PROJECT TITLE: The Impact of Gamification in Higher Education

PROJECT SUMMARY

The primary objective of this study is to explore the impact of gamification elements and strategies within the Moodle Learning Management System (LMS) on enhancing student engagement and learning outcomes in higher education. The participants of the study included a group of participants who had completed primary education, providing their perspectives on the effectiveness of gamification in higher educational settings.

Data was collected through a questionnaire, and a comprehensive analysis was conducted. The study's major findings reveal significant positive effects of gamification on student motivation and engagement levels. Participants reported enhanced learning experience, increased motivation, and a deeper understanding of the course content.

Conclusively, the study affirms the potential of gamification and game-based learning as practical strategies to improve educational outcomes in higher education. The findings suggest that when implemented thoughtfully, gamification can lead to a more engaging, motivating, and enriching learning environment, ultimately contributing to better academic performance and student satisfaction.

DATA COLLECTION

The study was conducted with thirty participants obtained through the snowball sampling technique. These participants are between 18 and 50 years old and have completed primary education. Among these participants, thirteen are female, fifteen are male, and two prefer not to say. Eighteen of them are between the ages 18 to 24, seven of them fall in the age range 25 to 34, one person is between 35-44 and four people are aged 45 to 50. Regarding their current level or highest level of education attained, fifteen answered 'bachelor's degree', twelve answered 'master's degree', two answered 'college degree', and one answered 'doctorate'.

Data was collected from the study participants using Microsoft Forms in the form of a questionnaire. The questions are contained in APPENDIX A. The form includes the researcher's

details and the study's title. Quantitative and Qualitative data were also collected from participants to gain insights into their experience with gamification and the Moodle platform.

Ethical Issues

The study ensures the anonymity of participants by solely focusing on the participants' experience with the platform. The names and contact information of participants were not collected via questionnaire; hence, the data collected cannot be tied to individuals. However, during registration on the Moodle site, the participants had to provide personal information such as their names (real or not), email addresses, city, country of residence, etc. This information, which the participants freely provided, was erased upon project completion. The participants were also made aware of the terms and requirements of the study before participation. Those given access to the website and whose responses were recorded filled out the questionnaire agreeing to the consent statements in APPENDIX B.

PROBLEM STATEMENT

It is a known fact that education is essential to success as it helps develop crucial life skills, which include reading, writing, independent learning, social skills, etc. It is also believed that attending school and attaining several degrees aligns a person on the path to success. While attending classes can have positive results, this belief holds only ideally and not realistically. Education is supposed to teach facts while training the mind to think, but the traditional teaching methods defeat the latter purpose of 'training the mind to think'. Nowadays, students are fed a lot of information without the means to utilise this information. The instructors carry on teaching, but learning does not occur. The conventional techniques teach what to think instead of the 'how' or 'why'. Frankly, the average student is not interested, as their main goal is to complete that level of education regardless of whether a subject or topic was learned. The current education system focuses on the conformity of students, where every student learns the same thing at the same pace. Cramming rather than studying to pass an exam is prevalent in schools because too much information is delivered but cannot be understood and applied, defeating the primary purpose of examinations. This system results in students who are less passionate about learning and look to others instead of themselves for knowledge.

The focus, instead, is attaining a passing grade by whatever means, regardless of whether learning took place. Gamified education focuses on personalised learning and immersing students in the course content. The use of games and game elements in classrooms has become more popular over the years. However, the importance of ‘fun’ and ‘play’ in universities is still severely underrated. The misconception remains that learning is only achieved in formal and serious environments utterly devoid of humour. Hence, there is a need for more research in this field to disseminate information on the importance of gamification in universities to understand incorporation principles in the education system better.

AIM OF THE PROJECT

The study aimed to demonstrate gamification capabilities at higher education levels using the free and open-source learning management system known as Moodle, commonly used by higher education providers/universities, as a starting point for incorporating gamification in higher education and collect data on the learning experiences of users of the platform. The information gathered was analysed to gain insights into its effectiveness in education.

PROJECT OBJECTIVES

a. Develop a prototype Moodle platform to demonstrate gamification and collect user experience data.
b. Analyse the data collected.

PROJECT SCOPE

The study focuses on gamification via Moodle Learning Management System and data analysis based on participants' experience with the platform. The development part of the project involves gamifying a level 6 (undergraduate) course on Usability Engineering. This study will demonstrate this gamification with Moodle Learning Management System and provide insights into its effectiveness in learning. It should be noted that the essence of this study is not to propose eliminating paper and pens in classrooms but rather to limit the over-reliance on reading and writing lengthy texts to study or understand a lecture, which could be mentally stressful and tiring.

WEBSITE DEVELOPMENT

The processes involved in the development of the Moodle Platform are as follows:

Installation of the Moodle server

The Moodle installer package, version 4.3.3+ for Windows, was downloaded on a Microsoft Azure virtual machine. This virtual machine used a Windows x64 architecture, Standard E2s v3 (2 vcpus, 16 GiB memory), and the Moodle installer package files were extracted to set up the Moodle server.

Configuration of the Moodle server

The server configuration comes after the extraction of files and successful installation of the Moodle server. Due to the nature of the project, there was a need to reconfigure the server files to allow the website to be accessible to the participants via the Internet. This process involved configuring the network security group, firewall, and testing of the network connection to solve network connectivity issues between the server and Azure virtual machine.

Gamification Elements

The study achieved gamification mainly through Moodle plugins, downloaded from Moodle's official website, moodle.org. The plugins H5P, Game, Level Up XP, Stash, and associated dependencies, such as stash availability, shortcodes and tiny stash, were downloaded and installed for Moodle version 4.3.3+ via the plugin settings available to site administrators.

Ideally, each course's content will be set to be completed weekly, with the course materials and games for each week being different. Then, at the end of each week, incentives, for example, grades, will be awarded to students at the top of the Level Up XP leaderboard who have also gained all the necessary stash items in their inventory. Figure 1 depicts the layout of 'My Courses' page on the platform. Figure 2 depicts the layout of a course's main page.

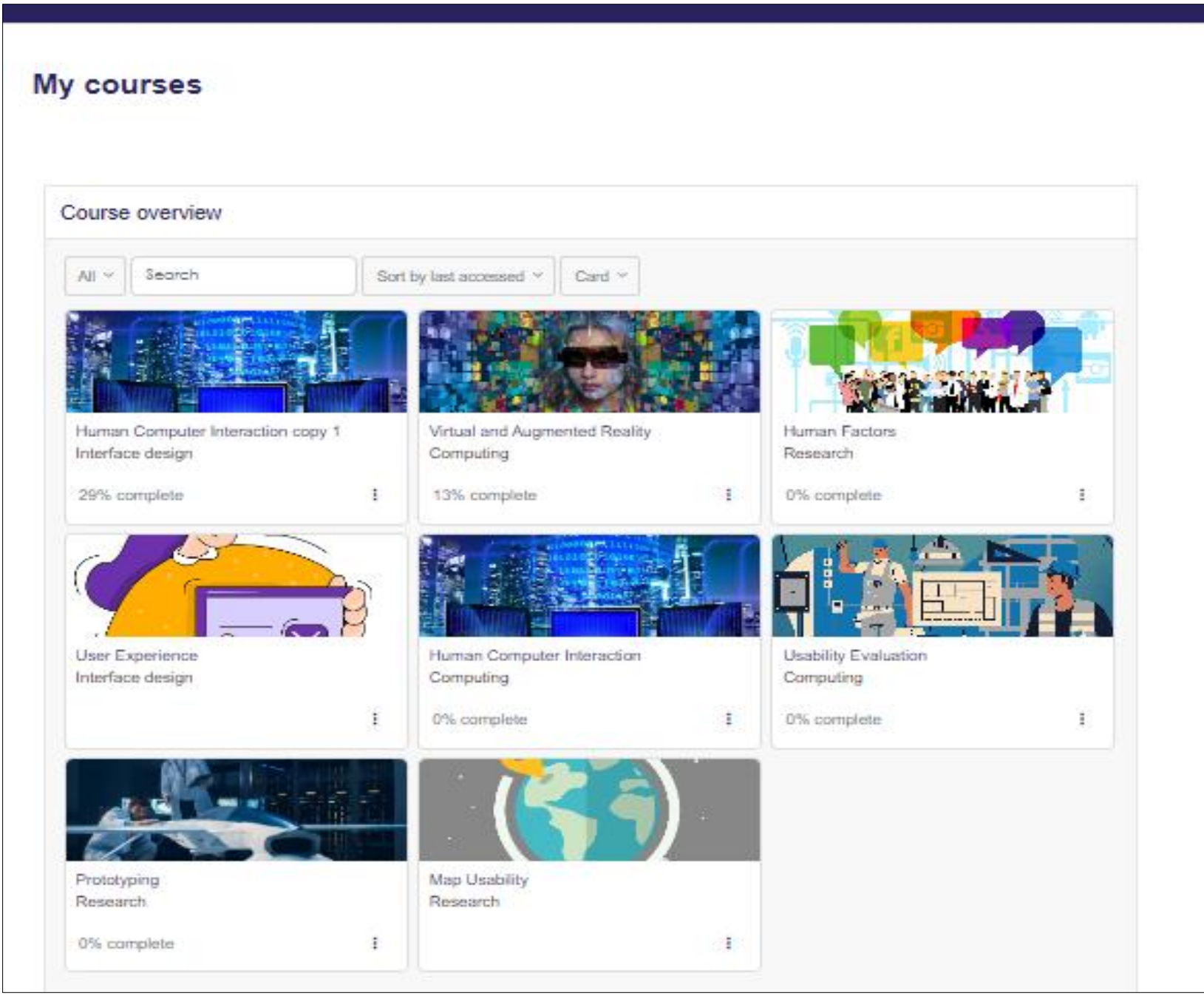

Figure 1: Participants' courses page.

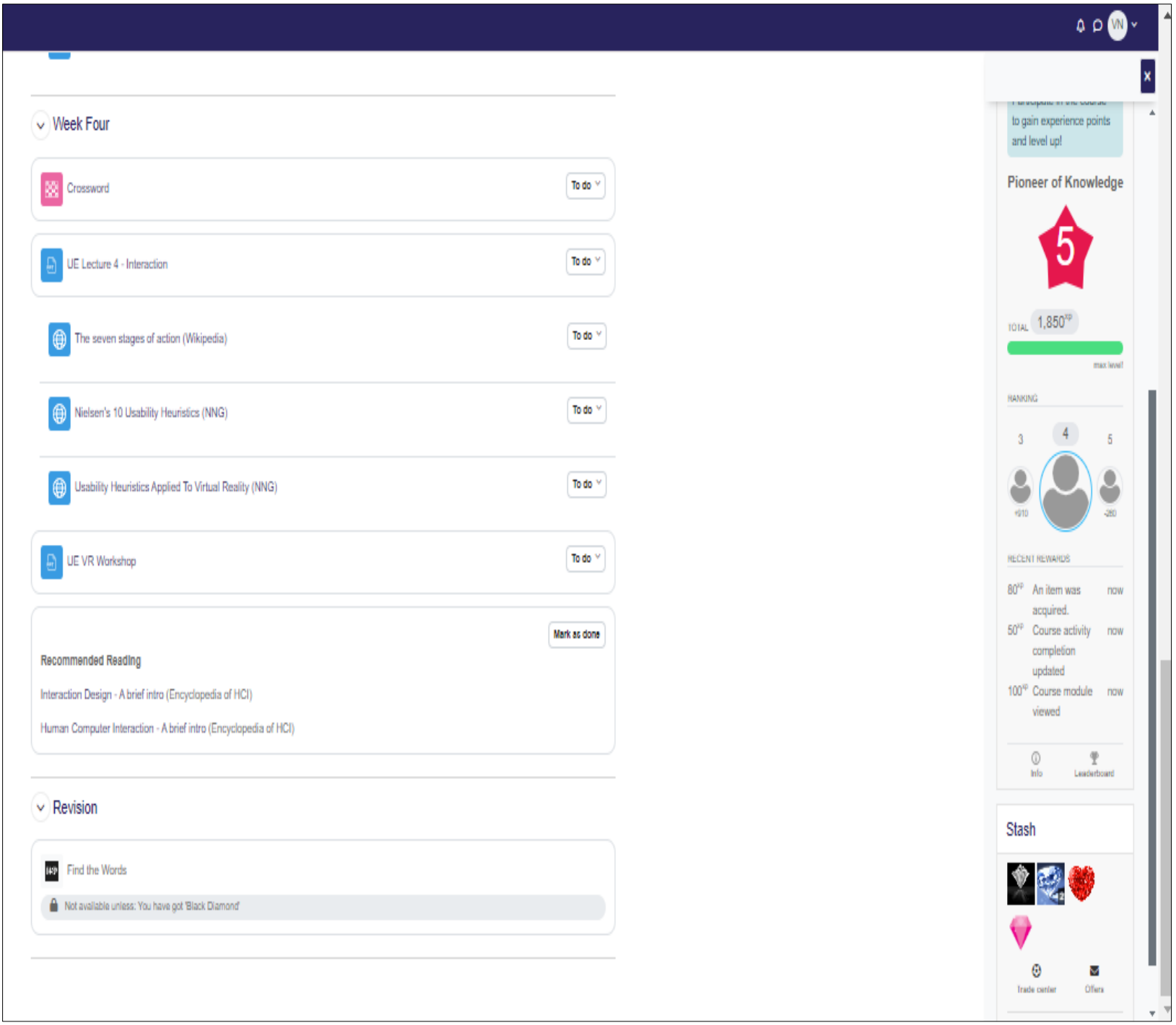

Figure 2: Example of a course's main page

Level Up XP plugin

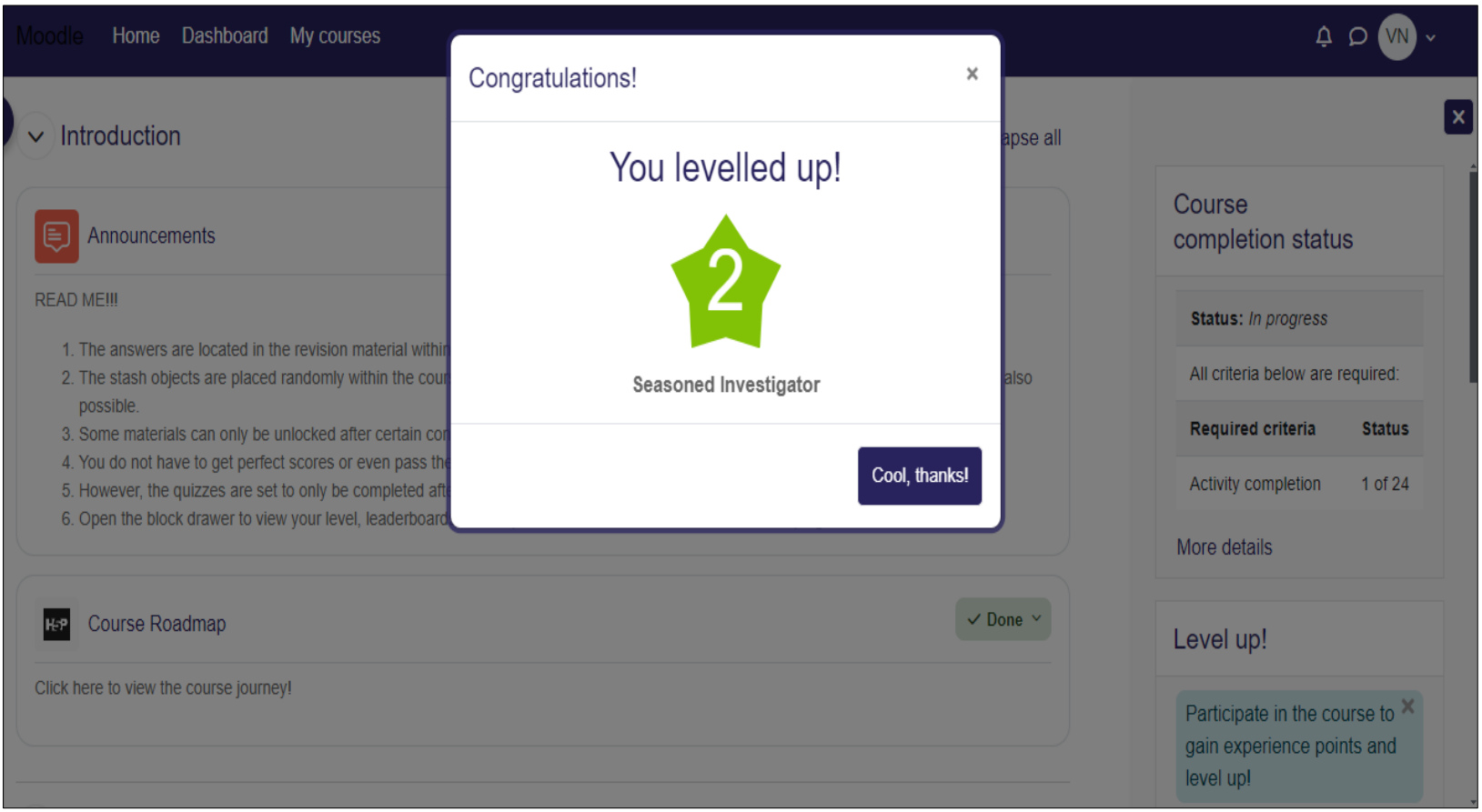

Figure 3: Levelling Up

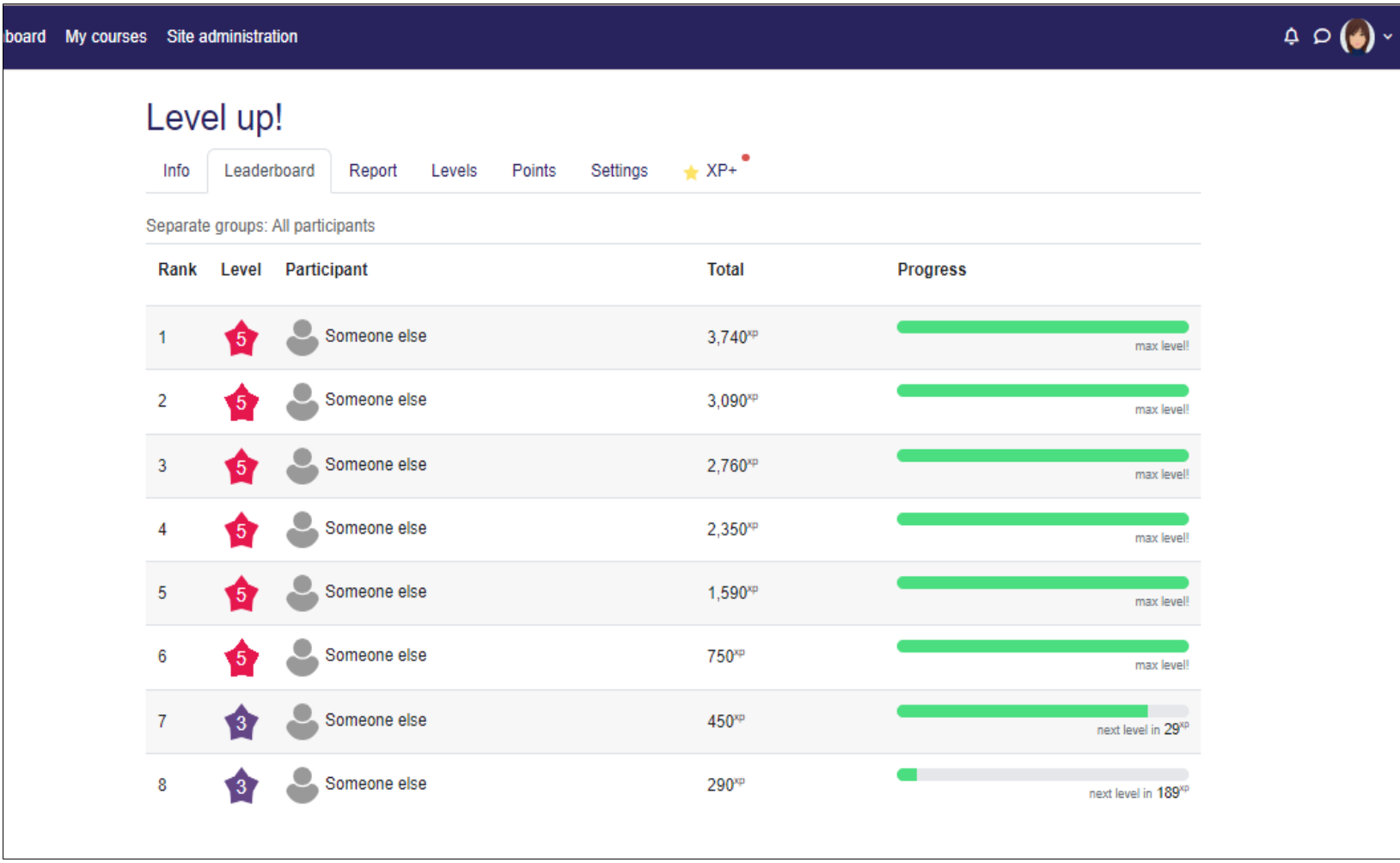

Figure 3: Level Up XP leaderboard

Stash plugin

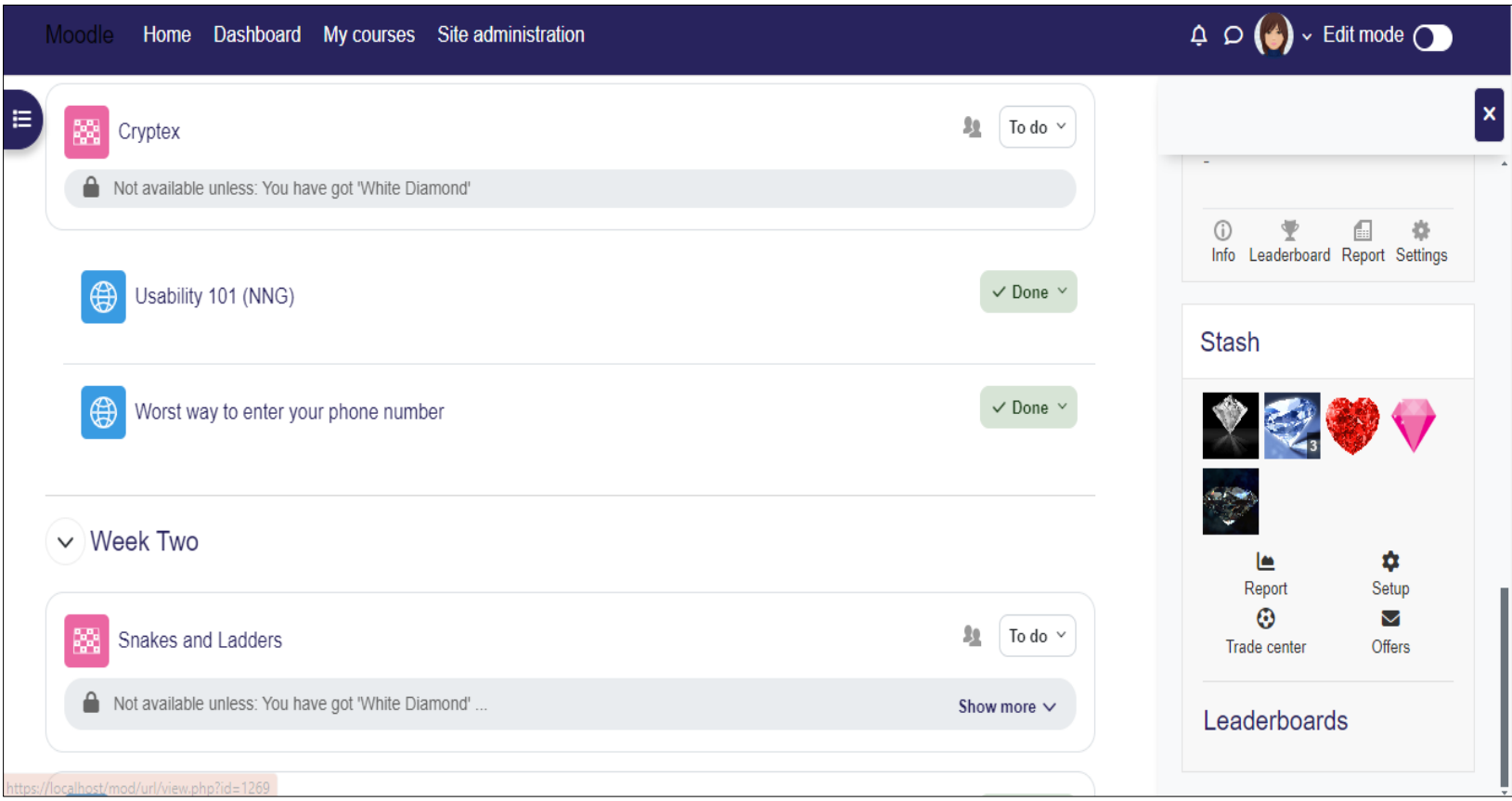

Figure 4: Stash Inventory

Game plugin

The Game plugin is one of the plugins in the gamification set on Moodle's official website. This plugin consists of games that use quizzes, glossaries, and questions to offer interactive and gamified activities. This project used Millionaire, Cryptex, Hangman, Crossword and Snakes and Ladders, which are included in this plugin.

The Millionaire game uses multiple-choice questions. The questions were created in Moodle's multiple-choice or Aiken question format, shown in Figure 6. The game is shown in Figure 7.

```
1. What is user research primarily about?
A) Coding practices
B) System design
C) Asking users their thoughts and feelings
D) Statistical analysis
ANSWER: C

2. What type of data is subjective?
A) Quantitative
B) Qualitative
C) Objective
D) Observational
ANSWER: B

3. When should you consult users in the design process?
A) Only at the beginning
B) After completion
C) At various stages
D) Never
ANSWER: C

4. What type of question allows for a wide range of answers?
A) Closed
B) Leading
C) Open
D) Multiple-choice
ANSWER: C

5. What method involves watching people then asking questions?
A) Surveys
B) Interviews
C) Observation
D) Focus groups
ANSWER: C
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Figure 6: Aiken Format

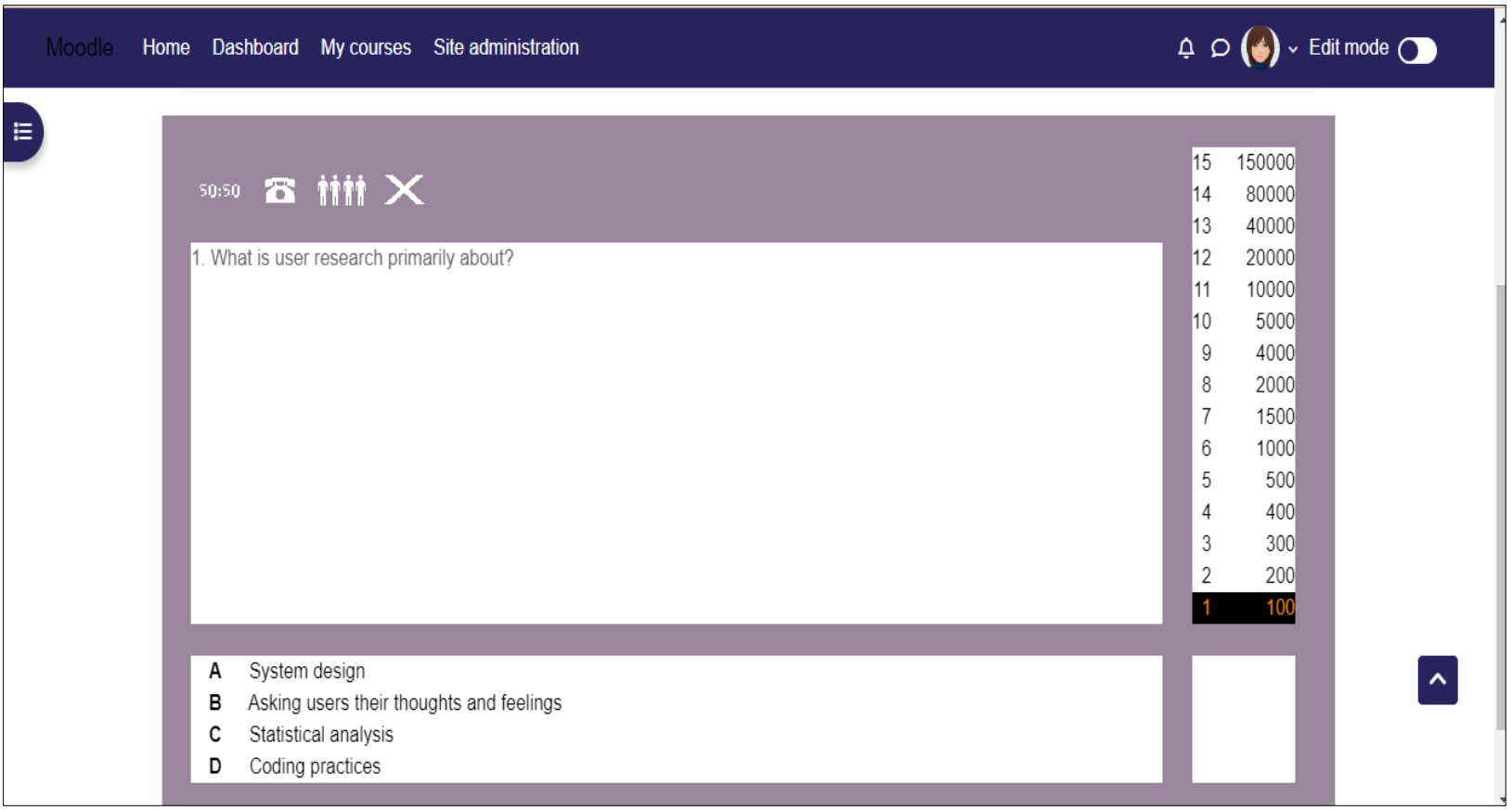

Figure 7: Millionaire

The Snakes and Ladders, Cryptex, Hangman, and Crossword games used short answer questions. The questions were created in Moodle's short answer questions or GIFT format, shown in Figure 8. The Snakes and Ladders game is shown in Figure 9, Cryptex is depicted in Figure 10. The Hangman game, in Figure 11, and Crossword game in Figure 12.

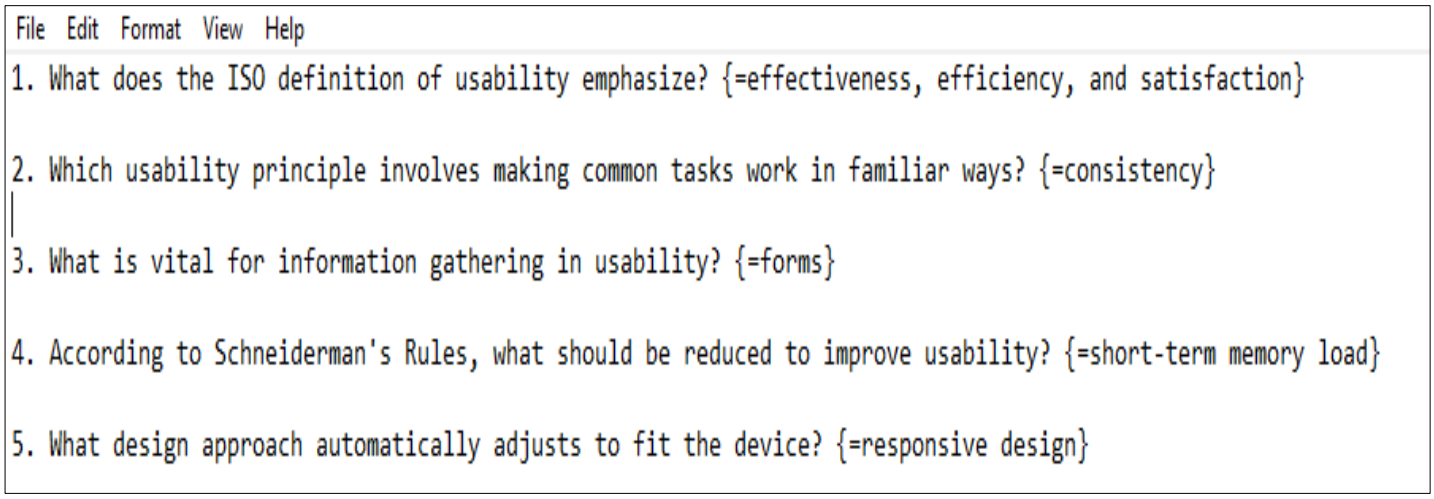

Figure 8: GIFT format

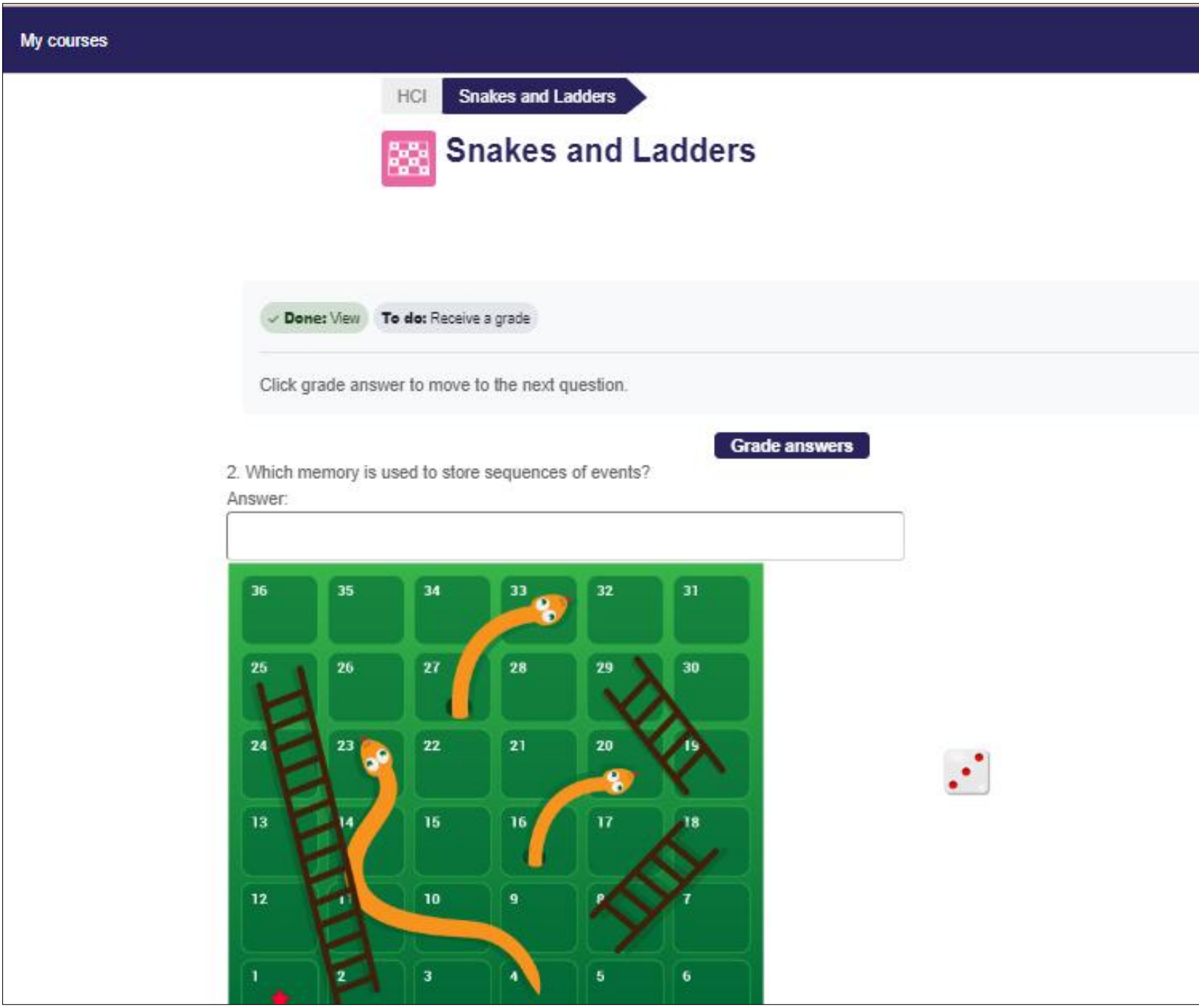

Figure 9: Snakes and Ladders

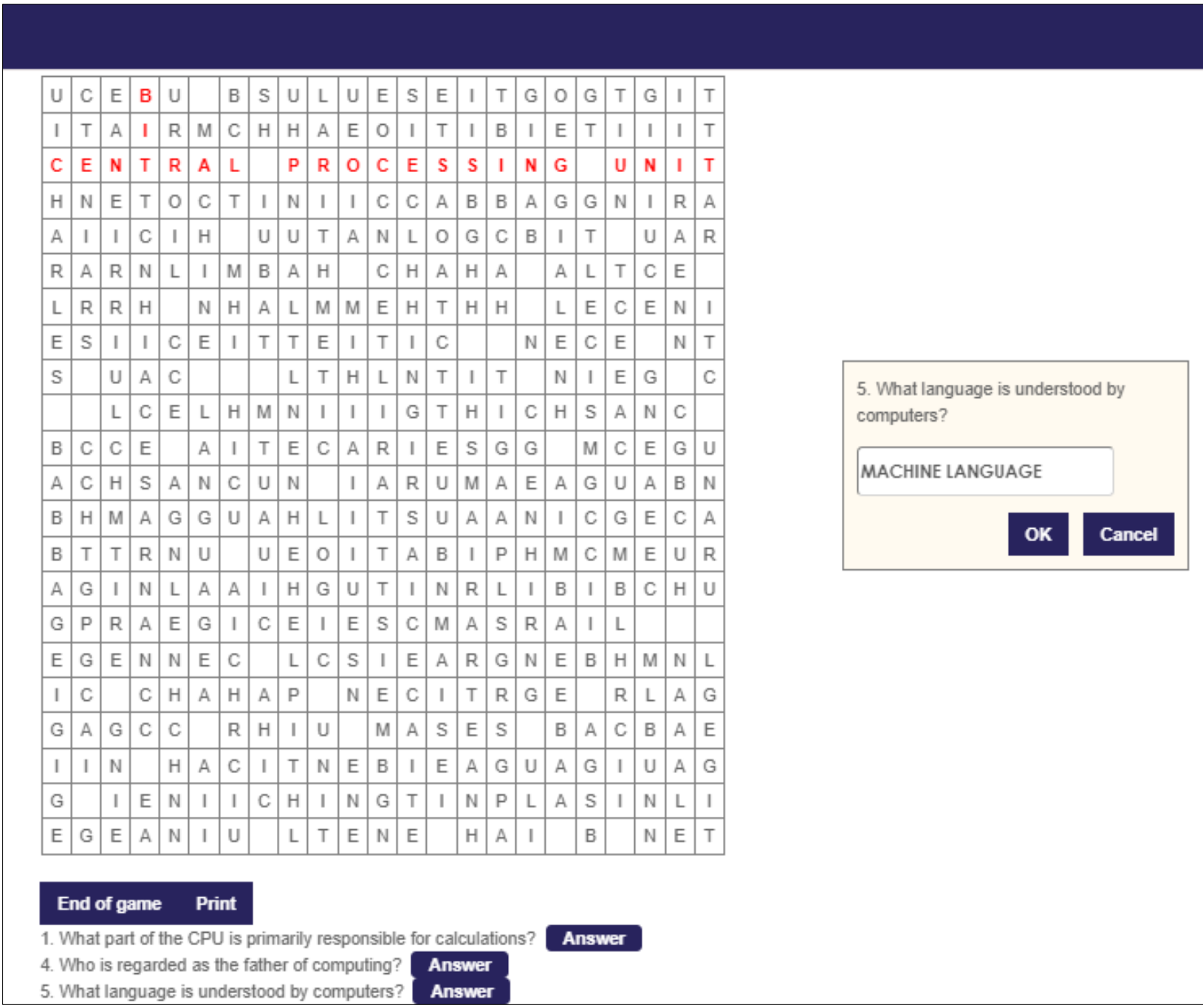

Figure 10: Cryptex

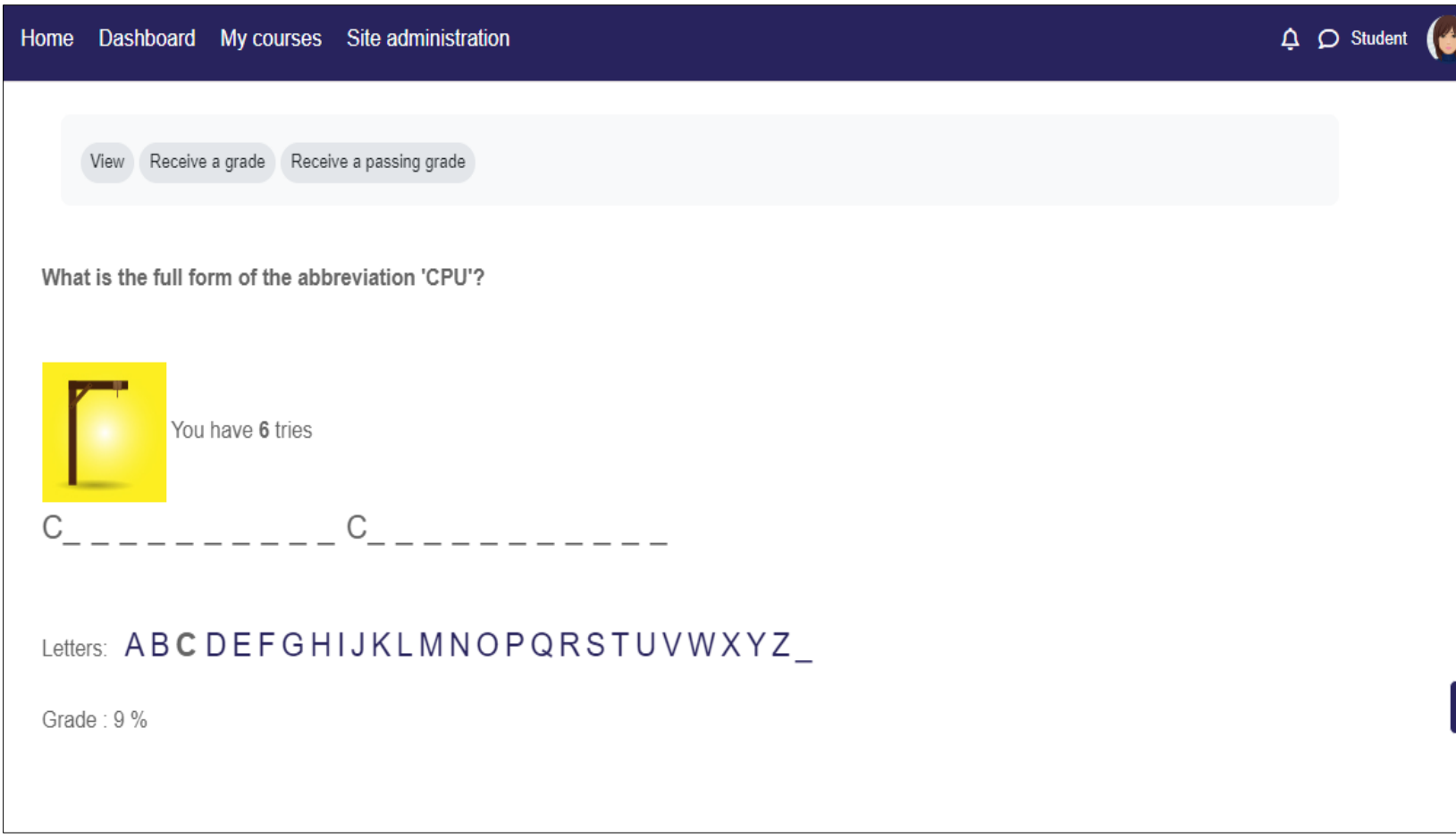

Figure 11: Hangman

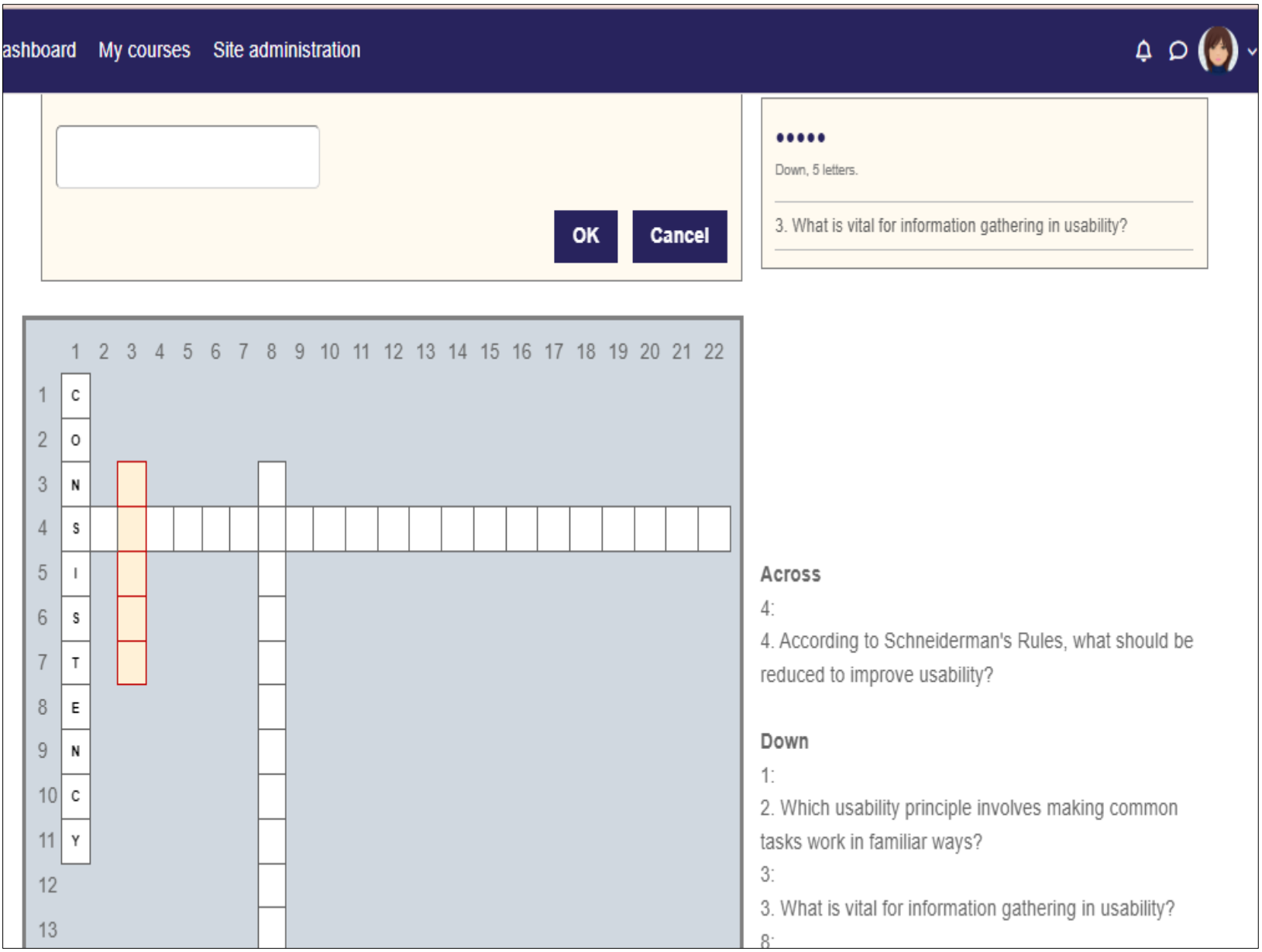

Figure 12: Crossword

H5P plugin

The H5P contents used in this project include Picture with hotspots, Multiple-choice questions (with images), Dialog cards, and Find the words. The ‘Picture with hotspots’ shown in Figure 13 was used to display the course syllabus interactively.

Figure 13: Course Roadmap (Picture with hotspots)

The Dialog cards (with an embedded stash item), Multiple-choice questions, and Find the words, shown in Figure 14, Figure 15 and Figure 16, were incorporated as revision materials, one for each gamified course and were put in place to provide participants with the answers to some of the game questions.

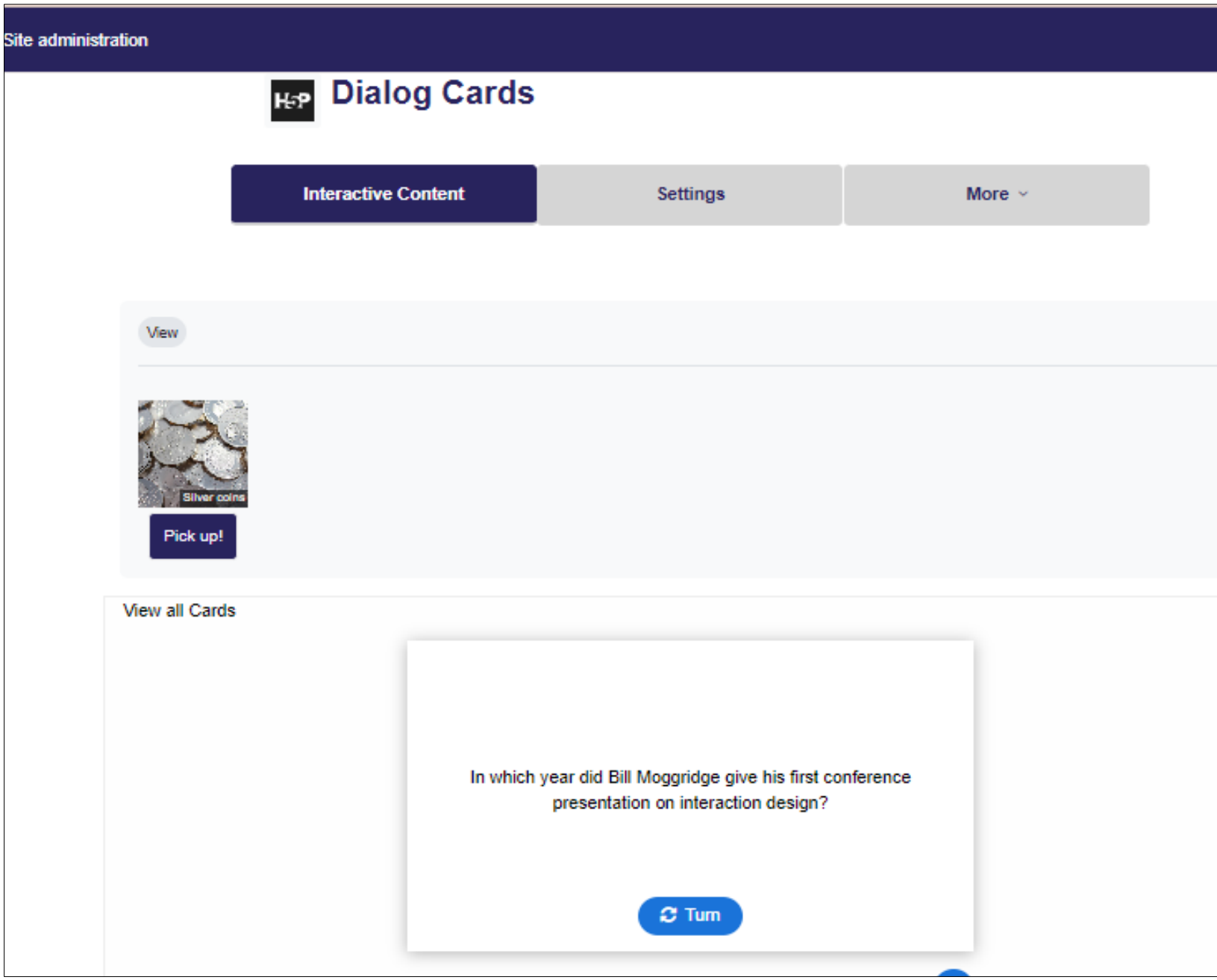

Figure 14: Dialog Cards

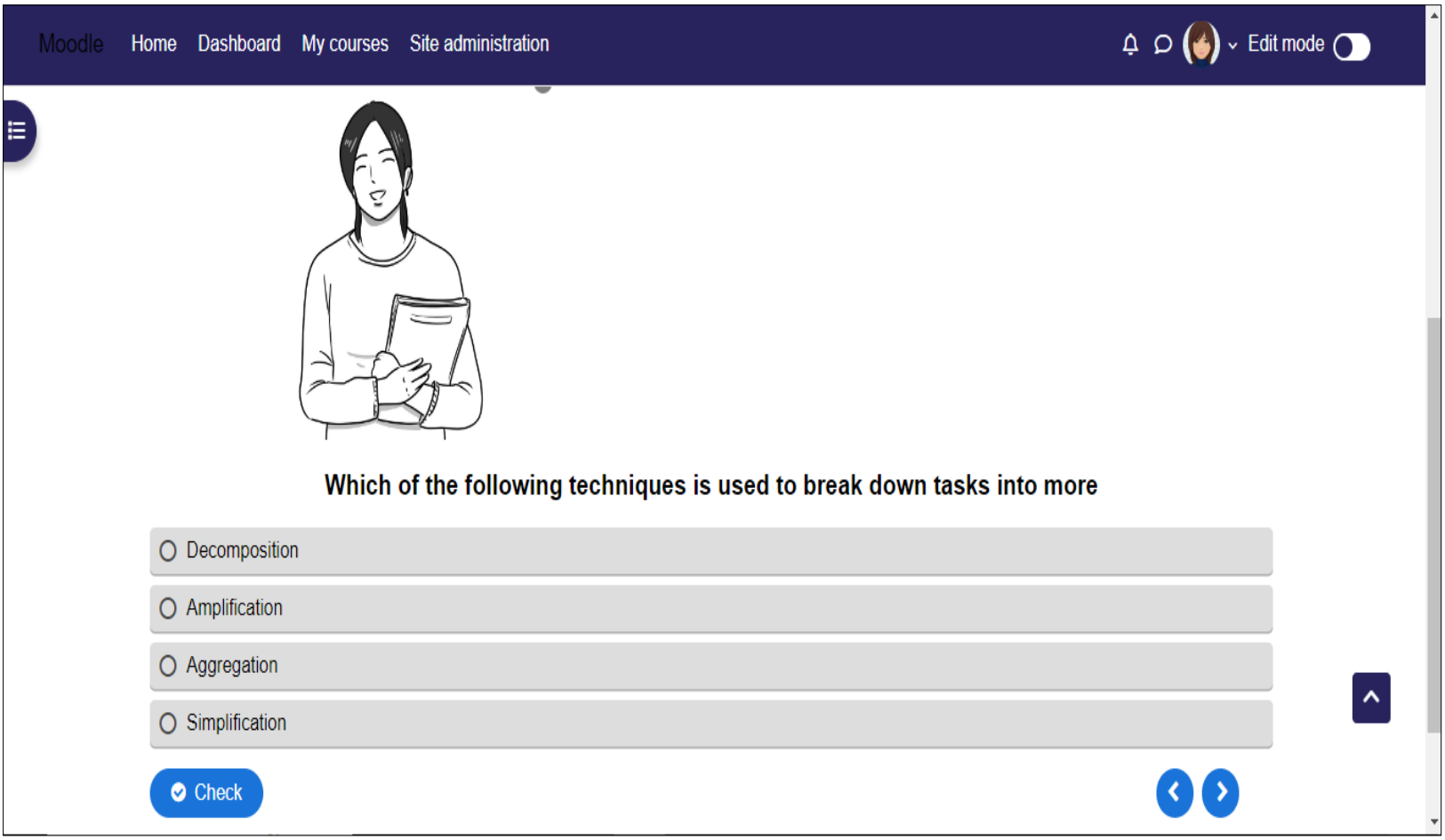

Figure 15: H5P Multiple Choice Questions

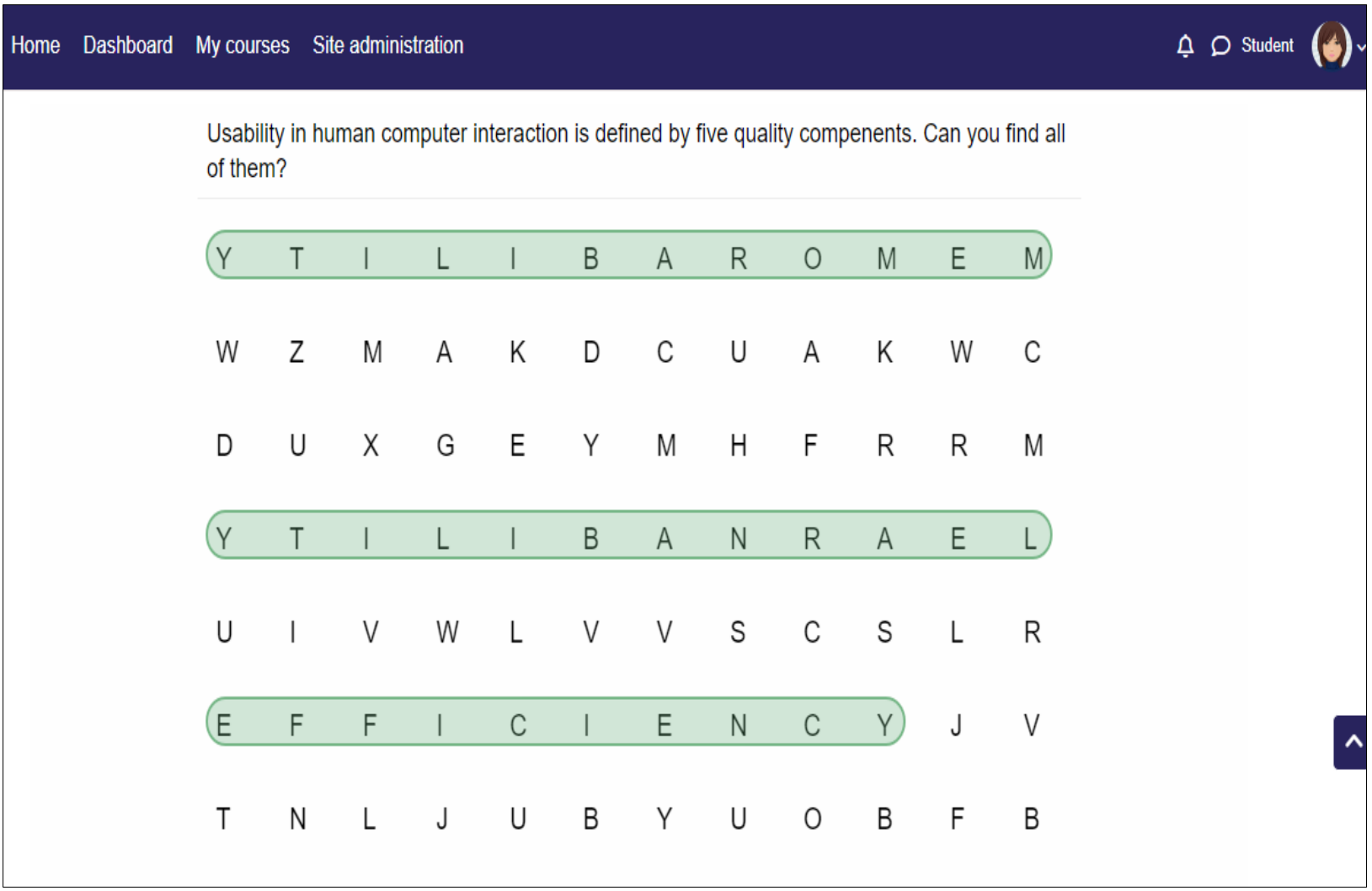

Figure 16: H5P Find the words

DATA ANALYSIS

The data obtained from the 30 study participants was organised and analysed using Microsoft Forms, Microsoft Excel spreadsheet, and R Studio for analysis in R programming language. Initially, with the questionnaire, the study tries to determine:

a. Contrary to the information gained from the literature review, gamified learning does not improve student engagement and is not potentially effective in higher education.
b. Similar to the information obtained from the literature review, gamified learning improves student engagement and is potentially effective in higher education.

Primary Data Processing

The data collated using a Microsoft Forms questionnaire was imported into Microsoft Excel for primary data cleaning. Primary pre-processing activities were as follows:

a. Removing unnecessary columns: Columns such as id, start time, completion time, and email (anonymous) that were unnecessary to the analysis were removed.
b. Renaming Columns: When the data was imported into Excel, the questions were retained as column names, so they needed to be renamed to more concise and suitable column names. This activity, when carried out in R Studio, resulted in more complications. Therefore, the column names were simply changed in Excel.
c. Merging Columns: The questions below were presented to participants to better understand each participant's perspective on gamification and the gamified courses. The answers were then merged into a column called 'opinion_on_gamification'.

i. Did the project meet your initial expectation(s) on gamification? Explain
ii. What is your overall opinion on the gamified courses?
iii. Were you more likely to revisit gamified course content than non-gamified content?
iv. If yes, why?

d. Identifying themes: The main point was selected verbatim to replace the information provided for columns with qualitative data, such as opinion_on_gamification', reason_best_elements, etc. When multiple themes were conveyed, these themes were separated with '|'. For Instance, where the participant said, 'They (gamification elements) make it easier to understand taught concepts and make learning less cumbersome', the theme was set as 'effective'. Also, in areas

where the participants responded ‘good’ without further explanation, the theme ‘good’ was chosen without making assumptions about what they considered good.

This was also done to provide answers to their challenges, suggestions, and modifications.

Secondary Data Processing

After cleaning and organising data in Microsoft Excel, it was read into an R dataframe using R Studio.

a. Reading the file into a dataframe: The read_excel() function, which takes the Excel file path and sheet as arguments, was used to convert the file to a dataframe called ‘data_df’.
b. Splitting best_elements column: The best_elements column contains the gamification elements selected by participants as the most motivating or enjoyable. This question allowed for the selection of multiple items; therefore, it was split into individual columns. Binary values 0,1 were used to indicate a selection or non-selection of the elements. In the R code, the presence or absence of each element is determined using grepl to search for the element within the best_elements string, and ifelse, to assign a 1 or 0 based on the search result.
c. Conversion to factor datatype: Categorical values for columns such as age_group, gender, education_level_attained, rate_level_up_xp, satisfaction_elements_used, etc., were converted to factor datatype using the mutate() and factor() functions, for future manipulation and analysis.

Key Insights

The data analysis involved descriptive, correlation, and thematic tasks to delineate existing relationships and patterns supported by data visualisation techniques.

Demographic Analysis

a. Age group and Gender

The plot in Figure 17 depicts the distribution of each gender across the various age groups. There are more participants (16 people) between ages 18 and 24, balanced between males and females. It shows that more young people are represented in the study. Within the age group 25-34, there are five more male than female participants. The diagram also shows that while there are slightly

more male participants, more older females than males aged between 35 and 50 participated in the study. The few people who withheld their genders also fall within the age group 18 to 24.

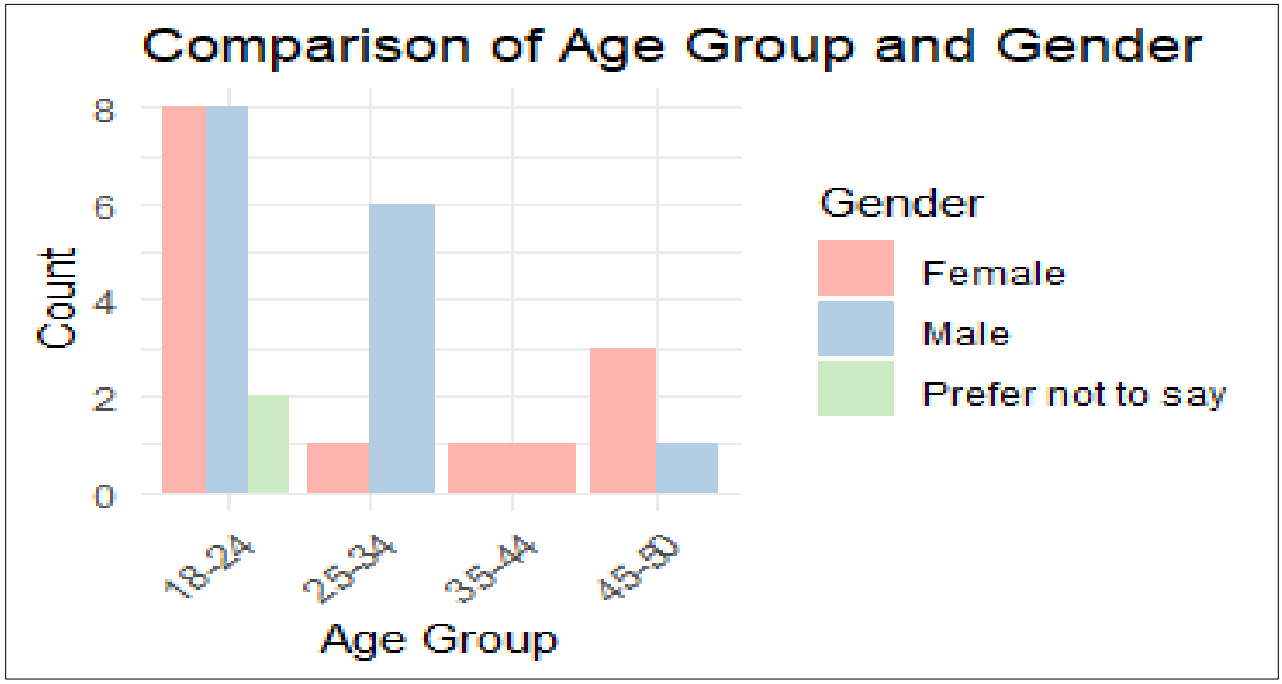

Figure 17: Age Group vs Gender

a. Education levels

Figure 18 shows the distribution of participants by education level attained. This means that those who chose college have completed or are in college, those who chose a bachelor's degree are currently pursuing it or have earned it, etc. The graph shows that more people in this study have completed their undergraduate degree or are currently pursuing it, meaning they have completed education at the foundation level. Figure 19 compares age groups and fields and gives more information about the participants. Many of them have a college degree or bachelor's degree or are in pursuit of either one of them and are between the ages of 18 and 24. This could mean that these participants are recent graduates or early career professionals. Here, participants over 34 are either pursuing their second degree or are currently multiple degree holders. However, the diagram also shows that the study does not really represent those who selected college or a doctorate as their current or highest level of education.

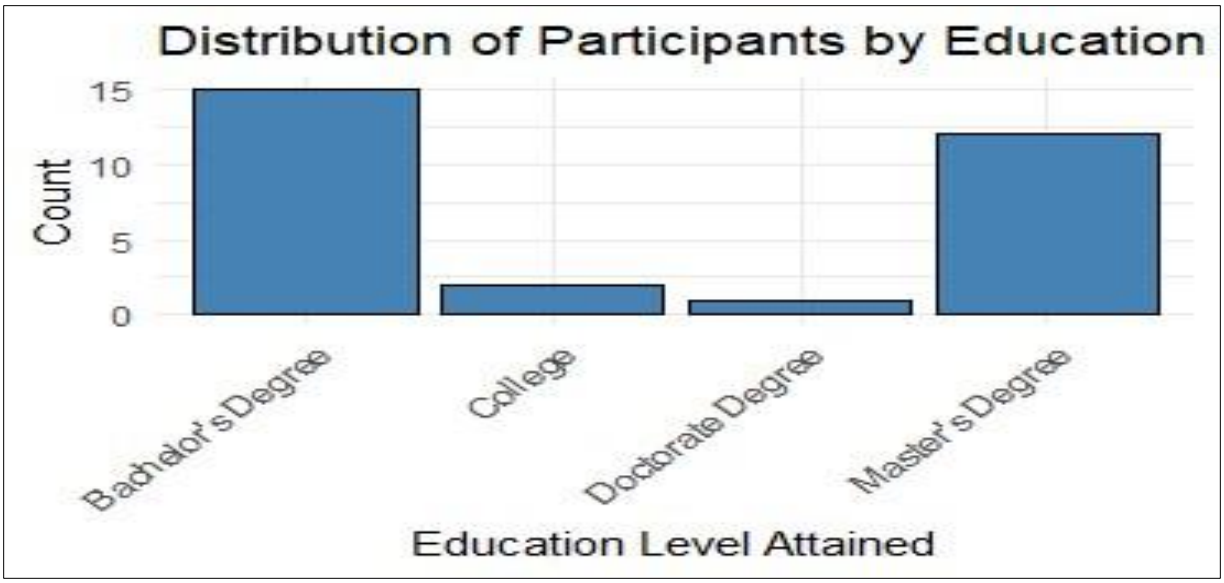

Figure 18: Education level of participants

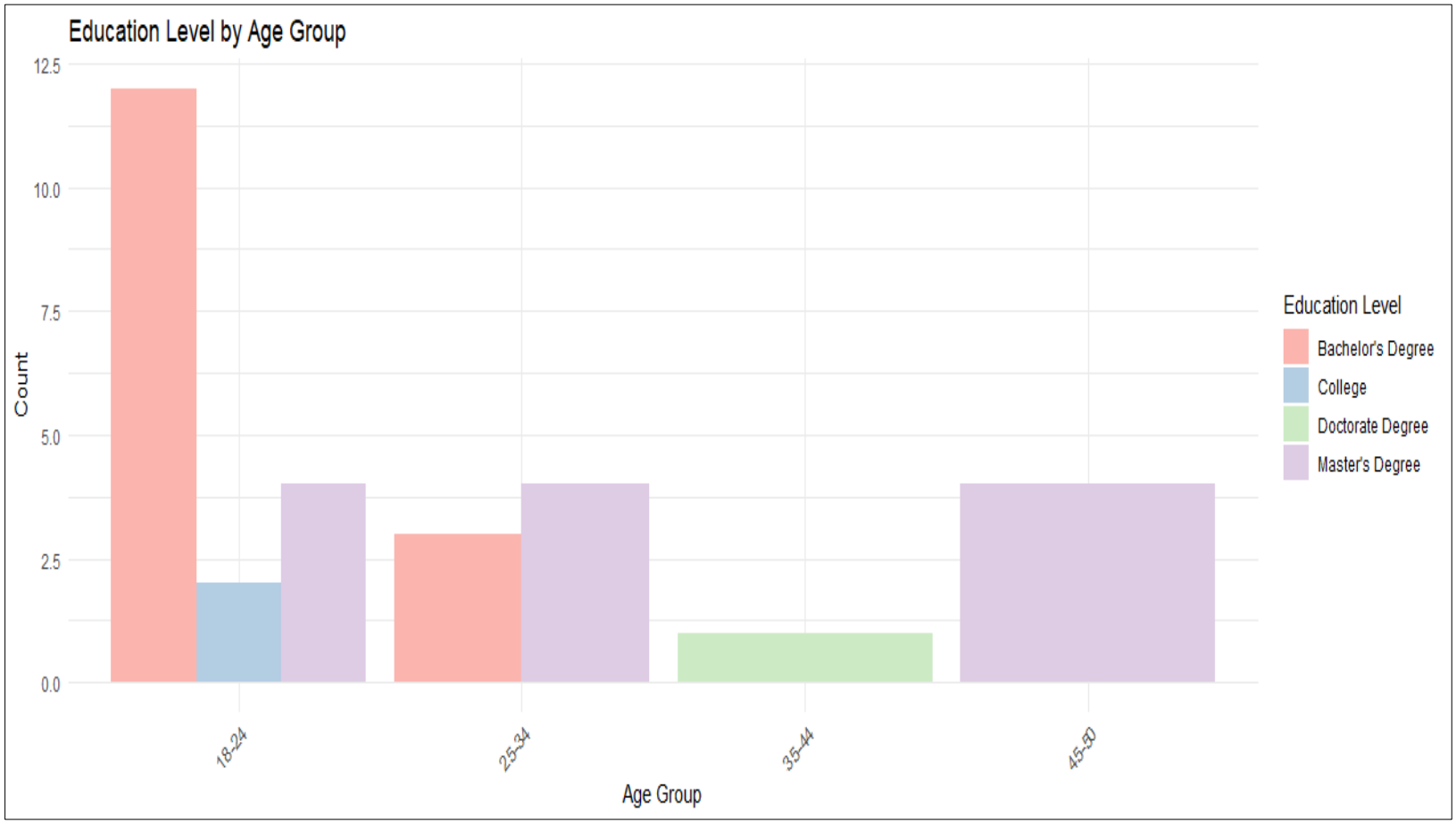

Figure 19: Education level and age group

c. Fields of Study or Major

Figure 20 shows the distribution of the participants across their various fields. The image shows that the participants are predominantly in the IT and computing field, for example, cybersecurity, data analytics, etc., with 6 of them in the Computer Science field, 4 in the Data Science field, and the others spread across other fields. This means that the study does not represent the opinions of people from different fields.

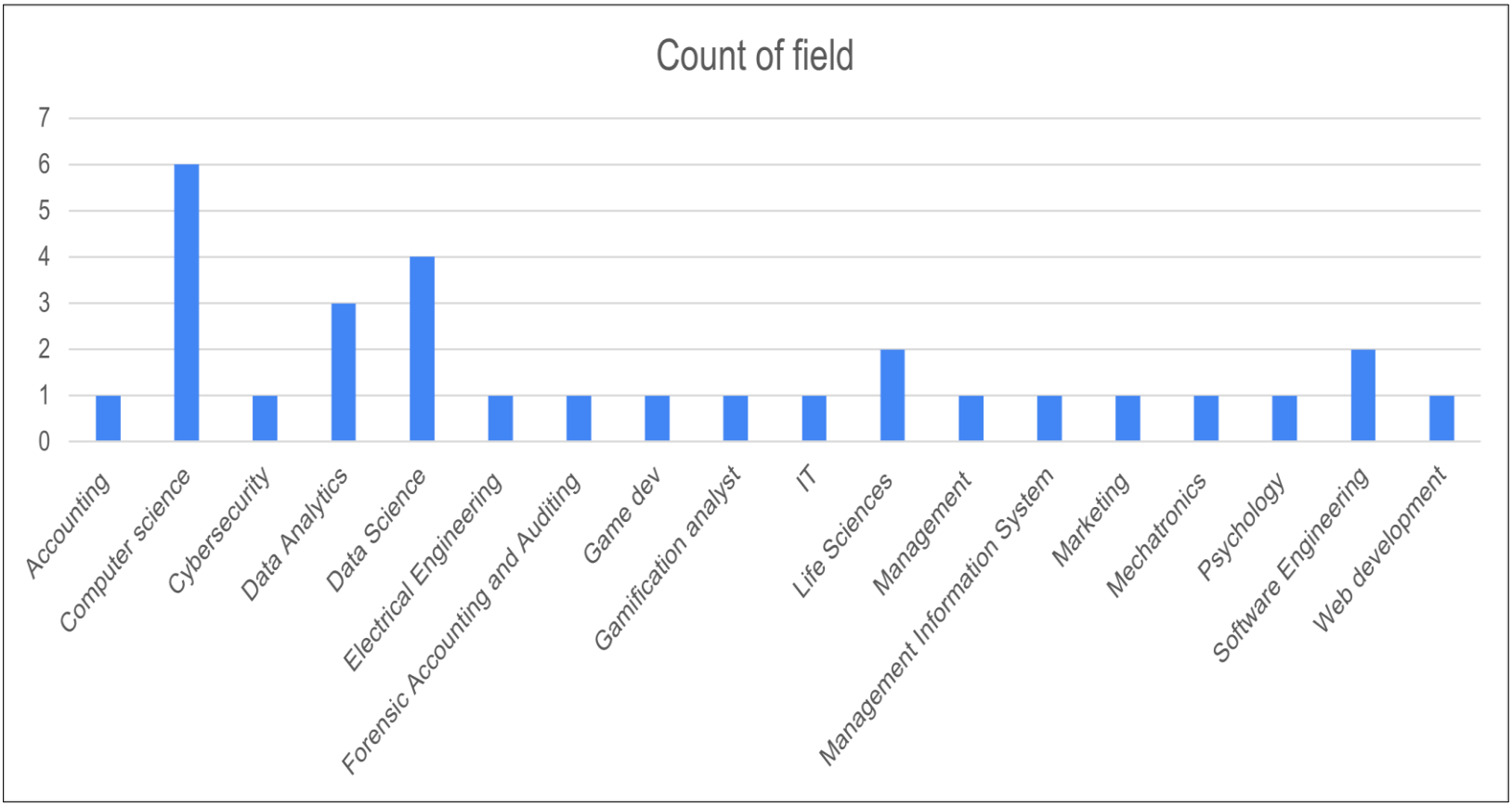

Figure 20: Field of study or major

Relationships Analysis

a. Prior knowledge of gamification versus Perspective of learning with games

The graph in Figure 21 compares the relationship between prior knowledge of gamification and the participants' perspective on learning with games before participation. This analysis determines their views on gamified learning before participation in the study. It shows that most were

previously aware of the term and its meaning and felt it was moderately to highly effective. Among the people without prior knowledge, only one felt it was highly effective, and another thought it was ineffective before participation. Also, among those without prior knowledge, there was a tie between the people who felt it was slightly ineffective, those who were neutral about its effectiveness, and those who felt it was moderately effective. It can be gathered from this graph that prior knowledge of gamification most likely influenced their perspective on its effectiveness.

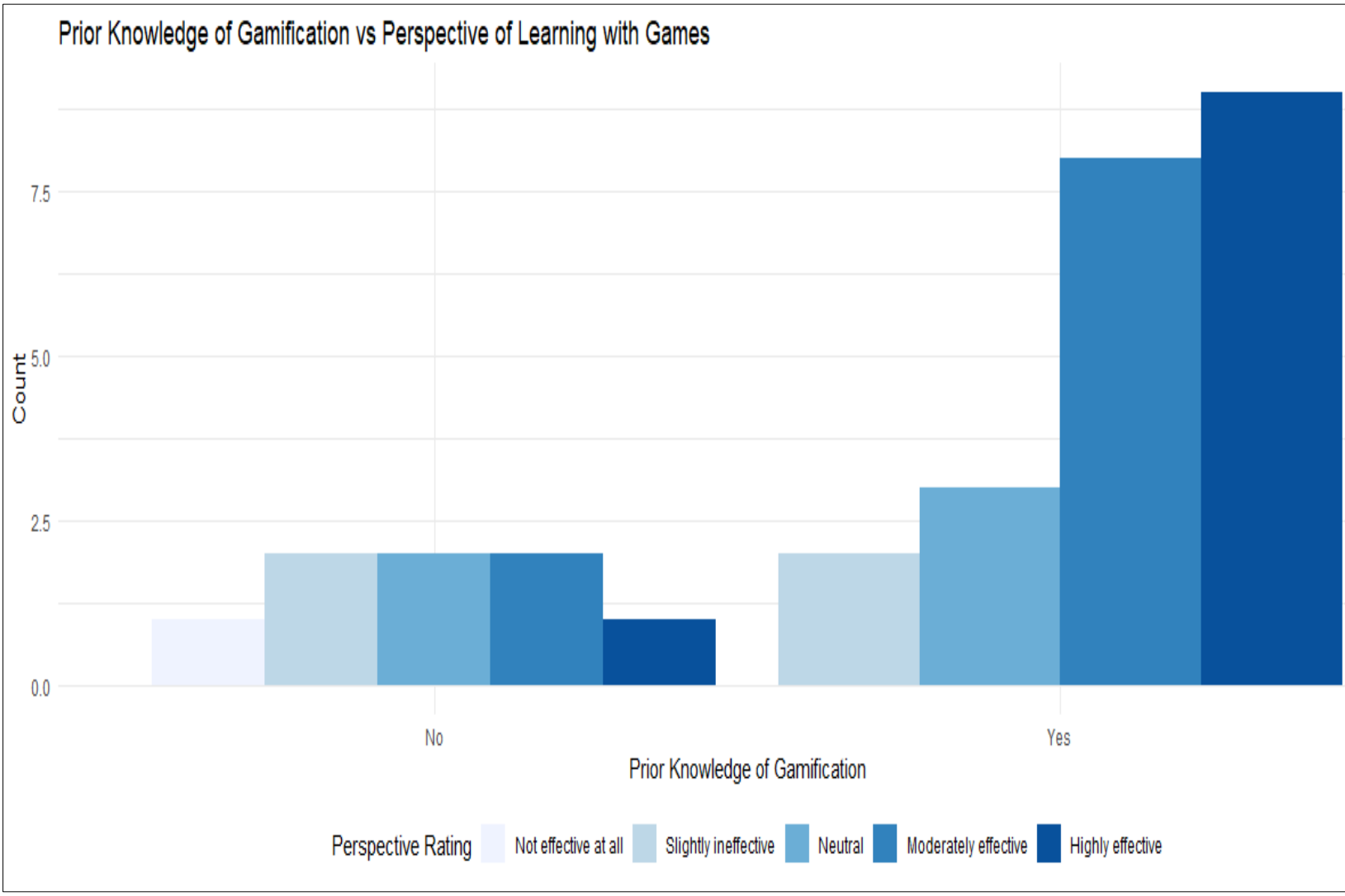

Figure 21: Prior Knowledge vs Effectiveness

b. Perspective on learning with games and Improved understanding

The study also compared the participants' perspectives on learning with games before participating in the project with their perspectives on the ability of gamification to improve understanding during the project. This analysis is to determine the changes in their perspective of gamified learning. As shown in Figure 22, it was discovered that most people felt that the gamified elements helped them understand the course materials better, including those who previously felt it was slightly ineffective and those who were neutral about its effectiveness. After partaking in the study, only one person who, prior to the study, felt it was not effective at all maintained their opinion on its effectiveness. This means that the gamified elements impacted the majority of participants and did indeed improve their understanding, of course, the materials. This discovery also supports the theory that awareness and exposure to gamification in education can influence people's opinions on its effectiveness.

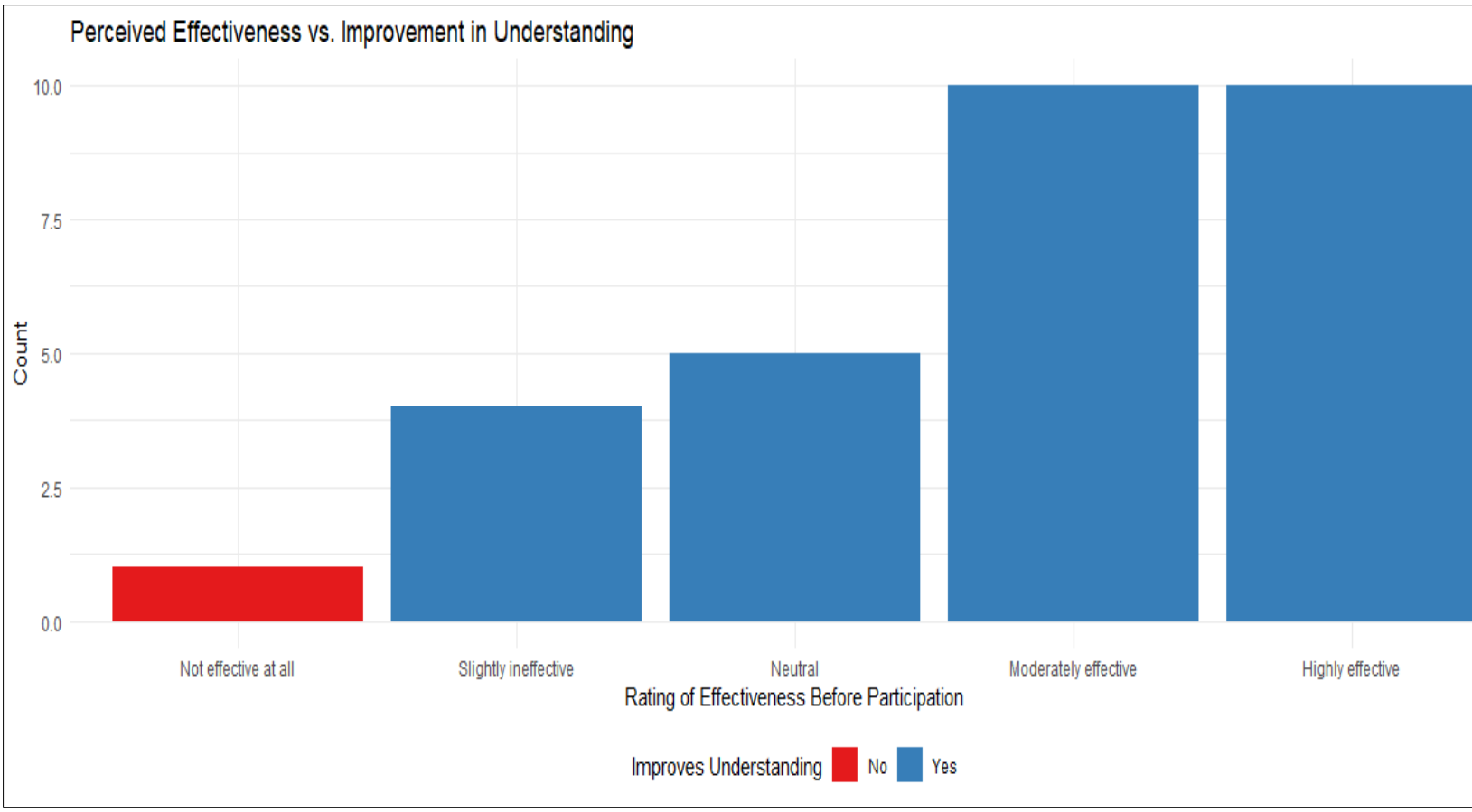

Figure 22: Perceived Effectiveness vs Improved Understanding

b. Engagement levels and Improved understanding

Figure 23 shows the relationship between participants' engagement levels and their improved understanding of the course materials. It illustrates some association between these factors. While there is no evidence suggesting that the improved understanding of participants was due to increasing engagement levels, the plot shows that the gamification elements not only improved understanding but also contributed to increased engagement levels, as 27 participants found it more engaging than non-gamified course content (a combination of 'more engaging', and 'much more engaging'). Here, only one person found the gamified courses less engaging than non-gamified courses. The person found the non-gamified content more engaging at engagement level 1.

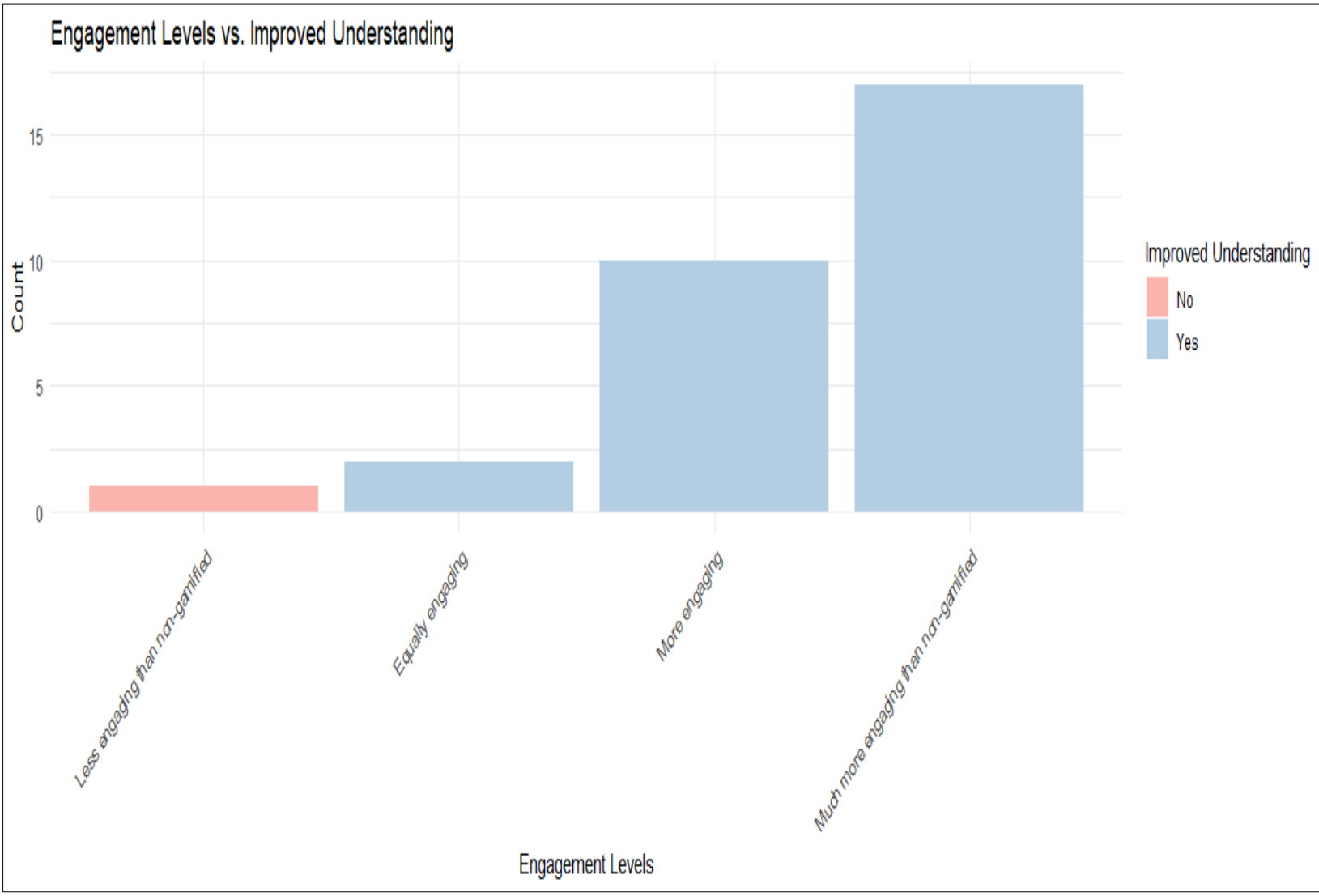

Figure 23: Engagement Levels vs Improved Understanding

c. Engagement Levels and Gender

Figure 24 is a graph showing the comparison between the gender and engagement levels of participants. This analysis determines if a particular gender engages with gamification more than the other. The participant who withheld their gender information considered the non-gamified course more engaging (engagement level 1). The graph also shows that there were slightly more males than females, with engagement levels at 4 and 5, a ratio of 14:12. This means that engagement levels between both genders were relatively balanced, noting the fact that the number of males in this study was also slightly more than the females. No one gender found it more engaging than the other.

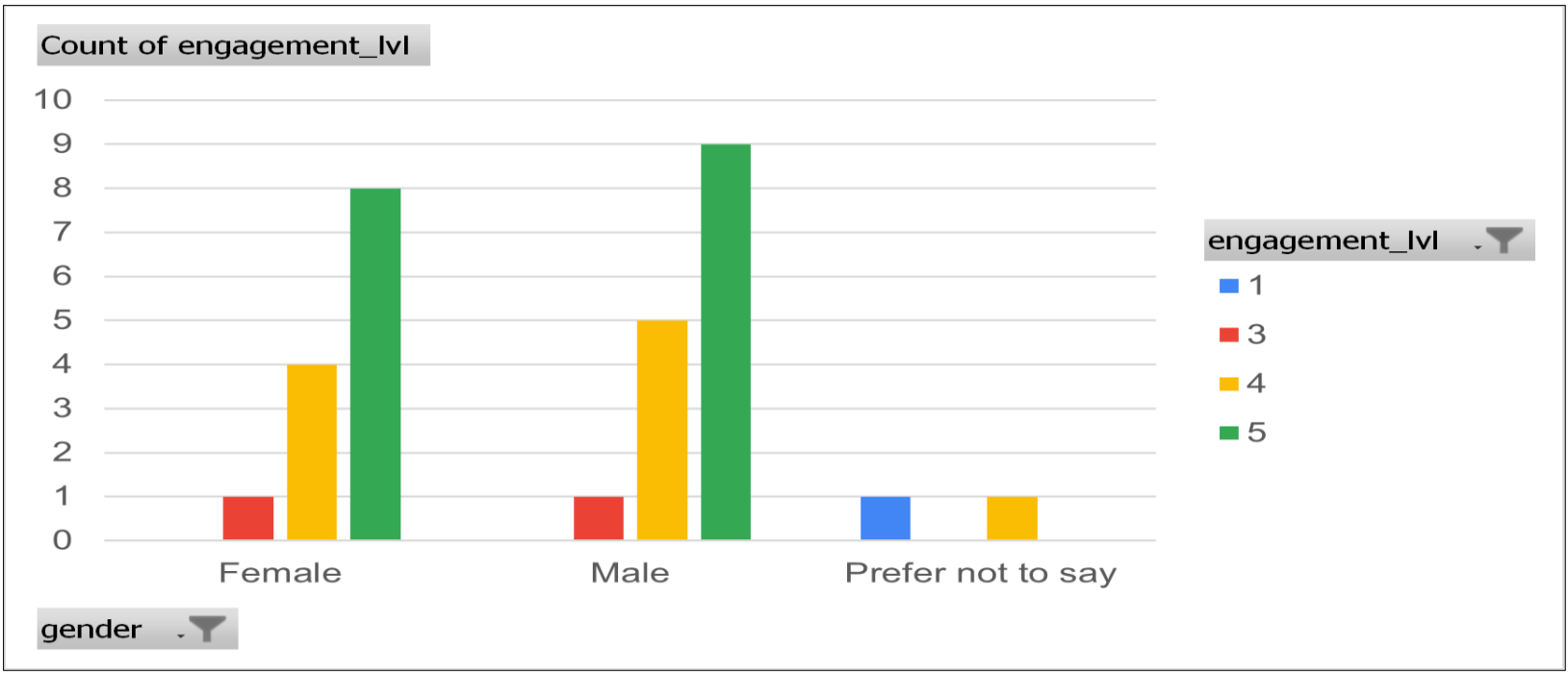

Figure 24: Gender vs Engagement levels

d. Age Group and Engagement Levels

It is not unusual to assume that different age groups will respond to gamified learning differently, hence the diagram in Figure 25. Firstly, it is worth noting the data imbalance between the age groups. Secondly, the chart shows that most participants aged 18-24 found the gamified courses more engaging than non-gamified courses. Of the eighteen, 11 found it 'much more engaging',

five found it just ‘more engaging’, one found it less engaging, and another found it equally engaging. The study reveals that older people between 25 and 50 responded well to the gamified courses. Out of the 12 of them, 11 found it engaging and much more engaging. None of the participants here, aged 25 to 50, considered the non-gamified course more engaging.

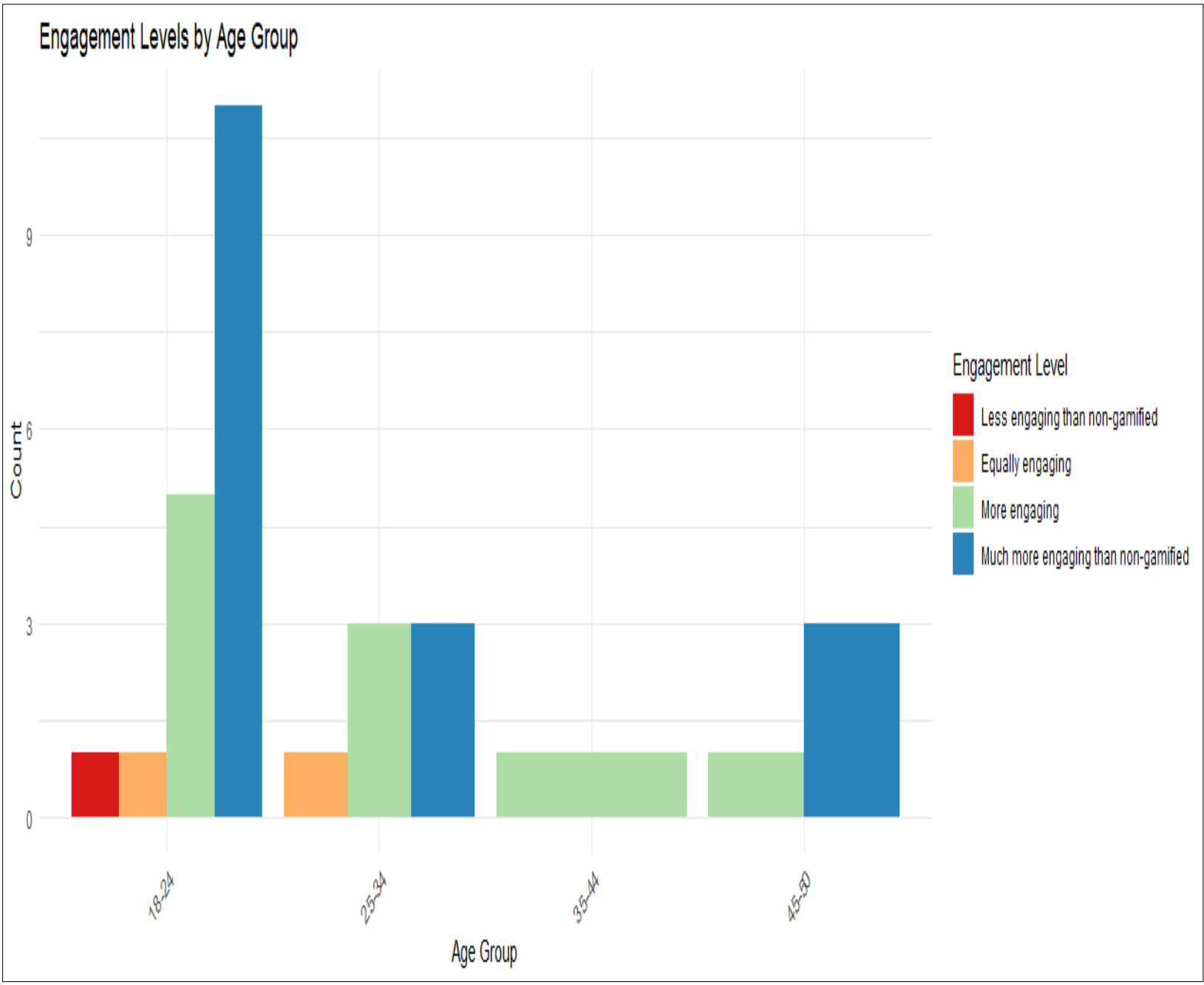

Figure 25: Age Group vs Engagement Levels

Elements Analysis

a. Best elements

The best elements graph in Figure 26 depicts the elements chosen as most enjoyable or motivating by the study participants. This question allowed participants to select multiple gamification elements. 19 out of the 30 participants selected the Level Up XP as the most enjoyable or motivating. This was followed by stash items and avatars, with 15 selections for each. The Cryptex is seen to be the least selected gamification element.

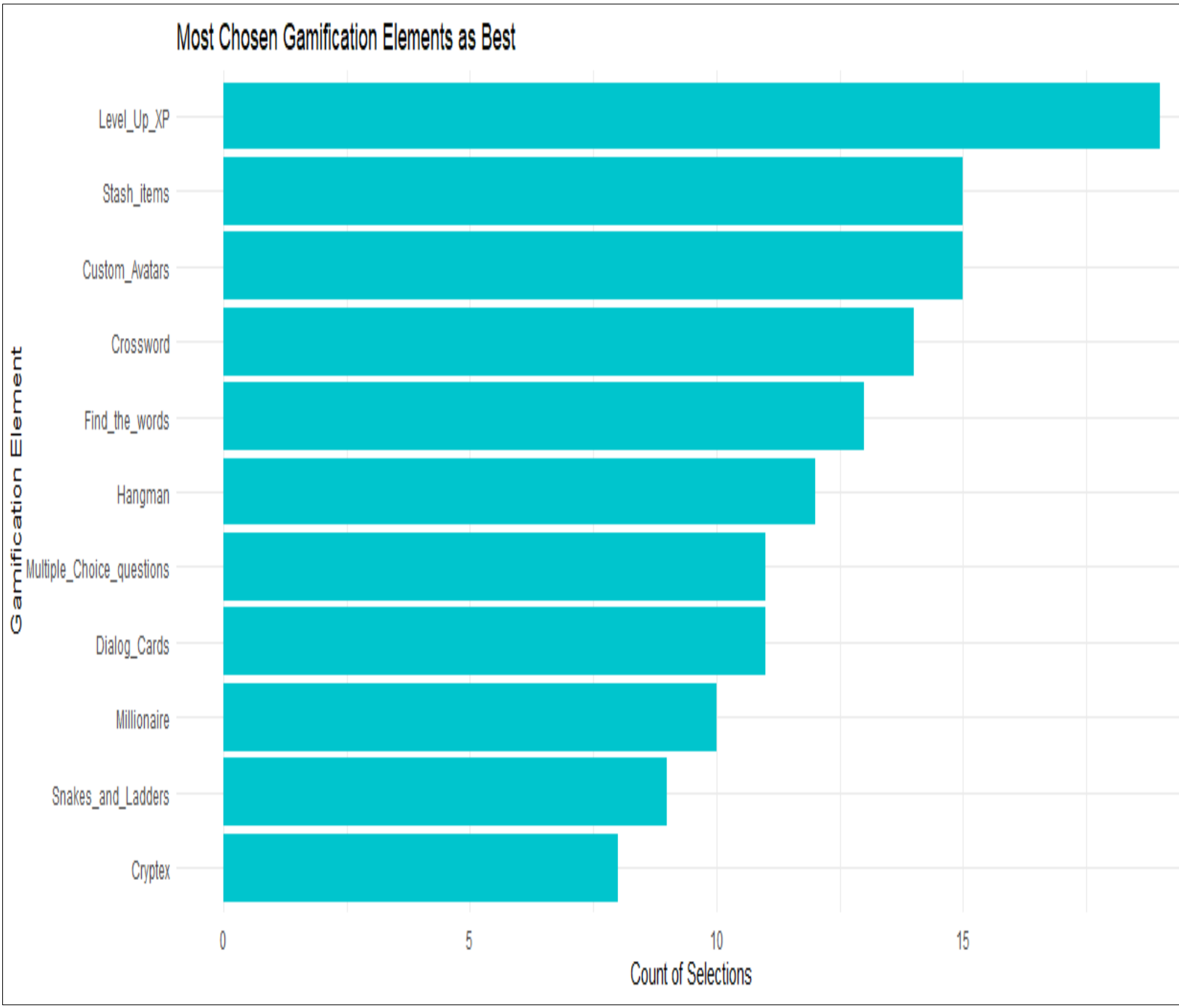

Figure 26: Most motivating/Enjoyable gamification elements

b. Connections between best elements and demographics of participants

Figure 27 depicts each gamification element, age group and gender of participants who made the selection. This analysis is to determine how demographic factors influenced the participants' choices. More females generally selected each element for the age group 18 to 24 than males. They also made many selections for the elements used, which suggests they engaged with many of the elements.

The Level Up XP, which had the highest selection, was balanced between the male and female participants in this age group alone. Participants in other age groups did not select this element as much. For participants aged 25 to 34, the Crossword was the most popular choice, although by males. Only one female participant in this age group selected the Level Up XP. The single participant within the age group selected the Stash element. For the age group 45 to 50, the elements 'Find the words', 'Multiple choice questions', and avatars were their most selected element, also by makes. However, this graph cannot give suggestive or conclusive information due to data imbalance. As depicted in Figure 28, the simplified version of Figure 27, excluding the Level Up XP, the stash, avatars and H5P find the words, were commonly selected by females. The stash, avatars, and crossword were more selected among the male participants, excluding the Level Up XP.

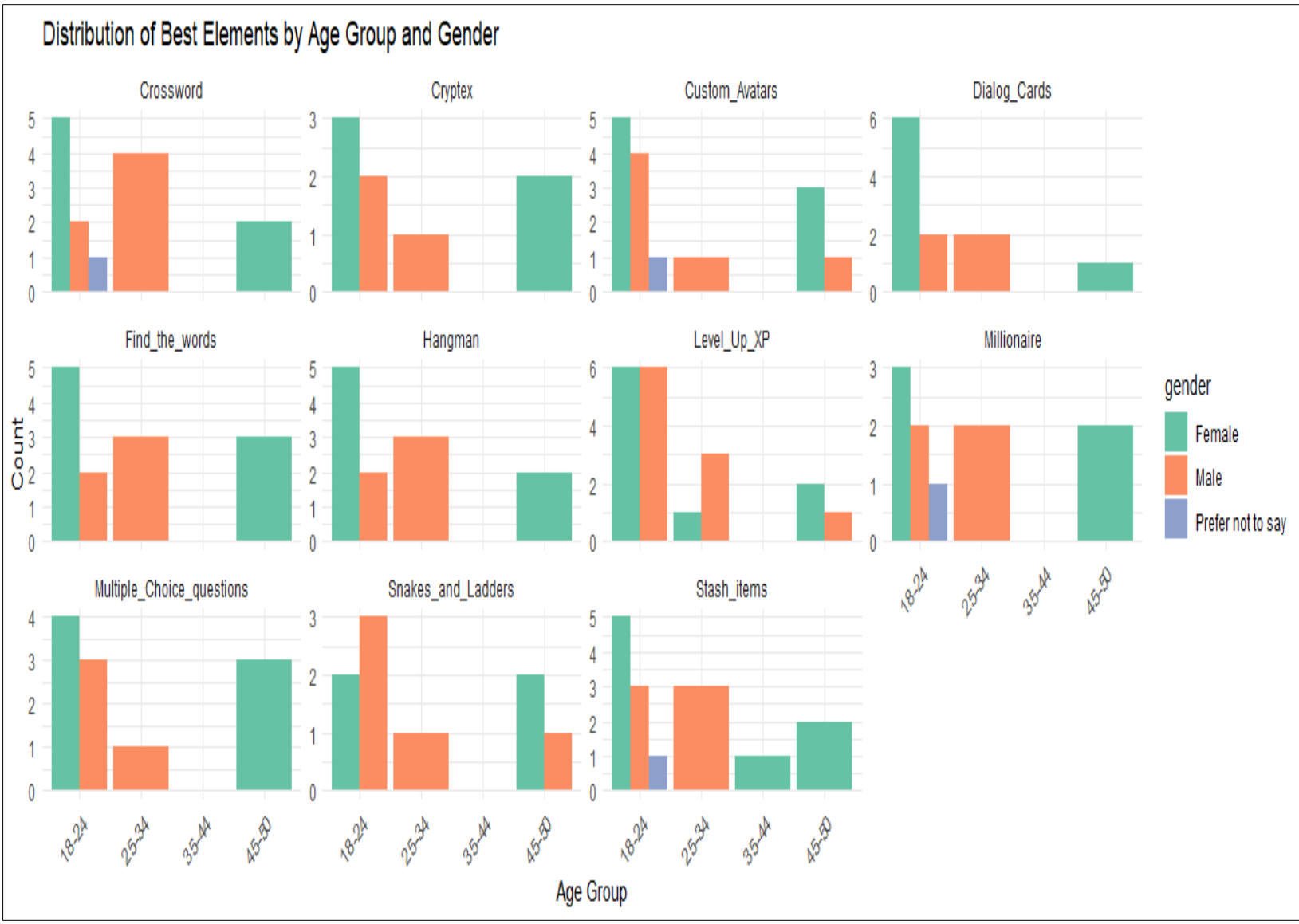

Figure 27: Best elements vs age group and gender

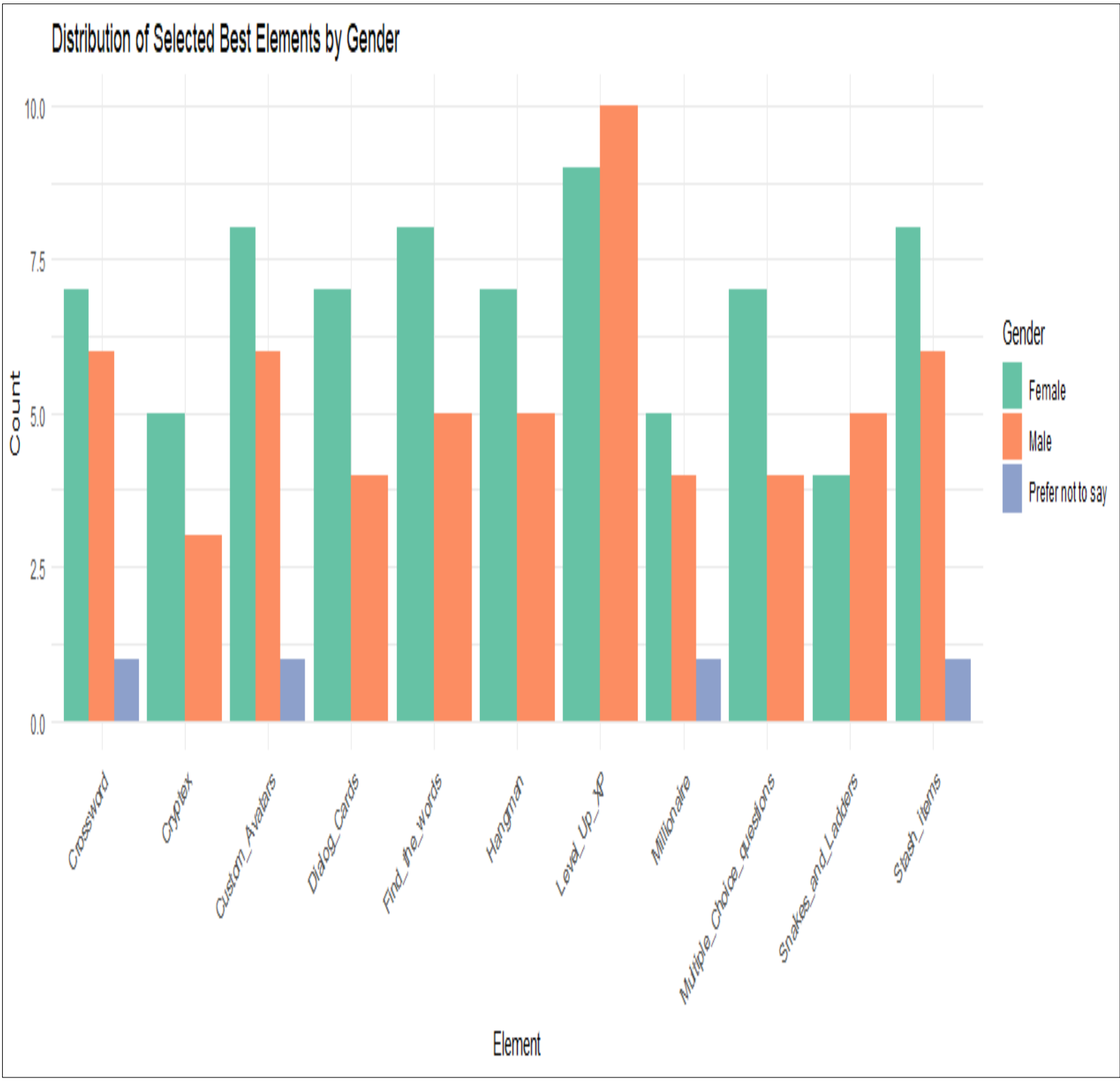

Figure 28: Best Elements vs Gender

c. Frequency of themes

Figures 29 and 30 are graphs showing the themes in the participants' responses regarding questions on their opinion on gamification and the reason for their best element. The expectation was that they would state the reason(s) for each selected element. Since that was not the case, their answers were generalised. The most frequent themes in their opinion on gamification were 'effective', 'engaging', 'fun', and 'interactive', with over 26 comments. The most frequent themes in their reasons for selected elements were 'interesting', 'fun', 'good', and 'engaging' with 18 comments. From these data, it can be deduced that the gamification elements were fun, engaging, effective and interesting for the study participants. It clearly shows very few comments related to low satisfaction or interest.

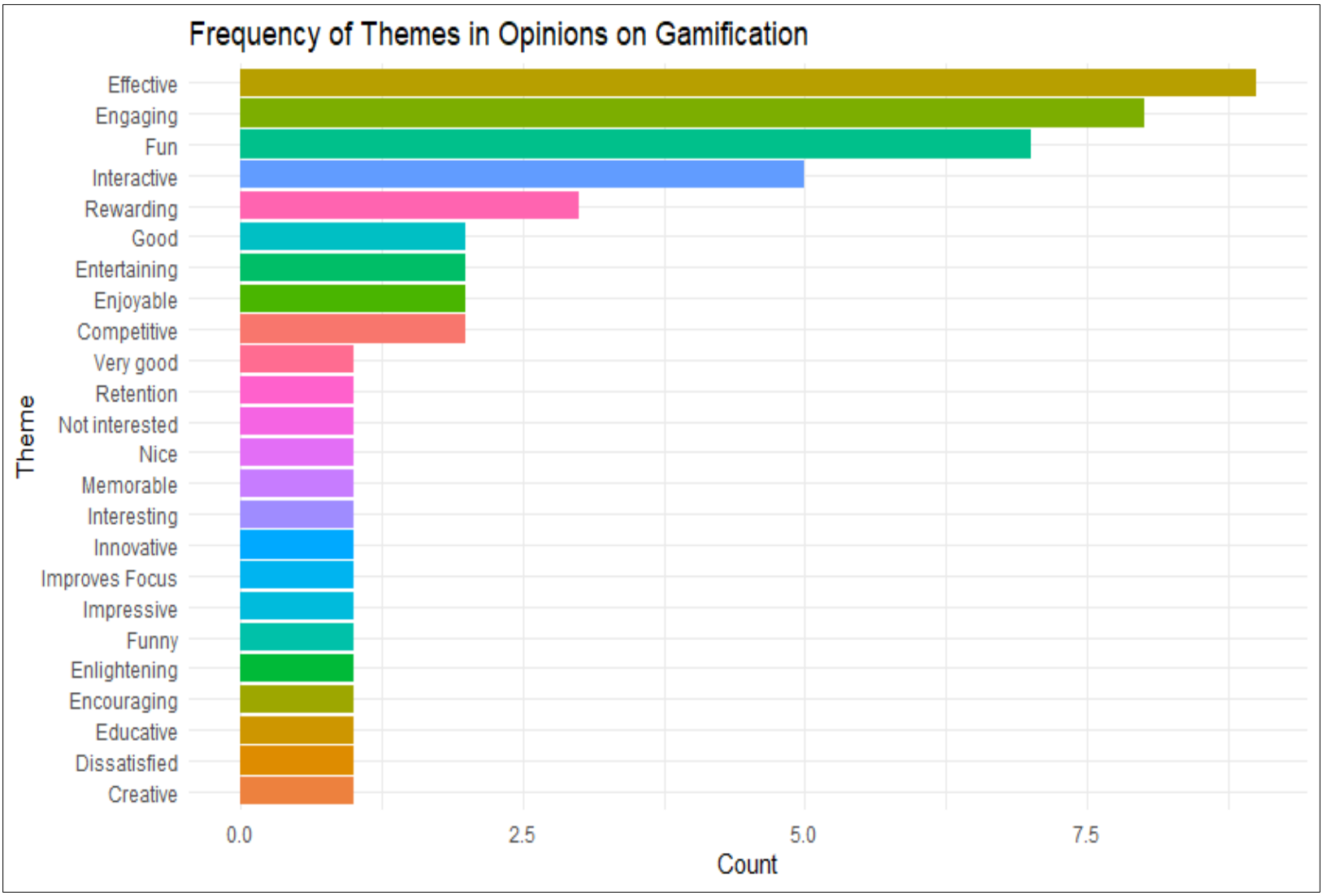

Figure 29: Opinion on gamification

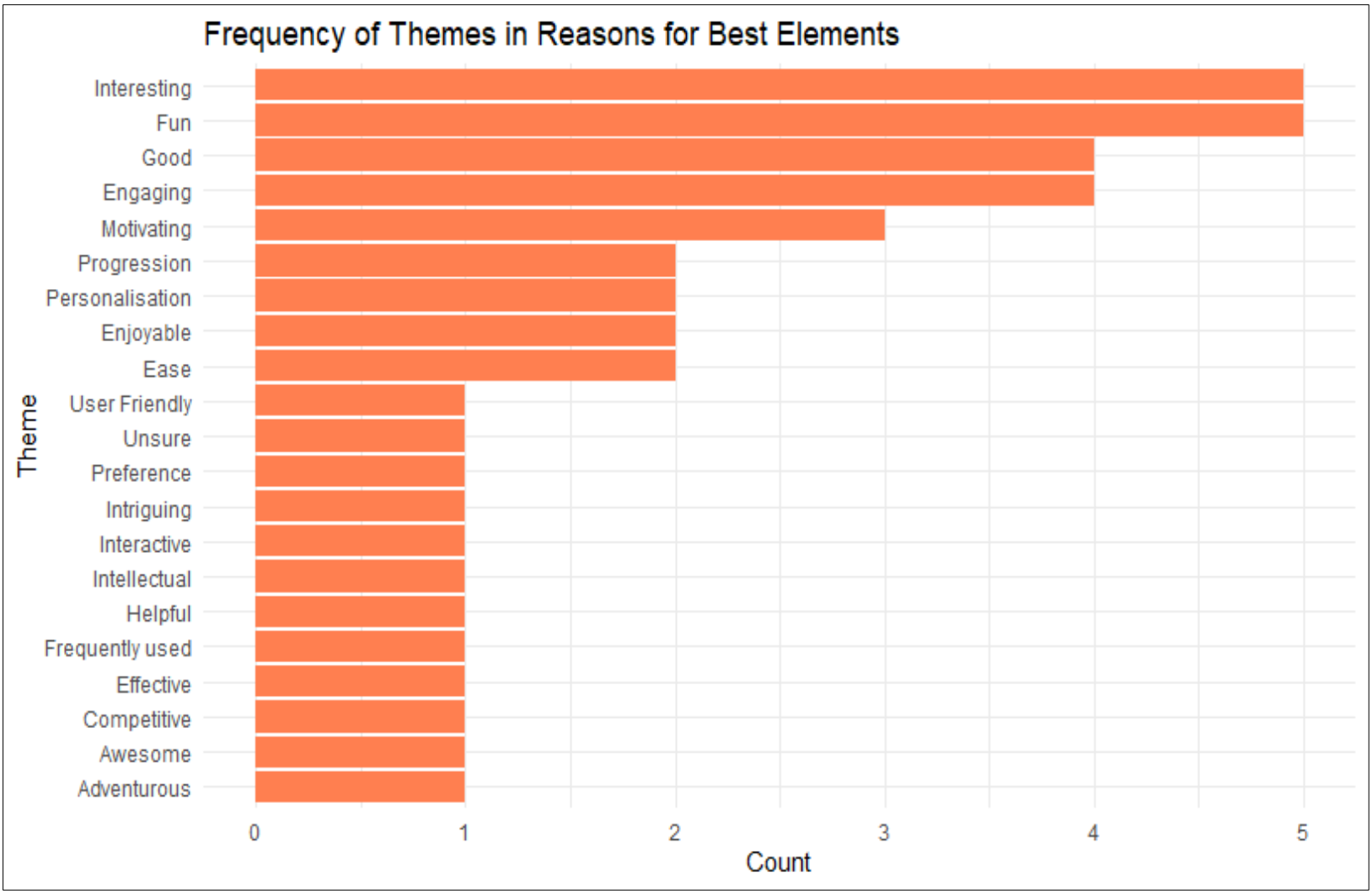

Figure 30: Reason for selected elements

Satisfaction and Improvement Analysis

a. Satisfaction Level

The graph in Figure 31 shows the participants' overall satisfaction with the gamification elements used in this project. Many of them had a positive experience overall. Twenty-eight participants answered 'satisfactory' and 'very satisfactory', which shows that they were satisfied with the gamification elements. Two participants, however, found the elements very unsatisfactory.

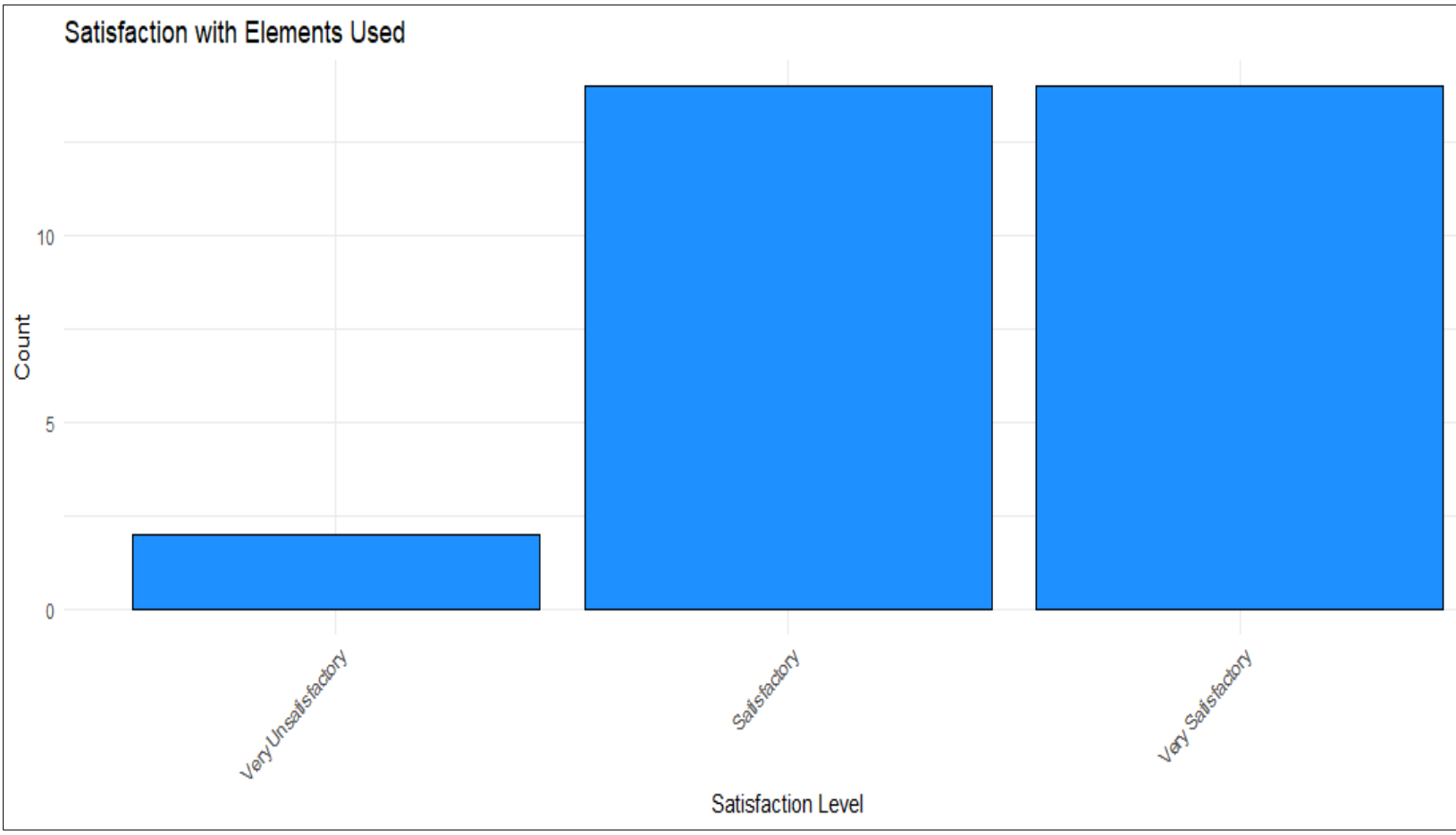

Figure 31: Satisfaction with gamification

b. Previous experience with gamification and challenges encountered.

The diagram in Figure 32 compares participants' previous experience with online learning platforms to the challenges they had using the Moodle platform. This is to determine whether the challenges faced could result from inexperience with learning management systems and online learning platforms. The graph provided contrary results. The graph shows that challenges were encountered only by people with a moderate to comprehensive understanding of online learning platforms. This means that the previous experiences of certain participants allowed them to spot usability issues that others could not spot. The graph also depicts that most participants recorded 'none', which means they had no challenges with the platform. Where 'the games' were listed as a challenge, based on their responses, the participants had little to no understanding of how to play the gamified quizzes or use the games in general. For participants who recorded 'Navigation' as a

challenge, they had difficulties navigating the Moodle site and identifying the gamification elements. The information that can be obtained from this graph is that while there were few challenges with the platform, more information on the navigation of the Moodle site and an explanation of the gamification elements would have been necessary.

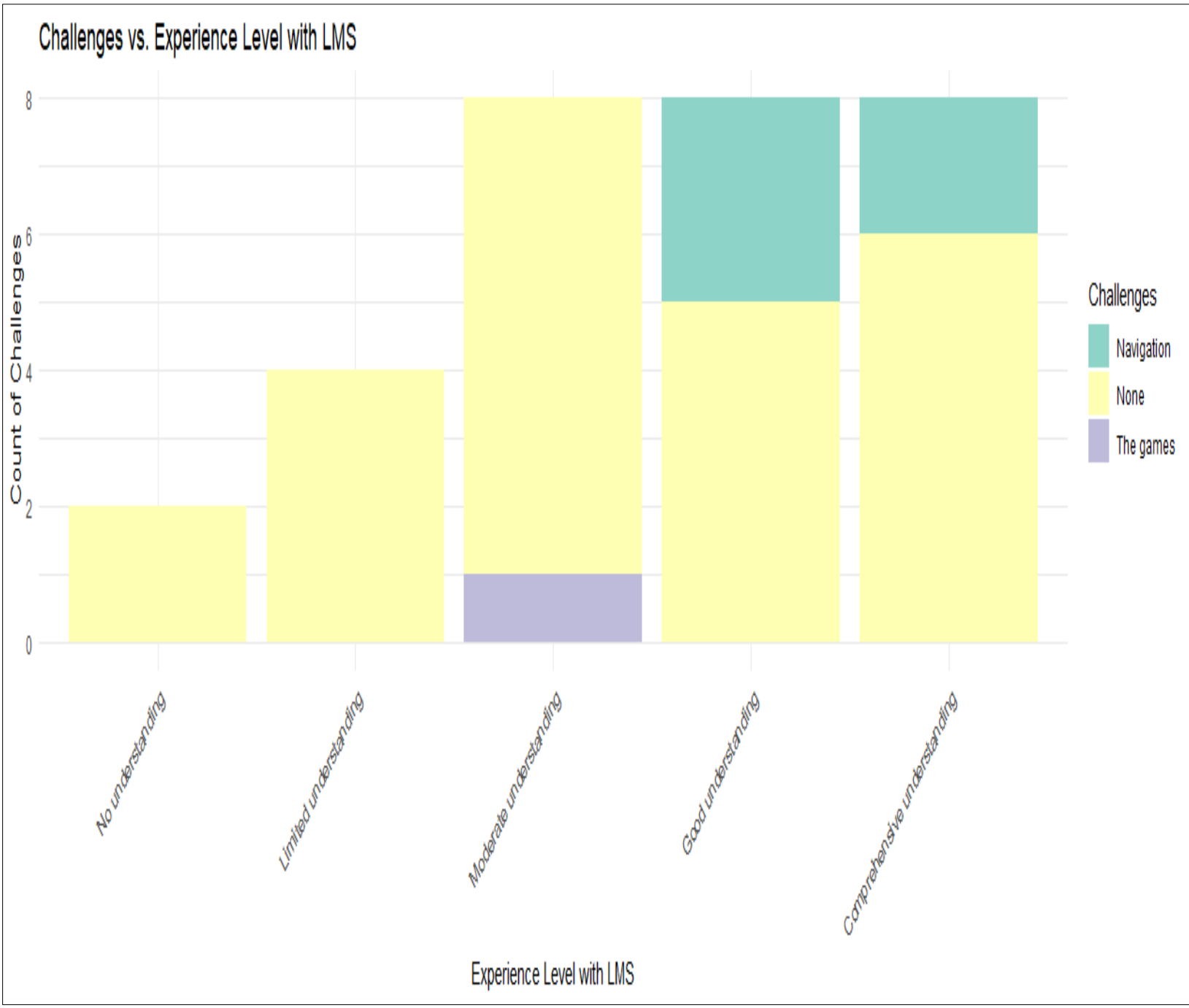

Figure 32: Challenges vs Experience with LMSs

c. Suggestions for Improvement/Modification

The suggestions by 40% of the participants include more explanation of the games, easier navigation, better user interface and design, inbuilt functionality for avatars, more learning games, speech-to-text functionality, and optional participation in leaderboards. Other participants (59%) answered ‘No’, ‘None’, etc., while 1% answered ‘Unsure’. For elements to be removed or modified, Snakes and Ladders and Cryptex were suggested to be removed by 2 participants (one for each element) because they found it confusing. The Snakes and Ladders, alongside Cryptex, were also the least selected elements as the most enjoyable or motivating. Therefore, in utilising these games, the instructor will have to provide more detailed guidance on these two compared to the other elements.

RESULTS

Although conducted with a limited number of participants, the study produced results that indicate that most participants were engaged and felt that the gamification elements improved understanding. This indicates the potential usefulness of gamification in education due to the number of positive experiences recorded, referring to themes like fun, engaging, effective, interesting, etc. Similar to literature review, the study also indicates that prior experience with online learning platforms does not significantly impact the usability of gamified Moodle platforms. On the other hand, prior knowledge/awareness of gamification can influence its perceived effectiveness.

Since understanding participants' demographics is useful information when researching capabilities for personalised learning, the distribution of participants' fields, age groups and genders were compared with their selected best elements. As the participants were predominantly in the information technology and computing field, comparing fields with engagement levels did not provide much information. The data does not provide much information about how people from other fields, such as social sciences or engineering, will respond to gamified learning, but it did show that people in this field might connect with gamification. Many participants, both male and female, were seen to have connected with gamification, especially the participants aged between 18 and 24, due to their high engagement levels. This suggests that gamification with Level Up XP, Stash and Avatars could be effective with this population, presumably undergraduate students or early career professionals.

This study acknowledges the need for careful planning, design, implementation and explanation when integrating game elements and game-based apps into the learning process.

REFLECTION

Conducting this research was very tasking but rewarding. I had little to no understanding of setting up a Moodle server and conducting detailed research, so most of the activities required frequent iterations. During the project, participants' activities, such as their stash inventory and position on the leaderboard, were monitored. Moodle's activity completion was also used to achieve this. During the study, some participants inquired about the identities of the participants who scored higher than them in the leaderboards because they were curious about their performance. As this information could not be revealed, they inquired about activities that could put them at the top of the leaderboard even when there were no rewards involved. This means that these participants were intrinsically motivated. They wanted to do better not because of external rewards but rather their own sense of accomplishment. Many people engaged with this Level Up XP feature, contributing to its success. Their activities also revealed that while the participants were given a form containing instructions about the project for review, and the instructions were also placed on each course's main page on the website, many participants ignored them because they were not interested in 'reading'. Hence, verbal communication of the requirements of the project and the use of the elements was important.

At the beginning of the study, I was interested in a complete reformation of the education system with gamification. Then I realised that people could have been very engaged because it was new. Implementation in education could lead to overuse to the point that it becomes less effective and engaging. The results made me realise that while people engaged with the games, they still did not open the lecture materials. Many of them did not want to read but preferred to quickly look up the answers online. However, this is also a form of learning, as they might be able to remember the questions due to their reason for looking up the questions online. That is, playing a game. This is a form of tricking the brain to learn. For it to be effective, I feel it is necessary to use it periodically as a tool to increase engagement levels. Introducing new gamified activities once or twice a week can be more beneficial than daily implementation.

APPENDICES

The following appendix files, such as the questionnaire, participants' responses, and R code, can be found in the 'appendices' folder.

Appendix A: Questionnaire

Appendix B: Participants_Responses

Appendix C: LMS_Project (R code)