

# Pengembangan Permainan Tic-Tac-Chem sebagai Media Pembelajaran Kimia pada Materi Sistem Koloid Kelas XI SMA/MA

## *Development of Tic-Tac-Chem as Learning Media for Colloid System Topic for Class XI SMA/MA*

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### ARTICLE INFO

#### **Received on:**

25<sup>th</sup> October 2023

#### **Revised till:**

18<sup>th</sup> December 2023

#### **Accepted on:**

22<sup>th</sup> December 2023

#### **Publisher version published on:**

29<sup>th</sup> December 2023

### ABSTRACT

*The importance of innovative approaches to chemistry teaching is becoming increasingly apparent, especially at the high school level. One way to explore is the use of interesting and interactive learning media, namely developing the Tic-Tac-Chem game as a chemistry learning media on Colloid Systems material for class XI SMA/MA students. The purpose of this study is to create educational materials in the form of Tic-Tac-Chem games using colloidal system material and to establish the game's validity category. This kind of research falls under the category of Research and Development (R&D), and it uses the 4D paradigm, which has four stages: define, design, develop, and disseminate. By evaluating the Tic-Tac-Chem game's reliability, this research was constrained to the Develop stage. A validation questionnaire was used to gather data about validity. Five validators—three chemistry lecturers and two chemistry teachers—performed the game's validation. a method of data analysis employing the Aiken's V formula. According to the gaming media test results, a valid category yielded an average Aiken's V value of 0.86. Tic-Tac-Chem games are regarded as legitimate teaching tools that can be applied to colloidal system material.*

### KEYWORDS

*Aiken's V, Colloidal Systems, Learning Media, R&D, Tic-Tac-Chem, 4D models*

### ABSTRAK

Pentingnya pendekatan inovatif dalam pengajaran kimia menjadi semakin jelas, terutama di tingkat sekolah menengah atas. Salah satu cara untuk mengeksplorasinya adalah dengan penggunaan media pembelajaran yang menarik dan interaktif yaitu mengembangkan permainan Tic-Tac-Chem sebagai media pembelajaran kimia pada materi Sistem Koloid untuk siswa kelas XI SMA/MA. Tujuan dari penelitian ini adalah untuk menghasilkan bahan ajar dalam bentuk permainan Tic-Tac-Chem pada materi sistem koloid dan menentukan kategori kevalidan dari permainan tersebut. Jenis penelitian ini termasuk dalam kategori Research and Development (R&D), dan menggunakan paradigma 4D, yang memiliki empat tahap yaitu pendefinisian (define), perancangan (design), pengembangan (develop), dan penyebaran (disseminate). Dengan mengevaluasi reliabilitas permainan Tic-Tac-Chem, penelitian ini dibatasi pada tahap Develop. Kuesioner validasi digunakan untuk mengumpulkan data tentang validitas. Lima orang validator-tiga dosen kimia dan dua guru kimia-melakukan validasi terhadap permainan ini. Metode analisis data menggunakan rumus Aiken's V. Berdasarkan hasil pengujian media permainan, kategori valid menghasilkan nilai Aiken's V rata-rata sebesar 0,86. Permainan Tic-Tac-Chem dianggap sebagai media pembelajaran yang valid dan dapat diterapkan pada materi sistem koloid.

### KATA KUNCI

*Aiken's V, Colloidal Systems, Learning Media, R&D, Tic-Tac-Chem, 4D models*



## 1. INTRODUCTION

Curriculum 2013 is a government initiative to improve education standards in Indonesia and is implemented in several ways, including knowledge, attitudes and skills<sup>1</sup>. Curriculum 2013 offers students the opportunity to learn actively, with teachers acting as facilitators and motivators<sup>2</sup> and everything in life has the potential to be a source of knowledge.

One of the chemistry learning materials discussed in class XI SMA/MA even semester is the colloidal system<sup>3</sup> in accordance with the 2013 curriculum. The colloidal system textbook teaches students about various types of colloids, their characteristics, how to make them, and how to purify them. This information requires sufficient understanding because it contains factual, conceptual, and procedural knowledge<sup>4</sup>. Training is needed so that students master the concepts, principles, and learning processes<sup>5</sup>.

Students can benefit from a relevant learning environment that can be fostered by teachers. Chemistry teachers have a challenging task to develop a learning environment that can trigger students' interest in chemistry<sup>6</sup>. The use of interesting learning materials is one strategy to consider to make students interested in learning chemistry<sup>7</sup>. When deciding which media is best for students' needs and circumstances, it is important to consider its attributes<sup>8</sup>.

The results showed that students have not fully understood the colloidal system material based on the distribution of questionnaires by teachers completing surveys at SMA Negeri 2 Padang, SMA Negeri 5 Padang, and SMAN 8 Padang. This can be seen from the material that has not been fully learnt by students, namely colloidal systems with a proportion of 69%. Textbooks and LKPD are learning resources used by teachers. Learners are social creatures who like to be in groups, like to play, and are competitive in learning<sup>9</sup>. For this reason, especially during the training process, learning media is needed that can be used in groups. The use of media can be discussed before or after<sup>10</sup>. Efforts to engage students in exercise activities can be enhanced by employing enjoyable and interactive learning media<sup>11</sup>. One of the learning media that teachers can use in the learning process is games<sup>12</sup> when given learning material in the form of games, students will be more involved.

A game that is played quite often, commonly known as the Javanese chess game, is called the Tic-Tac-Toe Game. This game is easy to understand the rules of the game but needs a strategy to win the game so it is quite challenging to play. The player who can make straight lines horizontally, vertically, and diagonally will win the Tic-Tac-Toe game. The square-shaped Tic-Tac-Chem game with a 3x3 grid is one of the variations of the Tic-Tac-Toe game<sup>13</sup>.

In the study "Development of Chemo-Karuta Japanese Card Game Media on Electrolyte and Non-

Electrolyte Solution Materials for Class X SMA", about the use of game media in the learning process. They found that the Chemo-Karuta game is practical to use, it can help consolidate concepts and increase children's interest in learning. The relay game has a high validity and practicality value so that it can help students understand the material and can make chemistry learning more fun<sup>14</sup>.

Based on the description, in an effort to enhance student engagement during practice exercises and reinforce students' understanding of factual, conceptual, and procedural knowledge in the colloid system material, the author is interested in creating instructional materials in the form of a game. The validity of the product will be determined through research titled "Development of Tic-Tac-Chem Game as a Chemistry Learning Media on Colloid System Material for Grade XI High School/MA."

## 2. METHOD

In order to create specific items and evaluate them based on identified difficulties<sup>13</sup>, this study utilised the Research and Development (R&D) research technique<sup>15</sup>. In order to improve students' conceptual understanding of colloidal systems, this project intends to create a product in the form of an original Tic-Tac-Chem game<sup>16</sup>.

The 4-D model is a research model used in research. The four stages in making the 4-D model are defining, designing, developing, and disseminating<sup>17</sup>. Due to limited resources (time and cost), this research can only reach the develop stage<sup>18</sup>.

The data analysis method used in this research is categorical assessment on Aiken's V scale, which is a descriptive statistical method<sup>19</sup>. Aiken's V formula was used to analyse validity data from the validity questionnaire, which is as follows:

$$V = \frac{\sum s}{n(c-1)} \quad (1)$$

$$s = r - 10$$

Description:

Io = the lowest score in the scoring category (in this case = 1)

c = the number of categories chosen by the rater (in this case = 5)

r = the score given by the rater

n = number of raters

Validity assessment categories using Aiken's V in Table 1.

Table 1. Validity Assessment Criteria using Aiken's V

Nilai V	Category
$\leq 0,4$	Less
$0,4 < V \leq 0,8$	Medium
$0,8 < V$	Valid

### 3. RESULT AND DISCUSSION

#### 3.1 Defining stage (*Define*)

The five main processes in this stage are front-end analysis, learner analysis, task analysis, idea analysis, and formulation of learning objectives<sup>14</sup>.

##### 3.1.1 Front end analysis

The purpose of the front end analysis is to identify and highlight the fundamental problems that teachers and students face in the learning process. Chemistry teachers filled out questionnaires for the front end analysis and distributed them to students at SMAN 5 Padang, SMAN 2 Padang, and SMAN 8 Padang. Based on the questionnaire results, printed books, modules, LKPD, and PowerPoint are the main learning aids used by teachers when students learn chemistry. Teachers provide practice questions taken from the LKPD and textbooks. Other teaching tools that can attract students' attention during the learning process are still needed. There is a need for more teaching tools that attract and keep students on task<sup>20</sup>. If learning materials are offered in the form of games as a variety of learning exercises, both students and teachers will be engaged.

##### 3.1.2 Learner analysis

The purpose of the learner analysis is to identify the characteristics of the learners. The teachers and students of SMAN 2 Padang, SMAN 5 Padang, and SMAN 8 Padang filled out questionnaires to conduct the learner analysis. After analysing the questionnaire data, it was found that students enjoy playing, prefer to work in groups when completing activities, and have a competitive attitude when learning. The findings from the survey revealed that learning material in the form of games is one that can attract students' attention<sup>21</sup>. Therefore, there is a need for learning aids that allow for group use by students and encourage learning through play. If there is a Tic-Tac-Chem game available, students will be interested.

##### 3.1.3 Task analysis

The content of the learning unit can be determined using various task analysis approaches. To conduct this analysis, a review of the Core Competencies (KI) and Basic Competencies (KD) of the 2013 Revised 2018 curriculum for colloidal system material was conducted. Competency achievement indicators (IPK) were developed based on a review of the KI and KD contained in the curriculum.

##### 3.1.4 Concept Analysis

The identification and study of key concepts in colloidal systems material is referred to as concept analysis. Concept maps are used to methodically explain and visualise the ideas in the colloidal system material.

##### 3.1.5 Formulation of learning objectives

The foundation of learning objectives is the elaboration of basic competencies and indicators of competency achievement. The following is the formulation of learning objectives for colloidal system material: It is expected that students can complete the exercises in the game actively, happily, and are able to answer questions about various types of colloids, their properties, how they are made, and how they are purified<sup>22</sup>. The Tic-Tac-Chem game is used as an alternative learning media to provide exercises in the process of consolidating concepts.

#### 3.2. Design Stage (*Design*)

As a learning media for colloidal system material, the product design carried out at the design stage is a Tic-Tac-Chem game. The game box contains game components that have been assembled. Each game set consists of a game board, black pawns and yellow pawns, player question cards, coordinator question and answer cards, scoring cards, game rules and OHP pens.

##### 3.2.1. Tic-Tac-Chem game board

The Tic-Tac-Chem game board consists of a 3x3 grid designed using the Corel Draw X7 application printed with banner paper measuring 60 cm x 60 cm. the game board is printed with banner material so that it is protected from water, can be folded and is not easily damaged. The following game board can be seen in Figure 1

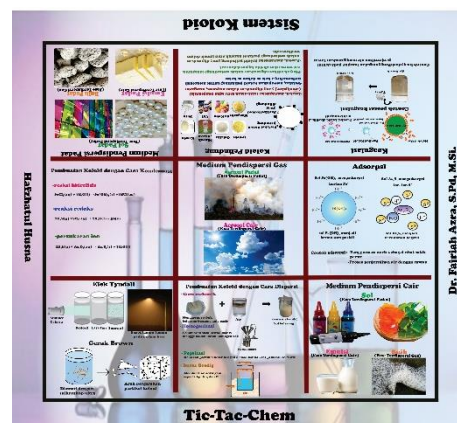


Figure 1. Tic-Tac-Chem game board

Based on figure 1, the Tic-Tac-Chem game board contains a background that is in accordance with the discussion of colloidal systems which can function to help students remember concepts about colloidal system material for concept consolidation.

##### 3.2.2. Tic-Tac-Chem game pawns

The pawns in the Tic-Tac-Chem game consist of 3 round-shaped pawns for each group. The following Tic-Tac-Chem game pawns can be seen in Figure 2



Figure 2. Tic-Tac-Chem game pawns

Based on figure 2, both groups have different colours of pawns which are beige and black.

### 3.2.3. Making Tic-Tac-Chem question cards

The question cards consist of player question cards and question and answer cards and the Tic-Tac-Chem game question card coordinator consists of 50 questions and is designed using the Microsoft office Power Point 2007 application with a size of 15 cm x 15 cm printed on thick paper and spiral bound in the form of a small book. On the question card there are multiple choice answers. There are no responses on the player question cards, while the question and answer cards for the coordinator have responses. Figure 3 shows the following Tic-Tac-Chem game question cards.

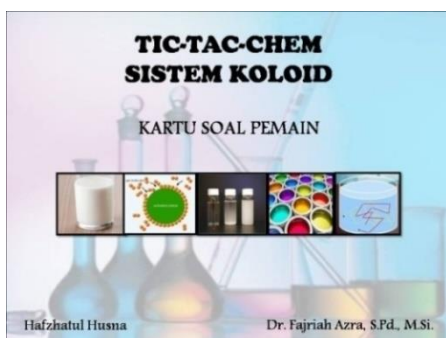


Figure 3. Tic-Tac-Chem game question cards

The question and answer cards are held by the coordinator so that only the coordinator can know the player's answer is correct or wrong. The following question and answer cards for the coordinator can be seen in Figure 4



Figure 4. Tic-Tac-Chem game coordinator question and answer cards

### 3.2.4 Tic-Tac-Chem game rules

The Tic-Tac-Chem game rule card for colloidal system material was designed using Microsoft Office Word 2007 application. The game rule card is printed on HVS paper and laminated thinly with a size of 15 cm x 9 cm. The following Tic-Tac-Chem game rules can be seen in Figure 5

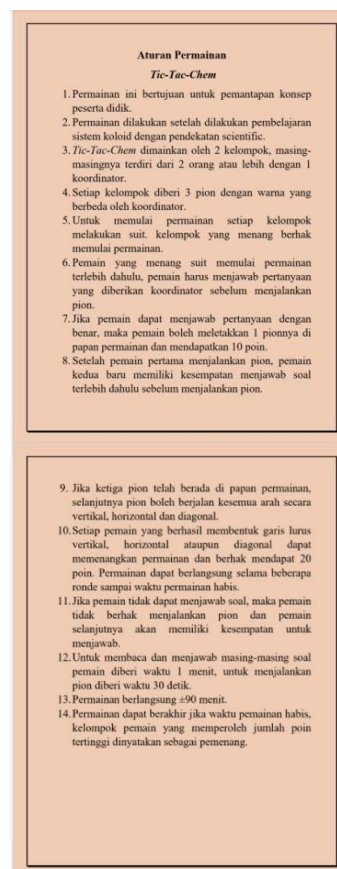


Figure 5. Tic-Tac-Chem Game Rule Card

Based on Figure 5, on the Tic-Tac-Chem game rules card there are 14 game rules.

### 3.2.5. Scorecard

The Tic-Tac-Chem game scorecard was designed using Microsoft Office Word 2007 and printed on HVS paper with a scorecard size of 17 cm x 12 cm and thin laminated. The scorecard is held by the game coordinator and written with an OHP pen that can be erased after use so that it can be used repeatedly. The following scorecard can be seen in Figure 6.

Perilaian	Nomor soal yang dijawab benar diberi tanda ceklis (✓)										Total soal	Total poin soal (total soal x10)	Poin bonus (membentuk garis lurus x20)
<b>Kelompok 1</b>	1	2	3	4	5	6	7	8	9	10			
Nama:	11	12	13	14	15	16	17	18	19	20			
1. ....	21	22	23	24	25	26	27	28	29	30			
3. ....	31	32	33	34	35	36	37	38	39	40			
4. ....	41	42	43	44	45	46	47	48	49	50			
<b>Kelompok 2</b>	1	2	3	4	5	6	7	8	9	10			
Nama:	11	12	13	14	15	16	17	18	19	20			
1. ....	21	22	23	24	25	26	27	28	29	30			
3. ....	31	32	33	34	35	36	37	38	39	40			
4. ....	41	42	43	44	45	46	47	48	49	50			
Jumlah skor total (jumlah poin soal * jumlah poin bonus)													
Kooridinator ( ) Catatan:													

Figure 6. Tic-Tac-Chem game assessment board

### 3.2.6. Game box

The game equipment is put together in one plastic box so that it is not easily scattered. The box is equipped with a handle so that it is easy to carry around. The front of the game box is given a design that aims to be more attractive and given an identity designed using the Corel Draw X7 application. The following is the Tic-Tac-Chem game box in Figure 7



Figure 7. Tic-Tac-Chem game box

### 3.3. Development stage (*develop*)

Five experts and experts who are experienced in their fields, including three chemistry lecturers from Universitas Negeri Padang, one chemistry teacher from SMAN 7 Padang, and one chemistry teacher from SMAN 8 Padang, conducted the validity test of the Tic-Tac-Chem game as a learning media. Four media functions—cognitive, attentional, emotional, and compensatory—were used to validate the game. Aiken's V was used to analyse the validity test results given by each validator for the product in question. Figure 8 displays the results of the validity test of the Tic-Tac-Chem game conducted by the validators using the four media functions.

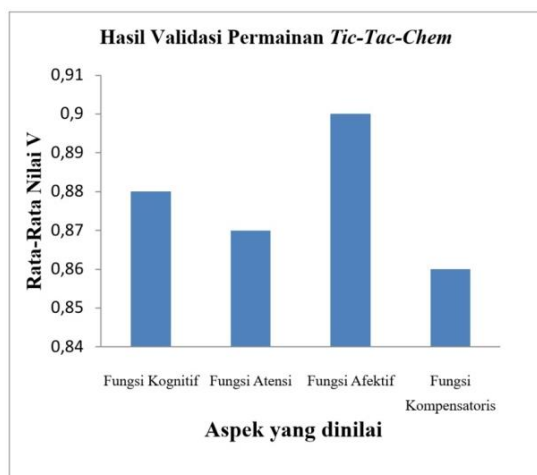


Figure 8. Tic-Tac-Chem game validity test

Based on the picture of the validation test results above, it is known that the value of the four media functions varies. The highest value is the affective function with a V value of 0.90. Next is the value of the cognitive function which is 0.88. Followed by the V value of the attentional function which is 0.87 and finally the value of the compensatory function with a V value of 0.86.

The affective function of the media can be considered from how students enjoy learning or reading illustrated text. The average result of V value on cognitive

function is 0.90. According to Aiken's V scale, the assessment category for the  $V > 0.8$  scale is valid. So, the assessment for the affective function of the Tic-Tac-Chem game media is declared valid.

V value of 0.88 based on the results of the evaluation of the cognitive function of the media. The assessment category for the  $V > 0.8$  scale is valid according to Aiken's V scale, so that the evaluation of the cognitive function of the media can be said to be valid. The cognitive benefits of the media serve to facilitate the achievement of goals so that the messages contained in the images are easier to understand<sup>23</sup>.

The V value is 0.80 based on the results of the media attention function assessment. The assessment category for the  $V > 0.8$  scale is valid according to Aiken's V scale. Thus, it was determined that the media used for the Tic-Tac-Chem game fulfilled the attentional function. Learning content placed on media with attractive packaging can attract learners' attention<sup>21</sup>.

The compensatory function assessment results obtained a V value of 0.86. According to Aiken's V scale, the category for the  $V > 0.8$  scale assessment is valid. Learning media serves to accommodate learners who are slow to receive and understand the content of lessons given through text or verbal.

Based on the results of the validity test through a validation questionnaire by the validator on four media functions, it can be concluded that the Tic-Tac-Chem game product as a learning media on colloidal system material has a valid category with an average Aiken's V value of the four media functions of 0.87.

The developed Tic-Tac-Chem game has advantages and disadvantages including: (1) the Tic-Tac-Chem game is accompanied by a question card and a question card and a coordinator's answer that is equipped with a discussion of the question so that the reason for the answer is known to be correct. Question cards are provided in 1 series with 50 questions that allow all GPAs to be represented by all questions and can be answered by students. (2) Tic-Tac-Chem games can be played anywhere and not necessarily in class learning but can be used at home and outside of learning hours and can be used repeatedly. (3) The Tic-Tac-Chem game board is designed by adding facts and concepts related to colloidal system material that can help students answer practice questions but there are some facts, concepts and procedures that are not included due to limited space on the board. One of the weaknesses of this game is that the material, concepts and images contained on the game board have opposite positions so that not all of them can be read by the player (4) Another advantage of the Tic-Tac-Chem game is that students who answer the questions first have the right to run their pawns. Players try to block the opponent's pawns so that they cannot form a straight line and compete to answer questions so that they can run pawns and form a straight line and collect the most points. (5) a strategy is needed to win the game and collect points (6) the weakness of the Tic-Tac-Chem game is that some students do not know about the Tic-Tac-Chem game so that a more detailed explanation of

how to play and the rules of the game is needed before the game starts.

#### 4. CONCLUSION

For class XI SMAN/MA, Tic-Tac-Chem learning material on colloidal system material has been created. Based on four media functions namely cognition, attention, affection, and compensation functions, the Tic-Tac-Chem game has a high validity category as a learning media.

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