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Development of module based introduction, connection, application, reflection, extention (icare) on ion balance and pH of salt solution class xi sma/ma

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ABSTRACT

The development of a ICARE-based Module on the material of ion balance and pH of salt solution aims to develop a valid module and determine user responses in learning. The research method used is the research and development (R&D) method by applying a 4-D development model which includes Define, Design, Develop and Disseminate, pandemic conditions cause research to only be carried out until the Develop stage which was followed by one-on-one trials, teacher trials, and limited trials. The data collection tools used are validity sheets and user response questionnaires. The data analysis technique used is to calculate the results of the validation percentage score and user response. The results of the study explain that the ICARE-module developed has been categorized as "valid" according to 3 material validators and based on the feasibility of content, ICARE characteristics, language, graphics and respectively were 93.93%, 100%, 95.2%, 95% and 100%. The results of the user response test for three teacher and 20 students were categorized as “very good”. The percentage of user response scored based teacher and student response questionnaires were 93.33% and 90.12% respectively.

1. Introduction

Learning is a process of change, which is a change in thingking and behaving as a results of interaction with the environment in meeting the needs of life (Abdullah, 2020). In the learning process, teachers are required to be able to develop their own teaching materials. This is intended so that the learning process runs effectively. Teaching materials are all of forms of materials that are systematically arranged that allow students to learn independently and that are designed according to applicable curriculum (Nuryasana & Desiningrum, 2020; Sinaga et al. 2022; Silaban, 2021)

Teaching materials have various types, ranging from printed, audio and visual forms. One of the printed teaching materials is a module. According to Lasmiyati & Harta (2014), modules are a learning teaching material whose contents are relatively short and spesific compiled for achieve learning objectives. The use of modules is very important because the module is independent learning, meaning that students are able to learn on their own with the module without the presence of a teacher. The application of the use of the module resulted in students becoming more active in understanding, seeking and processing concepts independently. This is line with what (Siew & Ambo,

2018) said that The learning module focused on activities that required student to generate new ideas through writing and various images and any sketch (Pratiwi et al. 2019).

However, the problem that often occurs in the learning process is the limited use of teaching materials that can facilitate students to be active in learning so that they can help students understand the learning materials well. Based on information obtained through interviews with chemistry teachers at SMAN 1 and SMAN 5 Pekanbaru, teachers have used modules in the learning process, especially on the subject of ion balance and pH of salt solutions. However, the modules used by the teacher are still informative (containing descriptions of the material and examples of questions only) and the modules used are not based on learning models.

The solution to overcome this is the need for the development of an innovative module teaching material. The learning system using modules focuses on student activities and creativity in the learning process and applies advanced and continuous learning (Munthe et al. 2019; Nisa et al. 2022). Beside that, Guido (2014) said that instructional modules in material science are useful for student's knowledge and according to the student's level.

The development of modules based on a learning model that can lead students to understand, process and construct their own knowledge in learning. The learning model that can be used in teaching materials is the ICARE model. ICARE is a learning model that can make it easier for students to apply their knowledge in everyday life. ICARE also makes students have skills so that students can be more active in learning process and increase learning activitles (Mazidah et al. 2020; Alfian et al. 2021). One of advantages of the learning ICARE is to require students to be able to apply the material obtained with the real problems in life, so the students will better understand the concept of chemistry concept (Wahyuni et al. 2021). Also ICARE model can be applied to the chemistry learning because chemistry does not only focus on things about conceptual understanding, but students are guided to be able to integrate the concepts in everyday life (Rahmayani et al. 2019). One of the chemistry learning materials that is closely related to everyday life is ion balance and the pH of a salt solution. That things compatible that ICARE model is one of the learning models that's emphasize the cultivation of concepts and activities to apply student knowledge in everyday life (Handayani et al. 2021).

ICARE model has 5 stages, they were introduction, connection, application, reflection and extension. Sa'diyah et al. (2021) explained 5 stages of ICARE, they were Introduction section contains an explanation of the goals and context. Connection section contains to make students to be essential to comprehensive education purposes connected to the chemistry material. In this section, students connect knowledge with the material which have being studied. In Application section, students doing experiments. In Reflection section, students are given the opportunity to reflect what they have or have not been reached and Extention section, students are given the task to expand and strengthen the concepts that have been achieved. The ICARE model used has several advantages, namely mapping a balanced content structure between theory and practice for teachers and students, having a life skills-based approach and providing opportunities for teachers to make apperception of each lesson that will be carried out easily (Imania & Bariyah, 2018).

Several similar studies that support the development of ICARE-based modules include the research conducted by Kartija (2021) entitled "Development of ICARE-Based Modules on Acid-Base Materials for Class XI SMA". Indicates that the developed module is valid. Yani's research (2018) on the development of ICARE-based modules in Mathematics for SMP/MTs students shows that the modules developed are valid and suitable for use in the learning process. Another study conducted by Purwaningsih et al. (2019) entitled the development of ICARE-based learning modules in statistics subjects for class VIII SM/MTs students showed that the teaching materials developed had met the eligibility and requirements to be used as learning modules.

The aims of this research are first to develop a valid module of ion balance and pH of the salt solution based on feasibility of content, presentation, liguistic, grapics and ICARE characteristics. Second, to determine the user responses in the learning process.

2. Method

The research was carried out at the Chemistry Faculty of Riau University, Senior High School 1, and Senior High School 5 in Pekanbaru. The research time was spent 7 months starting from January to August 2021. The research method used was the research and development (R&D) method by applying a 4-D development model. 4-D model consist of Define, Design, Develop and Disseminate. The selection of the 4D model was based on the effectiveness and time efficicency in the implementation. 4D model more compact compared to other models. There are stages that are not listed in the 4D model but the procedure includes the testing and revision stages. However, due to the pandemic conditions and time constraints, the research was only carried out up to the Develop stage. The following is the 4-D development flow by Triyanto (2012) which was modified by the researcher. Development Flow of ICARE-Based Module Material Ion Balance and pH of Salt Solution with a modified 4-D model can be seen Figure 1.

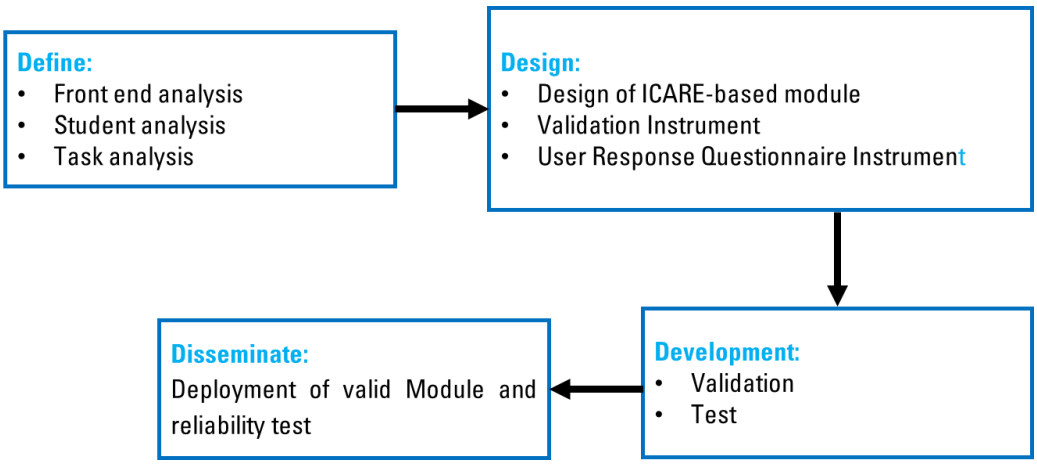

Figure 1. Development Flow of ICARE-Based Module Material Ion Balance and pH of Salt Solution with a modified 4-D model.

The data analysis technique was in the form of validity analysis by 3 material expert validators and user response analysis in the form of 3 chemistry teachers and 20 high school science class XII students. Validity analysis data was processed and calculated the percentage of validation value. The calculation results are converted into qualitative values to see the validity of the developed module. The validity criteria refer to the validity criteria proposed by Rohmad et al. (2012). The validity criteria can be seen in Table 1.

Table 1. Validity Category (Rohmad et al. 2012)

Percentage	Category
75.00-100	Valid
50.00-74.99	Quite Valid
25.00-49.99	Not Valid
0.00-24.99	Invalid

Analysis of user responses, namely chemistry teachers and students, uses a linkert scale in the form of numbers 1-4 referring to the alternative score proposed by Widoyoko (2017). The selection of

the four-linkert scale was carried out so that the user was not neutral. The alternative scores for the attitude statement can be seen in Table 2.

3. Results and Discussion

The product resulting from this development research is an ICARE-based module on the subject of Ion Equilibrium and pH of Salt Solutions. ICARE-based modules can be used during the learning process both inside and outside the classroom as independent teaching materials. Following are the results and discussion regarding the development phase that has been carried out:

Table 2. User Responses (Sari et al. 2016)

Persentase	Kategori
75.00-100	Very Good
50.00-74.99	Good
25.00-49.99	Low
0.00-24.99	Not Good

3.1. Define of Module

This stage consist of 3 steps which inlude, front end analysis, student analysis and task analysis.The results of the front end analysis are that there are still limited teaching materials that can facilitate students in finding and understanding learning concepts. based on interviews conducted at senior high school 1 pekanbaru and senior high school 5 Pekanbaru, information was obtained that the teacher had used the module in learning, especially on ion balance material and the pH of salt solutions. However, the teaching materials used by the teacher are still informative (containing material descriptions and examples of questions only) and the modules used are not based on learning models. In the learning process, teaching materials are required. Teaching materials determine teaching and learning activities because teaching materials are the core in learning process (Kholida, 2021). Teaching materials must also include learning strategies that can arrange student activities in understanding a learning concept. One of the learning models that can arrange and can be used is ICARE model. ICARE is one of the learning models that can fasilitate students in understanding concept and applying knowledge in everyday life. This is also by what Rahmayani et al. (2019) said that the used of ICARE to ensure that students have to opportunity to apply what they have learned.

The results of the front end analysis are the average age of module users on the subject of ion balance and salt solution pH is around 16-17 years. Based on Piaget's theory of cognitive development, students in this age range have been able to think logically and understand abstract things, reason logically and draw conclusions.

Task analysis is a collection of procedures to determine the content in the learning unit. Tas analysis includes content structure analysis, concept analysis, procedural analysis and objective analysis. The results of the contents structure analysis are content analyzing curriculum such as core competencies, basic competencies, and ion balance material and salt solution pH (KD 3.11 and KD 4.11). Concept analysis is analyzing the sub-materials that will be taught systematically. The material of ion balance and the pH of the salt solution is obtained in several sub-topics, including the neutralization reaction, ionic equilibrum and properties of salt solutions and pH of the salt solution. Procedural analysis is the stages of task completion using the ICARE model in the form of (Introduction, Connection, Application, Reflection, Extension). Analysis of objectives in the form of learning objectives that are formulated based on basic competencies and indicators of competency achievement listed in the content structure analysis.

3.2. Design of Module

At the design stage, the design of module on the subject of ion balance and the pH of salt solutions is based ICARE models. Materials and student work steps referring to the ICARE learning models. The module is designed to produce module components in the form of module content consisting of: (1) Pages Cover, (2) Preface, (3) Table of Contents, (4) Instructions for Module Use, (5) Module Description, (6) Concept Map, (7) Introduction which includes: a) Core Competencies b) Basic Competencies c) Competency Achievement Indicators d) Objectives End e) Time, (8) Learning, (9) Summary, (10) Formative Test, (11) Feedback, (12) Summative Test, (13) Answer Key, (14) Glossary, and (15) Bibliography. In addition, in this study, validation sheets and questionnaires for teacher and student responses were also designed.

3.3. Development Phase (Development)

At this stage, the realization of the design stage is carried out, namely validation and testing. Validation aims to obtain assessments and suggestions for the developed module. Validation was carried out by a material expert validator consisting of 1 lecturer in Chemistry Education, Riau University and 2 FMIPA lecturers, Riau University.

Aspects of the validation assessment include aspects of the feasibility of content, presentation, language, graphics and ICARE. In the validation stage, the validator provides suggestions and comments on the module. In the aspect of the feasibility of the contents of the Validator correcting a conceptual error in the module when doing the first validation, it is necessary to revise it according to the suggestions and comments of the validator for further validation. Before the revision, the discourse written in the introduction was not correct and still had the wrong concept. The researcher wrote down the meaning of neutralization reaction which was still wrong. So it needs to be revised. The wrong concept can affect the acceptance of the next concept. This is as stated by Yuliati (2017). If left unchecked, of course it will be dangerous considering that if this condition is allowed to persist, it will have an impact on the acceptance of the next concept. In the aspect of presentation feasibility, the validator suggests replacing the same questions found in a formative test. This can cause students to work on the same questions so that the questions become ineffective.

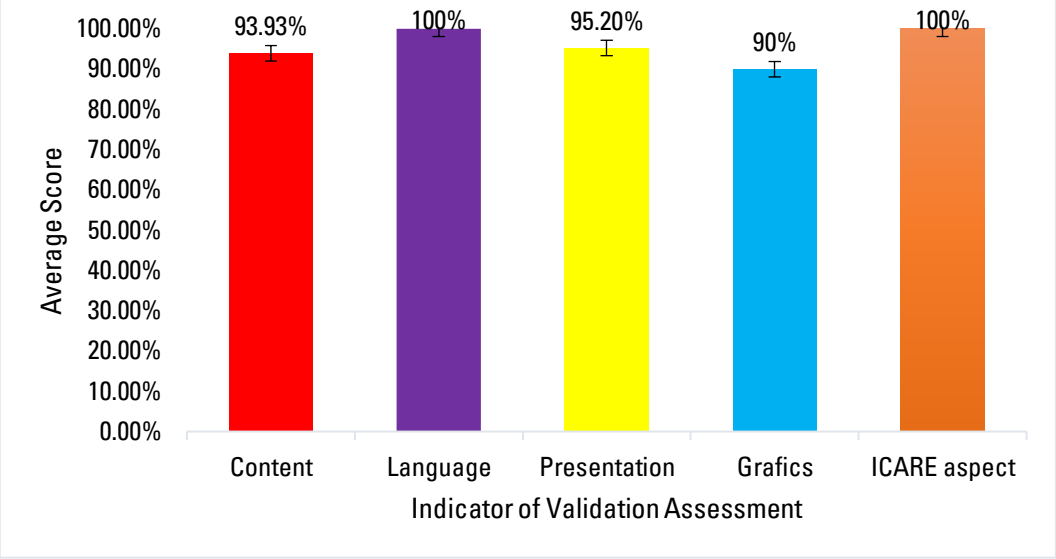

Figure 2. The percentage of the second validation score.

In the aspect of linguistic feasibility, the validator revises the redaction of the sentence so that the sentence is easy for students to understand and the quality of the questions is better. According to

Lendra et al. (2019) the use of language modules should use simple sentences and easy to understand. The validator also revises the use of punctuation that is not appropriate so that it needs to be improved. This is done so that students can easily understand the commands in the module because punctuation errors can change the meaning of a sentence.

In the aspect of graphic feasibility, the validator revises the writing on the cover to make it more proportional. Before the revision, the writing on the cover was cut off so that it became illegible. All suggestions and improvements have been revised by the researcher. After the second revision and validation was carried out, the scores for the validation of the feasibility aspects of content, presentation, language, graphics and ICARE were 93.93%, 100%, 95.2%, 90% and 100%, respectively. The percentage of the second validation score can be seen in Figure 2.

At the trial stage, consisting of one-on-one trials, teacher trials and limited trials to students. One-on-one trials were conducted on 3 students with high, medium and low abilities. In the one-on-one trial, positive comments were obtained from students. The researcher recorded the time required for each student during the one-on-one trial. It aims to get the average time used to complete the product, namely the module. During the one-on-one trial, students received positive comments. Students' comments can be seen in Table 3. In the one-on-one test, it was found that there was a longer processing time than the time allocated for working on the module. Previously, the time allocated by researchers in working on the module was 45 minutes for one learning activity. The researcher revised the time needed to work on the module, namely 1 learning activity was 60 minutes.

Table 3. Student Comments One-on-One Trial.

Number comment	Comment
01	The module is very easy to understand because the material is written in a structured manner.
02	The module is very good and interesting because the module uses a lot of color variations so that working on questions and exercises doesn't feel boring
03	The module is very interesting because it consists of various colors, animations, and images besides that the module has a neat layout.

The teacher trial was conducted on 3 chemistry teachers from 1 chemistry teacher at SMAN 5 Pekanbaru and 2 chemistry teachers at SMAN 1 Pekanbaru. The teacher test got a positive response. The teacher considers that the ICARE-based module on the subject of ion balance and pH of salt solution is quite good, equipped with a very clear and structured explanation animation of the module so that the module can be used and applied to students. The teacher's trial was carried out by distributing questionnaires and obtained an average percentage score of 93.33% with very good criteria. During the teacher's test, no significant errors were found. Limited trials were conducted on 20 students from 10 students of SMAN 1 Pekanbaru and 10 students of SMAN 5 Pekanbaru. The limited trial also received a positive response by the students. Limited trials were carried out by distributing questionnaires and obtained an average percentage score of 90.12% with very good criteria. Based on the validation scores, teacher and student trials, the final module is obtained and can be used in the learning process.

4. Conclusion

The ICARE-based modules on the subject of Ion Equilibrium and pH of salt solution in class XI SMA/MA equivalent has been categorized as "valid" with a percentage of the feasibility of content, presentation, linguistic, graphic and ICARE aspects with an average consecutive score of 93.93%, 100%, 95.2%, 95% and 100% and the final average of validation is 96.82% with valid criteria. User

responses are included in very good criteria with an average percentage of 93.33% by teachers and an average percentage of 90.12% by students, so the module is suitable for use in the learning process.

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