

WORDLE IN THE CLASSROOM: A GAME-CHANGING APPROACH TO ACTIVE LEARNING

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Abstract

This paper presents an innovative approach to engage students' participation through active learning, using the popular online word-guessing game, Wordle. The method involves students solving personalized Wordle puzzles, which include key concepts studied in the previous lecture, and competing with other classmates in a Wordle league throughout the semester. We validated the proposal in the Requirements Engineering course at Universidad Rey Juan Carlos and we found a positive correlation between Wordle participation and academic performance. The paper discusses the benefits and challenges of this active learning strategy and suggests future directions for research.

Keywords: active learning, key concepts, concept map, UML, Wordle game.

1 INTRODUCTION

Over the past decade, absenteeism in university classrooms has emerged as a significant global concern in higher education [1]. This issue is not confined to a specific region or country but is a global phenomenon affecting universities at various levels. Absenteeism refers to the absence of a student from class, either with or without an excuse. It is one of the main causes of class repetition and has a decisive impact on many issues such as students' academic success and social development. The rate of absenteeism has increased considerably in recent years, especially in certain fields of study.

Students' motivation is a critical factor that influences academic achievement [3],[4]. Over the last decade, motivation for school has been observed to decline throughout school time. Achievement motivation, which energizes and directs behavior toward achievement, is known to be an important determinant of academic success [3]. It comprises various constructs such as motivational beliefs, task values, goals, and achievement motives [3]. However, many education systems focus more on foundational skills, such as literacy and numeracy, and neglect a broader set of skills needed to thrive in a rapidly changing, technologically advanced world [5], despite the importance of motivation.

In the context of Computer Science degrees, motivation is indeed a crucial factor that influences students' academic performance [6]. Intrinsic motivational strengths such as achievement motivation, willingness to improve, accomplishment feeling, and self-confidence play a significant role in students' academic success [3]. However, there are also motivational gaps that can negatively impact students' academic performance. These gaps can be related to the desire to attend classes, the evaluation processes, the perceived utility of their efforts, the attention received by their professors, and the resources provided by the college [4]. For example, the way students perceive their own abilities had the most significant connections with their future grades [3]. Several recommendations to handle these motivational gaps and to take advantage of the motivational strengths have been established. These recommendations are related to setting of activities, regulation of challenge difficulty, evaluation processes, learning methods and continuous improvement of professors. In addition, integrating active learning strategies in higher education can further enhance these efforts.

The use of active learning strategies in higher education has been widely advocated to enhance students' engagement, motivation, and performance [7],[8],[9]. Active learning involves students in the process of constructing knowledge, rather than passively receiving information from the professor. This approach requires students to engage in higher-order thinking activities such as analysis, synthesis, and assessment [7]. One of the challenges of implementing active learning in the classroom is to design activities that are relevant, meaningful, and appealing to students, while also aligned with the learning objectives and outcomes of the course [10].

This paper proposes an innovative pedagogical strategy to foster active learning and student participation during the Requirements Engineering (RE) course, a second-year subject in the Software Engineering degree at Universidad Rey Juan Carlos (Madrid, Spain). This strategy addresses the challenges of low motivation and attendance that we observed in the previous year, as well as the

theoretical and diagrammatic nature of the subject, which involves the specification of software requirements using UML notation (UML, from Unified Modeling Language, is a standard visual language for designing systems [11]), without any coding practice. Our active learning methodology consists of using the popular online word-guessing game, Wordle [12], as a pedagogical tool to enhance attention, identification of key concepts, and creation of conceptual maps, while also introducing gamification elements. It should be noted that the applicability of this proposal is general and easily adaptable to any subject or subject matter. The objective of our proposal is:

To enhance student engagement and learning outcomes in the RE course through the integration of Wordle as an active learning tool.

To evaluate the effectiveness of our proposal, we formulate the following Hypothesis (H) and Research Questions (RQ1 and RQ2):

H: The use of Wordle as a pedagogical tool for active learning increases the motivation of the students in the RE course.

RQ1: How does the use of Wordle affect the academic performance of the students in the RE course?

RQ2: How does the use of Wordle influence the attendance and participation of the students in the RE course?

The rest of the paper is organized as follows. Section 3 describes the design and implementation of the active learning activity. Section 4 presents the data collection and analysis methods, and the main findings. Section 5 discusses the implications and limitations of the study and suggests directions for future research. Finally, Section 6 concludes the paper and summarizes the main contributions.

2 METHODOLOGY

In this section, we describe the tools, participants, activities, planification, and measures used to implement and evaluate the proposal of using Wordle as a pedagogical tool in the classroom.

2.1 Tools

The main tool used for this proposal was Wordle, an online game that has become viral in recent years. Wordle is a word-guessing game where players have six attempts to guess a five-letter word. With each guess, the letters turn the background color to indicate correctness: green for correct letters in the right position, yellow for correct letters in the wrong position, and gray for incorrect letters, see Figure 1 as an example. Players aim to deduce the mystery word using logic and word association within the given attempts, making it both challenging and rewarding. Wordle was accessed through an external application, available through an exam in the Virtual Classroom in Moodle. The external application allowed the creation of customized Wordle with key words from the subject matter taught that day. The application also generated reports for each student and were easily exportable for analysis.



Figure 1. Example of the Wordle game

Additionally, UML diagrams were used to create conceptual maps with the words included in the Wordle, as a final review of the subject. To develop UML diagrams, we highly recommended to our students the use of any UML modeling software, which usually provides a comprehensive set of features that are beneficial for RE students. It supports most of the diagram types specified in UML, which is crucial for the students as they learn to specify software requirements, which aligns well with the theoretical and

diagrammatic nature of the RE course. Some well-known alternatives include StarUML, Visio, Lucidchart or draw.io, among others.

2.2 Participants

The participants of this proposal were the students enrolled in the Requirements Engineering subject, belonging to the second year in the Software Engineering degree at the Universidad Rey Juan Carlos. Those students who voluntarily participated in the Wordle at the end of each class also needed to present a concept-map diagram constructed with the key words at the end of the course. The participation was voluntary, and the students were informed of the objectives and procedures of the proposal.

2.3 Activities

The activities consisted of solving several Wordle at the end of each class, with key words from the content taken at the class that day. Students had a limited time of 5 minutes to solve all the Wordle proposed, which forced them to pay attention to the class and to make a mental effort to identify and remember the key words of the lesson, fostering their active learning. In addition, the students competed in a Wordle league, in which they accumulated points for each word guessed. The league ranking was updated throughout the course, encouraging competition among students, and increasing their motivation to improve their results. As an example, we depict an anonymized ranking of the Wordle League in Figure 2. At the end of the course, the students created conceptual maps with the words included in the Wordle, using UML diagrams, to synthesize and organize the information learned.

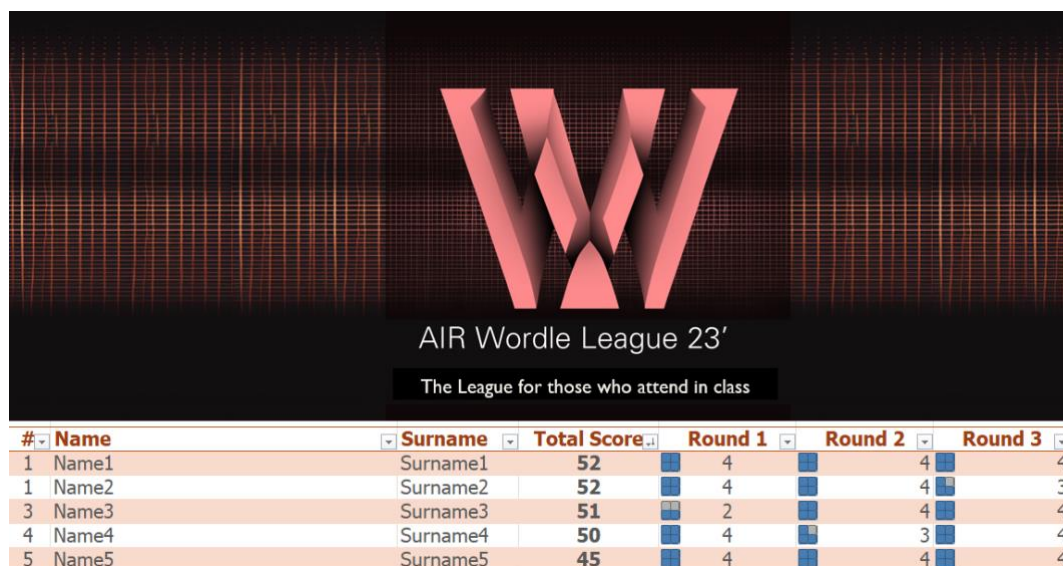


Figure 2. Ranking example of the Wordle League

2.4 Planification

The proposal was implemented in the course 2022/2023 in the subject RE, previously mentioned. The subject consisted of 15 sessions of 2 hours each, in which the theoretical and practical contents of the subject were taught. At the end of each session, the students had to solve from 3 to 5 Wordle, depending on the difficulty of the words, related to the contents presented in class. The Wordle were created by the professor using an external application and they were accessed by the students through an exam in the Moodle platform of the university. The results of the Wordle were recorded in the Moodle by the students and later analyzed by the professor, who updated the league ranking after each session. At the end of the course, the students must create a conceptual map with the words included in the different Wordle proposed during the year, using UML diagrams, and submit it to the professor for evaluation.

2.5 Measures

The measures used to evaluate the proposal were the following: the final grade of the subject, the attendance to class, the participation in the Wordle, the points obtained in the Wordle league, and the quality of the conceptual maps.

The final grade of the subject was calculated as the weighted average of the grades obtained in the exams and practices by the students. The attendance to class was recorded by the professor in each session. The participation in the Wordle was measured by the number of Wordle solved by each student throughout the course. The points obtained in the Wordle league were calculated by the external application, based on the number of words guessed and the number of attempts used. The quality of the conceptual maps was assessed by the professor, using a rubric that considered the accuracy, completeness, clarity, and organization of the information.

3 RESULTS

As it was aforementioned, this experience was tested in the 2022/2023 academic year in the RE subject. Particularly, among the 71 students enrolled in the course, 39 followed the whole methodology, i.e., they participate actively in the wordles at the end of each class and constructed the map of key concepts. These participants achieved an average final grade in the subject of 6.41, while those who did not participate continuously obtained an average of 5.30. Although these results do not demonstrate causality, they indicate a positive correlation between participation in Wordle and better academic performance. This suggests that the students who actively engaged in the activity showed a higher commitment to the subject and a better understanding of the key concepts.

Figure 3 shows the evolution of participation in the Wordle activity throughout the 13 sessions of the course. The average participation was 53.20 students, with a maximum of 59 and a minimum of 43. The figure reveals a slight downward trend in participation, which could be attributed to several factors, such as fatigue, or difficulties to deal with multiples subjects. However, the participation remained above 40 students in all sessions, indicating a sustained interest and involvement of most of the students.

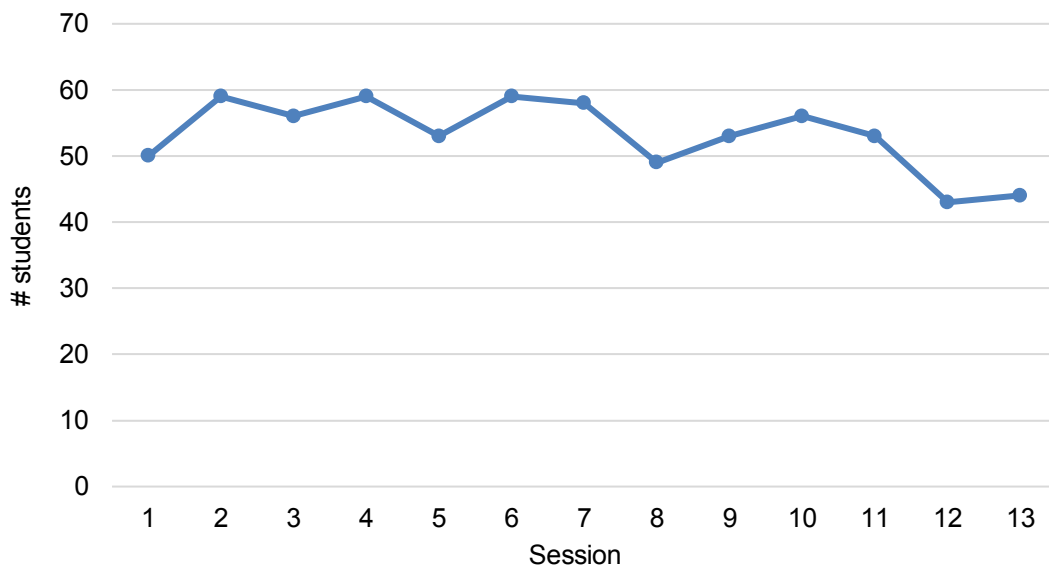


Figure 3. Evolution of the participation in the Wordle activity throughout the 13 sessions of the course

4 DISCUSSION

In this section, we discuss the benefits, challenges, and implications of our strategy, as well as the extent to which our objective and hypothesis are fulfilled.

The benefits of this active learning proposal are manifold. It encourages class attendance, as the students need to be present in order to participate in the Wordle activity and earn points for the league. It also improves attention in class, as the students need to pay attention to the key concepts taken in class, since they might be included in the Wordle. Moreover, it increases students' motivation, as they

compete with other classmates in a fun and engaging way, while learning and reinforcing the course content. Additionally, it aids in consolidating acquired knowledge and developing synthesis and information organization skills, as the students create conceptual maps with the words included in the Wordle, as a final review of the course.

The implementation of this strategy also faced some difficulties that need to be addressed. One of them was the time constraint, as the students had only 5 minutes to solve all the Wordle at the end of each class, which sometimes resulted in frustration or stress. Another challenge was the technical issues, such as the Internet connection or the compatibility of the external applications, which occasionally caused delays or errors in the Wordle activity. A third challenge was the difficulty level of the words, which varied depending on the topic and the familiarity of the students with the course content, and sometimes required hints or clues from the teacher.

The implications of our results for active learning and student engagement are significant, as they suggest that the integration of Wordle as a pedagogical tool can enhance the learning experience and outcomes of the students in the RE course. This strategy can also be replicated in other courses or subjects, as long as the words are relevant and meaningful for the course content and objectives. Furthermore, this proposal can be adapted to different contexts and scenarios, such as online or hybrid teaching, by using different platforms or tools that allow the creation and sharing of Wordle.

Transitioning from the implications to the research questions posed, we first asked: RQ1: How does the use of Wordle affect the academic performance of the students in the RE course? The results indicate that the students who participated in the Wordle activity achieved a higher average final grade in the subject (6.41) compared to those who did not participate continuously (5.30). This suggests that the use of Wordle positively impacts the academic performance of the students.

Building on this, we then considered RQ2: How does the use of Wordle influence the attendance and participation of the students in the RE course? The data showed that out of the 71 enrolled students, 39 actively participated in the Wordle at the end of each class and completed the asked activity of building a concept-map using UML. This indicates that the use of Wordle encourages attendance and active participation in the course.

With these findings in mind, we turned to our Hypothesis: The use of Wordle as a pedagogical tool for active learning increases the motivation of the students in the RE course. The positive correlation between participation in Wordle and better academic performance, as well as the sustained interest and involvement of the majority of the students throughout the 13 sessions, supports this hypothesis.

Finally, we evaluated our Objective: To enhance student engagement and learning outcomes in the RE course through the integration of Wordle as an active learning tool. The results suggest that this objective has been achieved. The students who actively engaged in the Wordle activity demonstrated a higher commitment to the subject and a better understanding of the key concepts. Moreover, the creation of conceptual maps with the words included in the Wordle, as a final review of the subject, helped to consolidate the acquired knowledge and develop skills of synthesis and organization of information. Therefore, we can conclude that our proposal was effective and successful in fulfilling our objective. This brings our discussion full circle, affirming the value of Wordle as a pedagogical tool for active learning.

5 CONCLUSIONS

This paper has presented an innovative pedagogical strategy to foster active learning and students' participation in the Requirements Engineering course, using the popular online word-guessing game, Wordle. The results of the proposal indicate that the use of Wordle as a pedagogical tool has a positive impact on the motivation, performance, attendance, and participation of the students in the course. The students who actively engaged in the Wordle activity demonstrated a higher commitment to the subject and a better understanding of the key concepts. Moreover, the creation of conceptual maps with the words included in the Wordle, as a final review of the subject, helped to consolidate the acquired knowledge and developed skills of synthesis and organization of information. Therefore, we can conclude that our proposal was effective and successful in fulfilling our objective of enhancing student engagement and learning outcomes in the Requirements Engineering course.

The implications of our results for active learning and students' engagement are significant, as they suggest that the integration of Wordle as a pedagogical tool can enhance the learning experience and outcomes of the students in any course or subject, as long as the words are relevant and meaningful for the course content and objectives. Furthermore, this proposal can be adapted to different contexts and

scenarios, such as online or hybrid teaching, by using different platforms or tools that allow the creation and sharing of Wordle.

Some directions for future research in this area are to explore the effects of different levels of difficulty and feedback in the Wordle activity, to compare the results of this proposal with other active learning strategies, and to investigate the transferability and applicability of this proposal to other disciplines and domains.

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