions on catalyst and temperature factors [4]. Whereas the other research found that 47.8% of students experienced a misconception on the factor of surface area, 35.1% on the catalyst factor, 36.2% on the temperature factor, and 17% on the concentration factor [5].

There are three important terms regarding misconceptions, namely concepts, conceptions, and misconceptions. The concept is an essential character of an object, process, phenomenon or event [6]. conception is one's interpretation of a particular concept, whereas misconception is a mismatch of concepts understood by someone with a scientific concept used by experts [7]. Misconceptions which is experienced by students difficult to convert into the correct concept, therefore the initial understanding of a concept before students receive a new concept is very important for the teacher to pay attention. Incorrect preconceptions can lead to new misconceptions.

There are three steps that can be used to overcome misconceptions, they are finding misconceptions experienced by students, then finding the causes of these misconceptions, and finding the appropriate solutions to overcome these misconceptions [3]. Based on the results of interviews with chemistry teachers from three different schools, they helped overcome misconceptions by giving a re-explanation or just using traditional texts. Both have the potential to cause boredom and ineffectiveness because students may experience misconceptions on the same concept, the location and causes of misconceptions are not known so the treatment given is not on correct target.

Conceptual change text is one of strategies that can be used so that the treatment given to students can shift the wrong preconceptions to the correct conception right on target. Conceptual change text is designed to shift students' conceptions from misconceptions into knowing concepts by giving things that are contrary to what they understand as a misconception so that they can lead to dissatisfaction, followed by a correct explanation of the wrong concept which is easily understood and makes sense for students. Conceptual Change Text (CCT) and practicum methods are more successful in overcoming misconceptions than traditional instructions [8].

Traditional text sometimes is considered to be less efficient, the solution to this problem is the need for a more efficient and practical instrument in accordance with one of the learning principles mentioned in regulation of the minister of education and culture number 22 of 2016 concerning the standards of primary and secondary education processes where the use of technology information and communication are expected to be able to improve the efficiency and effectiveness of learning [1]. Along with the development of technology which is increasingly fast demanding the world of education to prepare superior and competent human resources to be able to compete globally. Based on the regulation of the national education minister number 16 of 2007 concerning academic qualification standards and teacher competencies, schools and educational institutions are required to increase the use of information and communication technology so that they can support educational strategy reforms and be able to balance progress in the globalization era [9]. Because of that reason, computers are used as learning aids in the education needs to continue to be developed and one of them is a software. Based on research chemical misconception detection software is able to detect chemical misconceptions on the subject of acid base in terms of the output obtained [10].

Based on the description of several paragraphs above, it need to develop a students' misconceptions detection and reduction software in the reaction rate material with conceptual change text strategy. So the aim of the research is to get a feasible software in detect and reduce students' misconceptions on reaction rate topic.

METHOD

The type of this research is research and development (R&D). The object of this research is the students' misconceptions detection and reduction software in the reaction rate with conceptual change text strategy. Research methods can be described as the following research and development pathways on figure 1.

Based on Figure 1, there are 10 steps in research and development method, but the research is conducted until the main product

revision step. The developed software consist of pre-test to detect the student' misconception, CCT to reduce the misconception, and post-test to detect the shifted of the student conception. Pre-test and post-test here using three-tier diagnostic test.

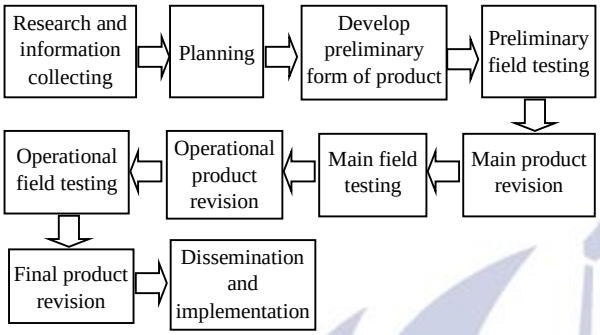

Figure 1. Research and Development (R&D) method

[11]

Three-tier tests are composed of three levels of questions. The first level (first-tier) in the form of ordinary multiple choice, second level (second-tier) in the form of multiple choices containing the reasons for the answer choices in the first-tier, and third-tier question is the level of confidence of the answer that has been chosen at the first and second levels. Three-tier test can find out the possibility of students answering questions by guessing also it can be distinguished between students who answer incorrectly because they experience misconceptions or lack of understanding of material [12].

Table 1. The Student Concept Understanding Category

First tier	Second tier	Third tier	Category
True	True	Certain	Scientific knowledge (T)
True	False	Certain	Misconception 1 (MK1)
False	True	Certain	Misconception 2 (MK2)
False	False	Certain	Misconception 3 (MK3)
True	True	Uncertain	Lack of knowledge (TK)
True	False	Uncertain	Lack of knowledge (TK)
False	True	Uncertain	Lack of knowledge (TK)
False	False	Uncertain	Lack of knowledge (TK)

[14]

Three tier-tests have several advantages including being applicable to many subjects, more valid in distinguishing students who do not know the concept with students who are misconceptions of ordinary multiple-choice instruments or with two-tier tests. In addition the three tier-tests also have a disadvantage, it cannot know whether the respondent is sure of the answer at the first or second level [13]. The student concept understanding category is shown by the Table 1.

Analysis of data related to the feasibility criteria of software, they are analysis of the content and construct validity, the practicality, and the efectiveness. Content and construct validity are based on the result of validation by 3 validators. The score is based on the Likert scale.

Table 2. Likert Scale

Judgement	Score Scale
Very good	5
Good	4
Enough	3
Bad	2
Very bad	1

[15]

The results are calculated by the following formula.

$$P(\%) = \frac{\sum total\ score\ from\ the\ validators\ for\ each\ criteria}{maximum\ score\ for\ each\ criteria \times 3} \times 100\%$$

Then the percentage obtained is interpreted based on the score interpretation table, shown by the Table 3.

Table 3. Interpretation of Validity Score

Percentage (%)	Category
0% - 20%	Very less valid
21% - 40%	Less valid
41% - 60%	Valid enough
61% - 80%	Good/valid
81% - 100%	Very good/very valid

[15]

The practicality of software based on the response questionnaire supported by the student activity observation. Score for the result of the student response questionnaire and student activity observation are shown by the Table 4. The score is calculated by the following formula:

$$P(\%) = \frac{\sum total\ score}{maximum\ score} \times 100\%$$

Table 4. Guttman Scale

Answer	Score for statement	
	Positive	Negative
Yes	1	0
No	0	1

[15]

Then the percentage obtained is interpreted based on the score interpretation Table 5.

Table 5. Interpretation of Practicality Score

Percentage (%)	Category
0% - 20%	Very less practical
21% - 40%	Less practical
41% - 60%	Practical enough
61% - 80%	Good/practical
81% - 100%	Very good/very practical

[15]

Based on shifting students' conceptions from misconceptions to knowing concepts in preliminary field testing, knowing the effectiveness of software. The effectiveness is calculated by the following formula.

$$Effectiveness(\%) = \frac{\sum shift\ from\ MK\ to\ T}{\sum\ \ initial\ MK} \times 100\%$$

Then the percentage obtained is interpreted based on the score interpretation Table 6.

Table 6. Interpretation of Evectiveness Score

Percentage (%)	Category
0% - 20%	Very less effective
21% - 40%	Less effective
41% - 60%	Effective enough
61% - 80%	Good/ effective
81% - 100%	Very good/very effective

[15]

RESULT OF RESEARCH AND DISCUSSION

This research is a research and development of students' misconceptions detection and reduction software in the reaction rate material with a conceptual change text strategy. The general aim of this research and development is to get a feasible software in detect and reduce students' misconceptions in the reaction rate, which is describing software validity in terms of content and construct validity, describing software practicality in terms of student responses and activities, and describing the effectiveness of software in terms of shifting students' conceptions from misconceptions into knowing concepts. There are five steps in this research and development, they are research and information collecting, planning, preliminary field testing, and the last is main produt revision.

The things that conduct in the first stage, which is research and information collecting are need assesment, literature study, and small scale research.Need assesment is conducted by considering several criterias such as how important the product for education, misconceptions detection and reduction software in the reaction rate material developed also has the value of science, beauty, and practicality, researchers have knowledge, skills, and experience in developing these products and considerations the available time. Literature studies are carried out to obtain concepts or theoretical foundations that strengthen a product. In addition, literature studies are also needed to find out the most appropriate steps in product development. While the small scale reasearch in this case is pre-research which is conducted in SMAN Jogoroto, MAN 1 Gresik, and SMAN 1 Pandaan. The result of the pre-research is shown by the Figure 2.

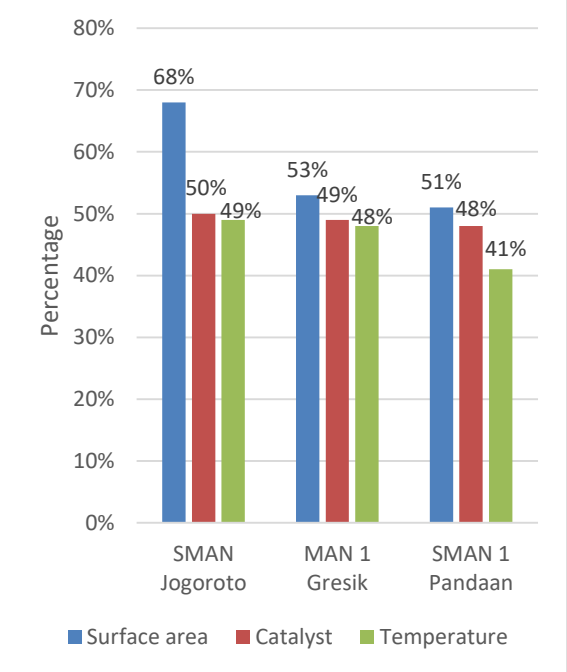

Figure 2. Students' Misconception Percentage

Figure 2 show that the higher percentage of students' misconception happened in SMAN Jogoroto. Based on those result, this school was decided to become the preliminary field testing place. The software should fulfill the content and construct validity before it is tested on the preliminary field testing at school.

Content Validity

The content validity of the software in general is 89.92% in very valid category. It means that the components of the software developed in this study are in accordance with developing science. The components of software are the pre-test, CCT, and post-test. Related to these components, the validity of the content of the software in terms of several aspects, namely the truth of the material with the concepts that influence the rate of reaction includes the suitability of the items contained in the software with basic competencies in the reaction rate material and suitability to the concept of surface area influence temperature and concentration of the reaction rate. In addition, the accuracy of writing symbols, formulas or numbers and the suitability of the content of the material asked with the school level is high school.

The other aspects that are reviewed in the validity of the software content is the suitability of animation, images, and videos used with the concept of the influence of surface area, catalyst, temperature, and concentration on the reaction rate. The CCT in the software was also validated by reviewing several aspects such as CCT conformity with the questions asked in the pre-test and post-test, the suitability of the CCT with the concepts in the reaction rate material and the suitability of the CCT with which the objectives were to reduce misconceptions that occur in students on the concept of the influence of surface area, catalyst, temperature, and concentration on the reaction rate.

Construct Validity

Software components that are also interrelated and need to be validated are about linguistic, presentation, graphics, and requirements as ICT media criteria. The results of the validation of these criteria are referred to software construct validity.

Software construct validity in linguistic criterion is 81.67% in very valid category. Language criterion in this regard relate to the suitability of writing questions in the pre-test and post-test as well as text writing in CCT with good and correct Indonesian language rules, the clarity of writing in the software, effectiveness and efficiency of the language used and choice of words which does not cause multiple interpretations.

Based on the validation results of several aspects such as clarity of software objectives, accuracy of the order of presentation in software, clarity of software usage instructions, software interactivity, speed and accuracy of software in analyzing student answers, the software construct validity on the presentation criterion is 85.56% in very valid category.

The next criterion is related to software graphics which includes several aspects such as the accuracy of choosing the type, color, and font size, accuracy of the layout of text, images, videos and animations, accuracy of background color selection, audio and visual clarity in video, visual clarity of images also the clarity of the animation presented in the software, the relationship between narration and visuals in the video, and the harmony between layout design, typography, and color. Based on the results of the validation of several aspects, the software construct validity on graphic criterion is 87.33% in very valid category.

The software construct validity on the software requirements criterion as an ICT medium is 82.22% in very valid category. Some aspects reviewed in this regard are related to its maintanable, usability, and compatibility of the software.

Software practicality

Practicality is one part of the software feasibility criteria as a media. Software is said to be practical if it is useful for the intended users, in this case are teachers and students and it is easy to apply in the field. The practicality of research and development is based on student response questionnaires supported by observations of student activities during the initial field testing.

Figure 3 show some percentages of student response questionnaire aspects. Aspect number 1 is about the level of attractiveness of the software display design, number 2 is about background color, number 3 is about the clarity of font type, number 4 is about the accuracy of font size selection, number 5 about a comfortable appearance or not, number 6 and 7 are about image and animation clarity on software, number 8 is about audio and visual video clarity, number 9 is about the ease of understanding software usage instructions, number 10 is about button function, number 11 is about simplicity and ease of operation of the software and the last is number 12, that is about regarding learning motivation with software.

All aspects of the student response questionnaire obtain percentages that can be categorized as very practical, except in the aspect

of the attractiveness of the background color with percentage of 50%. It means that 6 out of 12 students think that the software background color is not attractive. It's caused by choosing of the background color. The color chosen as the background in the pre-test and post-test questions in the software is dominated by white and light gray or other colors that are not too striking. It is be intended in order to students stay focused on the questions and answers presented.

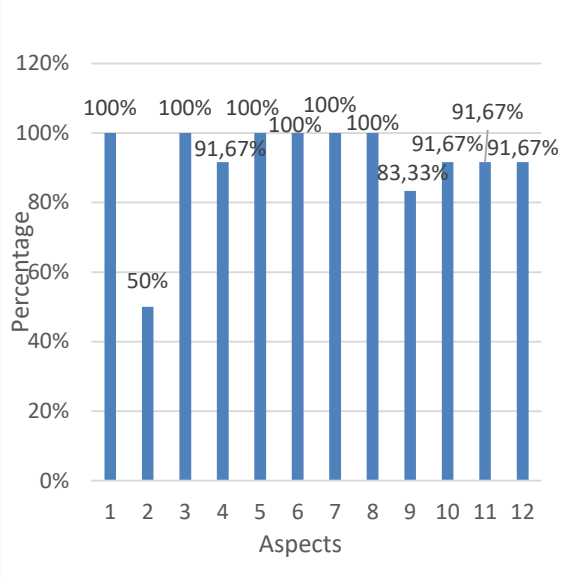

Figure 3. Percentage of Student Response Questionnaire Results

Different from the appearance of the pre-test and post-test questions, the CCT display is made more colorful because there are some parts that are made with brighter colors such as red or yellow, for example in the key words that are forced to be the center of student attention when reading it. In addition the striking and different colors in important parts of the CCT is intended that the students will more easily remember it.

Based on the percentage average of several aspects in Figure 3, it is known that the percentage of software practicality in research and development is based on the results of student questionnaire responses of 91% in very practical categories, while based on the average percentage of practicality on the four aspects in the software shown in Figure 4, it was known that the practicality of software reviewed from the observation of student activities was 95.16% in very practical category. So it can be said that the software developed in this study is useful for the intended users in this case students and it is easy to apply in the field.

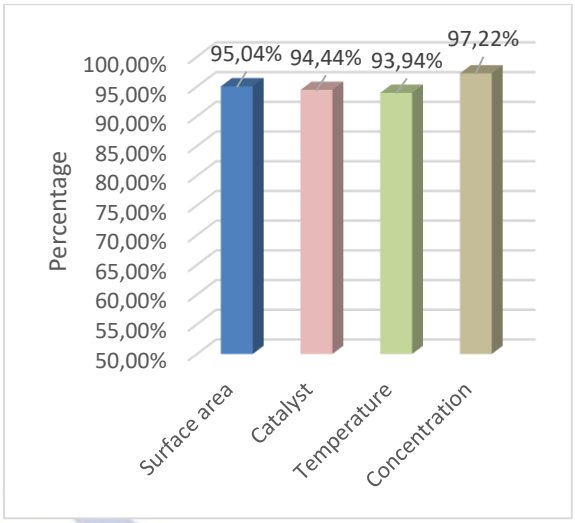

Figure 4. Percentage of Students Activities Observation Result for each Concept

Some aspects were observed by four observers in the initial field testing of software. The activities related to the implementation of several activities expected to be carried out by students in accordance with the software design.

The percentage of observations result of student activities on the four concepts presented in the software is less than 100%, this indicates that there are some activities that were not carried out during the initial field testing of the software. The activities are when students who are detected experiencing misconceptions or lack of knowledge should choose the "Help / material" button but students do not choose the button and directly work on the post-test questions presented. The inactivity of these activities certainly influences the results of the shift in student conceptions because the "Help / material" button if selected will display 4 CCT stages that are intended to reduce misconceptions that occur in students. Opportunities for the reduction of misconceptions are small because students do not experience cognitive conflict and do not accommodate the preconceptions that are wrong with new concepts that are correct in accordance with the scientific concepts accepted by experts.

Software Effectiveness

In addition one of the software feasibility criteria is effectiveness that is based on the results of shifting student conceptions that are obtained after students carry out software testing. Software developed is said to be effective, if it is able to be understood by students as a target user and able to achieve the

desired results, namely being able to detect misconceptions in students then reduce the misconception.

From the results of initial field testing with 12 students, data obtained from the shift in students' conceptions on the concepts of the influence of concentration, surface area, temperature, and catalyst, were presented in Tables 7, 8, 9, and 10.

The first concept of the software in this research is the effect of concentration on the rate of reaction concept. The results of the shift in conception of 12 students who carried out software testing can be seen in Table 7.

Table 7. Results of Shifts in Student Conception on the Concept of Concentration Effects

Student		Question number		
		1	2	3
Conception Shift	S1	MK1 – T	MK1 – T	T – T
	S2	T – T	TK – T	T – TK
	S3	TK – MK1	MK3 – T	T – T
	S4	T – T	MK1 – T	MK2 – TK
	S5	T – T	T – T	MK2 – MK2
	S6	T – T	TK – T	MK1 – T
	S7	T –	T –	T –
	S8	T –	T –	T –
	S9	T –	T –	T –
	S10	T –	T –	T –
	S11	TK – T	TK – TK	MK1 – T
	S12	T – T	T – TK	MK1 – T

Based on the Table 7, it can be seen that 4 of 12 students did not detect misconceptions in 3 questions related to the effect of concentration on the rate of reaction presented. The percentage of misconceptions in this concept is relatively small compared to the other three concepts that developed in the software of this research. The 7th, 8th, 9th, and 10th Students (S7, S8, S9, S10) detected knowing the scientific knowledge or concept (T) of the three pre-test questions, so that the four students were not presented with CCT and 3 post-test questions.

The percentage of software effectiveness in the concept of the influence of concentration on reaction rates is generally shown in Figure 5.

Figure 5 show that the shift from MK to T, MK to TK, MK to MK respectively is 87%, 6%, and 7%. Therefore the software on the concept of the effect of concentration on the reaction rate can be categorized as very effective. It means that CCT presented in software is able to be understood by students so that it can reduce misconceptions that occur in students.

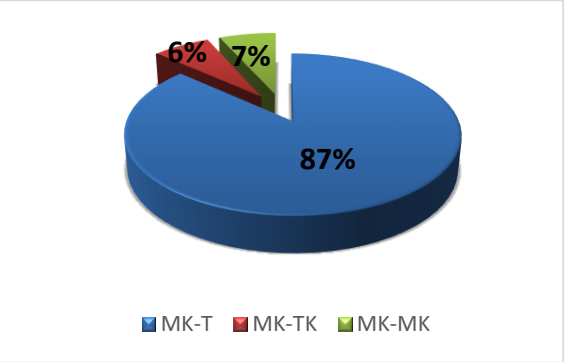

Figure 5. Percentage of Shifting MK to T, MK to TK, and MK to MK in Concept of Concentration Effect on Reaction Rate

The second concept in the students' misconceptions detection and reduction software which is developed is the effect of the surface area on the reaction rate. The students' conception shift shown by the Table 8. The table show that the results of the conceptual shift from 12 students showed that only the 11th student (S11) experienced a shift in conception to lack of knowledge (TK) in the 3 questions presented. It means that students feel uncertain about the answers to the post-test questions. After analyzing the results of observations of student activities, it is known that the students did not press the "Help / material" button in the software, which means the students did not go through 4 stages in CCT, so there was an opportunity that the students did not know which parts of the preconceptions were not in accordance with the concept of experts, therefore the student did not feel confident with the answer that chosen.

Table 8. Results of Shifts in Student Conception on the Concept of Surface Area Effects

Student		Question number		
		1	2	3
Conception Shift	S1	T – T	MK1 – T	MK1 – T
	S2	MK1 – T	TK – T	MK1 – T
	S3	T – T	MK1 – T	MK1 – T
	S4	MK1 – T	T – T	TK – T
	S5	MK1 – T	MK2 – T	T – T
	S6	MK1 – T	T – T	T – T
	S7	MK1 – T	MK3 – T	TK – T
	S8	T -	T -	T -
	S9	MK1 – T	MK1 – T	MK1 – T
	S10	MK1 – T	MK1 – TK	T – T
	S11	TK – TK	TK – TK	MK1 – TK
	S12	T – T	TK – T	TK – T

Misconceptions are resistant and persistent, it means that misconceptions are difficult to change [16]. The condition that must be created so that students are able to change their misconceptions into a concept that is correct in accordance with the concept of science that is accepted by experts is that students must be dissatisfied with their conceptions and the concept is unable to solve the problems it faces so the most important thing is that students must accommodate the preconceptions that are wrong with the right new concepts. This is in line with Piaget's cognitive development theory which states that a person's scheme will adapt and change during cognitive development through assimilation and accommodation and based on constructivist learning theory which states that students discover themselves and transform complex information, check new information with old rules and revise it if the rules are no longer appropriate. All these conditions can be created with CCT, so that if students do not pass the CCT stage and directly answer the post-test questions after answering the pre-test questions, the chances of a reduction in misconception are very small.

The percentage of software effectiveness on the concept of the influence of surface area in reaction rates is generally shown in Figure 6.

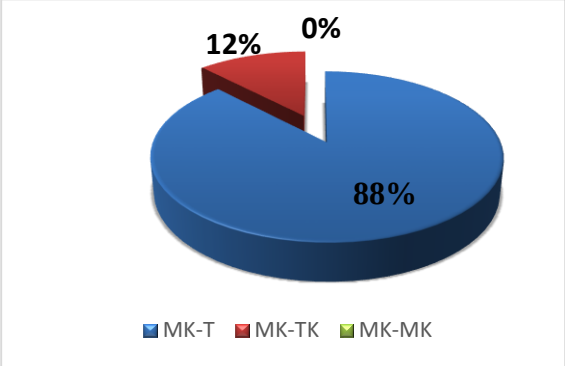

Figure 6. Percentage of Shifting MK to T, MK to TK, and MK to MK in Concept of Surface Area Effect on Reaction Rate

The Figure 6 show that the average percentage shift in students' conceptions of misconception (MK) to know the concept or scientific knowledge (T), misconceptions (MK) become lack of knowledge (TK), and misconceptions (MK) remain misconceptions (MK) of the 3 questions presented. From the picture it is known that the shift from MK to T, MK to TK, MK to MK respectively were 88%, 12%, and 0%. Therefore the software in the concept of the effect of surface area on the reaction rate can be categorized as very effective. It means that CCT presented in software on this concept presents several analogies because the analogy used in CCT produces a positive effect on student conception [17]. In addition CCT is able to be understood by students so that it can reduce misconceptions that occur in students.

The third concept in the students' misconceptions detection and reduction software of this research and development is the effect of the temperature on the reaction rate. The students' conception shift shown by the Table 9.

Table 9. Results of Shifts in Student Conception on the Concept of Temperature Effects

	Student	Question number		
		1	2	3
Conception Shift	S1	MK2 – T	MK1 – MK3	TK – MK3
	S2	T -	T -	T -
	S3	TK – T	MK1 – T	MK1 – T
	S4	TK – T	MK2 – T	MK2 – MK1
	S5	MK2 – T	MK3 – T	MK2 – T
	S6	MK1 – T	MK1 – T	MK3 – TK
	S7	TK – T	T – T	T – T
	S8	MK1 – T	MK2 – T	MK3 – TK
	S9	TK – TK	TK – T	TK – T
	S10	MK3 – T	MK3 – T	T – T
	S11	TK – TK	T – T	MK1 – T
	S12	T – T	T – T	MK1 – T

Based on the Table 9 known that the first student (S1) shows that 2 of the 3 questions show a shift in conception into misconception 3 (MK3) which means that the student's answer in the first and second tier are false but the students feel confident with his/her answer. After analyzing the results of observations of student activities while conducting a software initial field testing, the fact was that the student worked on the post-test without going through 4 CCT stages because students did not select the "help / material" button in the software so that students did not experience cognitive conflict by presenting facts that contradict misconceptions that allow students to do accommodation that is to doubt the old concept or preconceptions with new concepts that are correct in accordance with the concept of science that are accepted by experts.

The percentage of software effectiveness in the concept of the influence of temperature on reaction rates is generally shown in Figure 7. It show that the shift from MK to T, MK to TK, MK to MK respectively was 81%, 9%, and 10%. Therefore the software on the

concept of the influence of temperature on the reaction rate can be categorized as very effective. This means that CCT presented in software is able to be understood by students so that it can reduce misconceptions that occur in students.

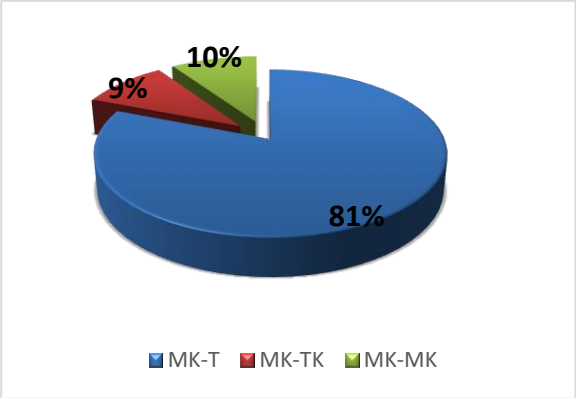

Figure 7. Percentage of Shifting MK to T, MK to TK, and MK to MK in Concept of Temperature Effect on Reaction Rate

The fourth concept in the students' misconceptions detection and reduction software in this research and development is the effect of the catalyst on the reaction rate. The students' conception shift shown by the Table 10.

Table 10. Results of Shifts in Student Conception on the Concept of Catalyst Effects

	Student	Question number		
		1	2	3
Conception Shift	S1	MK3 – T	TK – TK	MK3 – TK
	S2	MK3 – TK	MK3 – T	MK1 – T
	S3	MK3 – T	MK3 – MK1	TK – MK3
	S4	MK3 – T	MK3 – T	MK3 – T
	S5	MK3 – T	MK3 – TK	MK3 – T
	S6	MK3 – MK1	MK3 – T	MK1 – MK3
	S7	MK1 – T	MK2 – T	TK – T
	S8	MK2 – T	MK3 – T	MK3 – TK
	S9	TK – T	TK – T	MK3 – T
	S10	MK3 – MK1	MK2 – T	MK1 – T
	S11	MK3 – T	MK3 – T	T – T
	S12	MK2 – T	MK3 – T	MK3 – T

The conceptual shift that is not in accordance with the objectives of developing the software in this study occurred in the first (S1) and 3rd (S3) students. The first student (S1) did not experience a shift in conceptions on question number 2, namely in the pre-test and post-test they did not know the concept or lack of knowledge (TK), while in question number 3 the concept shifted from misconception 3 (MK3) to not knowing the concept (TK). It means that the first student (S1) does not feel confident about the answer in the post-test question. Based on the results of the analysis of the observations of student activities, students choose the "help/ material" button which means students follow the software path according to instructions but the results of activities observation also indicate that the student does not read, pay attention to, and understand the text, images, animations or videos presented on the CCT students directly press the "advanced" button to be able to continue each stage of the CCT without regard to the contents of the CCT. The same thing also happened to the 3rd student (S3) except that the students felt confident in the answer in the post-test question without knowing the truth of the conception.

The percentage of software effectiveness in the concept of the influence of catalyst on reaction rates is generally shown in Figure 8. The figure show that the average percentage shift in the conception of students from misconception (MK) to know the concept or scientific knowledge (T), misconception (MK) to not know the concept or lack of knowledge (TK), and misconception (MK) remains misconception (MK) of the 3 questions presented. From the picture it is known that the shift from MK to T, MK to TK, MK to MK respectively was 73%, 14%, and 13%. Therefore the software on the concept of the influence of the catalyst on the rate of reaction can be categorized as effective. It means that CCT presented in software is able to be understood by students so that it can reduce misconceptions that occur in students.

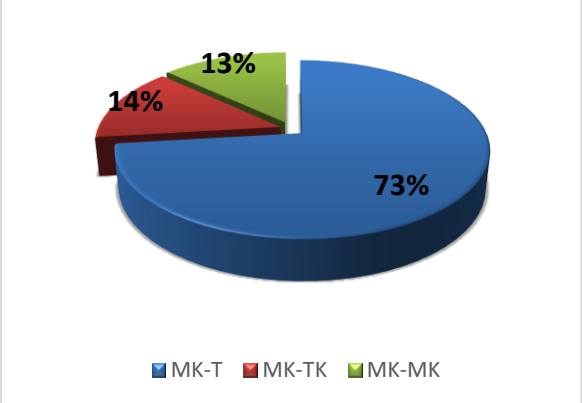

Figure 8. Percentage of Shifting MK to T, MK to TK, and MK to MK in Concept of Catalyst Effect on Reaction Rate

Based on the average percentage of effectiveness of the 4 concepts contained in the

software, in general the effectiveness of detection software and reducing student misconceptions in the material reaction rate in this study and development was 82.13% in very effective category.

CLOSURE

Conclusion

Software developed in this research is appropriate to be used to detect and reduce students' misconceptions on the concept of the of surface area, catalyst, temperature, and concentration effects on the reaction rate. Software feasibility is based on 3 following criteria.

1. Content and construct validity obtained from the validation results by 3 validators. Software content validity was 89.92% in very valid category, while software construct validity in linguistic, presentation, graphics criteria, and requirements as ICT media were 81.67%, 85.56%, 87.33%, and 82.22%, so that the four criteria for software construct validity can be categorized as very valid.
2. Practicality of software is based on observation of students activities and questionnaire responses of 12 students were 95.16% and 91% in very practical categories.
3. The effectiveness of software based on the results of the shift in students' conceptions from misconception to knowing the concept in the initial field testing of 12 students was 82.13% in very effective category.

Suggestion

Based on some of inputs and limitations when conducting research, then some of the suggestions given for improvement in future research are as follows.

1. Software in this research and development requires the admin or teacher and students to be in the same network when the process of detection and reduction of misconceptions is carried out, it is expected that later more flexible software can be developed that can be used by students without having to be in a network with admin or teacher.
2. Students detected misconception can work on the post-test questions without having to go through the 4 CCT stages presented in the software to reduce the misconception. It is hoped that a software will be developed that requires students to pass the CCT stage or other strategies that can be used to reduce misconceptions.

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