

CATEGORY 4: RESOURCE DEVELOPMENT

Group 4-012 *Let's Make the Periodic Table ELEMENTary!*

Project Work Written Report

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ABSTRACT

In our project, we undertake to develop an educational resource pack that is themed around the Periodic Table and its elements. Our aim is to adopt a game-based approach which incorporates learning and playing as research shows that an interesting gameplay will better engage the students. Our comprehensive resource package comes with key concepts and is content-rich, presented in different formats to enhance the effectiveness of learning. Our pilot tests have produced positive evidence that our resource is interactive, engaging and is an effective learning tool. It is also a scalable product such that its content has an option to be expanded and built on, depending on the needs of the users.

1. INTRODUCTION

1.1 Rationale

We understand how other lower secondary students may find the Periodic Table and its 118 discovered elements overwhelming. Since the study of chemistry revolves around elements, and all matter around us is composed of these elements, we would like to demonstrate that such knowledge can be gained through gameplay, not just limited to textbooks study and science laboratories.

1.2 Objectives

Our objective is to create a resource package on Periodic Table using a game-based approach. We aim to make learning fun and effective. With good knowledge acquired through gameplay, it should provide our target audience a stronger foundation for upper secondary chemistry and ideally, to spark their interest in this subject.

1.3 Target Audience

Our target audience is the lower secondary students who are learning the periodic table or who have an interest for in-depth learning.

1.4 Resource Package

Our resource pack comprises:-

- Board Game (comes with 300 Question Cards & 246 Element Cards);
- 2 Guidebooks (Book I & II) and
- Elements Crossword Puzzles

Each of them can operate as a standalone learning tool. Collectively, they provide a powerful suite of different learning formats, complementary to one another and allow an engaging learning experience.



Fig. 1 – Complete Resource Package

2. LITERATURE REVIEW

We have reviewed relevant write-ups which affirmed our project objective of creating an effective learning package. Our ideas behind the creation of the resource pack were built on these premises – learn Chemistry through games in a fun way and learn through visuals.

A research paper titled “Making Chemistry Fun to Learn”¹ showed that by correlating with everyday use, players will be drawn into learning the topic. Hence, we have designed our resource package to include practical use of the elements.

¹ Written by Wu C & Foos J (2010) published in Literacy Information and Computer Education Journal (LICEJ), Volume 1, Issue 1, March 2010, 3-7.

Another paper titled “Substantial Integration of Typical Educational Games Into Extended Curricula”² and supported by a blog “Teaching Chemistry Through Games”³, showed that students who play games as part of their regular curriculum were significantly more engaged, and outperformed their peers. Thus our board game would be an effective way to help students learn, rather than mere study of subject notes.

The third article was “Visual Imagery in the Classroom”⁴, which discussed that visuals are more easily remembered than words. On the basis that visuals can decrease learning time, improve understanding, enhance retrieval, and increase knowledge retention, we have incorporated effective use of visuals to aid better learning.

3. METHODOLOGY

3.1 Needs Analysis

We conducted a needs analysis with the lower secondary students to get their views on their understanding of Periodic Table.

3.2 Survey Results

Based on a total of 100 responses, many students (64%) have expressed that they did not understand the concepts of the periodic table and most of them (66%) were interested to know more about the elements. Furthermore, a relatively large number of respondents (78%) felt that a board game would be more interactive and easier to learn the topic.

² Written by written by Douglas B. Clark, Emily Tanner-Smith, Andrew Hostetler, Aryah Fradkin & Vadim Polikov (2018) published in the Journal of the Learning Sciences, 27:2, 265-318.

³ Written by Tham Zi Sheng, a Raffles Institution teacher

⁴ Written by Haig Kouyoumdjian Ph.D. and published in Psychology Today in July 2012

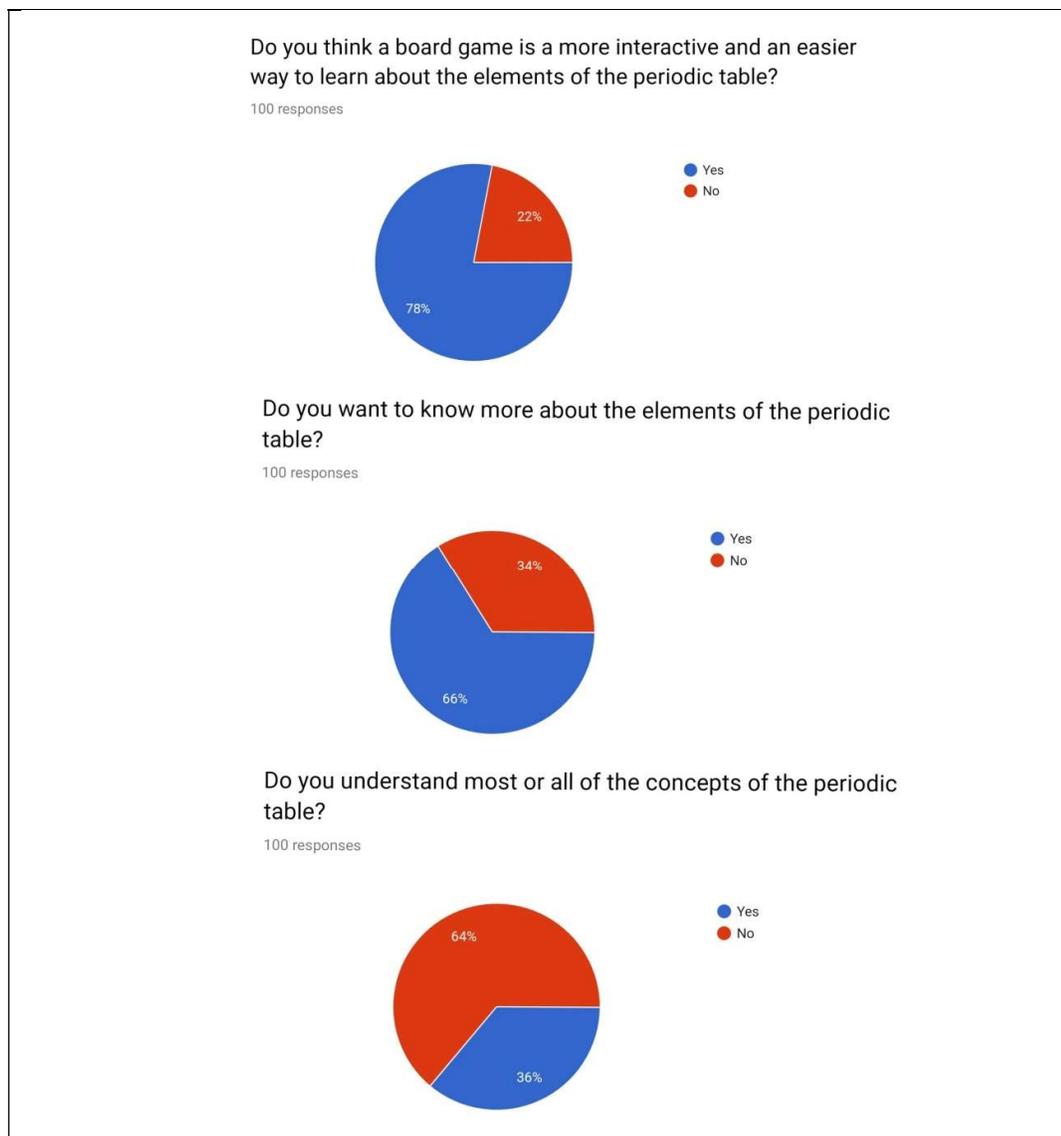


Fig. 2- Survey results of needs analysis

3.3 Development of Resource Package

Our idea started with creation of a board game with questions cards (answer keys in a separate booklet), and score sheets to record marks for every correct answer given by individual players. We brainstormed for an idea to improve the play mechanic. The only efficient method was to place the question and answer ("Q&A") on the same card, and have another player read it out. All players would hear the Q&A concurrently and benefit from this process, and the interaction level would also increase.

Besides, the score sheets method would slow down the game pace. Therefore we used Element Cards as rewards. We designed these cards to provide basic information and the players would inevitably refer to them as they need to form family sets in order to win the game.

For the game board design, we produced various versions of mock-up over the months either hand-drawn or on Google Draw, from clustered to the final simple one. We were aware that the "look and feel" of the game board was important as it would be the first impression to entice the players' interest. We were pleased with our final version of using different shapes as "tiles" to form the letters "DM", the initials of Dmitri Mendeleev.



Fig. 3 - Improvements of the game board (From left to right)

With the board game and the play mechanics mostly cast in stone, we looked to improve the content of our resource package. During the time when we were formulating the questions, we came across many good online resources and reference books. We then compiled easy-to-read guide (Book I) as reference materials. With 2019 being the “International Year of the Periodic Table”, it sees wide sharing of elements infographics on Instagram (hashtag #IYPT2019). This gave us the idea to add more visuals to aid learning, whilst joining in the celebration to share them on hardcopy with the players and other readers as reference materials. Thus “Book II” was compiled. We would like to emphasize that this does not result in any infringement of intellectual property as IYPT website has given permission to use them as education materials.

During the mid-term evaluation, we received a comment about conducting a test to find out the effectiveness of our resource pack. Instead of a typical written test, we have designed crossword puzzles, taking 100 questions from the existing questions. To entice them to take this test, we made this a bonus round for the players to earn additional Element Cards.

3.4 Pilot Tests

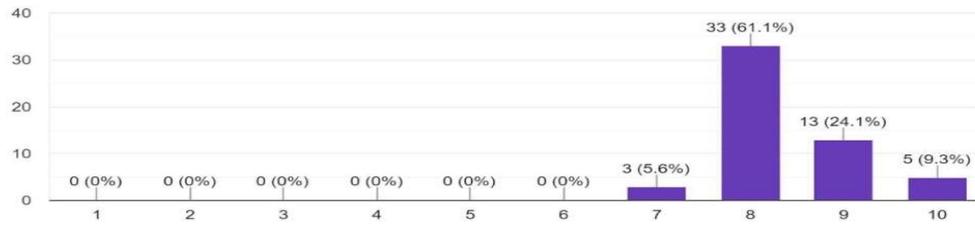
We conducted 2 rounds of pilot tests for our board game and resource package.

The first round was carried out on 54 students, primarily to obtain opinions of their play experience and feedback on areas for improvement. After improving on the different aspects of the board game, a second round of pilot test was carried out on 57 students to seek their opinions on the improved board game and the other components, on top of their play experience.

In both rounds, we focused on getting their opinion on knowledge improvement after playing the board game and using the resource package. The respective rounds results are shown below.

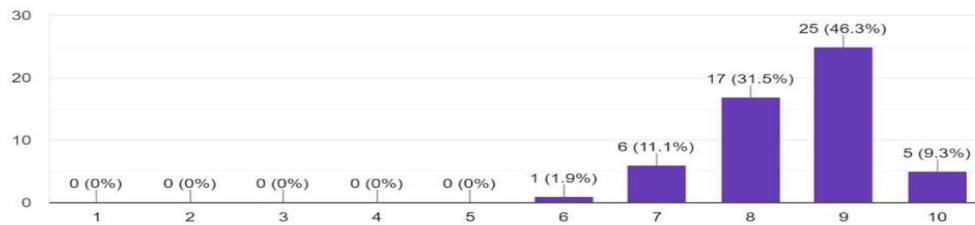
On a scale of 1 to 10, 10 being the best, do you think your knowledge on the periodic table and its elements has improved after playing this board game?

54 responses



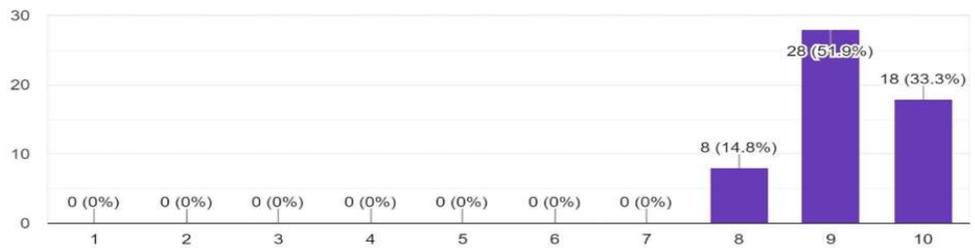
On a scale of 1 to 10, 10 being the most, is the difficulty of questions appropriate for your level?

54 responses



On a scale of 1 to 10, 10 being the best, how do you rate the presentation of the board game overall?

54 responses



On a scale of 1 to 10, 10 being the most likely, would you play again or recommend this board game to your friends?

54 responses

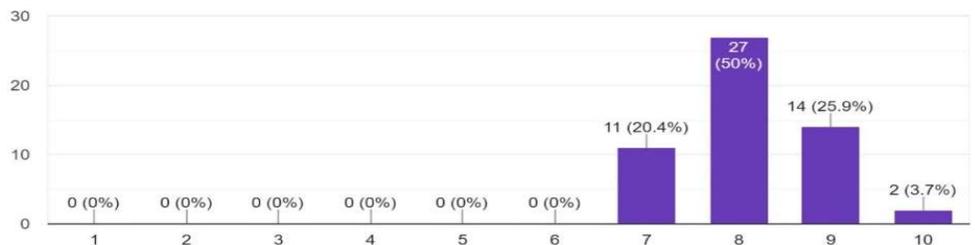
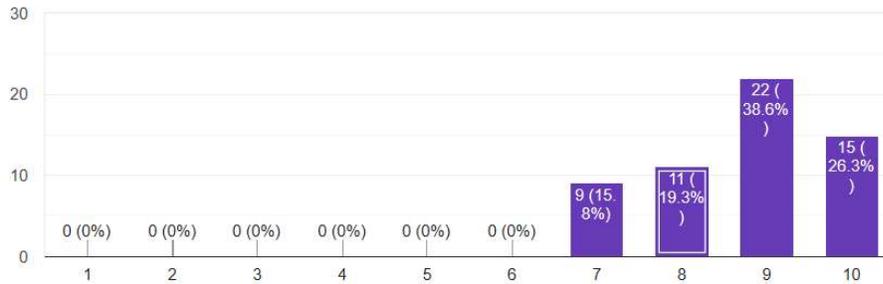


Fig. 4 – Results of Pilot Test 1

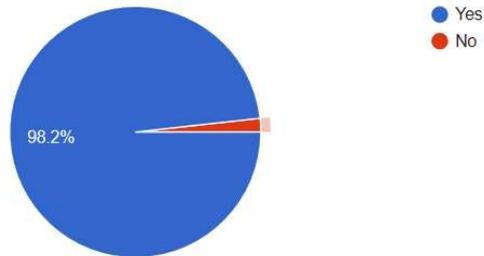
On a scale of 1 to 10, 10 being the best, do you think your knowledge on the periodic table and its elements has improved (even more) after using our resource pack (again)?

57 responses



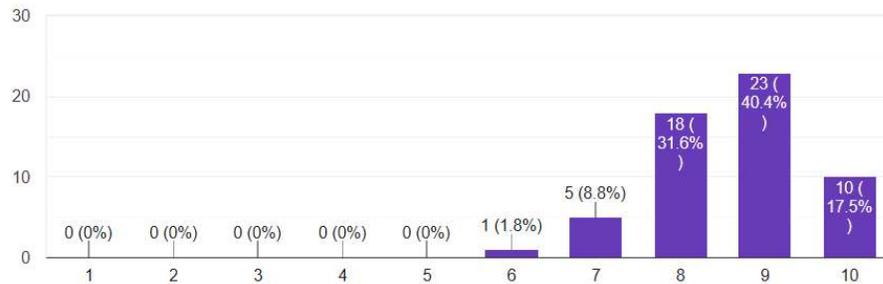
In regards to our rule book, do you understand how the game should be played?

57 responses



On a scale of 1 to 10, 10 being the best, how useful and relevant do you find our two booklets? (In terms of educational purposes).

57 responses



Has the bonus round, which is the crossword puzzle, helped to reinforce the knowledge you learnt? If no, please state why under 'others'.

57 responses



Was our resource pack enjoyable?

57 responses



We have made improvements to our resource pack according to the suggestions that you have given in the previous pilot test. Are there any other improvements you would like to see us make? If yes, please state under 'others'.

57 responses

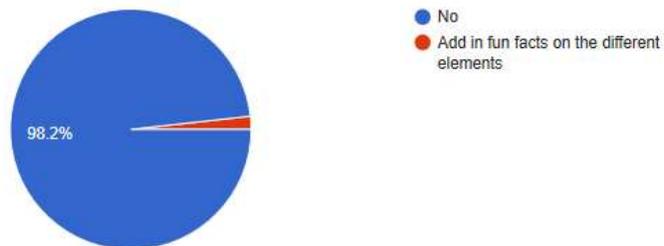


Fig. 5 – Results of Pilot Test 2

4. OUTCOME & DISCUSSION

The pilot runs of the project showed that it is successful, as evidenced by the tests results. Our resource pack has received high ratings among a sample of our target audience. The crossword puzzles that some of them have attempted were also indicators that they benefited from the board game.

Since the board game centers round the periodic table content, it would be of more interest to schools rather than individuals or families. This will be the main limitation as it might be an uphill task if we expect individuals to buy-in to this product, unlike other roll and move board games for entertainment purposes. Our board game would appeal to schools which will see the benefits of using it in lessons or science related CCA.

We would also like to mention that our resource pack is not a closed-end product and has opportunities for expansion and built-on. More questions of higher order can be added depending on the needs of the users. More element cards can be created should there be more players in a game, or when new elements are being discovered in future.

5. CONCLUSION

We are delighted to see our school mates who participated in the pilot runs enjoyed the game and that we are able to introduce fun and interaction into learning a technical topic. As a team, we have engaged in many debates on refining the resource pack. It has been a tedious yet meaningful journey, having to build the pack from scratch, which involved many hours of reading, conceptualization and hands-on art and craftwork. Nevertheless we have gained much more knowledge on this topic along the way.

REFERENCES

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