

Development of Chemistry Game Card as an Instructional Media in the Subject of Naming Chemical Compound in Grade X

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Abstract. The purpose of this research was to produce a chemistry game card as an instructional media in the subject of naming chemical compounds and determine the degree of validity and practicality of instructional media produced. Type of this research was Research and Development (R&D) that produced a product. The development model used was 4-D model which comprises four stages including: (1) define, (2) design, (3) develop, and (4) disseminate. This research was restricted at the development stage. Chemistry game card developed was validated by seven validators and practicality was tested to class X_c students of SMAN 5 Padang. Instrument of this research is questionnaire that consist of validity sheet and practicality sheet. Technique in collection data was done by distributing questionnaire to the validators, chemistry teachers, and students. The data were analyzed by using formula Cohen's Kappa. Based on data analysis, validity of chemistry game card was 0.87 with category highly valid and practicality of chemistry game card was 0.91 with category highly practice.

1. Introduction

Naming chemical compound is the subject that learned by grade X student in the second semester. This topic consists of fact, concept, principle, and procedure. Some facts in this subject namely chemical formula of acetic acid is CH_3COOH , chemical formula of sodium chloride is NaCl , and chemical formula of calcium carbonate is CaCO_3 . Examples of concept in this subject are binary compound which is a compound that consists of two different substances, and polyatomic compound which is the compound that consist of three or more different substances.

The principle in this subject is IUPAC rule for naming simple organic and inorganic compound. Procedure in this subject is the step in naming organic and inorganic compound. To understand the fact, concept, principle, and procedure and to make this subject long stay in student mind, the students have to read this subject more than two or three times and answer the exercise questions. One way to make lesson stay in the student mind is repeating the lesson that was learned [1].

Based on the results of author interviews with chemistry teacher at SMAN 5 Padang, SMAN 7 Padang, SMAN 10 Padang, and SMAN 12 Padang, it was found that the learning process of naming chemical compounds used lecture and discussion by using worksheets, textbooks, and power point media. Based on the curriculum of 2013, learning approach mandated is scientific learning that has five stages of learning activities: observation, asking question, data collection, association, and communication. However, based on interviews, on the stage of association, the students discussed and worked on the problems worksheet and textbooks exercise. This influenced student activity which was still low. The low activity of students would have an impact on the ability of academic and student



learning outcomes. Therefore, in the learning of naming chemical compounds needed a media that can enhance the activity of students, easy to recall and solidify their understanding of that subject.

A game is one of the alternatives that can be used as an instructional media to increase student activity, and make students easier to remember the learning material. The game is something fun to do and allow the active participation of students in learning [2]. 80 % of teens who had an age range 12-21 years is still likely to enjoy the game, ranging from the traditional to the modern game such as online games [3] .

Game used as a instructional media was a game card that had been chemically modified. Chemistry game card contained questions that were used as exercise at the stage of association. This game would enhance students to understand the subject of naming chemical compound. Research about this game card had already done by Salmi (2014) with the title of the Periodic System Card for Game In Chemistry Learning In Class X High School. The game card of the periodic system was used effectively to improve student learning outcomes [4]. Other studies related to the use of the card was the research conducted by Sudjana (2015) with title Cation-Anion Card as Learning Media Innovation Subjects in Chemistry in High School. The results showed that the cation-anion game card could improve student learning outcomes in the subject of naming chemical compounds ^[5].

Based on these cases, authors were interested in designing and creating alternative instructional media in the form of a game card for chemistry subject in senior high school under the title "Development of Chemistry Game Card as an Instructional Media in the subject of Naming Chemical Compound in Grade X".

2. Research Methods

This research was Research and Development (R&D). Research and development is the research that used to produce a specific product and test the effectiveness of the product. This research was done in class X₆ of SMAN 5 Padang. The object of this research was a game card of chemistry as an instructional media in the subject of naming chemical compound in grade X.

The development model used was Four D model (4-D model). 4-D model consisted of four stages, namely: (1) define, (2) design, (3) develop, and (4) disseminate [6]. This research was limited to the stage of develop.

Define stage consisted of the front-end analysis, students analysis, task analysis, concept analysis, and analysis of learning objective. At the design stage, it was made a prototype of chemistry game card in the subject of naming chemical compound that consisted of a game card, the rules of the game, answer key and assessment sheet.

The third stage of this research was the develop stage. Chemicals game card that had been designed was validated by some validators. Furthermore chemistry game cards revised based on suggestions that given by validator. Chemical game card which had been revised subsequently tested to determine the level of practicality.

Instruments that used in determining the validity of chemistry game card was a validation sheet filled out by some validators, they are four Padang State University chemistry lectures and three high school chemistry teachers. The instrument used to determine the practicalities of chemistry game card is a questionnaire that completed by the students. Validity and practicality of chemistry game cards was analyzed by using formula Kappa Cohen.

$$momen\ kappa\ (k) = \frac{\rho_o - \rho_e}{1 - \rho_e} \quad (1)$$

Here k is momen kappa describing validity of the product, ρ_o is Realized proportion; counted by summing the score given by validators and then divided it by maximum total score and ρ_e Unrealized proportion; counted by subtracting the maximum total score with the sum of total score given by validator, which then divided by the maximum total score. Kappa moment value (k) ranges from 0 to 1 [2]. Interpretation kappa moment value can be seen in Table 1

Table 1. The category of decision based on Kappa moment (k).

Interval	Category
0.81 - 1.00	Very high
0.61 - 0.80	High
0.41 - 0.60	Medium
0.21 - 0.40	Low
0.01 - 0.20	Very low
$\leq 0,00$	Invalid

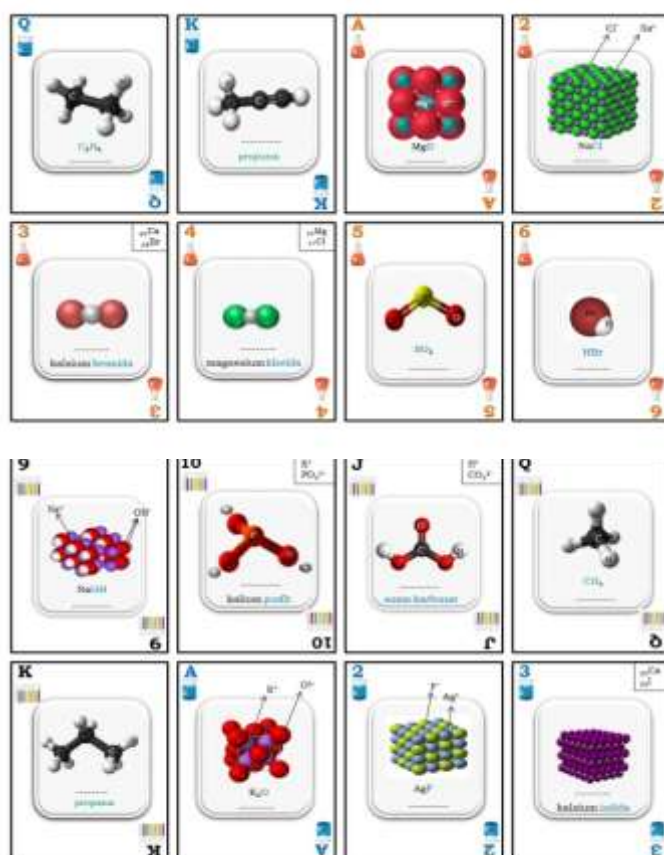
3. Results and Discussion

3.1 Result

The results of this research was the chemical game card as an instructional media in the subject of naming chemical compounds. A set of chemical game card consisted of game card, answer key, rules of the game, and the assessment sheet.

3.1.1 A game card. This game was designed for Indonesian students, so that set of chemical game card used Indonesian language. The game cards were the cards that can be played by students. The real bridge cards had four logos; those were spade, heart, diamond and clover. Chemical game card logos were modified. These were five kinds of card with different logos, they were volumetric glass, erlemeyer, beaker glass, test tube and pipettes.

Each kind of card had fourteen cards, that consisted of number 2 to 10, A (As), K (King), Q (Queen), J (jack) and Jocker. The total number of car was 70 pieces. In the following picture, it can be seen an example of game cards.

**Figure 1.** Example of game cards

3.1.2. Answer Key. Answer key was designed on the piece of paper that contained the answers of the questions in the cards. This answer key can be seen in Figure 2.

3.1.3. The rule of the game. The rule of the game was written on the piece of paper. There are five students in one group, one student as the coordinator and four students as players. Each player has six cards, and the remaining cards are put on the table as the pulling cards. The game is started when the coordinator takes a piece of pulling cards, reads the question on that card, then answers that question. After that, the players continue the game. The player who has the same logo with the prior card that coordinator played picks his card, reads the question on the card and answers it. The correct answer is scored by coordinator. If the answer is wrong, the second player will continue the game. If the player does not have a same logo's card, he has to take a card from the pulling card. The playing is continued by the next player. After playing the first logo, the game will be continued with the other logos. The first player is the player who has the biggest card number on the prior logo playing. The winner on this game is the player who has the highest grade. The rule of the game can be seen in Figure 3.

KUNCI JAWABAN					
					
A	aluminium oksida	kalsium oksida	magnesium oksida	natrium fluorida	barium fluorida
2	kalsium iodida	perak fluorida	natrium klorida	aluminium fluorida	kalsium sulfida
3	NaBr	CaI ₂	CaBr ₂	CaF ₂	K ₂ S
4	Al ₂ S ₃	AlCl ₃	MgCl ₂	Mg ₃ N ₂	CaO
5	karbon monoksida	sulfur heksafluorida	sulfur dioksida	fosfor pentaklorida	diod pentaoksida
6	asam sulfida	asam klorida	asam bromida	asam fluorida	asam iodida
7	SF ₄	SO ₂	CCl ₄	CO ₂	CS ₂
8	H ₂ O	NH ₃	H ₂ O ₂	PCl ₃	N ₂ O ₅
9	natrium hidroksida	kalsium sianida	kalsium karbonat	amonium klorida	barium hidroksida
10	K ₃ PO ₃	Na ₂ S ₂ O ₃	NaNO ₂	NaClO ₃	Na ₂ CrO ₄
J	H ₂ CO ₃	H ₃ PO ₄	K ₂ SO ₃	H ₂ SO ₄	CH ₃ COOH
Q	metana	etana	butuna	glukosa	urea
K	C ₃ H ₈	C ₃ H ₄	C ₂ H ₂	C ₂ H ₆	CHCl ₃

Figure 2. Answer Key

3.1.4. Evaluation Sheet. This sheet was designed to record the score of each player. The right answer was scored by 4, and the wrong one was - 1. The following figure 4 is the figure of evaluation sheet.

Aturan Permainan	
a.	Permainan ini berkelompok, tiap kelompok terdiri dari lima orang. Satu orang sebagai koordinator dan empat orang sebagai pemain.
b.	Kartu bermain dipegang oleh setiap pemain, sementara kunci jawaban dipegang oleh koordinator.
c.	Permainan dimulai dengan pengocokan kartu bermain oleh koordinator dan membagikan enam lembar kepada setiap pemain dan sisanya untuk kartu tarikan.

Figure 3. Rule of the game

LEMBAR PENILAIAN

Petunjuk Penilaian

Berilah poin 4 pada kolom benar apabila pemain menjawab benar, dan berilah poin -1 apabila pemain tidak dapat menjawab atau jawaban yang diberikan salah pada kolom salah.

Pemain 1		Pemain 2		Pemain 3		Pemain 4	
Benar	Salah	Benar	Salah	Benar	Salah	Benar	Salah

Figure 4. Evaluation Sheet

In the development stage, there had been done the validity and practicality test of this chemistry game card.

3.1.5 Validity Test. The aspects were assessed in validity test of chemistry game card was cognitive function, attention function, and compensatory function. Validity data of chemistry game card can be seen in Table 2.

Table 2. The validity of chemistry game card

No	Validity Aspect	<i>k</i>	Validity category
Cognitive Function			
1	The facts contained in chemistry game card are in accordance with the Basic Competence 3.10	0.88	Very high
2	The concepts contained in chemistry game card are in accordance with the Basic Competence 3.10	0.78	High
3	The principles contained in chemistry game card are in accordance with the Basic Competence 3.10	0.84	Very high
4	The procedures contained in chemistry game card are in accordance with the Basic Competence 3.10	0.88	Very high
5	The questions contained in chemistry game card are in accordance with the Basic Competence 3.10	0.78	High
Kappa moment for cognitive function		0,84	Very high
Attention Function			
6	The language used in the chemistry game card use Indonesian spelling properly	0,88	Very high
7	The language used in the chemistry game card is easy to understand	0.84	Very high
8	Images and symbols in the chemistry game card is clear and interesting	0.88	Very high
9	Design of chemistry game card is interesting	0.92	Very high
10	The font used in chemistry game card is clear and legible	0.96	Very high
11	The size of the font used in chemistry game card is clear and legible	0.96	Very high
12	Color display in chemistry game card is interesting	0.78	High
Kappa moment for attention function		0,89	Very high
Compensatory Function			
13	Chemistry game card as instructional media can strengthen student understanding	0,84	Very high
Kappa moment for compensatory function		0,84	Very high
Kappa moment for validity of chemistry game card		0,87	Very high

Based on the above table, it can be seen that the validity of chemistry game card as an instructional media had a moment kappa 0.87 with very high category. Nevertheless, there were some cases that need to be revised based on advice from the validator. The suggestions were:

- Change the shape of the molecule in game card, the original filling space change into ball and stick. This ball and stick make the player can see the bond that exist in a compound.
- Simplify the answer key to one sheet. Answer key that originally numbered 70 sheets made into one sheet. The aim of this is to facilitate the player coordinator in correcting the answer.
- Clarify the intent highest value at point G in the rules of the game.
- Before making a question for the game card, try to make the grating for all the learning objectives achieved.
- Using paper on both sides slippery for the game card in order not to get caught in the hand.
- Using symbols associated with chemicals to make it looks more attractive.

3.1.6 *Practicality Test*. Practicalities of chemistry game cards as an instructional media in subject of naming chemical compound obtained from the use of the product based on limited testing in the school. Practicality data were obtained from the responses of student questionnaire. This assessment data can be seen in Table 3.

Table 3. The practicality of chemistry game card

No	Practicality Aspect	k	Validity category
Attention Function			
1	Chemistry game cards as an instructional media has an attractive color	0,96	Very High
2	The inscription in chemistrygame card as an instructional media clear and legible	0,90	Very High
3	Language that used in chemistry game cardis easy to understand	0,90	Very High
4	Images and symbols in chemistry game card isclear and interesting	0,90	Very High
kappa moment for attention function		0,91	Very High
Affective Function			
5	Chemistry game card as an instructional media is interesting to play	0,92	Very High
6	Chemistry game card as an instructional media is easy to play	0,81	Very High
7	Chemistry game card as an instructional media makes learning chemistry on the subject of naming chemical compound to be enjoyable	0,96	Very High
8	Chemistry game card as an instructional media makes the learning process more effective	0,96	Very High
Kappa moment for affective function		0,92	Very High
Compensatory Function			
9	Chemistry game card as an instructional media makeseasier to understand the subject of naming chemical compounds	0,90	Very High
10	Question in chemistry game card help to understand the the subject of naming chemical compounds	0,94	Very High
11	Question in chemistry game card in accordance with the subject of naming chemical compounds	0,92	Very High
12	Chemistry game card as an instructional media is portable	0,87	Very High
13	Chemistry game card as an instructional media can be played anytime and anywhere	0,85	Very High
14	Chemistry game card as an instructional media can be played over and over again	0,90	Very High
Kappa moment for compensatory function		0,90	Very High
kappa moment for practicality of chemistry game card		0,91	Very High

3.2. Discussion

3.2.1. Validity of Chemistry Game Card. The validity of chemistry game card as instructional media derived from the assessment of seven validators through the validation sheet. Validity test of the instrument can be used on expert opinion (judgment experts) that the amount of at least three people^[8]. Validators provided an assessment of the chemistry game cards as a instructional media in subject of naming chemical compound based on the functions of media, namely cognitive function, attention function, and compensatory function. Validity data of instructional media developed were analyzed using formula Kappa Cohen. This data can be seen on Table 2.

Cognitive Function

Based on assessment data from seven validator on cognitive function of chemistry the game card, it was obtained momen kappa 0.84 with category very high. Facts, concepts, principles and procedures contained in the chemistry game card accordance with the Basic Competence 3.10, which is applying the IUPAC rules for naming simple inorganic and organic compounds. In addition, the question that obtained in chemistry game card for subject of naming chemical compound correspond with learning objective that will achieved, so the instructional media in the form of chemistry game card has meet cognitive function. If the medium that used is conformity with the learning objective, the media can be used to make student learn^[9].

Attention Function

The average of kappa moment for validity on attention function of chemistry game card was 0.89 with very high category. The language used in the media developed is easy to understand and are in compliance with Indonesian language spelling. Media display is attracted to student attention. The increase of students attention will make the process of learning become better^[10]. In addition, the type and size of font on the media that developed can be clearly legible by the user. Therefore, it can be said that the instructional media in the form of chemistry game card has fulfilled the attention function. With the fulfillment of attention function, students can concentrate and be able to direct students' attention to the content of learning^[11].

Compensatory Function

Based on assessment data from seven validators on compensatory function of chemistry game card derived momen kappa 0.84 with very high category. It shows instructional media that developed can help students who are slow in learning to be easier to understand and enhance their understanding in subject naming chemical compound. With the fulfillment of compensatory function, the media can help students remember information and enhance understanding of the subject^[11].

Chemistry game card that developed has fulfilled the three functions of an instructional media, ie cognitive function, attention function, and compensatory function. Kappa moment for the validity of the media that developed can be seen in Table 2. The validity of chemistry game card as a instructional media visits of cognitive function, attention function, and compensatory function, and has a gain of kappa moment consecutive 0.84; 0.89; 0.84. Thus, instructional media has been developed in accordance with the assessment instrument (validation sheet). A product is said to be valid if the instrument can measure what should be measured^[12].

Although the level validity of instructional media that developed was very high, but there were some cases that need to be fixed according to the suggestion of validators to make instructional media better. Revision of this chemistry game card was being developed, and then it was be tested to the students.

3.2.2 Practicality of Chemistry Game Card. Practicality of chemistry game card as a instructional media in subject naming chemical compound was viewed from the uses of product from limited trial involving practicality and enforceability of the products. Practicality assessment of chemistry game card as an instructional media in subject of naming chemical compound was responded by the

students. Practicality of media that developed assessed by students based on the function of instructional media, namely compensatory function, attention function, and affective functions.

Compensatory Function

Based on data from student questionnaire, the results of practicality on compensatory function of chemistry game card obtained an average kappa moment 0.90 with very high category. Chemistry game card that developed was able to increase the interest and motivate students in order to achieve the learning objectives in subject naming chemical compound. Motivation also plays a role in the achievement of learning objectives to be achieved by connecting the meaningfulness of learning objectives^[13]. Chemistry game cards greatly assisted students in recalling the subject of naming chemical compounds that have been studied previously. In addition, the media developed was nice to used in the learning process in naming chemical compound, so the media that developed in compliance with the compensatory function as in [11].

Attention Function

The results of practicality on the attentional function of chemistry game card obtained the average of kappa moment 0.91 with very high category. Rules of the game and the language used in the media as well as the type and size of font was obvious. In addition the design or color display on chemistry game card attracted students attention. Design or color image more attracted students than black and white design, so the media that developed compliance with the attentional functions^[14].

Affective Functions

Based on data from student questionnaire, the results of practicality on affective function of chemistry game card obtained kappa moment 0.92 with very high category. Chemistry game card that developed was capable to increase student interest in learning subject naming chemical compound and fun to play. Chemistry game cards greatly assisted students in establishing understanding subject naming chemical compound. In addition, the media that developed could increase the activity of students in the learning process. If the media is able to increase the pleasure of students in learning, it can be said that it has meet the affective function [15]

Based on questionnaire data processing practicalities of students obtained moment kappa 0.91. It was revealed that the chemistry game cards as a instructional media has very high category for use in the learning process of naming chemical compound. In addition, the game card packed in a box and the right size, so it was easy to carry and use anywhere. The media can be used whenever desired, so the students can play the card so many times to repeat the subject of naming chemical compound that have been studied.

Based on this, it can be concluded that the chemistry game cards as a instructional media in subject of naming chemical compound can help students in repeat and solidify the understanding in learning of naming chemical compounds in a fun way.

4. Conclusion

Based on research result and data analyzed, it can be concluded that chemistry game card as an instructional media in subject of naming chemical compound that developed has category highly valid and highly practice.

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References

- [1] Silberman, Melvin L. 2006. *Active Learning 101 Cara Belajar Siswa Aktif*. Bandung: Nusamedia dan Nuansa
- [2] Sadiman, Arief, dkk. 2012. *Media Pendidikan Pengertian, Pengembangan, dan Pemanfaatannya*. Jakarta: Raja Grafindo Persada.
- [3] Sari, Kurnia Wening. 2014. *Pengembangan Game Edukasi Kimia Berbasis Role Playing Game (RPG) pada Materi Struktur Atom sebagai Media Pembelajaran Mandiri untuk Siswa Kelas X SMA di Kabupaten Purworejo*, Jurnal Pendidikan Kimia (JPK), vol 3 No.2
- [4] Salmi, Hayatus. 2014. *Pembuatan Kartu Sistem Periodik Sebagai Media Permainan Pada Pembelajaran Kimia Di Kelas X SMA*. Skripsi, Jurusan Kimia, Universitas Negeri Padang
- [5] Sudjana, Jamilah. 2015. *Kartu Kation-Anion sebagai Inovasi Media Pembelajaran pada Mata Pelajaran Kimia di Sekolah Menengah Atas*. Jurnal Lingkar Widyaiswara. Edisi 2 No 1. ISSN: 2355-4118
- [6] Trianto. 2012. *Model Pembelajaran Terpadu: Konsep, Strategi dan Implementasinya dalam Kurikulum Tingkat Satuan Pendidikan (KTSP)*. Jakarta: Bumi Aksara
- [7] Boslaugh, Sarah & Watters, Paul A. 2008. *Statistics in a Nutshell, a desktop quick reference*. Beijing, Cambridge, Farnham, Köln, Sebastopol, Taipei, Tokyo: O'reilly
- [8] Sugiyono. 2008. *Metode Penelitian Pendidikan (Pendekatan Kuantitatif, Kualitatif dan R & D)*. Bandung: Alfabeta
- [9] Sanjaya, Wina. 2006. *Strategi Pembelajaran*. Jakarta: Kencana Prenada Media Group.
- [10] Haryono. 2013. *Pembelajaran IPA yang Menarik dan Mengasyikkan: Teori dan Aplikasi PAIKEM*. Yogyakarta: Kepel
- [11] Kustandi, Cecep dan Bambang Sudjipto. 2011. *Media Pembelajaran Manual dan Digital*. Bogor : Ghalia Indonesia
- [12] Sukardi. 2011. *Evaluasi Pendidikan, Prinsip, Dan Operasionalnya*. Yogyakarta: Bumi Aksara
- [13] Jalius, Ellizar. 2009. *Pengembangan Program Pembelajaran*. Padang: UNP Press
- [14] Sudjana, N. dan Rivai, A. 2011. *Media Pengajaran*. Bandung: Sinar Baru Algesindo
- [15] Arsyad, Azhar. 2010. *Media Pembelajaran*. Jakarta: Raja Grafindo Persada