**ASIAN PENDIDIKAN**
ISSN: 2735-2331, eISSN: 2805-4350
DOI: https: //doi.org/10.53797/aspen.v3i1.10.2023

# Development and Perception of Chemistry Trainee Teachers towards Usability of Periodic Block Game for Topic Periodic Table

**Joseph, Violeta Connie[1] & Wan Salleh, Wan Mohd Nuzul Hakimi[1*]**

[1*]Department of Chemistry, Faculty of Science and Mathematics, Universiti Pendidikan Sultan Idris, 35900 Tanjong Malim, Perak, MALAYSIA

*Corresponding Author: wmnhakimi@fsmt.upsi.edu.my

Received 21 May 2023; Accepted 20 June 2023; Available online 20 June 2023

**Abstract:** The purpose of this research was to develop the Periodic Block game as a teaching aid to tackle the issues in teaching and learning a periodic table topic in Chemistry Form Four through the implementation of game-based learning methods and to determine Chemistry teacher trainees' perception on the Periodic Block game in terms of design, content, and adequacy. In this research, the researcher has adopted a developmental research method embedded with the ADDIE model as a research design. This quantitative research was using the validity form to assess the validity and questionnaire to find the reliability and usability of the Periodic Block game. Three experts were involved to evaluate the validity of the game and research instruments. Meanwhile, a total of 122 Chemistry teacher trainees of Sultan Idris Education University were involved as the research sample. The result showed that the content validity of the Periodic Block game had achieved 96.67%. In the pilot test, the reliability of the research instrument was interpreted as high reliability with the Cronbach's alpha value of 0.927. The results obtained from the actual research showed the average mean obtained from 3 constructs of usability – design, content, and adequacy. This research showed a positive result in terms of design (mean= 3.81), content (mean= 3.78), and adequacy (mean= 3.76). The Periodic Block game developed was validated and has a positive perception from trainee teachers. Periodic Block game allows the students to explore, play, and construct knowledge simultaneously on the periodic table topic in Chemistry Form 4.

**Keywords:** Game, game-based learning, periodic table, perception

## 1. Introduction

The Ministry of Education (MoE) aims to improve the quality of Malaysian students to a level that is at par with the international education systems such as the United States and United Kingdom, in which has developed educational curricular. Malaysia Education Blueprint (MEB) 2013-2025 has become a ray of hope for education in Malaysia to make the improvement needed to ensure that Malaysia is on the right track of strengthening the educational quality including the aspect of Science, Technology, Engineering and Mathematics (STEM) education (Minister of Education Malaysia, 2013).

As stated in the Malaysia Education Blueprint (2013-2025), there is a need to sharpen teachers' skills and abilities to deliver the curriculum using various pedagogical strategies to make STEM learning more engaging. One of the various methods that can produce an effective learning session would be game- based learning (GBL). Past research shows that GBL has the potential to produce an interactive learning environment and at the same time giving students the chance to be involved in the class. Even though there were research done on the physical involvement of GBL, there are only a few of those that were developed based on the topic of periodic table (Subhash & Cudney, 2018; Bower, 2017).

Therefore, Periodic Block game was developed to aid in teaching and learning sessions of the topic of the periodic table. The Periodic Block game was then evaluated by Chemistry trainee teachers to determine their perception towards usability in terms of design, content, and adequacy.

*Corresponding author: wmnhakimi@fsmt.upsi.edu.my

## 2. Literature Review

The periodic table is the main concept that exists in the study of chemistry in which it is described as a categorization of elements and its characteristics in one systematic classification. Students often go through a hard time when trying to understand the basic concept of the periodic table as the topic is abstract, containing heavy information, and historic perspectives such as the development processes and understanding what the elements are. Teachers often promote rote learning through traditional methods of teaching, but this method is considered boring and causes students to lose interest in learning. It focuses on teacher-centered learning which decreases the students' participation (Traver et al., 2021; Scerri, 2010; Bierenstiel & Snow, 2019).

Constructivism theory is one of the learning theories that is used to gain knowledge. It has beenaround for decades and is widely used in pedagogical approaches often. Implementing constructivism in learning encourages learners to explore and construct their own understanding of what they have learned. Past researches have shown a positive response to the idea of constructivism, causing learners or students themselves to gain new knowledge from their existing knowledge (Stapleton & Stefaniak, 2018; Kurtes et al., 2017).

Game-based learning is a teaching method that can be used to induce learners' participation in a class by making it interesting through the implementation of a fun element in the process. Students were able to have a deeper understanding of the lesson when games are used rather than the conventional method of teaching. Thus, it is clear that GBL method increases students' motivation, engagement, and learning efficiency. When being applied in chemistry classes, GBL was able to make the chemistry content less complicated and provide a way for students to review concepts in a different and more entertaining way (Bernardo & Gonzalez, 2021; Hoffman & Hennessy, 2018).

## 3. Methodology

In this study, the design that was adopted was the Developmental Research design. ADDIE model was applied throughout the development of the game, as developmental researches are frequently structured in phases. ADDIE model consists of five phases which are mainly known as Analysis, Design, Development, Implementation and Evaluation. The researcher had undergraduate Chemistry students of Sultan Idris Education University, in which are known as Chemistry trainee teachers, to take part in the study. A sample of 122 out of a population of 177 teacher trainees with a confidence level of 95% (Krejcie & Morgan, 1970) were selected through a simple random sampling method (West, 2016) to take part in this study. Two research instruments were constructed for this study. The two instruments stated were validity forms as well as a questionnaire to get the perception towards the usability of Periodic Block game. Both questionnaires cooperate on the Likert Scale as 1 (Strongly disagree), 2 (Disagree), 3 (Agree), and 4 (Strongly agree).

The validity forms for the experts developed were validity forms for Periodic Block game and another for the validity of the instrument for the perceptions of the respondents. A questionnaire was also generated to find the perception towards the usability of Periodic Block games. The instruments were developed by adopting and adapting from Rogayan & Dollete (2019) with some modifications were done to fit with the objectives that are set for this study. The questionnaire consists of three constructs as I (Design), II (Content), and III (Adequacy). The instrument was built in *Google Form* and distributed to the respondents to respond. The instrument in this research used English language as most of thereferences used for this study and the written study itself uses English as a medium of language.

## 4. Results and Discussion

Validity factor of a research is fundamental as it shows the accuracy of the research productsand instruments. The validity forms were sent to experts and the collected data from the experts were analyzed by using the percentage of validity to determine the content validity of the product and instrument asshown in Table 1.

**Table 1. The Percentage interpretation of internal validity results**

| Percentage | Criteria | Percentage |
|---|---|---|
| 0%-20% | Very low | 0%-20% |
| 21%-40% | Low | 21%-40% |
| 41%-60% | Valid enough | 41%-60% |
| 61%-80% | Valid | 61%-80% |
| 81%-100% | Very valid | 81%-100% |

In this study, three experts that had experience in teaching Chemistry with the expertise of Analytical, Organic and Inorganic Chemistry respectively. One of the experts was from University Malaysia Sabah while the remaining two was from Sultan Idris Education University. The results acquired for both validity forms are shown in Table 2.

**Table 2. The percentage interpretation of internal validity results**

| ContentValidity | Expert | Expert score $x/8$ | Validity (%) | Interpretation |
|---|---|---|---|---|
| Instrument | 1 | 8/8 | 100 | Very Valid |
| | 2 | 8/8 | 100 | |
| | 3 | 8/8 | 100 | |
| | Average (%) | | 100 | |
| Periodic Block Game | 1 | 10/10 | 100 | Very Valid |
| | 2 | 9/10 | 90 | |
| | 3 | 10/10 | 100 | |
| | Average (%) | | 96.67 | |

The reliability of the research instrument was obtained through the pilot study done by the researcher. This is done to assess the stability and consistency of the research instrument as the instrument will only be considered reliable when the results obtained from pilot testing are consistent under the same methodology and similar conditions. The data analysis result for Cronbach's alpha value has achieved a high value of 0.927. Interpretation of this value was found to be high reliability and is considered to have a strong reliability and can be further used in the study.

The perception towards the usability of the Periodic Block game was evaluated in this study. This is done by collecting the responds from Chemistry teacher trainees through a questionnaire developed by the researcher. The perception measured was based on three constructs, namely, design, content, and adequacy. The average mean was calculated by using Statistical Package for the Social Sciences (SPSS). The mean score was interpreted as shown in Table 3.

**Table 3. Mean range and its interpretation**

| Range | Interpretation |
|---|---|
| 1.00 – 1.49 | Unrelated |
| 1.50 – 2.49 | Low |
| 2.50 – 3.49 | Moderate |
| 3.50 – 4.00 | High |

The average mean values for Construct 1 (Design), Construct 2 (Content), and Construct 3 (Adequacy) were 3.81, 3.78, and 3.76, respectively. Based on the average mean obtained, the values achieved an interpretation of high. The results of the mean score obtained from each categoryare as shown in Table 4.

**Table 4. Descriptive statistics for Chemistry Teacher Trainees' perception**

| Construct | AverageMean | Average Standard Deviation | Interpretation |
|---|---|---|---|
| Design | 3.81 | 0.393 | High, Acceptable |
| Content | 3.78 | 0.413 | High, Acceptable |
| Adequacy | 3.76 | 0.428 | High, Acceptable |

## 5. Conclusion

In this study, an educational game was successfully developed to study the perception of Chemistry trainee teachers on the Periodic Block game for teaching and learning a periodic table topic. Based on the analyzed data collected on the validity and reliability of the product, both validity percentage and Cronbach's alpha value were interpreted as very valid (96.67%) andhigh reliability (0.927) respectively. The objectives of this study was to develop the Periodic Block game on the topic Periodic Table and to study the perception towards usability were both achieved with the average mean and standard deviation values for each of the constructs falling into the category of high and acceptable. The study found that the Chemistry trainee teachers had positive perceptions towards the games in use, considering game-based learning to be useful and engaging.

## Acknowledgement

We would like to thank all Chemistry Trainee Teachers, Department of Chemistry, Faculty of Science and Mathematics, UPSI who involved in this research.

## Conflict of Interest

The authors declare no conflicts of interest.

## References

Bernardo, J. M. M., & Gonzalez, A. F. (2021). Chemical battleship: discovering and learning the periodic table playing a didactic and strategic board game. *Journal of Chemical Education*, 98(3), 907-914.

Bierenstiel, M., & Snow, K. (2019). Periodic Universe: A Teaching Model for Understanding the Periodic Table of the Elements. *Journal of Chemical Education*, 96(7), 1367-1376. http://dx.doi.org/10.1021/acs.jchemed.8b00740

Bower, M. (2017). Pedagogy and Technology-Enhanced Learning, Design of Technology-Enhanced Learning. Emerald Publishing Limited, Bingley.

Hoffman, A. & Hennessy, M. (2018). The People Periodic Table: A framework for engaging introductory chemistry students. *Journal of Chemical Education*, 95(2), 281-285.

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement*, 30(3), 607-610.

Kurtes, S. & Kopytowska, M. (2017). Communicating identities in daily interaction: Theory, practice, pedagogy. *Lodz Papers in Pragmatics*, 10(1), 1-18.

Minister of Education Malaysia (2013). Malaysia education blueprint, 2013-2025: Preschool to Post-Secondary Education.

Rogayan Jr, D. V., & Dollete, L. F. (2019). Development and Validation of Physical Science Workbook for Senior High School. *Science Education International*, *30*(4), 284-290.

Scerri, E. (2010). Explaining the periodic table, and the role of chemical triads. *Foundations of Chemistry*, 12(1), 69-83.

Stapleton, L. & Stefaniak, J. (2018). Cognitive constructivism: Revisiting Jerome Bruner's influence on instructional design practices. *TechTrends*, 63(1), 4-5.

Subhash, S. & Cudney, E. A. (2018). Gamified learning in Higher Education: A systematic review of the literature. *Computers in Human Behavior*, 87, 192-206.

Traver, V. J., Leiva, L. A., Martí-Centelles, V., & Rubio-Magnieto, J. (2021). Educational videogame to learn the Periodic Table: Design Rationale and lessons learned. *Journal of Chemical Education*, 98(7), 2298-2306.

West, P. W. (2016). Simple random sampling of individual items in the absence of a sampling frame that lists the individuals. *New Zealand journal of forestry science*, *46*(1), 1-7.