

Development of chemino card learning media (chemical domino cards) on elemental stability material

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ABSTRACT

This research is research and development which aims to determine the level of validity, practicality and effectiveness of Chemino Card learning media as a learning media on elemental stability material which was carried out at X IPA. This development refers to the ADDIE development model which consists of five stages, namely: (1) analysis stage, (2) design stage, (3) development stage, (4) implementation stage and (5) evaluation stage. The validity instrument is in the form of a validation sheet for media experts and material experts. Practical instrument include learning implementation observation sheets, teacher response questionnaires, student response questionnaires. The effectiveness instrument is a learning outcomes test. Research results show that: (1) the validity of the Chemino Card media based on material experts and media experts, respectively 3.33 and 3.46 which are included in the very valid category, (2) the practicality of the Chemino Card media based on the observation of learning implementation, response questionnaire teachers and student respectively 96.67%, 90.03% and 83.42% which are included in the very high category, (3) effectiveness of Chemino Card media based on student learning outcomes that achieve class mastery of 92% that it is included in the effective category. Based in these data, it was concluded that Chemino Card learning media on elemental stability material developed using the ADDIE model were stated to be valid, practical and effective for us in learning.

Introduction

Education is an effort to form knowledge, skills and habits in humans so that existing potential continues to develop. Education aims to develop abilities and shape the character and civilization of a dignified nation in order to educate the life of the nation and state as stated in Law no. 20 of 2003. According to Gagne (1977) learning is defined as a set of external events designed to support an internal learning process. This means that in learning there is a learning process that gives rise to interaction. The interactions that occur can be in the form of interactions between teachers and students, students and students and students and learning media.

Learning media has an important role in the learning process. The importance of learning media is to increase interest in learning (Supriyono, 2018; Madgalena et al., 2021) and learning outcomes (Miftah, 2013; Ekayani, 2017; Wahid, 2018; Wahyuningtyas and Sulasmono, 2020). Likewise in chemistry learning, the presence of learning media is very necessary because it can increase students' enthusiasm for learning. The presence of chemistry learning media is expected to help students fully understand chemistry at all three levels of representation, both symbolic, macroscopic and submicroscopic representations. Therefore, it is very important to develop learning media in the chemistry learning process.

The results of a field study conducted at the IMMIM PUTRA Islamic Boarding School in Makassar showed that students' activeness in learning chemistry still needs to be improved, as does their interest in learning and learning outcomes. The cause of less than optimal learning is due to limited variations in applying the learning media used to support the chemistry learning process. The learning media used so far are power points (PPT), Student Worksheets (LKPD), and teaching aids (molymod).

One example that shows the need to increase students' cognitive understanding is the material on electron configuration, stability of elements (duplet and octet rules) which are within the scope of chemical bonding material. This has been proven, as many as 70% of students have not achieved a KKM score of 75. Therefore, ways are needed to increase students' understanding, one of which is using chemistry learning media.

Chemistry learning media that is suitable for use in the learning process is learning media that is flexible, practical and flexible. One example of a game that is often played by students is the domino game when it is related to chemistry material, which is a good solution to increase students' enthusiasm for learning. The result between the two is a Chemino Card (Chemical Domino Card). Various studies on the use of Chemino Card learning media and similar have been used on chemistry materials such as the Periodic System of Elements (SPU) (Setiyati, 2016; Anggraini et al., 2022), nomenclature of chemical compounds (Ariyani, 2017; Gusti et al., 2017; Nurlaela, 2020; Lestari et al., 2021), electron configuration (Imdad, 2017), colloids (Pramawidyaka, 2015; Sari et al., 2020; Wahyuni and Azra, 2022), elemental chemistry (Larasati and Poedjastoeti, 2016; Aisah et al., 2022); chemical bonds (Irawati, 2019). Based on existing article sources, it shows that the use of Chemino Card learning media has been applied in various existing chemical materials. Based on the findings of the sources above, in the Periodic System of Elements (SPU) material there are two articles, four articles on the nomenclature of chemical compounds, one article on electron configuration, two articles on colloids, two articles on chemical elements and one article on chemical bonds.

Based on the description above, the Chemino Card learning media used in electron configuration material, the stability of elements (duplet and octet rules) within the scope of chemical bonds is still small. Therefore, it is necessary to develop Chemino Card as a chemistry learning medium. Chemino Card learning media in Elemental Stability material is very suitable because it suits the characteristics of current students. Some of these characteristics include being easy to understand concrete examples, liking to innovate, and multitasking. So, applying the Chemino Card learning media to the characteristics of current students is a form of innovation that will make it easier for students to understand the material in the learning process using chemistry learning media.

The aim of using Chemino Card chemistry learning media is so that the learning material is easy for students to remember because of the process and its game-like form. Previous research on chemistry card learning media was carried out by Dwi and Poedjastoeti (2016) and found that it could increase students' understanding and attract attention and interest in learning so that students were more enthusiastic about participating in learning (Setiawan, 2020). Therefore, to achieve the implementation of the learning process, a learning model is needed.

One of the appropriate learning models to use is the Team Game Tournament (TGT) type cooperative learning model. The TGT learning model is a cooperative learning model that is easy to implement, involves the activities of all students without any differences in status, involves the role of students as peer tutors and contains elements of games and reinforcement. Student activities using the TGT model allow students to learn more relaxed while fostering responsibility, cooperation, healthy competition and learning involvement (Hamdani, 2011). Based on this, the TGT type cooperative learning model is very suitable for use in implementing the learning media developed.

Methods

This research is Research & Development (R&D) development research using the ADDIE development model. This research was conducted at the IMMIM PUTRA Islamic Boarding School in Makassar class X IPA 1 with 26 students.

General Procedure

The instruments used in this research are: first, validation sheet for material experts and media experts to determine the validity of learning media. Second, the learning implementation observation sheet, teacher response questionnaire and student response questionnaire to determine the practicality of learning media. Third, test student learning outcomes to determine the level of effectiveness of learning media.

The research procedure carried out consisted of five stages. The first stage is the analysis stage which aims to collect data by carrying out performance analysis and needs analysis. The second stage, design (design) aims to design learning materials, learning tools, learning media and learning instruments). The third stage, development, aims to develop activities in the second stage and carry out product validation tests and conduct limited trials (small groups). The fourth stage, implementation (implementation) aims to apply products that have been validated. The fifth stage, evaluation (evaluation) aims to find out input regarding products that have been implemented in schools.

The data collection techniques used in this research were interviews, questionnaires and learning outcomes tests (posttest). Interviews were conducted at the beginning of the pre-research to collect information and then present the data in narrative form to draw conclusions. Questionnaires were given to teachers and students during the research and then calculated the average score for each aspect to see the percentage. Learning outcomes tests are given to students at the end of learning. If the answer is correct, a score of 1 will be given, whereas if the answer is wrong or no answer, a score of 0 will be given.

Data Analysis

Techniques consist of validity, practicality and effectiveness analysis. Data analysis of validity, practicality and effectiveness respectively, namely:

1) Validity Data Analysis

$$\text{Average score } V = \frac{\text{the total score of the assessment results for all items}}{\text{score all items}}$$

Information:

V = Validator

V1 = Validator 1

V2 = Validator 2

$$\text{Average score per aspect} = \frac{\text{average V1 score} + \text{average V2 score}}{2}$$

$$\text{Average overall score} = \frac{\text{average score of all aspects}}{\text{many aspects}}$$

- 2) Practicality Data Analysis
a. Observation of Learning Implementation

$$\text{Percentage of implementation} = \frac{\sum x}{N} \times 100\%$$

With:

$$\frac{\sum x}{N} = \text{total score for each item}$$

N = maximum score

- b. Teacher and Student Response Questionnaire

$$Vp = \frac{TSEp}{S-Max} \times 100\%$$

With:

Vp = Average of each aspect

TSEp = Score for each aspect

S-Max = Total score for each aspect

$$\% \text{ Average response} = \frac{\text{average score of all aspects}}{\text{many aspects}} \times 100\%$$

- 3) Effectiveness Data Analysis

$$\text{Class completion percentage} = \frac{\text{number of students who completed}}{\text{the total number of students}} \times 100\%$$

The following are the validity criteria according to Harahap (2019), the practicality criteria according to Supardi (2015) and the effectiveness criteria, in this case individual completeness, can be seen respectively in Table 1, Table 2 and Table 3.

Table 1. Media validity level criteria

Average value	Validity Criteria
3.26 -4.00	Very valid
2.51-3.25	Valid
1.76-2.50	Less valid (revised)
1.00-1.75	Invalid (total revision)

Table 2. Practicality criteria

% learning implementation	Criteria
81-100%	Very high
61-80%	Tall
41-60%	Currently
21-40%	Low
5-20%	Very low

Table 3. Individual completion criteria

Mark	Criteria
≥ 75	Completed
< 75	Not Completed

Results

Analysis

At the analysis stage, two stages are carried out, namely performance analysis and needs analysis. Performance analysis was obtained from interviews with chemistry subject teachers at the IMMIM PUTRA Islamic Boarding School in Makassar. The interview results obtained were then analyzed regarding the obstacles faced so far so that it was found that the material that was considered necessary to understand was the material on elemental stability in class X Science. This is evident from the minimum completeness score for this material which was only passed by a few students. On the other hand, the use of learning media still needs to be developed to increase student enthusiasm for learning and participation. Of course, this causes students to experience difficulties in understanding the material provided by the teacher, especially the material on elemental stability in class X Science. So it can be concluded that innovation is needed in the form of learning media that can foster enthusiasm for learning or student participation in the learning process. The needs analysis consists of four parts, namely: (1) a curriculum analysis is carried out to determine the competencies that students must achieve during the learning process. The curriculum implemented by the IMMIM PUTRA Islamic Boarding School in Makassar is the 2013

Curriculum which expects students to play a more active role in learning to improve cognitive, affective and psychomotor skills where the teacher is only a facilitator who becomes a guide in learning. The chemistry subject syllabus has several main materials, one of which is material stability of elements in the scope of chemical bonds. This material is for class X Science has Core Competencies (KI) and Basic Competencies (KD) that students must achieve which are described into several indicators of competency achievement and learning objectives. (2) material analysis is carried out to identify material that students consider difficult and then rearrange it systematically. So that the materials used are stable elements within the scope of chemical bonds. In general, a concept map is created to teach the material to facilitate the preparation of the material. (3) analysis of student needs. The results obtained from the analysis of student needs are that students lack understanding of learning which causes learning to be less interesting and monotonous. In addition, the learning process that uses Power Point media causes students to be less interested in participating in the learning process, because Power Point learning media is less able to make students actively involved and increase their enthusiasm for learning. Apart from that, the lack of learning resources obtained by students still relies on books in the library, so that the source of information is only one way, namely from the teacher.

Based on the results of the student analysis, it can be seen that the level of understanding of students in chemistry subjects, especially elemental stability material, is still a small number who have a score above the set minimum completeness criteria, while the majority of students have not reached the set KKM score. From the analysis above, it can be seen that students need something learning media that can attract attention and enthusiasm for learning. (4) The results obtained after conducting media analysis are that so far students have carried out the learning process using power point, molymod and LKPD media. Even though using these learning media, data was obtained that students' activeness in the learning process still needs to be improved, as does their interest in learning and learning outcomes. One learning media that can then be used based on media analysis is the chemino card learning media. Chemino card can be a learning medium that can increase student activity in the learning process. Apart from that, it can also increase interest in learning and learning outcomes.

Design

This stage is the stage that can produce a design for the chemino card learning media in accordance with the data generated from the previous stage. There are four stages carried out at this stage, namely: (1) designing learning materials. The process of designing the material content that will be included in the chemino card learning media uses microsoft office word. The design of the material must be structured and systematic so that the delivery of the material during the learning process is easy. The material that will be prepared is material on elemental stability within the scope of chemical bonds which is divided into three meetings. The first meeting was about elemental stability material. The second meeting was about types of chemical bonds. The third meeting was about the properties of compounds for all types of chemical bonds. (2) designing learning tools including Learning Tool Designs (RPP) and Student Worksheets (LKPD). The learning tools prepared are RPP and LKPD. This arrangement is intended to make it easier for teachers and students to carry out the learning process. The preparation of the RPP is based on the syllabus for the class X Science chemistry subject on the stability of elements within the scope of chemical bonds in accordance with the 2013 curriculum. The RPP is prepared in three meetings with a time allocation of 3 x 45 minutes for each meeting. (3) designing chemino card learning media. The design of the chemino card learning media framework was made based on the core competencies and basic competencies contained in the 2013 curriculum. The time allocation included in the 2013 curriculum syllabus for elemental stability material in the scope of chemical bonds is three meetings. Therefore, three learning media will be created each chemino card will be used in every meeting. The chemino card learning media design that was developed was creating an attractive design for the chemino card learning media using the canva application. The design in question is the chemino card background design. This design aims to make the cards look more beautiful and attractive so that they can make students enthusiastic about carrying out the learning process in the classroom. (4) designing research instruments. What is done at this stage is to create research instruments that are used to obtain the data needed in the research. The data obtained using this instrument is useful for measuring the level of validity, practicality and effectiveness of the chemino card learning media produced. The preparation of instruments is based on aspects that are tailored to the objectives of each instrument. The instruments prepared in this research are validation sheets for material experts and media experts, observation sheets for learning implementation, teacher and student response questionnaires to the chemino card learning media, and test questions on student learning outcomes. Through the indicators that have been formulated in the previous stage, a learning outcomes test is created in the form of multiple choice questions with twenty numbered items.

The design process is carried out in the second stage of design after carrying out analysis in the first stage. The following designs for the chemino card and magic card can be seen in Fig-1 and Fig-2.

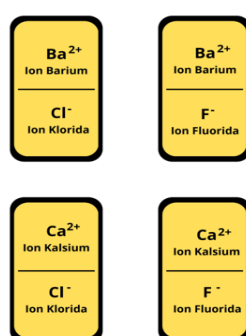


Fig-1. Chemino card image



Fig-2. Magic card image

Development

This development stage is carried out by realizing the conceptual framework that was created at the design stage into a product by inserting the material that has been designed into media that has also been previously designed. The product produced at this stage is the chemino card. Chemino card, then validated by 2 material experts and 2 media experts, was then implemented to students and teachers at the IMMIM PUTRA Makassar Islamic Boarding School. In general, activities at this development stage include the process of creating chemino card learning media, instrument validation, and validation of chemino card learning media. Instrument validation is carried out with the aim of obtaining validity information from the instruments used so that the instruments used in this research can measure what is to be measured so that it is in accordance with the objectives to be achieved. Instruments validated by instrument validators are validity instruments in the form of material expert and media expert validation sheets, practicality instruments in the form of learning implementation observation sheets, teacher response questionnaires and student response questionnaires, and effectiveness instruments in the form of learning outcome test grids and learning outcome test questions. The three instruments that have been validated by the validator have been declared valid.

Chemino card learning media was given to two media expert lecturers and material experts each. Validation of the material and media obtained is used as a reference for revising the chemino card learning media so that it can be implemented well in learning. The assessments of material experts and media experts can be seen in Table 4 and Table 5.

Table 4. Validation results by material experts

Assessment Aspects	V1	V2	Average Score	Category
Material Contents	3.00	3.50	3.25	Valid
Presentation	3.00	3.50	3.25	Valid
Language Eligibility	3.00	4.00	3.5	Very Valid
Average			3.33	Very Valid

Table 5. Validation results by media experts

Assessment Aspects	V1	V2	Average Score	Category
Programming	3.50	3.50	3.50	Very Valid
Appearance	3.14	3.71	3.42	Very Valid
Average			3.46	Very Valid

Practicality analysis is used to determine the level of practicality of the learning media being developed. The instruments used in practical analysis are learning implementation observation sheets, teacher questionnaires and student questionnaires. The instruments that have been created are validated first before use. The results of the instrument validation of learning implementation observation sheets, teacher questionnaires and student questionnaires can be seen in Table 6, Table 7 and Table 8 respectively.

Table 6. Validation results of the learning implementation observation sheet

Assessment Aspects	V1	V2	Average Score	% average Value	Category
Assessment Format	4.00	4.00	4.00	100%	Very high
Contents	3.60	3.60	3.60	90%	Very high
Language	3.00	4.00	3.50	87.50%	Very high
Average				92.50%	Very high

Table 7. Results of teacher questionnaire validation

Assessment Aspects	V1	V2	Average Score	% average Value	Category
Instructions (construction)	4.00	3.67	3.83	95.75%	Very Valid
Contents	4.00	3.67	3.83	95.75%	Very Valid
Language	3.67	3.67	3.67	91.75%	Very Valid
Content	3.00	3.50	3.25	81.25%	Valid
Average				91.13%	Very Valid

Table 8. Results of student questionnaire validation

Assessment Aspects	V1	V2	Average Score	% average Value	Category
Instructions (construction)	4.00	3.67	3.83	95.75%	Very high
Contents	4.00	3.67	3.67	91.75%	Very high
Language	4.00	3.67	3.67	91.75%	Very high
Average				93.08%	Very high

Based on Table 6 above, it can be seen that the results of the validation of the learning implementation observation sheet are in the very high category with an average score of 92.50%. Table 7 can be seen that the validation results of the teacher response questionnaire are in the very high category with an average score of 91.13%, while for the validation results of the student questionnaire in Table 8 the average score is 93.08% with a very high category. Before the Chemino Card learning media was implemented, a small (limited) group trial was first carried out. Small group trials were carried out to determine the level of practicality of the Chemino Card learning media before using it in large groups. A small trial was carried out by 6 students. After that, a student response test is carried out.

Implementation

Implementation phase was carried out at the IMMIM PUTRA Makassar Islamic Boarding School in the odd semester of the 2023-2024 Academic Year. Chemino Card learning media is implemented in class X science, totaling 26 students. The learning process is carried out in three meetings with a total of 3 x 45 minute lesson hours. Learning activities are carried out in accordance with the syntax of the TGT model. There are three important activities in the TGT syntax, namely preliminary activities, core activities and closing activities. Preliminary activities consist of conveying learning objectives and motivating students. The core activities include presenting information, organizing students into study groups, guiding group work and study, evaluation & games and distribution of awards. The closing activity is in the form of presenting conclusions. Teachers and students became respondents to measure the level of practicality and effectiveness of the chemino card learning media developed. The practicality of the chemino card learning media can be seen from data analysis on the learning implementation observation sheet, teacher response questionnaire and student response questionnaire.

The use of practical instruments that have been created in the previous stage is first validated. After the instrument is validated by an expert validator, it is then used in the research process. The learning implementation observation sheet is filled in by the chemistry subject teacher at every meeting held at school and data is obtained as in Table 9.

Table 9. Observation results of learning implementation

No.	Aspect	Value of the 2nd Meeting			Average Percentage (%)	Category
		I	II	III		
1.	Preliminary activities					
	Conveying Goals	10	10	10	100%	Very high
2.	Core activities					
	Presenting Information	4	6	6	88.89%	Very high
	Organizing students into study groups	2	2	2	100%	Very high
	Guiding group work and study	6	6	6	100%	Very high
	Evaluation and games	6	8	8	91.67%	Very high
	Give awards	2	2	2	100%	Very high
3.	Closing Activities					
	Closing	2	2	2	100%	Very high
Total Average					96.667%	Very high

Based on Table 9 above, it can be concluded that the implementation of learning is stated to be very high with an average percentage of 96.667%. The results of the teacher and student response questionnaire can be seen in Table 10 and Table 11. Effectiveness analysis using learning outcome test instruments after providing the material. The results obtained can be seen in Table 12. Based on Table 12 above, it can be seen that as many as 25 students exceeded the KKM 75 which was determined with a class completion percentage of 92%.

Table 10. Teacher response questionnaire results

No.	Assessment Aspects	Percentage	Category
1.	Navigation/Media Operations	83.33 %	Very high
2.	Appearance	87.50 %	Very high
3.	Media Benefits	89.28 %	Very high
4.	Content	100%	Very high
Average		90.03 %	Very high

Table 11. Results of student response questionnaires

No.	Assessment Aspects	Percentage	Category
1.	Navigation/Media Operations	84.14%	Very high
2.	Appearance	87.31%	Very high
3.	Media Benefits	81.81%	Very high
Average		83.42%	Very high

Table 12. Learning outcome test results

Variable	Descriptive Value
Research subject	25
Ideal Value	100
KKM	75
Average	83.2 %
Maximum Score	95
Minimum Score	70
Number of Students Completed	23
Number of Students Who Did Not Complete	2
Class Completion Percentage	92%

Evaluation

The evaluation stage in the research and development of the ADDIE model was carried out by revising the shortcomings of the chemino card learning media which is developed if there are still deficiencies in the form of input and suggestions which are taken into consideration in revising the chemino card learning media both in terms of material and media. In media validation, the validator team did not provide input and suggestions. During material validation, the validator team provides input to correct typing errors.

Improvements were made after receiving suggestions from students after the learning process that the instructions for using the chemino card learning media still needed to be improved. Thus, the instructions for implementing media use have been revised, accompanied by pictures as a visual form of discussion or explanation.

Discussion

This research aims to determine the level of validity, practicality and effectiveness of the learning media used. Using the ADDIE development model for class X Science students at the IMMIM PUTRA Islamic Boarding School in Makassar on the material of elemental stability in the scope of chemical bonds. Using the chemino card can foster students' enthusiasm and interest in learning. This is in line with research that the use of chemino cards can increase students' understanding and attract attention and interest in learning so that students are more enthusiastic about participating in learning (Setiawan, et al., 2020).

In the initial stage, the first activity was to carry out performance analysis and needs analysis. Based on the data obtained, it was concluded that students' understanding still needed to be improved, especially at the symbolic, macroscopic and submicroscopic level of chemical representation, in this case the material of elemental stability. Coupled with learning media that must be creative, the chemino card emerged.

In the second stage, the design or drafting process is carried out. Design of learning materials, learning tools, learning media and research instruments. The learning media designed must be as good as possible because learning media can make it easier for students in the learning process. This is in line with research by Kristanto (2016) that learning media can make it easier for students to receive the material provided and learning takes place efficiently and effectively.

In the third stage, the development process of learning media that has been designed previously is carried out. Before the product is used, material and media validation is carried out first. The validation results from material and media experts were 3.33 and 3.46 respectively. This is included in the very valid category.

The next step, it was declared suitable for use, then a limited trial (small group) consisting of 6 people was carried out before the research. This is necessary to find out whether the media that has been created is practical or not. Based on the results of limited trials, a score with a percentage of 81.94 was obtained. When compared with the large group test carried out at the time of the research, a value of 83.42% was obtained. This reveals that there is an increase in students' abilities, in other words, learning media can improve students' understanding.

The next practicality can also be seen from the results of teacher and student questionnaires. This is in line with Yamasari's (2010) research that learning media is said to be practical if it is practical in practice from teacher response questionnaires and student response questionnaires. This questionnaire was given during the research and was filled out at each meeting by the teacher and students. The results obtained for the teacher questionnaire were 90.03% and the results obtained for the student questionnaire were 83.42%. When compared with research conducted by Wiratni et al. (2021), the teacher questionnaire results were 89.25% and the student questionnaire results were 89.00%. This means that everything is in the very high category.

The fourth stage is implementation. This means applying learning media or products that have been created for use in the learning process, in its application using the TGT (Team Game Tournament) learning model. At the end of the research,

students' learning outcomes were measured to determine their level of effectiveness and data was obtained that as many as 92% of students succeeded in passing 85% of the class.

The fifth stage is evaluation. At this stage, improvements are made to the product based on suggestions received from students. The suggestion given is to improve the rules or how to play the game on the chemino card learning media. So improvements were made by attaching pictures as explanations to make it easier for students to receive material in the learning process using this media. This media is only used for elemental stability materials within the scope of chemical bonds so that for future research it is necessary to develop this media for other chemical materials.

Conclusion

Based on the results of the research and discussion, it can be concluded that the chemino card learning media is suitable for use because it meets the criteria of being valid, practical and effective. The level of validity based on validation from material experts is 3.33 and media experts is 3.46. The level of practicality based on the learning implementation observation sheet was 96.67%, teacher response questionnaire 90.03% and student response questionnaire, 83.42%. The level of effectiveness based on class completion is 92%

Conflict of Interests

The author(s) declares that there is no conflict of interest in this research and manuscript.

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