An OpenAI Integration Experience in a PBL Multimedia Project

Alberto Real-Fernández[1], Carlos José Villagrá-Arnedo[1] Jesús Lorenzo-Gallego[2], Sara Morote-Baños[2], Daniel Giménez López-Torres[2], José Daniel Neme-Jerez[2], and Alejandro Martínez-Gonzálvez[2]

[1] Smart Learning Research Group, University of Alicante, Spain
{alberto.real, villagra}@ua.es
[2] University of Alicante, Spain {jlg96, smb86, dgl37, jdnj1, amg334}@alu.ua.es

Abstract. This research analyses the experience of integrating OpenAI in a multimedia web project. It has been developed by five students of the Undergraduate degree in Multimedia Engineering at the University of Alicante, following PBL methodology, and consists on a web application aimed to enhance the teaching and learning process of physics. Among other features of the platform, it allows to simulate different physics problems, being able to create them using OpenAI. In this paper we describe the platform and its integration with OpenAI, analysing it utility and performance.

Keywords: OpenAI, physics learning, multimedia engineering, PBL

1 Introduction

In the educational environment, the powerful emergence of ChatGPT has caused confusion and disagreement among its professionals, some of them predict the end of education as we currently know it, while others state that the use of AI tools could help to enhance our learning environments for students and teachers. These ones believe that this kind of tools such as ChatGPT could be used in subjects and courses to enhance the learning process, as well as teaching students about the ethical use of them. For this reason, we believe that their use can be appropriate, and we want to show their application in a concrete case.

The case we expose has been developed following the methodology called PBL (Project Based Learning), that we apply in the last course of the Undergraduate degree in Multimedia Engineering at the University of Alicante. In this methodology, the students develop a complete multimedia project in groups, so that they learn and evaluate the contents of all the corresponding subjects of the course, without taking any exams.

In the current academic year 2022/2023, one of the developed projects is Solv3d, a web application designed to improve the teaching and learning of physics, allowing teachers and students to create and simulate different problems. In addition, given the mentioned rise of AI, the students developed a new feature that integrates the creation of problems using OpenAI.

Therefore, the aim of this research is to expose the mentioned platform, see a small use case, analyse the usefulness of its idea and performance through real feedback, and check how it has been integrated with an OpenAI tool.

2 Background

2.1 PBL Methodology

The Undergraduate degree in Multimedia Engineering has been taught at the University of Alicante since the 2010/11 academic year. Its objective is to teach the students to be professionals capable of managing projects in the area of Multimedia, either in the sector of digital entertainment or in content management. Thus, the 4th year of the degree has been organised into two itineraries, oriented towards training in each of the two sectors mentioned: digital creation and entertainment, and content management. So that in this year a PBL (Project Based Learning) methodology is applied, students are divided in teams of 5 or 6 components to develop a multimedia project, with which they learn the contents of all the subjects of their itinerary and they are evaluated through the project itself, without taking any exam. This methodology has already been applied for 10 editions, with successful results and a high level of students and teachers satisfaction [1, 2].

Concretely, in the Content Management path, the projects are focused on the development of a multimedia content management system as a service, which usually consists on a multi-device web application which provides a solution to a specific problem. Each team is free to choose an idea for its project, and in the first phase this idea is conceived and defined with the advice of the itinerary's teachers. Once it has been validated, it is specified and then fully developed in three phases until a 100% functional product is obtained. The proposed project, called Solv3d, belongs to its itinerary and consists, as we mention in depth in section 3, on a web application focused on physics subject, that allows to create and simulate different kind of problems.

2.2 AI in education

The current rise of ChatGPT has caused alarm among different fields, but specially in education. Some of its professionals think it can lead to the end of education in its current form, specially due to the difficulty of detecting plagiarism in student works. However, other education professionals propose an alternative vision, where teachers can use AI tools like ChatGPT to create favourable learning environments for some students [3]. They also believe that it can be incorporated into subjects and courses to teach students the ethical use of these tools. Instead of asking them to repeat theories from a textbook, they can be asked to demonstrate their understanding by applying that knowledge to complex and fictional cases.

Besides, some researches state that the integration of AI technologies, in particular ChatGPT, has brought new opportunities and renewal to traditional

teaching processes and methods. They claim that ChatGPT, functioning as an intelligent learning assistant, is useful for enhancing task-oriented project-based learning (PBL), transforming traditional passive learning [4]. Also other researches are focused on its application mathematics and physics education [5, 6]. These studies focus on how the use of AI tools can affect the acquisition of critical thinking, problem solving and group working skills among students. The results indicate that students have been quick to adopt the ChatGPT tool, showing high confidence in their responses and general use in the learning process, along with positive evaluation.

3 Solv3d Project

As mentioned before, Solv3d is a web application focused on enhancing both teaching and learning process of physics by making use of the potential of current web technologies. It aims to make easier for students to learn physics concepts, even those with learning difficulties, as well as to help teachers during the teaching process.

Concretely, Solv3d presents the following main features:

- Create and simulate physics problems in a 3D environment in which objects can be added, with different configurable properties.
- Create new problems from templates of previously made exercises.
- Interact with a virtual assistant that helps you during the problem creation task and in the most of the application features.
- Using artificial intelligence to create a problem from a statement.
- Simulate the problems using virtual reality in a mobile device.
- Share created projects by a QR code or a link, or even an embed code that allows to upload them to a website, blog or Moodle.

Now from these explained features, let us see some of the main screens of the tool. Figure 1 shows the home page of the platform, that has a main menu on the left from which you can create a new project, access to different administration sections (if proceeds) and manage your created projects. By default, the page shows a section with your recently accessed projects and some recommended templates.

In figure 2 we can see a created project that has been opened for edition. This concrete project consists on two objects (cars in this case) that aim to arrive to a marked point (a finish line), in which both the cars and the finish line has been modeled with images. This can be done from the side menus displayed, from the left one we can access the project properties and manage the different objects in the scene, and from the right one we can edit all the properties of a selected object.

Below in figure 3 it's shown the virtual assistant we mentioned before. It is a virtual chat called ProtonBot that helps you with the different features of the platform, including the creation of projects, and with different doubts you can have.

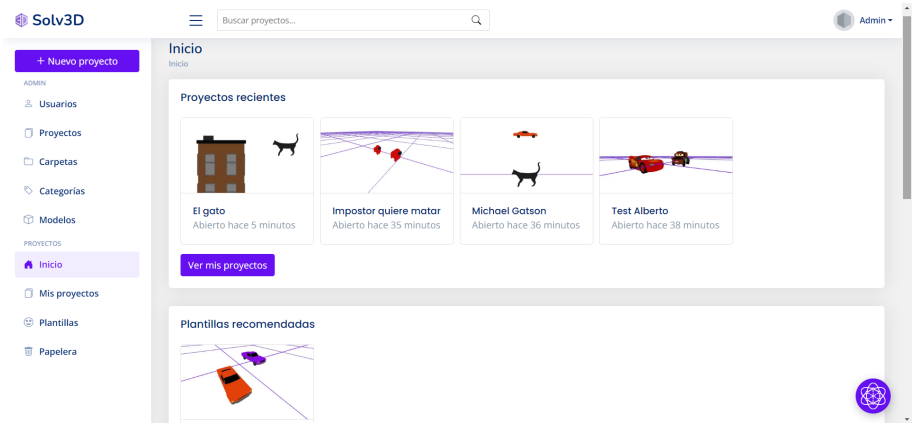

Fig. 1. Home page of Solv3d, where you can see your recently accessed projects and the main left menu with options for creating a new project, manage the created ones and different admin sections.

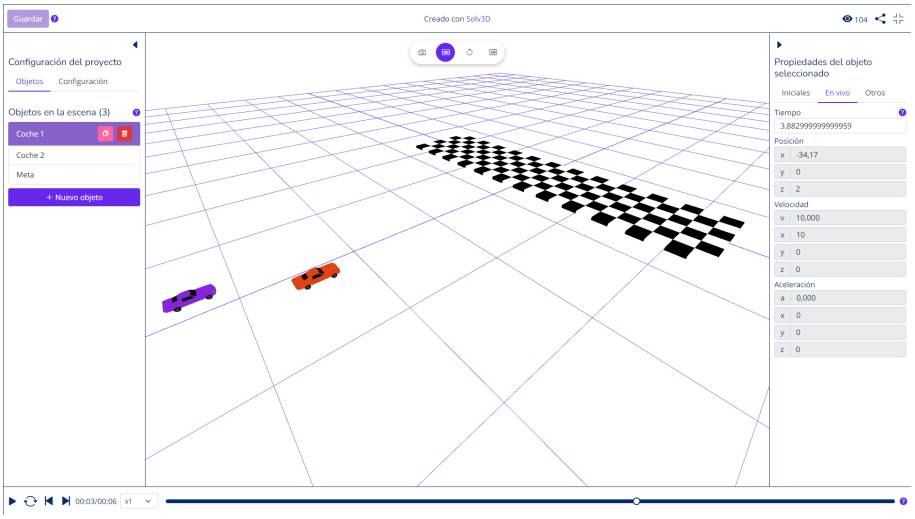

Fig. 2. Project edition page, from which we can edit different project properties and manage the objects we want to create in it.

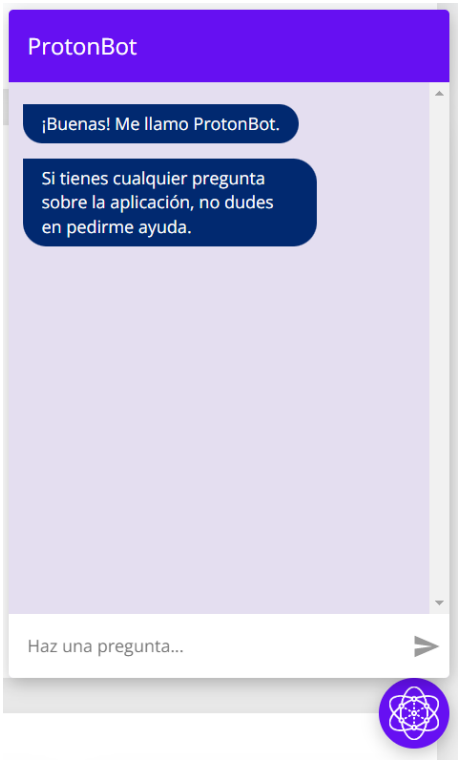

Fig. 3. ProtonBot, the virtual assistant of the application that helps you solve your doubts or create projects, among others features.

Finally, one the most interesting features of Solv3d is the integration with OpenAI, what allow us to create a project that is being using AI, with an option called "Generate with AI", which opens a model with an explanatory text of the instructions to follow. This feature is deeply explained in section 4.

4 OpenAI Integration

In the last phase of development, we focused on enhancing some aspects of the platform and adding some extra features, mainly the integration of Artificial Intelligence (AI) to create projects in the platform. We came to the conclusion that the use of AI in our application would be an interesting feature to automatically generate a project given a problem statement.

Concretely, we chose OpenAI's API, which offers different models that could be appropiate for our purpose. At the beginning we used text-davinci-003, with which we obtained very good results, but finally we changed to gpt-3.5-turbo, a much more optimized and cheaper model OpenAI released. Also, with this model you can provide example responses, which is very useful for understanding what task to perform beyond the given instructions.

Once the API connection was implemented, we were able to experiment with prompts engineering how GPT could understand the context of our application and generate a text file (in JSON format) with the structure of a project without fail 100% of the time. To do so, the first thing we did was to indicate the task to be performed, as well as the structure of the project data. This data includes information such as the objects of the project, their initial position, speed, acceleration or other forces involved, even the graphic model for each of them.

Finally, we indicated the most important part, which was to give examples of response from example prompts. In other words, we gave an output for different inputs. In this way, the response from the prompts would be almost 100% of the time a valid response with JSON structure interpretable by our application. After achieving this, the only thing left to do was to add the visual elements in the frontend of our application to be able to use this new functionality.

Let us show a real example of this feature, with a given problem statement and the result obtained. The statement propose is "A car reaches a speed of 10m/s over 2 seconds. What is the acceleration of the car if it has an initial speed of 0m/s?". From this statement, we obtained a JSON file containing the data of the project according to the information given, with a duration of 2 seconds, a car which has associated a graphic model that the AI previously learned, an initial speed of 0m/s since it was not provided as well as the position. Finally, it provides a computed acceleration of 5m/s2, obtained from the rest of the problem data.

From this information file obtained from the AI API, the platform create a project as showed in figure 4, where it can be seen a red car with their variables and forces values on the right with the mentioned values.

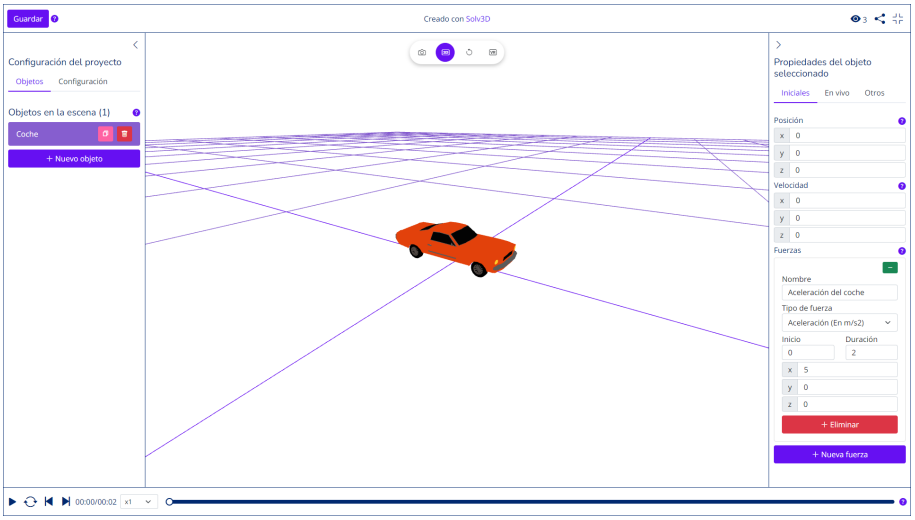

Fig. 4. ...

As it can be seen, the model has successfully interpreted how it should represent the problem from the statement. In addition to deducing and applying an acceleration of 5m/s2 for 2 seconds, it has indicated that the duration of the simulation is 2 seconds and has selected the model of a car from the list of models provided in the instructions. He was also able to interpret that the car should move along the X-axis in the positive direction starting from x=0, all this by indicating only the statement of a traditional physics problem.

For more complex problems or problems using other models, this method of generating problems is still very powerful in our tool because you can create a project base to work from and not have to start from scratch.

5 Validation

In order to validate the main idea of the project, we carried out a survey aimed to find out the main needs of students and teachers in relation to teaching and learning of physics and mathematics, concretely in the last years of secondary school.

This study was made during the first weeks of development and was carried out through Google Forms, in which we collected more than 100 responses between teacher and students. We focus on finding out whether people were satisfied with the more old-fashioned tools they had for learning physics or they would welcome a new digital tool in the classroom and they would be willing to use it.

Firstly, let us analyse the answers of the teachers, most of whom have been teaching for more than 15 years. On one hand, we asked if they have ever had

difficulties explaining some physics or mathematics problems, to which almost a 70% denied it. On the other hand, a same 70% states they find it difficult to successfully explain all the details involved in a problem in a traditional blackboard, what we found interesting. That means they do not usually have troubles explaining concrete problems of the subject, but they do when explaining them with a traditional tool. Related to this fact, and confirming it, almost a 90% claim that a digital tool to display problems in a virtual environment would be very useful and that they would be willing to use a new teaching method based on digital tools.

Regarding students, we asked similar questions in order to check the same concepts. More than an 80% have had some troubles to understand some physics or mathematics problems or to complete an exercise by themselves. On the other hand, a bit more than the 50% of them does not miss digital tools in class, but a huge 94% of them think that an additional method instead of the traditional blackboard would be useful to understand problems.

Therefore, the feedback given by teachers coincides with the given by the students, stating that traditional methods are not enough to fully explain or understand physics problems, and confirming our idea that a complementary tool was needed to improve the way classes are taught.

During the event "I Want to be an Engineer" organised by the University of Alicante we were able to show our project to students and teachers, which represent our target audience. The results were very positive, since the opinions of the students coincided with the results of the pre-development surveys, they even asked us if there was a version they could test. As for the teachers, they were not so agree with the idea at the beginning, but it changed when we explained the tool was not meant to substitute them, but as a complement during class lessons and homework.

At another event held by the University of Alicante, called UAContenidos, we collected opinions of students from our same degree course, who had already passed the academic stages than our platform. We asked them if they thought it would have made it easier for them to learn the concepts they had already learnt with our application. The answers were in line with those we got at the previously mentioned event. People were quite happy with the outcome of the project, we even did a survey to collect some data. In terms of usability, the first view people had from the outside is that the design is minimalist and clean but still a bit complicated to understand. However, when they started to use the platform, a 87% said it was very intuitive and easy to use.

Almost the same percentage of people found our application very useful and a 75% understood the exercise we proposed better after using Solv3D. Besides, almost all of people were willing to use it to complement their physics teaching, as they thought it could helped them focus more and understand complex physics concepts more easily.

In addition, different companies and professionals in the field were able to evaluate our idea and the result we had obtained, which was very useful to make the final touches until the final delivery. final delivery.

6 Conclusions

In this research we have analysed the impact of AI in education, which we consider a useful tool for helping both teachers and students and even enhance the learning process. For that reason, we have studied its integration with the web tool Solv3d, based on physics learning, in which the OpenAI API is used to create complete projects from a single statement.

The result of this integration has been really successful. In the web application, the user is able to create full physics problems, with different objects, forces and scenarios, and simulate them in a 3D or 2D environment. But with the help of AI, it can be done with a single statement of the problem. The platform sends this text to the AI module, it processes the statement and send a result back to the platform, that finally displays a complete created project to be simulated and tested by the user.

Given the feedback received regarding the idea of using a platform to support the teaching and learning process in physics, and the feedback of the use of the first stable version of the platform, along with the results obtained with its integration with OpenAI, we strongly believe that it can become a powerful tool both for teaching and learning.

In the future, we would like to continue enhancing this platform, extending the kind of problems it can solve, among other features. Also, we want to test this application in formal environments, such as actual academic courses or subjects, and collect more feedback from both teachers and users, in order to confirm its usefulness and the contribution we think it can make.

7 Bibliography

References

1. Patricia Compañ-Rosique, Carlos J. Villagrá-Arnedo, Rafael Molina-Carmona, Francisco J. Gallego-Durán, Rosana Satorre-Cuerda, and Faraón Llorens-Largo. Multisubject pbl: Implementing, maintaining and evolving through 15 years. In Panayiotis Zaphiris and Andri Ioannou, editors, *Learning and Collaboration Technologies. Designing the Learner and Teacher Experience*, volume 13328, pages 420–432. Springer International Publishing, 2022.
2. Carlos-José Villagrá-Arnedo, Francisco J. Gallego-Durán, Faraón Llorens Largo, Miguel Angel Lozano, Rafael Molina-Carmona, Francisco José Mora Lizán, Mireia Sempere-Tortosa, José M. Iñesta, Pedro José Ponce de León Amador, and Gabriel J. Garcia. Desarrollo de una metodología ABP para el itinerario creación y entretenimiento digital del cuarto curso del grado en ingeniería multimedia (4002). In *Memorias del Programa de Redes-I3CE de calidad, innovación e investigación en docencia universitaria. Convocatoria 2017-18*, pages 155–176. Universidad de Alicante. Instituto de Ciencias de la Educación (ICE), 2018.
3. University of Tasmania, Australia, Joseph Crawford, Michael Cowling, Central Queensland University, Australia, Kelly-Ann Allen, and Monash University, Australia. Leadership is needed for ethical ChatGPT: Character, assessment, and learning using artificial intelligence (AI). 20(3), 2023.

4. Xiaoming Zhai. ChatGPT and AI: The game changer for education. 2023.
5. Luis M. Sánchez-Ruiz, Santiago Moll-López, Adolfo Nuñez-Pérez, José A. Moraño-Fernández, and Erika Vega-Fleitas. ChatGPT challenges blended learning methodologies in engineering education: A case study in mathematics. 13(10):6039, 2023.
6. Philipp Bitzenbauer. ChatGPT in physics education: A pilot study on easy-to-implement activities. 15(3):ep430, 2023.