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Inquiry Social Complexity-Based Chemistry Module to Empower Critical and Creative Thinking Skills

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Abstract: Inquiry Social Complexity-Based Chemistry Module to Empower Critical and Creative Thinking Skills. Objective: This research explores the validity of the inquiry social complexity (ISC) based learning module to empower students' critical and creative thinking skills. **Methods:** The research method uses descriptive methods. The learning modules developed are validated and evaluated. Validation is carried out for experts in the fields of language, material, design, and learning instruments. While the evaluation phase is given to teachers and students, this is because teachers and students are directly involved in the implementation of the ISC module. ISC module evaluation given to teachers and students consists of four aspects, namely Content, Language, Presentation, and Graphic. The assessment criteria consist of a scale of 4, while the assessment by experts and evaluators uses a Likert 4 scale. **Findings:** The results of the language expert assessment, material, design, and evaluation of learning are in the excellent category. Student assessment results are in the very good category, and teacher ratings are in a good category.

Keywords: inquiry social complexity, chemistry modules, critical thinking, creative thinking.

Abstrak: Modul Kimia Berbasis Inquiry Social Complexity untuk Memberdayakan Keterampilan Berpikir Kritis dan Kreatif. ***Tujuan:*** *Penelitian ini mengkaji validitas isi modul pembelajaran berbasis inquiry social complexity (ISC) untuk memberdayakan keterampilan berpikir kritis dan kreatif peserta didik.* ***Metode:*** *Penelitian ini menggunakan metode deskriptif. Modul pembelajaran yang dikembangkan di lakukan validasi dan evaluasi. Validasi dilakukan pada ahli dibidang Bahasa, materi, desain, dan instrumen pembelajaran. Sedangkan tahap evaluasi diberikan pada guru dan peserta didik, hal ini dikarenakan guru dan peserta didik terlibat langsung dalam implementasi modul ISC. Evaluasi modul ISC yang diberikan pada guru dan peserta didik, terdiri dari empat aspek, yaitu Isi, Bahasa, Penyajian, dan Kegrafikan. Kriteria penilaian terdiri dari skala 4, sedangkan penilaian oleh ahli dan evaluator menggunakan skala Likert 4 skala.* ***Temuan:*** *Hasil penilaian ahli Bahasa, materi, desain, dan evaluasi pembelajaran berada pada kategori sangat baik. Hasil penilaian peserta didik berada pada kategori sangat baik, dan penilaian guru berada pada kategori baik.*

Kata kunci: *inquiry social complexity, modul kimia, berpikir kritis, berpikir kreatif.*

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INTRODUCTION

One of the strategies to improve the quality of learning implementation in schools is by developing teaching materials. Learning in the form of modules is currently a very urgent need, bearing in mind this is one of the consequences of implementing the 2013 curriculum. The scientific approach in the 2013 curriculum requires the use of modules in learning. The use of modules can condition learning activities better planned as a companion learning implementation plan (RPP).

Given the important role of modules to improve the quality of learning, teachers are required to be able to understand the understanding, characteristics, and procedures for module development. A learning module is a unit of teaching and learning program, which is studied by students themselves individually (Winkel, 2009). Other experts (Vembriarto, 1975) stated that the learning module is a teaching package that contains a unit of concepts rather than subject matter. Based on the expert's definition, it can be understood that the module does not depend on other teaching materials or other learning media so that the module can stand alone. By using a module, students do not need other teaching materials to learn and or do assignments on the module.

21st-century education requires schools to change teacher-centered learning strategies to be student-centered (Afandi. & Sajidan, 2017; Trilling & Fadel, 2009), using modules in learning can change learning strategies to be student-centered learning. It is intended that learning from teachers is no longer in line with the 21st-century learning paradigm (Zivkovil, 2016), given that learning resources are now freely accessible as a result of the industrial revolution 4.0 (Affandy, Aminah, & Supriyanto, 2019). The concept of 21st-century education requires students to have basic skills obtained through direct experience so that students are expected to have more complex knowledge (Vygotsky, 1978), in solving problems.

The basic skills that students should have are critical and creative thinking skills (Trilling & Fadel, 2009). Critical thinking skills are important in the world of education because they allow students to really get a more complex understanding of information. Critical thinking skills will lead students to discover, conclude their understanding (Affandy et al., 2019; N. C. Facione & Facione, 2001; N. Facione & Facione, n.d .; P. Facione, 2011). In addition to critical thinking skills, creative thinking skills must also be empowered by every student to achieve success in the 21st century. By having good creative thinking skills, students can see the world with a different perspective, and have the desire to experiment to get something new (Anna, Bob, & Mike, 2001).

Chemistry is a natural science that deals with the composition of substances, structures, properties, and interactions between them (Lee & Osman, 2012), which basically uses a scientific attitude in the form of products in the form of concepts, laws, theories (Nastiti, Rahardjo, Elfi Susanti, & Prime, 2018). Based on the characteristics of chemistry learning, chemistry subjects are very well used as a tool to develop the ability of the 21st century. The results of the study (Lee & Osman, 2012) show that students consider chemistry as a difficult subject, this is because the concepts learned are very abstract.

The use of modules in learning chemistry is expected to help reduce students' learning difficulties, considering the characteristics of modules can be learned without the need for other teaching materials (*stand-alone*). Based on the results of interviews with MA teachers in Surakarta showed that most chemistry teachers had difficulty in developing learning modules, so the learning modules used by teachers only referred to modules that were sold in the market. Characteristics of modules in the market do not

have good standards, both in terms of validity and benefits.

Modules used in learning should have been evaluated and validated. Evaluation is intended to find out and measure whether the implementation of learning with modules can be carried out following the design of the development while validation is a process to test the suitability of a module with competency as a learning objective. One of the goals of chemistry learning is to empower critical thinking and creative skills. One strategy to overcome the gap between module development and utilization, chemistry learning, and mastery of critical and creative thinking skills, is to utilize inquiry-based social complexity (ISC) learning modules (Perdana, Budiyono, Sajidan, Sukarmin, & Atmojo, 2019).

METHODS

The research method used is descriptive, where researchers want to know the validity of chemistry learning modules based on inquiry social complexity (ISC) to empower critical and creative thinking skills. The learning modules developed are validated and evaluated. Validation is a process to test the suitability of a module with competencies that are targeted for learning. Validation is done by asking the help of experts who master the competencies learned, in this case, validation is done on experts in the field of language, materials, design, and learning instruments.

The linguist validator is carried out on 4 aspects with 6 assessment indicators, while the assessment criteria refer to the rules proposed by (Mardapi, 2012), which consist of a scale of 4. The grading by linguists uses a 4 scale Likert scale so that a maximum score of 24 is obtained, minimum score of 6, ideal mean ($\bar{X}$) 15, and ideal standard deviation (SBi) 3. The range of scores of linguists' assessments on a scale of 4 is presented in Table 1.

Table 1. Criteria for assessment of validator linguists

No	Reference Scale for Ratings	Rating Interval Scores	Category
1	$X \geq \bar{X} + 1.SBi$	X > 18	Very good
2	$\bar{X} + 1.SBi > X \geq \bar{X}$	15 < X < 18	Well
3	$\bar{X} > X \geq \bar{X} - 1.SBi$	12 < X < 15	Pretty good
4	$X < \bar{X} - 1.SBi$	X < 12	Not good

X: Earned Scores

Material expert validators are conducted on 11 aspects with 38 assessment indicators while the assessment criteria refer to the rules proposed by (Mardapi, 2012), which consist of a scale of 4. The grading of material experts use a four scale Likert scale so that a maximum score of 152 is obtained, a score minimum 38, ideal mean ($\bar{X}$) 95, and ideal standard deviation (SBi) 19. The range of expert rating scores Material on a scale of 4 is presented in Table 2.

Table 2. Criteria for evaluation of material expert validators

No	Reference Scale for Ratings	Rating Interval Scores	Category
1	$X \geq \bar{X} + 1.SBi$	X > 114	Very good
2	$\bar{X} + 1.SBi > X \geq \bar{X}$	95 < X < 114	Well
3	$\bar{X} > X \geq \bar{X} - 1.SBi$	76 < X < 95	Pretty good
4	$X < \bar{X} - 1.SBi$	X < 76	Not good

Module design expert validator is conducted on seven aspects with 33 assessment indicators while the assessment criteria refer to the rules proposed by (Mardapi, 2012), which consist of a scale of 4. The grading of the module design experts uses a four scale Likert scale, in order to obtain a maximum score of 132, a minimum score of 33, the ideal mean ($\bar{X}$) 82,5, and the ideal standard deviation (*SBi*) 16.5. The range of expert assessment score designs of the module in scale four is presented in Table 3.

The learning instrument expert validator is conducted on seven aspects with 32 assessment indicators while the assessment criteria refer to the rules proposed by (Mardapi, 2012), which consist of a scale of 4. The grading of the learning instrument expert uses a four scale Likert scale so that a maximum score of 128 is obtained, a minimum score of 32, an ideal mean ($\bar{X}$) 80, and an ideal standard deviation (*SBi*) 16. The range of scores of expert learning instrument scores in scale four is presented in Table 4.

Table 3. Evaluation criteria for design expert validators

No	Reference Scale for Ratings	Rating Interval Scores	Category
1	$X \geq \bar{X} + 1.SBi$	X > 99	Very good
2	$\bar{X} + 1.SBi > X \geq \bar{X}$	82.5 < X < 99	Well
3	$\bar{X} > X \geq \bar{X} - 1.SBi$	66 < X < 82.5	Pretty good
4	$X < \bar{X} - 1.SBi$	X < 66	Not good

Table 4. Evaluation criteria of learning instrument expert validators

No	Reference Scale for Ratings	Rating Interval Scores	Category
1	$X \geq \bar{X} + 1.SBi$	X > 96	Very good
2	$\bar{X} + 1.SBi > X \geq \bar{X}$	80 < X < 96	Well
3	$\bar{X} > X \geq \bar{X} - 1.SBi$	64 < X < 80	Pretty good
4	$X < \bar{X} - 1.SBi$	X < 64	Not good

The next stage is the evaluation stage. Evaluation is intended to find out and measure whether the implementation of learning with modules can be carried out following the design of the development. The evaluation instrument is based on the characteristics of the ISC module, which is aimed at both teachers and students. This is because teachers and students are directly involved in implementing the ISC module. So it is expected that the ISC module evaluation results can be objective.

The subjects involved in this study were expert validators, subject teachers, and students. Validators involved as many as four people, each in the fields of language, material, design, and evaluation. The ISC module evaluation was given to four teachers in Surakarta High School, while 20 students involved in Class XI MAN 2, XI MAN 1, XI Al-Islam, XI Al Muayad, Surakarta City.

■ RESULT AND DISCUSSIONS

The use of modules in learning chemistry is expected to help reduce students' learning difficulties, considering the characteristics of modules can be learned without the need for other teaching materials (*stand-alone*). The chemistry learning module is chosen acid-base teaching

material and salt hydrolysis which is arranged based on the ISC model syntax. Modules used in learning should be validated and evaluated. Validation is carried out for experts in the fields of language, material, design, and learning instruments. The results of the language expert validator's assessment conducted on 4 aspects of assessment are presented in Figure 1.

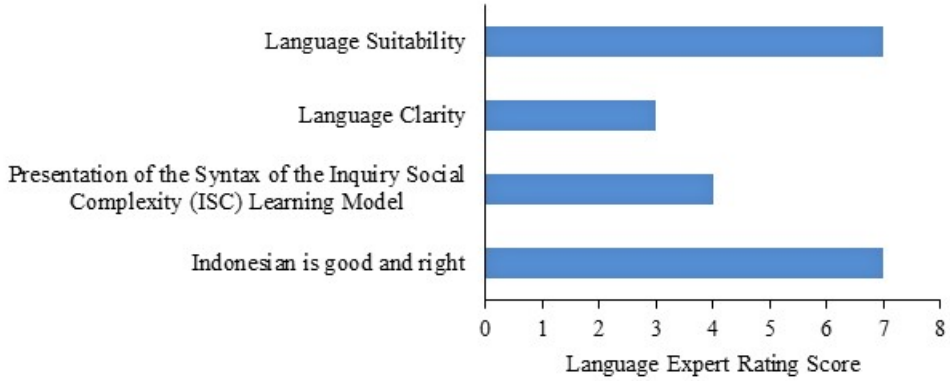

Figure 1. results of assessment of language expert validators

Language expert assessment consisting of 4 aspects reviewed, namely Indonesian language that is good and right, Presentation of the Syntax of the Inquiry Social Complexity (ISC) Learning Model, Language Clarity, and Language Suitability based on Figure 1 obtained a score of 21 which means very good. Therefore it is feasible to use in learning chemistry. The results of the chemical material expert validator's evaluation conducted on 11 aspects of the assessment are presented in Figure 2.

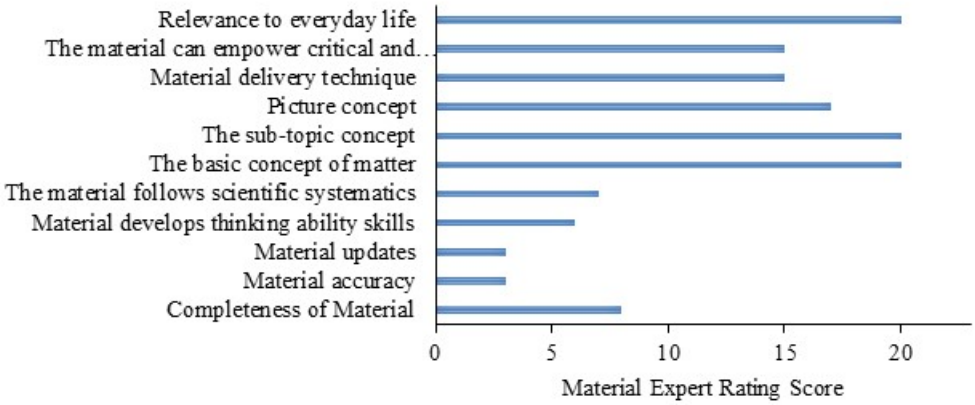

Figure 2. Results of assessment of material expert validators

Material expert assessment consisting of 11 aspects reviewed, namely Completeness of Material; Material accuracy; Material updates; Material develops thinking ability skills; The material follows scientific systematics; The basic concept of matter; The sub-topic concept; Picture concept; Material delivery technique; The material can empower critical and creative thinking skills; and Relevance to everyday life. The score of expert evaluation of salt and acid-base hydrolysis material obtained a score of 134 (Figure 2) which means very good. Therefore it is feasible to be used in chemistry learning. After being considered very good for use in learning, the next step is to validate the graphic design expert to find out the attractiveness and suitability of the image with the material. Validation results from graphic design experts can be seen in Figure 3.

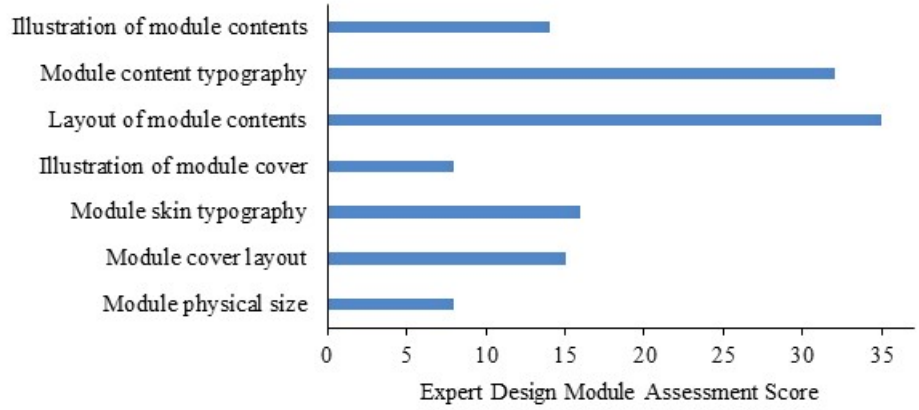

Figure 3. Results of the graphic design expert validator assessment

The module graphic design expert assessment consisted of 7 aspects that were reviewed, namely Module physical size; Module cover layout; Module skin typography; Illustration of module cover; Layout of module contents; Module content typography; and Illustration of module contents. The results of the graphic design expert validation of the salt and acid base hydrolysis material module obtained a score of 128 (based on Figure 3) which means very good. Therefore it is feasible to be used in chemistry learning. The next validation is from the education evaluation expert. The validation results are presented in Figure 4.

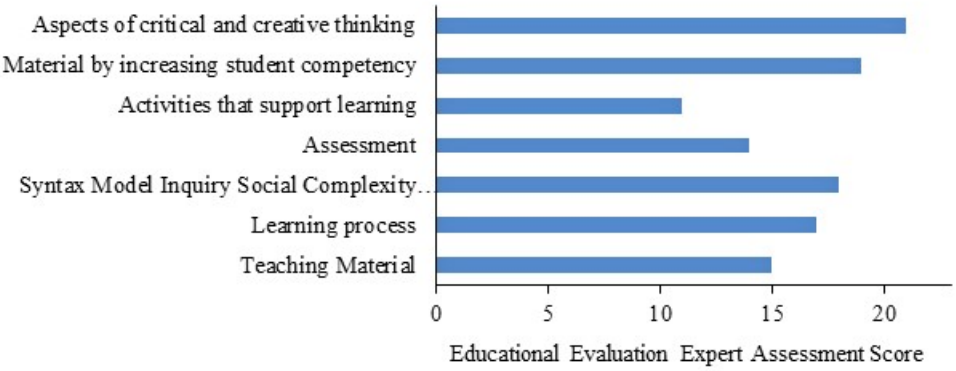

Figure 4. Evaluation results of learning evaluation expert validators

Learning evaluation expert evaluation consisting of 7 aspects reviewed, namely Teaching Material; Learning process; Syntax Model Inquiry Social Complexity (ISC) in Learning; Assessment; Activities that support learning; Material by increasing student competency; Aspects of critical and creative thinking. The results of the validation of learning evaluation experts obtained a value of 115, meaning that the learning instrument is very good. The learning instrument was considered to have conformity to the stages of the ISC model and acid-base and hydrolysis material. The instrument was also assessed in accordance with the CCT indicators as learning objectives using the ISC model. After being considered very good for use in learning, the next step is to evaluate the ISC module.

The ISC module evaluation was given to four teachers in Surakarta High School, while 20 students involved in class XI MAN 2, XI MAN

1, XI Al-Islam, XI Al Muayad, Surakarta City. ISC module evaluation given to students aims to see the practicality and response of students to ISC-based chemistry modules on salt and acid-base hydrolysis material. The results of the ISC module evaluation are presented in Figure 5.

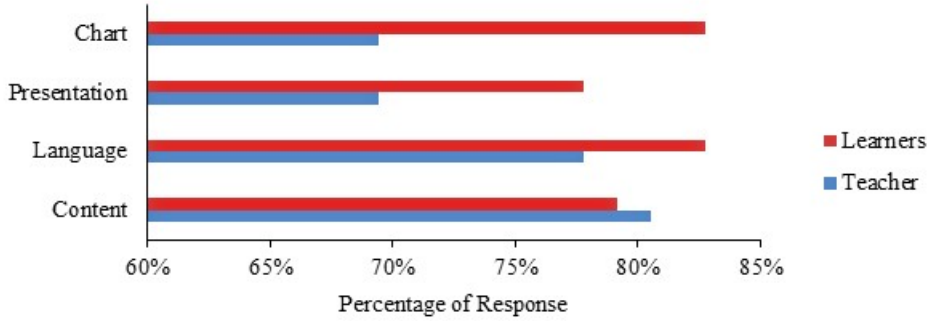

Figure 5. Results of the ISC module evaluation by teachers and students

ISC module evaluation given to teachers and students consists of four aspects, namely Content, Language, Presentation, and Graphic. Evaluation of ISC modules by teachers and students is obtained through practicality questionnaires and student responses. Based on the results of the evaluation by students in Figure 5, it shows that the ISC module has fulfilled the criteria well. While the evaluation results by the teacher show that the ISC module has fulfilled good criteria. According to Riduwan (2008), if these aspects get an assessment with a percentage of e" 61% according to the Likert scale then it is said to be feasible (Riduwan, 2008)

■ CONCLUSIONS

The concept of 21st-century education requires students to have critical and creative thinking skills gained through direct experience so that students are expected to have more complex knowledge. This can be made possible if the teacher is able to develop standardized learning modules. The results of the language expert assessment, material, design, and evaluation of learning are in the excellent category. Student assessment results are in the very good category, and teacher ratings are in a good category. For the next stage of research, assessment instruments should be analyzed to construct validity in order to obtain an instrument that is in accordance with the rules and theories of critical and creative thinking skills.

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