Design and validation smart teaching materials oriented multiple intelligences on global warming (STM2I-GLOW): Rasch model analysis

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Abstract. STM2I-GLOW is a web-based teaching material that is oriented to multiple intelligences in one of the physical materials, namely global warming. This study discusses web-based teaching materials that provide opportunities for students to study wherever students are. In addition, STM2I-GLOW can help students to improve their intelligence so that concepts of global warming can be used through the type of intelligence students have. This article presents the results of the STM2I-GLOW design and validation. A combination of quantitative and qualitative research methods is used in research. The design of the mixed method was chosen for the STM2I-GLOW implementation process in research at one school in Bandung. The instrument used was the STM2I-GLOW validation sheet. The assessor agreed five experts to assess three aspects, namely the media aspect, material aspects and conversation aspects. Validation test using the output menu 10. Items (columns): to order in the MINISTEP software for analysis with Rasch. The results obtained are in two categories in every aspect of the media, material aspects, and aspects that are approved in the category of accepted and rejected compilation of MNSQ clothing values that are installed in the MINISTEP free tool when analyzed using Rasch. The conclusion is that STM2I-GLOW is expected to be used in learning and makes it easy for students to discuss global material according to the type of intelligence of each student.

1. Introduction
The theory of multiple intelligences has attracted much attention in the field of education, although Horward Gardner as the discoverer of the theory did not intend to apply this theory in learning or teaching [1]. One particular concern that connects compound intelligence with education is compound intelligence in schools [2], and compound intelligence in classrooms [3]. Then, research into multiple intelligences became more specific, such as multiple intelligences in leadership [4] and multiple intelligences in reading and writing [3]. In the education process, each individual has different types of intelligence that can be used to understand concepts, solve problems, and make products [5].

Intelligence is one of the main factors that determine the success and failure of students while studying in school. Does not view human intelligence based on standardized test scores alone, but intelligence is the ability to solve problems that occur in human life, the ability to produce new problems to be solved, the ability to create something or to offer services that will give rise to appreciation in culture someone [6]. States that every human being has eight types of intelligence with different capacities namely logical-mathematical intelligence, verbal intelligence, visual intelligence, kinesthetic
intelligence, musical intelligence, interpersonal intelligence, intrapersonal intelligence, and natural intelligence [6]. Compound intelligence can be oriented into student activities that support the dominant intelligence of students by orienting the use of web-based teaching materials in learning.

At present, there are a number of studies of student activities in the educational process regarding the application of educational electronic materials or resources in the form of electronic teaching materials [7]. This can help students practice their intelligence optimally so that the conceptions obtained are in accordance with true scientific concepts because in the 21st century technology is developing rapidly and rapidly, in the grasp and one touch. The spread of technology in all walks of life has made people aware of the progress of science and technology. Various technologies such as computers, internet, social media have always been used and even become solutions to all problems in electronic media. Technology in the development of the 21st century brings a great impact in various fields of life, especially in the field of education. Thus the development of technology becomes a solution for the world of education to help students in a learning process in the 21st century. The development of these technologies can be utilized to create and compile a teaching material that is systematic and can be adjusted to the intelligence of students so that the conception can be conveyed correctly. Thus, one way to produce learning in accordance with the objectives of learning is to implement web-based teaching materials that can be accessed through electronic media such as smartphones and PCs. At present, there are a number of student activity studies in the educational process about the application of electronic learning materials or resources in the form of electronic teaching materials [7]. So that computer technology is often used in the use of teaching materials [8]. Abstract concept models can be presented to students more easily with the help of web-based teaching materials [8]. A distinctive feature of using web-based teaching materials compared to traditional educational tools is to provide information not only in the form of text, but also through images that allow students to focus on as much study as possible and contribute to better understanding and storage of information [9]. In addition, teaching materials in which there are content in the form of text, images, videos, sounds, animations or others [8]. In previous studies, in the development of compound intelligence the development of teaching materials was carried out on the earth's new protective material [10]. In addition, other researchers also developed web-based teaching materials oriented to global material intelligence that provided ideas for writers to perfect the teaching materials that had been made. The naming of STM2I-GLOW made by the author is an abbreviation of smart teaching materials oriented to various intelligences about global warming. This research was conducted to produce physics teaching materials on web-based global warming material that can accommodate student intelligence according to the intelligence type of intelligence that has been determined.

2. Methods
The combination of quantitative and qualitative research methods is used in research. Embedded mixed method design was chosen for the implementation process of STM2I-GLOW in research at one school in Bandung. The design of this study involves the use of convergent or sequential data, but the core idea is that quantitative or qualitative data is embedded in a larger design (for example, experiments) and data sources play a supporting role in the overall design [11]. The research process is given in Figure 1.
This article only discusses the result of STM2I-GLOW validation data that have been made before they are implemented in the research process so that STM2I-GLOW can meet the competencies that must be implemented in learning. The validation of STM2I-GLOW can be seen from three aspects, namely the media aspect, the musty material, and the orientation aspect. Validation is carried out by five experts chosen in accordance with fields covering all three aspects to be assessed. The results of the validation carried out by experts were analyzed using the output menu 10. Item (column): fit order in the MINISTEP 4.3.1 software for analysis with Rasch. The measurement of the validity test of this instrument can be seen from the results of the scores on the Outfit mean square (MNSQ), Z-standard Outfit (ZSTD), and Point Measure Correlation (Pt Mean Corr). These criteria are used to determine the level of compliance items (item fit) [12]. While research conducted stated that the Point Measure Correlation (Pt Mean Corr) is only used to determine the distinguishing power of an instrument [13]. So to measure the validity or validity of an instrument, only use the score on the Outfit mean square (MNSQ) and Z-standard Outfit (ZSTD) on MINISTEP software. Knowing the validity of each question can be found by interpreting in Table 1 as follows [13].

| Output item       | Score       | Category       |
|-------------------|-------------|----------------|
| Outfit MNSQ       | 0.5 < MNSQ < 1.5 | Accepted       |
| Outfit ZSTD       | -2.0 < ZSTD < +2.0  | Accepted       |

3. Result and Discussion

3.1. STM2I-GLOW
STM2I-GLOW provides opportunities for students to learn not only within the scope of the school but whenever and wherever students are. STM2I-GLOW can be accessed through computers, laptops, and mobile phones while connected to a computer network. In addition, STM2I-GLOW can also assist students in accommodating multiple intelligences in accordance with the dominant intelligence possessed by each of the students.

In accordance with the Embedded mixed method design stages, the steps taken to make STM2I-GLOW are as follows: first, identify students' multiple intelligences by giving questionnaires and interviews before STM2I-GLOW is made and implemented in learning so that STM2I-GLOW can be adjusted to eight types of compound intelligence. Then the STM2I-GLOW implementation is carried out in the learning process, and then the results of the STM2I-GLOW implementation will be seen. STM2I-GLOW can be accessed on the page https://pemanasan-global.ipba-gbl.id. STM2I-GLOW is designed with a registration system. After successful registration students can choose the groups they want with their study groups. Then, students are ready to conduct learning using STM2I-GLOW.

STM2I-GLOW Validation
The validity of the media aspects of STM2I-GLOW has eleven statements related to the feasibility of each activity in the STM2I-GLOW. Table 2 showing the results of expert validation for the STM2I-GLOW feasibility test on the media aspect.

Table 2 shows that there are two categories in the value of validation aspects of the media that are accepted rejected. This aspect is declared acceptable if MNSQ OUTFIT is in the range of 0.5 <MNSQ <1.5 or if ZSTD OUTFIT is in the range of -2.0 <ZSTD <+2.0. When viewed from the results for the 11 indicators contained in the media aspect obtained 9 indicators were received and 2 indicators were rejected. The assessment of media aspects is arranged in order of appearance, starting from the initial appearance of STM2I-GLOW, the page for global warming, the page for the impact of global warming, and the page for tackling global warming. Based on table 2, Ease of access (indicator 10) is included in the rejected category. According to the results obtained by Ease of access on STM2I-GLOW it is still considered having difficulties because of frequent errors at login.
Table 2. Media Aspect Validation Results

| No. | Media Assessment Aspects                                      | MNSQ Score | Categories |
|-----|--------------------------------------------------------------|------------|------------|
| 1.  | Language use                                                 | 1.07       | Accepted   |
| 2.  | Readability of text                                          | 4.71       | Rejected   |
| 3.  | Image display quality                                        | 0.70       | Accepted   |
| 4.  | Clarity of instructions                                      | 0.55       | Accepted   |
| 5.  | Clarity of sound in video and music                          | 0.55       | Accepted   |
| 6.  | The button works good                                        | 0.73       | Accepted   |
| 7.  | Appropriate font selection                                   | 1.38       | Accepted   |
| 8.  | Clarity of sound in video and music                          | 0.55       | Accepted   |
| 9.  | The written language is easy to understand                   | 0.73       | Accepted   |
| 10. | Ease of access                                               | 0.26       | Rejected   |
| 11. | Clarity in the assignment instructions                        | 0.55       | Accepted   |

Table 3. Results of Material Aspect Validation

| No. | Material Assessment Aspect                                      | Outfit MNSQ | Categories |
|-----|----------------------------------------------------------------|-------------|------------|
| 1.  | Conformity between Basic Competence (KD) and indicators or objectives | 0.52         | Accepted   |
| 2.  | The suitability of each indicator with the content description | 0.26         | Rejected   |
| 3.  | Content up to date                                            | 0.86         | Accepted   |
| 4.  | Accurate content, free from misconceptions                    | 0.42         | Accepted   |
| 5.  | Material structure and organization are arranged logically and coherently | 1.03         | Accepted   |
| 6.  | Style of exposure of interesting content to read              | 2.06         | Rejected   |
| 7.  | The written language is easy to understand                    | 0.58         | Accepted   |
| 8.  | Build understanding of students' conceptions                   | 1.32         | Accepted   |
| 9.  | Learning activities and evaluation according to indicators and objectives | 0.58         | Accepted   |
| 10. | About the evaluation / exercise questions in accordance with the subject matter | 0.86         | Accepted   |
| 11. | The evaluation / exercise questions are clearly formulated     | 0.58         | Accepted   |
| 12. | Evaluation / exercise questions represent each discussion      | 1.03         | Accepted   |
| 13. | Use SI symbols and units consistently                         | 1.03         | Accepted   |
| 14. | Integrated with environmental and social problems              | 0.86         | Accepted   |
| 15. | Content suitable for the age level of students                 | 1.76         | Rejected   |
| 16. | The language used is appropriate, effective, and in accordance with EYD | 1.03         | Accepted   |
| 17. | Provides context that is relevant to the environment           | 1.03         | Accepted   |
| 18. | Practice skills in various situations                          | 1.03         | Accepted   |
| 19. | Attributed to prior knowledge                                  | 2.40         | Rejected   |
| 20. | Connected with the application of everyday technology          | 0.86         | Accepted   |

Table 3 shows that in the assessment of material aspects of STM2I-GLOW there were 4 indicators that were in the rejected category and 16 aspects that were in the accepted category. In the indicators that are rejected, it is necessary to improve the STM2I-GLOW eligibility in the learning process. Based on the results obtained by the evaluator, the Style of exposure of interesting content to read (indicator 6) is in the rejected category. According to the assessors, the style of content exposure is less attractive so that the reader is easily bored in studying the material available in STM2I-GLOW.

The results of the STM2I-GLOW feasibility assessment on the aspect of orientation can be seen in Table 4. The orientation aspects found on the page of global warming, the impact of global warming,
and the mitigation of global warming are in the categories of accepted and rejected. There are 19 indicators accepted and 6 indicators rejected. In indicators that are in the rejected category, the assessor considers the orientation to STM2I-GLOW does not accommodate the expected orientation.

Table 4. Result of Orientation Aspect Validation

| No. | Aspect of Orientation Assessment                                                                 | MNSQ Score | Categories |
|-----|--------------------------------------------------------------------------------------------------|------------|------------|
| 1.  | showing illustration images (visual intelligence)                                                | 1.06       | Accepted   |
| 2.  | Playing animated video on music (visual and musical intelligence)                               | 1.45       | Accepted   |
| 3.  | Provides illustrations that depict material (naturalist and visual intelligence)                | 0.92       | Accepted   |
| 4.  | Provides logic problems (mathematical logical, visual, and naturalist intelligences)            | 0.60       | Accepted   |
| 5.  | Work on logic problems independently (interpersonal intelligence)                               | 0.60       | Accepted   |
| 6.  | Observing video views (naturalist and visual intelligence)                                     | 0.60       | Accepted   |
| 7.  | Discuss video observations (interpersonal intelligence)                                         | 0.27       | Rejected   |
| 8.  | Conducting observation through simulation media (mathematical logical, visual and kinaesthetic intelligence) | 1.17       | Accepted   |
| 9.  | Discuss the results of observations (interpersonal intelligence)                               | 0.46       | Rejected   |
| 10. | Presenting phenomena videos and asking to express ideas about videos (naturalist, visual and verbal intelligence) | 1.24       | Accepted   |
| 11. | Presenting features for creating and selecting tasks in the form of sound recordings, images, writing and songs (verbal, visual, mathematical logical and musical intelligence) | 0.60       | Accepted   |
| 12. | Doing self-reflection (interpersonal and verbal intelligences)                                 | 0.60       | Accepted   |
| 13. | Provide illustrative images (naturalist intelligence)                                           | 3.69       | Rejected   |
| 14. | Record and input data obtained based on observations (naturalist, kinaesthetic and mathematical logic intelligence) | 4.73       | Rejected   |
| 15. | Analyze and answer questions on observation (mathematical logical and verbal intelligence)      | 1.57       | Rejected   |
| 16. | Exploring by giving an opinion on one of the reading contents (naturalist, verbal, and interpersonal intelligence) | 0.50       | Accepted   |
| 17. | Make and choose one of the tasks in the form of sound recordings, images, writing and songs (verbal intelligence, logical mathematical, and musical) | 1.29       | Accepted   |
| 18. | Doing self-reflection (interpersonal and verbal intelligences)                                 | 0.27       | Rejected   |
| 19. | Present questions and answer to recall material concepts (naturalist and verbal intelligence)    | 1.29       | Accepted   |
| 20. | Give an example of innovation about the concept of matter (naturalist intelligence)             | 0.60       | Accepted   |
| 21. | Presenting features for selecting tasks according to talent / desires in the form of videos, news / data, songs, and interview reports (visual, mathematical logical, and musical intelligence) | 0.27       | Rejected   |
| 22. | Present assignment results (verbal intelligence)                                                | 0.60       | Accepted   |
| 23. | Conducting experiments (kinesthetic intelligence)                                               | 1.29       | Accepted   |
| 24. | Discuss, process and analyze experimental data (interpersonal, verbal, and mathematical logical intelligence) | 0.50       | Accepted   |
| 25. | Doing self-reflection (interpersonal and verbal intelligences)                                 | 0.60       | Accepted   |
4. Conclusion
STM2I-GLOW on the suitability of aspects of the media, material aspects and orientation aspects are in two categories, namely the categories of accepted and rejected. STM2I-GLOW that has been compiled can accommodate students' multiple intelligences including mathematical logical intelligence, logical linguistic intelligence, spatial visual intelligence, kinesthetic intelligence, musical intelligence intelligence, interpersonal intelligence, intrapersonal intelligence, and naturalist intelligence (natural intelligence). This research needs to be continued by implementing the use of STN2I-GLOW after it has been improved according to expert advice and the results of validation into physics learning to determine the effectiveness of using STM2I-GLOW.

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