information

MDPI

Article

Enhancing Accessibility to Analytics Courses in Higher Education through AI, Simulation, and e-Collaborative Tools

Celia Osorio , Noelia Fuster , Wenwen Chen , Yangchongyi Men and Angel A. Juan *

Research Center on Production Management and Engineering, Universitat Politècnica de València, 03801 Alcoy, Spain; cosomuo@epsa.upv.es (C.O.); nfuscom@epsa.upv.es (N.F.); cwenwen@upv.edu.es (W.C.); myangch@upv.edu.es (Y.M.)

* Correspondence: ajuanp@upv.es

Abstract: This paper explores how the combination of artificial intelligence, simulation, and e-collaborative (AISEC) tools can support accessibility in analytics courses within higher education. In the era of online and blended learning, addressing the diverse needs of students with varying linguistic backgrounds and analytical proficiencies poses a significant challenge. This paper discusses how the combination of AISEC tools can contribute to mitigating barriers to accessibility for students undertaking analytics courses. Through a comprehensive review of existing literature and empirical insights from practical implementations, this paper shows the synergistic benefits of using AISEC tools for facilitating interactive engagement in analytics courses. Furthermore, the manuscript outlines practical strategies and best practices derived from real-world experiences carried out in different universities in Spain, Ireland, and Portugal.

Keywords: higher education; artificial intelligence; analytics; e-collaborative tools

check for updates

Citation: Osorio, C.; Fuster, N.; Chen, W.; Men, Y.; Juan, A.A. Enhancing Accessibility to Analytics Courses in Higher Education through AI, Simulation, and e-Collaborative Tools. *Information* **2024**, *15*, 430. https://doi.org/10.3390/info15080430

Academic Editor: Silvia Ceccacci, Catia Giaconi and Noemi Del Bianco

Received: 1 July 2024
Revised: 17 July 2024
Accepted: 22 July 2024
Published: 25 July 2024

1. Introduction

As pointed out by Campos et al. [1], internet-related technologies have had a noticeable impact on higher education, particularly in STEM fields, enabling global access to courses. A globalized educational experience also raises the level of heterogeneity among students due to varied cultural and educational backgrounds. Zawacki-Richter et al. [2] provides a comprehensive overview of the different areas in which AI is being applied in higher education, highlighting four main applications: (i) profiling and prediction; (ii) intelligent tutoring systems; (iii) assessment and evaluation; and (iv) adaptive systems and customization. In this context, artificial intelligence (AI), simulation-based, and e-collaborative tools play a key role in online and blended higher education.

The increasing internationalization of higher education leads to a more diverse student body with varied cultural, educational, and linguistic backgrounds. This diversity presents accessibility challenges, as educators must address the needs of students who may have different levels of proficiency in the language of instruction or varying familiarity with academic norms and practices. In addition, the trend towards interdisciplinary education means that students are increasingly required to acquire knowledge and skills across multiple domains. While this broadens educational opportunities, it also poses accessibility challenges for students who may lack foundational knowledge in certain disciplines. Likewise, the expansion of online education and lifelong learning initiatives has made higher education more accessible to a wider range of learners, including working professionals and adult learners. However, online courses may present accessibility barriers for students with disabilities or those who lack reliable internet access or digital literacy skills. Thus, for example, students with disabilities may require alternative formats for course materials, such as accessible documents or multimedia content with captions and transcripts. Additionally, human–AI interaction and collaboration solutions are currently available to assist individuals with disabilities [3]. These technologies can motivate educators to incorporate them into educational environments, enhancing the learning experience for both students and instructors. The integration of human capabilities with advanced technologies is progressing swiftly. Complex computer systems utilizing machine learning (ML) algorithms can aid individuals with diverse abilities, executing human-like processes and complex tasks that are also applicable to educational contexts [4].

In this context, we define the concept of AISEC as the integrated application of artificial intelligence, simulation, and e-collaborative tools. This integration is visually depicted in Figure 1. Within each circle is shown which specific tools are being used for AI, simulation, and e-collaborative purposes, highlighting how they overlap and interact. This convergence illustrates the logic behind the definition of the AISEC concept.

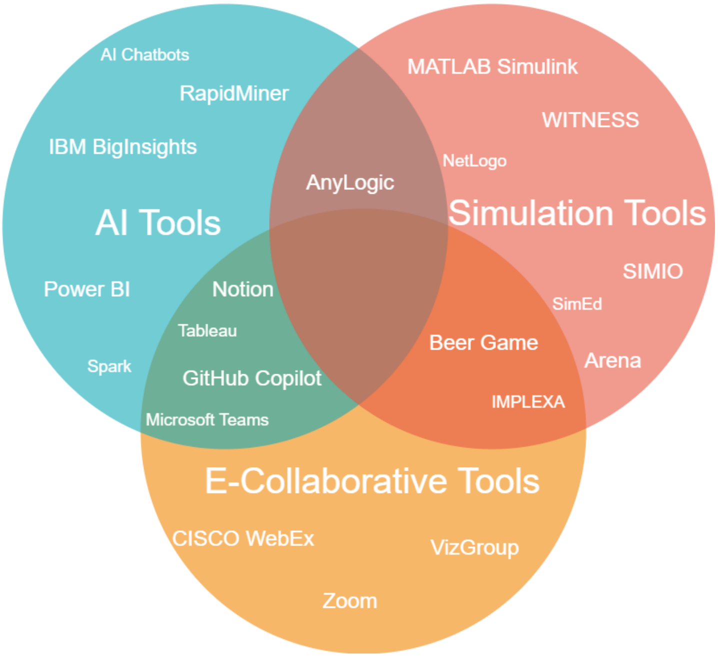

Figure 1. Overview and integration of AISEC tools.

Based on this definition, this paper discusses how the use of these AISEC tools can also enhance accessibility in higher education analytics courses, taking into account different linguistic backgrounds and analytical competencies. Through a comprehensive review of existing literature and empirical results from practical implementations, the benefits of using AISEC tools to facilitate interactive participation in analytics courses are highlighted. In addition, the paper outlines practical strategies and best practices derived from real experiences carried out in different universities. The remaining of this paper is structured as follows: Section 2 explains how the impact of AISEC tools on accessibility in higher education analytics courses was investigated. Additionally, the criteria for conducting the literature review and selecting university experiences are specified. Section 3 provides an overview of related work. Section 4 describes some of the most popular AISEC tools that are being used in higher education analytics courses, taking into account accessibility. Then, Sections 5–7 present some recent experiences teaching these courses at three different universities in Spain, Ireland, and Portugal. Finally, Section 8 provides a summary of the main findings of this work, as well as suggestions for future research.

2. Methodology

The methodology is organized into two main phases: defining the criteria for conducting the literature review and establishing the criteria for selecting university experiences.

Therefore, for the first phase, the focus was on identifying relevant literature on educational accessibility and technologies in teaching analytical courses. In this paper, a systematic search was conducted mainly based on the academic databases Web of Science, Scopus, and Google Scholar. In this sense, a systematic search based on keywords including "educational accessibility", "educational inclusion", and "disability education" was conducted to clarify the scope and the challenges of educational accessibility. Additionally, the keywords "analytics courses" and "teaching technologies" were used to thematically analyze the most recent academic literature from the past five years in order to synthesize research findings. An association network diagram was then created to visualize the main themes in the literature, and other relevant teaching technologies were discussed to address identified gaps. The literature review utilizes representative literature to support general conclusions regarding the effectiveness of AISEC discussed with respect to its effectiveness in teaching analytics courses. Subsequent searches for AI, simulation, and e-collaboration tools were conducted separately, with a focus on filtering out literature targeting courses related to educational accessibility and analytics.

For the second phase of our research, the emphasis was on selecting and evaluating university experiences that implemented AISEC tools in their higher education analytics courses. In this case, three European universities were selected: the Universitat Politècnica de València (UPV), the University College Dublin (UCD), and the Universidade Aberta (UAb) of Portugal. These institutions were selected due to the firsthand experiences of the authors, either as professors or students, offering a mix of geographical and cultural diversity from Spain, Ireland, and Portugal. UPV, UCD, and UAb are well-recognized in higher education, ensuring the experiences evaluated occur within a rigorous academic environment. The authors' familiarity and prior relationships with these universities facilitated data access and the implementation of AISEC tools, allowing for detailed monitoring of the practical experiences. Furthermore, the results of the practical experiences in each of these universities are explained in Sections 5–7. Data collection includes active participation in the lessons, where we engaged with both the tools and the students. We collected and analyzed data provided by the software after each session and also gathered students' feedback on the use of these tools and their impact on the class.

To address ethical concerns during our research, given that some of the authors were participants in these educational experiences, either as students or professors, we took extra measures to ensure objectivity in the analysis regarding the use of AISEC tools in these universities. We maintained an objective approach to prevent any potential bias. This included separating personal experiences from data analysis and also obtaining feedback from other students in the courses to ensure that our conclusions were based solely on empirical evidence and not personal perceptions. The feedback obtained was collected with informed consent and strict anonymity in order to ensure the students' confidentiality.

3. Literature Review

In the digital era, ensuring the accessibility of education for all students has become an urgent issue. Therefore, this section will focus on educational accessibility, with an examination of the existing research literature. This discussion will address the ways in which authors address these challenges through technological innovation.

3.1. The Role of Accessibility in Education

Accessibility in education refers to equal learning opportunities and resources for all students that are diverse in many dimensions, including gender, race and ethnicity, age, socioeconomic status, ability, disability, and learning style [5]. The flexibility of online education makes it an important tool for increasing equity during the learning process [6]. This diversity, while enriching, also presents distinct challenges that educators must address to ensure equitable learning opportunities. Among this challenges, we can consider:

1. Language barriers: One of the primary challenges faced by students from non-native language backgrounds is language barriers to comprehension and expression. These students often struggle to keep pace with their peers in understanding instructional materials and participating in classroom discussions. To address this issue, research

advocates for the implementation of language support services, such as ESL (English as a Second Language) programs, which can provide tailored assistance to help these students develop proficiency in the language of instruction [7].

2. Previous educational quality: The variability in the quality of prior education can result in significant gaps in foundational knowledge and skills among students. The student demographics in online education have changed, with 41.6% of online learners being over the age of 30 [8]. Those who have experienced subpar educational settings may struggle to meet the academic demands of their new environments [9]. To improve the accessibility of education, AI technology is widely used to help students improve teaching effectiveness and learning experience. Diagnostic assessments [10] can help identify these gaps early on, allowing educators to develop personalized learning plans tailored to each student's needs.
3. Learning disabilities and special needs: Students with learning disabilities or special needs require specific accommodations and tailored instructional methods to succeed academically. These students face unique challenges that standard educational practices may not adequately address [11]. The impact of the four most common disabilities on learning and the common solutions are illustrated in Figure 2.
4. Cultural differences: Students from diverse cultural backgrounds may find it challenging to fulfill the social and academic expectations of their new settings [12]. Culturally responsive teaching practices, which include incorporating diverse cultural perspectives into the curriculum and promoting an inclusive school culture, can help mitigate these issues. By valuing and respecting cultural diversity, educators can create a more welcoming and supportive environment for all students. This view aligns with the role of open educational resources (OERs) in promoting inclusive learning. Hockings et al. [13] highlighted that OERs provide flexible and accessible learning materials that cater to diverse student needs.
5. Socioeconomic disparities: The uneven distribution of resources is a serious impediment to the accessibility of education. In Norway and Switzerland, 95% of students are fortunate enough to have access to electronic devices, whereas in Indonesia, only 34% of students have such access [14]. Students without available resources face a host of socioeconomic challenges that affect their educational experiences. These students often lack access to essential resources such as technology, learning materials, and extracurricular opportunities, which are crucial for holistic development [15]. To combat these disparities, schools can implement financial aid programs that alleviate the economic burden on families. Providing free or low-cost learning materials and creating supportive environments where all students have equal access to educational resources can significantly enhance the learning outcomes for socioeconomically disadvantaged students.

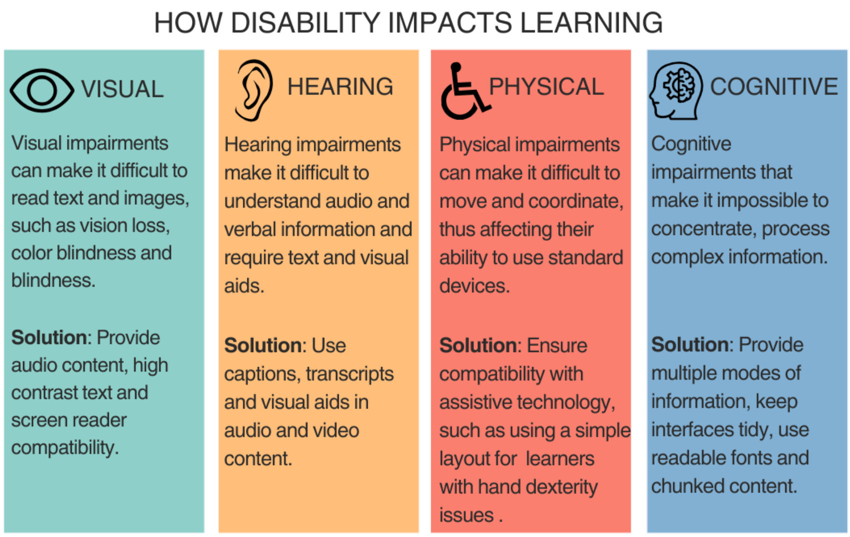

Figure 2. How disability impacts learning.

3.2. The Use of Technology in Teaching Analytical Courses

Analytics courses should cover a multi-stage framework related to data, such as acquisition, preparation, analysis, visualization, and interpretation, combining multiple fields such as statistics, business domain knowledge, and computer science to help students acquire relevant knowledge and skills [16]. Figure 3 shows the association and distribution of keywords in 171 papers related to analytics courses and teaching technologies recorded in Web of Science over the past five years. The size and color of the circles indicate the frequency of the keywords in the study and their relevance to other keywords, respectively. Topics such as educational technology, online learning, ML, and AI have gained particular attention in recent years.

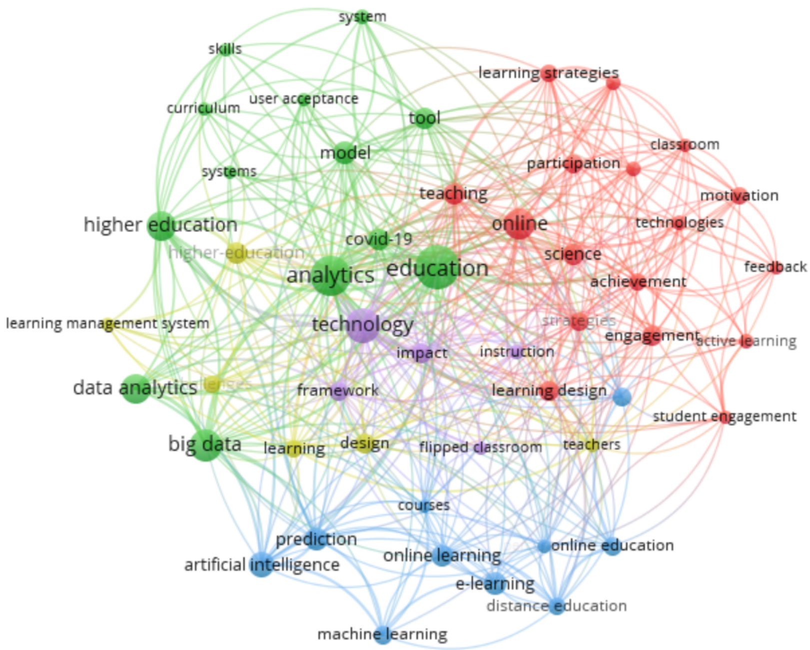

Figure 3. Keywords network visualization and association strength of studies with "analytics courses" and "teaching technologies".

Massive online open courses (MOOCs) provide teaching materials, assessment, and collaboration tools to thousands of students [17]. These online education platforms democratize access to education and enable learners from diverse backgrounds to acquire analytical knowledge and skills, regardless of their location or physical limitations. The rapid development of analytical tools such as ML and AI can greatly improve the effectiveness of data analysis [18]. Incorporating AI and ML into the course equips students with the necessary skills to utilize these powerful tools, preparing them for the data-driven challenges of the future.

In addition to the highly valued analytical course related topics of online education, AI and ML are shown in Figure 3. Simulation and e-collaboration should also be considered powerful tools for teaching analytical courses [19,20]. Simulation tools help students to conduct experiments and analyses in a virtual environment, enhancing their understanding of complex concepts. On the other hand, e-collaboration tools promote interaction and communication among students and between teachers and students, increasing the engagement and effectiveness of learning. Therefore, online education, AI, simulation, and e-collaborative tools can all be used as technologies for teaching analytics courses to improve the quality and efficiency of education.

4. AISEC Tools for Teaching Analytical Courses

4.1. AI Tools for Teaching Analytical Courses

The capabilities of AI in processing large data sets, generating insights, and facilitating customized learning experiences have made it increasingly popular in education. From the development of intelligent online and web-based education to the integration of computer systems with technologies like humanoid robots and chatbots, AI has been widely accepted by educational institutions and used to perform instructional tasks autonomously or with teachers [21]. Branches of AI such as ML, deep learning, and natural language processing work together to create personalized learning platforms and improve educational accuracy by building intelligent tutoring systems, agents, and collaborative learning systems that respond to students' needs and support teachers' decision making [22]. The integration of technology and AI is particularly expected in analytics teaching.

4.1.1. Various AI Tools Used for Teaching Analytics

In terms of AI tools for teaching analytics courses, Asamoah et al. [23] describe the pedagogical approach used to design a big data analytics course in the general management information systems (MIS) program at Midwestern University. The course modules cover various technologies: (i) the Apache Hadoop ecosystem for large-scale data collection and management; (ii) the IBM BigInsights and InfoSphere Streams for static and dynamic data; and (iii) Teradata Aster, a Big Data platform supporting MapReduce-enabled analytics. The course also utilizes Gephi for data visualization, and a combination of Tableau with Hortonworks, Teradata, and IBM tools. Advanced analytics techniques such as network analytics and stream mining are included. Survey results demonstrate the course's effectiveness in helping students acquire relevant knowledge and skills. Similarly, Eckroth [24] describes Stetson University's Big Data Analytics course for computer science students, featuring data preprocessing with Linux tools, distributed processing with Hadoop MapReduce and Spark, and database querying with Hive and Google BigQuery. Student feedback indicates the course effectively teaches parallel and distributed computing frameworks and techniques used in industry.

Business schools teaching business intelligence and analytics (BI&A) should integrate BI&A content into their core syllabus. Allil [25] proposed a framework for marketing analytics education that incorporates AI tools like ML and predictive analytics, including case studies of companies using AI-driven marketing analytics. Students use resources such as the UCI Machine Learning Repository. Also, utilize ML repositories such as Kaggle, Data.gov, and Google Dataset Search, and learn visualization tools like Tableau, Power BI, and Python, along with ML tools like scikit-learn, TensorFlow, and R's caret package. Sentiment analysis tools like TextBlob, VADER, and Stanford CoreNLP, and NLP libraries like NLTK, SpaCy, and Gensim are also included. Applications include predictive analytics for customer behavior, ML for customer segmentation and product recommendation, deep learning for targeted advertising, automated content creation, and voice assistants for customer interaction. Advanced data analytics courses incorporating robotic process automation (RPA) and AI in accounting graduate programs at northeastern U.S. public universities have proven effective in meeting learning objectives [26].

AI tools can also empower coding-related courses as a major theme in analytical courses. Large-scale language models (LLMs) such as the AI chatbot ChatGPT and the generative AI tool GitHub Copilot have shown their potential as programming learning tools [27]. González-Carrillo et al. [28] have added support for automated Jupyter notebook evaluation to the UNCode auto-grader, deployed at https://uncode.unal.edu.co (accessed on 1 July 2024), to facilitate instructor–student interactions. This enhancement allows instructors to configure the Jupyter notebook grader through an easy-to-use user interface and provides students with both summative and formative feedback related to programming assignments. The tool's application in AI-related courses—Introduction to Intelligent Systems and Machine Learning—at the Universidad Nacional de Colombia during the first semester of 2020 received positive feedback from students. Vittorini et al. [17] also developed an automated grading tool for MOOC assessment activities based on R commands and natural language annotations, improving grading efficiency and helping students achieve better learning outcomes.

Table 1 summarizes some AI tools that are used to teach the analytics courses in the different colleges mentioned in the paper, some of which are used for the AI skills required in the analytics courses themselves, some of which are used to help in other related courses such as those related to "Programming", and some of which are used to provide feedback to both students and teachers, as stated above. The Reference column cites case studies where these tools have been applied to enhance the student learning experience.

Table 1. AI tools used in teaching analytics courses.

Course	Tool	Reference
Big Data Analytics in MIS	Apache Hadoop	Asamoah et al. [23]
	Tableau	
	Gephi	
Big Data Analytics for Upper-Level Computer Science	Hadoop MapReduce	Eckroth [24]
	Spark	
	Hive	
	Google BigQuery	
Marketing Analytics	TensorFlow	Allil [25]
Introductory Java Programming	AI Chatbot	Maher et al. [27]
	GitHub Copilot	

4.1.2. AI-Based Language Support Tools for Non-Native Speakers

The diversity of both web-based and face-to-face classrooms is growing. The increasing globalization of the world economy continues to drive population mobility and bring greater cultural and linguistic diversity to communities and educational systems [29]. Current MOOCs are also attracting a wide variety of demographically diverse students of all ages and from 196 countries across the globe [30]. Analytics course are also bound to attract a diverse group of students, including international students, non-native speakers, and students with varying language abilities. Today's classrooms need to be more inclusive and technology-integrated than ever before [31]. Some of the AI-based language support tools include Presentation Translator and AI Speech Recognition, which offer real-time language translation and voice recognition capabilities [32]. Additionally, voice assistants or smart speakers and chatbots [33,34] are widely used for interactive communication and educational purposes.

AI-based language support tools have shown potential in the field of general education to help non-native speakers overcome language barriers and enhance their learning experience to improve inclusiveness and accessibility in the classroom. AI-based solutions such as Presentation Translator can provide real-time captions and enable students to listen to or read content in their native language through AI speech recognition. These technologies not only benefits students who are not native speakers or who are hearing impaired, but also help people with visual limitations to access and understand educational materials more effectively [32]. Voice assistants, including Google Assistant, Siri, and Cortana, utilize cloud computing to integrate AI to allow students to search for materials, reference questions, articles, and books by simply mentioning keywords, displaying the information being searched for in the form of text or images [32]. Similarly, Jordan et al. [35] investigate the use of LLMs (e.g., OpenAI's GPT) to generate programming exercises in multiple languages.

In addition, chatbots are promising in education. Properly designed chatbots can address logistical and diversity issues, from simple Q&A to scenario-based classrooms, filling gaps in teaching and learning [36]. The research of Chen et al. [33] on the chatbot Sammy, developed using Juji (https://juji.io, accessed on 1 July 2024), shows that chatbots can be engaging and responsive conversational learning tools, helping students learn AI concepts interactively and confidentially. Mageira et al. [34] use the Snatchbot platform (https://snatchbot.me, accessed on 1 July 2024) to develop AsasaraBot, an educational AI chatbot that teaches cultural content about the Minoan civilization in English or French. Evaluations in Greek language schools showed it provides instant feedback and maintains student interest through interactive dialogues. Companies like Google, Microsoft, IBM, and Amazon offer platforms for designing, developing, and testing chatbots.

4.2. Simulation Tools for Teaching Analytical Courses

In STEM fields, students often encounter complex models, including NP-hard problems that test their analytical skills [1]. McHaney [37] emphasizes expanding simulations beyond traditional settings. For instance, in a cloud computing course, simulations help develop web service emulations for efficient software testing. In Big Data courses, simulations generate data sets for learning analytics, allowing students to visualize and understand model outcomes effectively. Furthermore, simulation software tools offer simulation capabilities for business, manufacturing, and logistics systems [38]. This enables students to experiment with scenarios safely and cost-effectively. The Beer Game, another educational tool designed to teach logistics, includes online versions, extended supply chain models, and a virtual reality version [39]. SimEd, a simulation package for R, was designed with a pedagogical focus and enhances R's utility for simulation courses with text-based, visualization, and animation teaching methods in discrete-event simulation [40]. Table 2 summarizes a selection of simulation tools that are utilized in educational settings to teach various analytical concepts. Due to constant updates and innovations, a single simulation tool can be applied in various educational contexts; therefore, each tool is listed with its primary learning context. Additionally, the Case Study column references case studies demonstrating the practical applications and effectiveness of these tools in enhancing student learning experiences across different educational disciplines.

Table 2. Simulation tools used for teaching.

Simulation Tool	Learning Context	Type of Simulation	Case Study
WITNESS	Logistics	Discrete-event simulation	Tvrdoň and Jurásková [38]
The Beer Game	Logistics	System dynamics simulation	Jackson and Taylor [39]
SimEd	Statistics	Discrete-event simulation	Doddavaram and Corlu [41]
PhET Interactive Simulations	Physics, Biology, Chemistry	Interactive simulation	Perkins et al. [42]
JADE	Engineering, Social and Computer Science	Agent-based simulation	Sandita and Popirlan [43]
Simulink	Engineering, Control Systems	Model-based design simulation	Pires and Silva [44]
NetLogo	Economics, Computer Science, Mathematics	Agent-based simulation	Bernát [45]
AnyLogic	Business, Logistics	Multi-method simulation	Yalin et al. [46]
Simul8	Operations Management, Industrial Engineering	Discrete-event simulation	Chwif and Pereira [47]
Wolfram	Mathematics, Engineering	Mathematical simulation	Barba-Guaman et al. [48]
GAMS	Operations Research, Engineering	Optimization and mathematical simulation	Velázquez-Iturbide et al. [49]
SIMIO	Logistics, Economics, Industrial Engineering	Discrete-event simulation	Akundi and Edinbarough [50]

The variety of simulation tools outlined in Table 2 shows some of the diverse applications and learning contexts supported. They are employed to help students develop a deeper understanding of complex systems and improve their analytical skills, enabling them to apply theoretical concepts to real-world scenarios. This integration not only improves understanding and retention of challenging topics, but also prepares students for real-world challenges in their respective fields.

4.2.1. Discussion of How Simulation Software Enhances Experiential Learning

The ideal scenario would involve frequent opportunities for students to engage in real-life problem-solving situations. However, these opportunities are often limited, which restricts students' ability to apply theoretical knowledge in practical settings. Real-life contexts may not consistently provide sufficient or timely opportunities to practice and evaluate the outcomes of decisions, especially in critical situations where consequences unfold slowly or sporadically [51]. Such limitations highlight the need for alternative approaches, like simulation software, which provides a practical solution to these limitations by offering an environment where students can engage in problem solving without the constraints of real-world timing and resource availability. This type of software provides an interactive environment that allows students to apply theoretical knowledge gained in the classroom to practical and real-world scenarios. This approach not only helps students engage more effectively but also deepens their understanding and retention of complex analytical techniques. Through interactive simulations, students can explore various data sets and scenarios, experiencing the impact of their analytical decisions firsthand and learning from immediate feedback, therefore increasing both the effectiveness and enjoyment of the learning process [52]. Also, the integration of advanced technologies like virtual and augmented reality into simulation software offers a more immersive learning experience [53].

Furthermore, in the discussion of how simulation can enhance experiential learning, research shows the advantages of adopting AI-driven and simulation-based approaches. These methods not only enable students to solve analytical tasks more effectively than traditional learning approaches, but also promote critical thinking and analytical skills necessary for solving complex problems [54]. With the use of AI technologies, simulation software can analyze students' interactions and performance, offering them personalized feedback and creating learning paths that are specifically customized to the specific needs and strengths of each individual [55]. In other words, simulations can be adjusted and customized to the student's needs in order to match their learning stage, ensuring they are neither overwhelmed nor under-challenged. Also, simulation software enhances practical application skills and promotes collaborative learning by providing a safe environment for students to work together and experiment with and learn from failures without the fear of real repercussions or damage [56].

4.2.2. Examples of Simulation-Based Exercises for Teaching Statistical and Analytical Concepts

The work by Kuiper and Sturdivant [57] presents innovative simulation exercises designed to overcome common challenges in teaching complex statistical concepts that are difficult to address through traditional textbook methods. These simulations, suitable for educational levels ranging from undergraduate to graduate, offer practical experiences in data collection and analysis. One notable simulation involves an online tangrams game where students manipulate shapes to solve puzzles, collecting data on variables like puzzle completion times under different conditions, which may include factors such as the player's gender or background music. Another simulation, introduced by Kuiper and Sturdivant [57], is the 3D TigerSTAT game, where students take on the roles of wildlife researchers in a virtual preserve. Here, they estimate the age distribution of Siberian tigers by analyzing the extent of black pigmentation on the animals' noses, using this as an indicator of age. Through this exercise, students apply simple linear regression to model these age relationships and explore the effects of sampling variability on their conclusions. Kim and Hardin [58] have designed an exercise based on Google Calendar. In order to gather data, students have to answer the question of how they spend their time. This question is the starting point for learning tasks in data collection and analysis for undergraduate students. These students were tasked to document their daily activities such as sleeping, studying, and socializing using this application over 10–14 days. Then, these data were exported and imported into R, using R Markdown templates to guide students through a structured data wrangling process, using tools such as dplyr and lubridate.

Similar to previous examples, Bulmer and Haladyn [59] introduce a virtual environment known as "the Island" to teach statistical concepts through simulation-based exercises. This learning platform facilitates epidemiological analysis by allowing students to explore genetic backgrounds, geographic relationships, and disease spread among a virtual population, offering the students the opportunity to conduct more real experiments of their own choosing as part of a introductory statistics course. Moreover, Arinze [60] highlights the use of MISSimulation.com, a web-based election simulation. This simulation provides an interactive educational experience, enabling students to understand the concepts of data analytics through practical application [60]. Students initially play against the computer for practice and eventually compete against each other or continue against the computer to determine their score for the course. Throughout this process, they learn about different aspects of analytics, including descriptive, diagnostic, predictive, and prescriptive analytics.

4.3. The Use of e-Collaborative Tools for Teaching Analytical Courses

In today's world, using technology in education is very important, especially for analytical courses that require interaction and problem-solving skills [61]. In this sense, e-collaborative tools have become fundamental for knowledge transference and facilitating real-time collaboration between students and teachers. This section explores various e-collaborative tools transforming online learning environments for analytical courses, making learning more accessible and engaging while encouraging teamwork, essential for solving complex analytical problems. Microsoft Teams and Google Meet are good examples of collaborating tools, each aligning with their respective ecosystems, Microsoft Office 365 and Google Workspace, respectively, facilitating communication and collaborative efforts through integrated tools [62]. Microsoft Teams offers a unified interface supporting various communication forms and allows simultaneous document editing. Google Meet simplifies meeting scheduling and management, supporting high-definition communication and secure interactions [63]. Other platforms like Zoom and Notion have also become effective for teaching analytical courses. Zoom facilitates dynamic interaction and simulates a virtual classroom environment [64]. Notion, a multifunctional workspace, enables users to manage learning activities and supports collaborative learning [65]. All of these e-collaborative tools, along with others, are summarized in Table 3.

Table 3. Summary of e-collaborative tools. Weblinks accessed on 30 June 2024.

Platform	Key Features	Link	Author Source
Microsoft Teams	Chat, video conferencing, voice calls, and simultaneous document editing.	https://www.microsoft.com/en-us/microsoft-teams/group-chat-software	Febriana [62]
Google Meet	Scheduling, HD video, audio, screen sharing, and document collaboration.	https://meet.google.com	Gauthier and Husain [63]
Zoom	Remote learning, breakout rooms, polling, and interactive whiteboards.	https://zoom.us	Biletska et al. [64]
Notion	Write, plan, and organize learning activities content.	https://www.notion.so	Osawa [65]
Cisco WebEx	High-quality video and audio conferencing, screen sharing, virtual whiteboard, and in-meeting file sharing.	https://www.webex.com	Lopez et al. [66]
VizGroup	Visual data collaboration and analysis, data visualization, team brainstorming sessions, and project presentations.	https://www.vizgroup.com	Tang et al. [67]

4.3.1. Discussion of Virtual Collaboration Platforms for Group Projects

Currently, many platforms are widely used in modern education. However, not all are beneficial for teaching analytical courses, requiring an examination of their general advantages and disadvantages. For instance, Zoom and Google Meet offer advantages such as an enhanced accessibility and flexibility, which help students and instructors to engage from anywhere in the world. This feature is particularly beneficial for analytical courses that attract international students or part time students who may have mobility or scheduling issues [63,64]. Furthermore, tools like Microsoft Teams and Cisco WebEx integrate functionalities such as whiteboards, creating polls, and breakout rooms. These have the advantages of making classes more interactive and allow a real-time feedback among students [62,66].

The aspect of student collaboration is also an advantage that these platforms offer. They promote a collaborative environment where students can easily communicate and work together on group projects and discussions. For example, features like shared documents and simultaneous editing offered by Google Workspace and Notion allow multiple students to work on the same project in real time. Moreover, platforms such as Notion and Google Workspace facilitate seamless sharing of resources and real-time document collaboration. This is especially useful in analytical courses where students frequently work on projects requiring collective input and ongoing revisions. Additionally, tools like VizGroup offer specialized features for data visualization and analysis, which can be tailored to the specific needs of a course or project, allowing educators to design more effective and engaging learning experiences adapted to the analytical courses curriculum. These e-collaborative platforms are important to improving not only problem-solving skills but also interpersonal and leadership capacities [68]. Specifically, in business analytics courses, these tools allow students to practically apply statistical models and business strategies within a collaborative virtual workspace, narrowing the gap between theoretical knowledge and practical implementation [19].

After highlighting the advantages of the several e-collaborative platforms mentioned, it is equally important to address some potential drawbacks these tools might imply in teaching analytical courses. One significant concern is the potential for reduced face-to-face interaction, which can impede the development of deeper interpersonal relationships and communication often captured through physical and informal interactions [69]. Additionally, the reliance on technology introduces the risk of technical issues such as connectivity problems or software glitches, which can disrupt the flow of instruction and affect the learning process [70]. Finally, the access to these platforms might also lead to issues of over-reliance, where students might become too dependent on digital tools for learning and collaboration, potentially undermining the development of critical thinking and problem-solving skills that are required in more traditional approaches [71].

4.3.2. Exploration of Accessibility Features in Platforms like Teams and Google Meet

As previously mentioned, real-time collaboration tools have become essential in facilitating synchronous interactions and collaborative learning experiences. The Web Content Accessibility Guidelines (WCAG) are essential to ensure that people with disabilities can make use of online web and platforms. These guidelines provide an accessibility framework that includes providing textual alternatives for non-textual content, making it easier for users to view and hear content, and ensuring that user interfaces are navigable and operable [72]. As educational institutions and workplaces increasingly rely on these tools for day-to-day operations, adherence to WCAG ensures that no one is excluded. WCAG compliance is divided into three levels: Level A, which addresses the most severe accessibility barriers; level AA, which addresses general barriers to ensure usability; and Level AAA, which is the highest standard that improves accessibility for all the users [73].

Tools such as the ones highlighted in Section 4.3 provide features that account for the accessibility for users with different needs, particularly in online and blended education settings. These platforms share common accessibility features, including live captioning, screen reader support, keyboard shortcuts, and high-contrast themes. However, as Table 4 shows, they also have strengths and areas for improvement. While all platforms provide basic accessibility features, only Microsoft Teams includes an immersive reader, making it particularly useful for users with dyslexia. A study of the experiences of people with disabilities using these tools showed that none of them were considered fully accessible, and usability varied significantly. For example, Zoom was noted for better captioning and overall preference among users due to its simplicity and reliability, whereas Microsoft Teams was recommended for its better integration with assistive technologies and high-quality automatic captioning that includes speaker labels, making it easier for hearing-impaired users to follow conversations [74].

Table 4. Accessibility features and their WCAG level in e-collaborative tools.

Accessibility Feature	Microsoft Teams	Google Meet	Zoom	Cisco WebEx	VizGroup
Live Captions	Yes	Yes	Yes	Yes	Yes
Screen Reader Support	Yes	Limited	Yes	Yes	Limited
Keyboard Shortcuts	Yes	Yes	Yes	Yes	Yes
High Contrast Themes	Yes	Yes	Yes	Yes	Yes
Immersive Reader	Yes	No	No	No	No
Customized User Interface	Limited	Limited	Limited	Limited	Limited
Integration with Assistive Technologies	Yes	Limited	Yes	Yes	Limited
WCAG 2.1 Compliance Level	AA	AA	AA	AA	AA

All platforms currently achieve WCAG 2.1 AA compliance. This level ensures that general usability barriers are addressed, making the platforms accessible to most users. However, further improvements are needed to reach the final level. Reaching this higher level would involve better customization of user interfaces, better integration with a full range of assistive technologies, and more advanced text customization options.

5. Experiences at Universitat Politècnica de València

The Universitat Politècnica de València (UPV) (https://www.upv.es, accessed on 1 July 2024) is organized into 14 schools and faculties that span the fields of engineering, architecture, social sciences, and arts. UPV is consistently recognized as one of the leading technical universities in Spain and has achieved prominent positions in various national and international rankings as, for example, the U-ranking (https://www.u-ranking.es/ranking, accessed on 1 July 2024). In this section, it will be highlighted what steps has taken the UPV for integrating AISEC tools across some of its undergraduate and Master's degree programs.

5.1. Fishbanks: A Simulation for Sustainable Resource Management

Within the Master in Business Administration (MBA), the incorporation of the Fishbanks simulation into the Corporate Social Responsibility (CSR) course is noteworthy. This multiplayer internet simulation, developed by Dennis Meadows, John Sterman, and Andrew King, immerses participants in the roles of fishermen aiming to maximize their wealth in a competitive environment [75]. The simulation challenges students with dynamic fish population models and economic competition, requiring them to buy, sell, and construct boats, choose fishing locations, and negotiate with other players, thereby demonstrating the complexities of sustainable resource management within a shared ecosystem [76]. The integration of this Fishbanks simulation into the MBA curriculum was managed by a professor with prior experience in using this educational tool. This involved organizing and distributing access credentials and creating accounts for each student, ensuring full participation. To maximize the experience, the professor also conducted a training session to familiarize students with the simulation's interface and deepen their understanding of CSR and sustainable management. The use of this simulator significantly enriched the educational experience within the CSR course, providing students with practical insights into analyzing and managing sustainability issues effectively. Through this simulation, students gain a deeper understanding of the theoretical concepts of resource depletion, competitive dynamics, and strategic decision making in an interactive learning environment. The feedback from the students has been positive, emphasizing the simulation's role in improving engagement and practical application of the course content.

5.2. Markstrat: A Simulation for Marketing Management

Following the integration of the Fishbanks simulation, UPV extended its use of AISEC tools by incorporating the Markstrat simulation into the Marketing Management course to further improve the analytical and practical skills of the students in the marketing field. In the Markstrat simulation, students have the task of making a series of strategic decisions regarding product portfolio, research and development, marketing mix, and sales force allocation [77]. The main objective is to outperform competitor companies in terms of market share, financial performance, and brand value. The dynamic nature of the simulation requires students to analyze market trends, consumer behavior, and competitive moves, fostering a deep understanding of strategic marketing principles in practice [78]. To implement Markstrat effectively, the professor organized an introductory session to cover the basic mechanics of the simulation and the strategic concepts it aims to teach. Additionally, there were regular debriefing meetings in order to discuss the outcomes of each decision cycle, allowing students to reflect on their strategies and learn from both their successes and mistakes. The impact of this simulation within the Marketing Management course is remarkable. Students reported that it provides an invaluable perspective on the complexities of market competition and strategic decision making. It not only complements the theoretical knowledge provided in lectures but also allows students to experience the consequences of their own strategic choices in a risk-free environment.

5.3. Gestionet: A Finance Simulation for Financial Management

Gestionet is used in the Financial Management Advanced Techniques course. This is a business management simulator that focuses on the financial management aspect of running an industrial company. In the Gestionet finance simulation, students are tasked in managing budgets, optimizing investment portfolios, and developing funding strategies to enhance their own company growth and stability [79]. To effectively implement Gestionet, the professor introduced the main functions of the simulator and the necessary financial concepts needed in order to ensure that students are fully prepared to use the simulator. An advantage of Gestionet is that it reduces the emphasis on marketing and strategy decisions, automating these to allow students to focus solely on the financial challenges, making it more adequate for the already taught contents of the Financial Management Advanced Techniques course. Throughout the simulation, students compete against up to ten different virtual companies, managed by their classmates, in this way creating a competitive marketplace. This competitive element is designed to mimic real market conditions and fosters a deeper understanding of financial management in a live, competitive environment [79]. Also, from the second session onward, before students were allowed to make any new decisions, there was a class gathering. These regular debriefing sessions allowed students to analyze the outcomes of their decisions with their professor, learn from their experiences, and refine their strategies in subsequent rounds.

5.4. Implexa: An Evolutive Beer Game Simulation for Logistics

The subject of logistics is studied in the Master's Degree in Organization and Logistics Engineering and in the Bachelor's Degree in Business Administration. In order to learn about the supply chain, students make use of IMPLEXA (http://www.implexa.net, accessed on 1 July 2024). This software is an evolutionary game based on the classic Beer Game, designed to provide practical experience and help students learn about supply chain management in today's business context, where each player or student manages a company that is part of a supply chain. The activity is divided into two parts, starting with an initial round in which students play independently, without communicating with each other. This lack of planning and coordination between the companies in the supply chain can cause a bullwhip effect and decrease the efficiency of the whole. In the next round, students are free to share information and communicate, which facilitates the coordination of decisions and actions taken. In this round, the results improved significantly and the bullwhip effect was reduced thanks to the synchronization and integration between the students. Table 5 presents a comparative overview of various KPIs of the supply chain between two different rounds.

Table 5. Comparing results between rounds using IMPLEXA (Version 3)

	Round 1	Round 2	Variation
Total Cost	EUR 83,255.57	EUR 71,770.54	−14%
% of Demand Satisfied	75.43%	100%	33%
Lead-time	9.3 s	3.6 s	−61%
Average Stock	391.3 units	98 units	−75%
Total Orders	2698 units	3730 units	38%
Total Production	1751 units	3740 units	114%
Total Purchases	4693 units	7480 units	59%
Service Cost	EUR 60.4	EUR 19.25	−68%
Demand Amplification Ratio	0.47	1.02	117%

The results of the second round, detailed in Table 5, show significant improvements in all aspects measured. In particular, total costs decreased by 14%, lead times were reduced by 61%, and stock levels were significantly reduced while fully satisfying customer demand. This efficiency improvement and 68% reduction in service costs demonstrate how strategic information sharing can mitigate the bullwhip effect and optimize overall supply chain performance.

5.5. LLOG VR: Virtual Reality for Logistics

Another didactic simulation tool used at UPV is LLOG VR (http://www.llog.es/vr.html, accessed on 1 July 2024). This software incorporates virtual reality to simulate a logistics environment, allowing students to experience first-hand the actions and decisions involved in logistics processes, with the possibility of performing actions such as order reception and preparation, shipping, warehousing, and inventory management, among others. This simulator represents a "Learning Factory", since it reflects the processes and technologies of a real industrial environment, offering an educational platform that brings students closer to the practical challenges of the logistics sector. A case study presented by Solanes et al. [80] during the 2022/2023 academic year at UPV explored the impact of this tool on logistics education. The results revealed that, although only 11% of the students had previous experience with virtual reality devices, the tool was highly rated in terms of usability, with an average score of 87.08 out of 100. In addition, due to the fact that it was necessary to be at the front of the classroom stage for this activity to take place, one student's experience highlighted the potential of virtual reality to mitigate personal problems such as stage fright. Tasked with demonstrating a robotic system, this student entered the metaverse with nervousness, but soon began to concentrate deeply on the virtual demonstration and her anxiety disappeared [80].

5.6. Discussion on Accessibility and Usability in UPV

In terms of usability, Markstrat, Gestionet, and IMPLEXA are designed to be user friendly, requiring no prior computer skills or software installation. Additionally, they offer several educational resources, such as free learning guides, webinars, and a comprehensive user guide to aid both participants and educators. Although various simulation tools, such as Markstrat, Gestionet Fishbanks, and LLOG VR, promote general accessibility and usability, they lack specific features for individuals who are blind or colorblind. While the simulation provides valuable educational experiences in several areas and subjects, further steps are needed to ensure it is fully accessible to all students, regardless of visual impairment. Futhermore, some tools used at UPV are characterized by fast and continuous actions (e.g., IMPLEXA). Direct and constant stimulation can help to keep the attention of some people with ADHD focused on a specific task. On the other hand, individuals with autism may suffer from sensory overload, fatigue, or stress due to continuous interactions, because of the lack of anticipation and preparation between each task or action.

6. Experiences at University College Dublin

The University College Dublin (UCD) (https://www.ucd.ie, accessed on 1 July 2024), founded in 1854, is one of Europe's leading research universities and is currently ranked in the top 1% of higher education institutions in the world.

6.1. Turnitin and ChatGPT: AI Tools for Assisting Search

Ouriginal and Turnitin are used to help teacher check originality of assignments. To ensure that the work of students and researchers is the result of their own independent thinking and research, UCD employs originality checker tools to compare each student's submissions against a vast database, thereby ensuring academic integrity. Starting in May 2024, Turnitin Originality replaces Ouriginal as the new originality checker tool. Integrated with Brightspace, it provides access to millions of academic resources and generates detailed similarity reports. Additionally, researchers can use Turnitin iThenticate to verify the originality of their work intended for publication. This system will significantly reduce the workload of teachers in originality review and provide students with a platform to enhance the quality of their work. ChatGPT has largely changed the existing model of teaching and learning by providing students with a plethora of tools to help with conceptualization, writing, etc. UCD webinars teach students how to use AI tools to enhance their search for information, assist with reading, instructional guides, and self-checking, among other things.

6.2. Solver and LINDO Simulation Tools for Optimization and Analytics

SOLVER and LINDO are used as optimization tools in the course Hot Topics in Analytics. SOLVER is an optimization tool often included as an add-in in spreadsheet applications like Microsoft Excel (version 2021), as illustrated in Figure 4. It is used for various optimization problems, including linear, integer, and nonlinear programming. LINDO (version 6.1) is a more specialized and powerful software package designed for a broader range of optimization problems, including stochastic programming. These tools enable students to visually understand the structure of optimization problems, constraints, and the impact of the objective function. They help students move from abstract concepts to concrete applications in the process of teaching optimization problems. Students can construct and solve real optimization problems so as to apply theoretical knowledge to practice and enhance the learning effect and problem-solving ability. The tools are often able to provide immediate feedback to help students quickly identify and correct errors, optimize the learning process, and improve learning efficiency. They also give students the opportunity to be exposed to and solve more challenging topics, expanding their knowledge and skills. Furthermore, as optimization problems often involve multidisciplinary knowledge, the use of tools promotes interdisciplinary learning and application and fosters students' integrative skills.

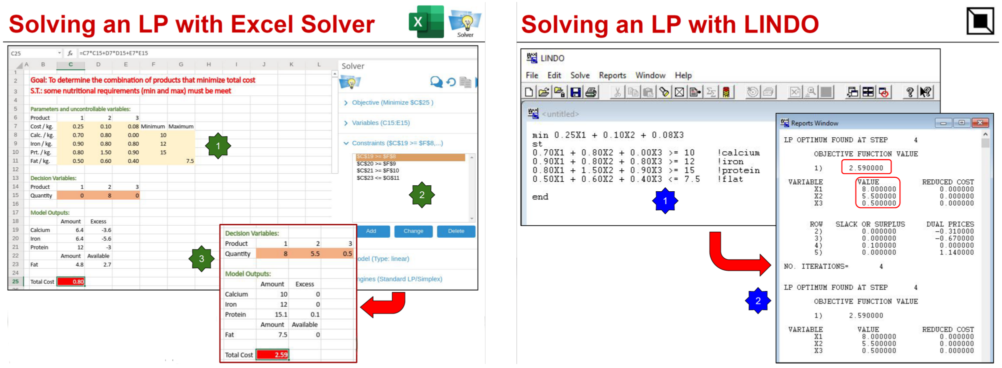

Figure 4. The use of SOLVER and LINDO in Hot Topics in Analytics course.

6.3. Ft.Com: A Stock Trading Simulation for Technology Consulting

Stock trading simulation platforms on the Financial Times website (https://www.ft.com, accessed on 1 July 2024) are used in the Technology Consulting module to help students experience stock trading while using Excel's multiple skill areas to actually practice technical forecasting and analysis in securities investing. Each team of three students has a budget of $100,000 to invest in at least three public technology companies. Students, as shown in Figure 5, can use this simulator to create portfolios and allocate budgets in their FT accounts, regularly checking the value of their portfolios and monitoring them. In this context, students use FT.com as a current source of financial data. The students will take the "dirty" data from the website, clean it up, compare several sets of data together, and graph the data. Finally, the charts are used to extract some overall statistics. In this way, the stock trading simulation helps students experience the investment decision-making process in a real market environment. The large amount of data generated by the simulation can be used to analyze portfolio counts and can help students apply and validate data analysis methods and models. Students can experience how different risk management strategies work in real markets and learn to use technical analysis to make better decisions in the face of uncertainty and risk. The simulation trading platform increases the interactivity of the analytical course Technical Consulting, students are more involved and active in learning, the course not only becomes more lively and interesting, but also can effectively enhance the students' actual technical analysis in securities investment in the operation of the ability and market sensitivity, laying a solid foundation for their future career development.

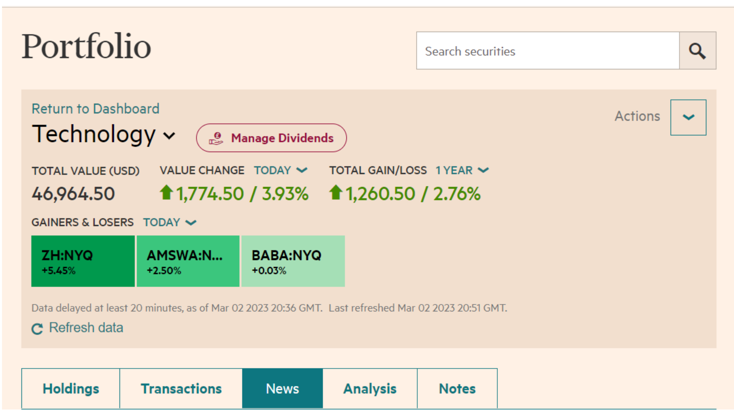

Figure 5. Creating asset portfolio simulation in Technology Consulting course.

6.4. Discussion on Accessibility and Usability in UCD

Through the experiences of UCD in utilizing the AISEC toolkit in their teaching as described above, students perceived the enhanced accessibility of these tools to the analytical course. Turnitin and Ouriginal help lecturers to check the originality of students' work while also providing students with automated feedback to help them better refine their analytical writing skills. This automated checker can meet the needs of larger and more diverse classes without constant instructor intervention, improving accessibility to the program. ChatGPT provides language support for non-native English speakers, breaking down the language barrier for non-native English speakers and making UCD's analytics courses more accessible. Optimization and simulation tools such as SOLVER, LINGO, and FT.com's stock trading simulation platforms provide students with a hands-on learning experience, allowing them to apply their theoretical knowledge to real-world scenarios, thereby improving their analytical skills. The ease of use and fun of those tools also enhance accessibility by helping students who have cognitive difficulties with purely theoretical content.

7. Experiences at Universidade Aberta

The Universidade Aberta of Portugal (UAb) (https://www.uab.pt/, accessed on 1 July 2024) is organized into various departments covering areas like Social Sciences, Humanities, Science and Technology, and Education. As a fully online university, it is also known for its leadership in e-learning in comparison to other educational institutions in Portugal, relying on digital platforms to improve its educational accessibility. This section discusses how Universidade Aberta has integrated AISEC tools across its undergraduate, master, and doctoral degree programs to improve the educational experience.

7.1. Simulation for Decision-Making Optimization

The Doctoral degree in Applied Mathematics and Modelling annually offers the Advanced Optimization course in an asynchronous learning format for better access of students to the class due to the different time zones. The course focuses on solving complex decision-making problems in different sectors such as logistics, transportation, and finance, among others. These problems are often large scale with stochastic and dynamic components, posing significant challenges. Throughout the course, students work with heuristic algorithms in programming languages like Python (version 3.10), MATLAB (R2022a), and Julia (version 1.7) to achieve solutions that are computationally efficient [81]. Additionally, simulation techniques are incorporated within these algorithms to manage the uncertainties in real-life systems, improving the students' ability to make informed decisions in complex scenarios.

7.2. Open Class Initiative

UAb has also launched a digital platform called the Open Class (Aula Aberta) Initiative (https://aulaberta.uab.pt, accessed on 1 July 2024). This initiative offers open access to contemporary themes and resources aligned with the university's formal educational offerings. It serves as an introduction to online learning, allowing participants to engage with the virtual learning platform for free over the period of one week. Within the STEM field, it is possible to find a number of related MOOCs on mathematics, geometry, and statistics, among others.

7.3. Discussion on Accessibility and Usability at Universidade Aberta

In terms of accessibility learning, there are online courses in the Open Class Initiative on how to customize educational processes and include students with difficulties. These courses include several goals, such as understanding and diagnosing learning styles, applying the theory in tutoring and teaching, exploring perspectives on technology use, and learning online pedagogical strategies based on different learning characteristics.

Furthermore, the Moodle platform used by UAb is configured to comply with WCAG 2.1 guidelines, ensuring that students can navigate and access content using screen readers such as JAWS or NVDA. Regarding people with hearing disabilities, the video lessons include subtitles and full transcripts, allowing them to fully engage with the educational material.

8. Conclusions

The rise of online and blended learning models has brought new challenges for educators, especially in meeting the needs of a diverse student population. AISEC tools, which combine AI, simulation, and E-collaboration technologies, have proven to play a key role in enhancing the accessibility of analytics courses. Within this umbrella, AI tools support students with different linguistic backgrounds and analytical competencies by offering personalized learning experiences, intelligent tutoring systems, predictive analysis, and adaptive assessments. Simulation tools enhance engagement and understanding by providing practical environments where students can apply theoretical knowledge to real-world situations. Finally, e-collaboration tools are essential for addressing complex analytical challenges by facilitating real-time communication and collaboration between students and educators.

Practical examples from universities in Spain, Ireland, and Portugal further confirm the synergistic benefits of AISEC tools in improving analytics education. These tools not only innovate teaching methods but also enhance students' learning outcomes, particularly in analytics courses that require strong logical thinking and data analysis skills. Educational institutions are encouraged to integrate AISEC tools into their curricula to strengthen their teaching's effectiveness and improve their learning outcomes. At the same time, attention must be paid to the accessibility features of these tools to ensure that all students, including those with disabilities, can use these resources equally and that alternative materials are provided when necessary.

Based on the analysis of the existing literature and tools, future research directions in the field of accessibility to analysis education are as follows: (i) investigating the long-term impact of AISEC tools on student learning outcomes and engagement; (ii) exploring strategies for effectively integrating AISEC tools into various educational contexts and establishing best practices for their implementation; (iii) developing tailored AISEC tools for students with disabilities or from diverse backgrounds; (iv) addressing the digital divide to ensure equitable access to AISEC-enhanced education; and (v) examining how the integration of innovative tools can further improve teaching effectiveness and the learning experience.

Author Contributions: Conceptualization, A.A.J.; methodology, C.O. and N.F.; investigation, W.C. and Y.M.; writing—original draft preparation, C.O., N.F., Y.M. and W.C.; writing—review and editing, A.A.J. All authors have read and agreed to the published version of the manuscript.

Funding: This work was founded by the Investigo Program of the Generalitat Valenciana (INVEST/2023/304), Coca-Cola Europacific Partners, and the Spanish Ministry of Science and Innovation (PID2022-138860NB-I00 and RED2022-134703-T).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: All required data are contained in the article.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Campos, N.; Corlu, C.G.; Nogal, M.; Juan, A.A.; Caliz, C. Simulation-based mathematical learning for higher education students from heterogeneous backgrounds. *J. Simul.* **2024**, *18*, 477–488. [CrossRef]
2. Zawacki-Richter, O.; Marín, V.I.; Bond, M.; Gouverneur, F. Systematic review of research on artificial intelligence applications in higher education—Where are the educators? *Int. J. Educ. Technol. High. Educ.* **2019**, *16*, 39. [CrossRef]

3. Kübler, A.; Holz, E.M.; Sellers, E.W.; Vaughan, T.M. Toward independent home use of brain-computer interfaces: A decision algorithm for selection of potential end-users. *Arch. Phys. Med. Rehabil.* **2015**, *96*, S27–S32. [CrossRef] [PubMed]
4. Andrews, S.; Bare, L.; Bentley, P.; Goedegebuure, L.; Pugsley, C.; Rance, B. *Contingent Academic Employment in Australian Universities*; LH Martin Institut: Parkville, Australia, 2016; p. 19.
5. Burgstahler, S.E.; Cory, R.C. *Universal Design in Higher Education: From Principles to Practice*; Harvard Education Press: Cambridge, MA, USA, 2010.
6. Means, B.; Toyama, Y.; Murphy, R.; Baki, M. The effectiveness of online and blended learning: A meta-analysis of the empirical literature. *Teach. Coll. Rec.* **2013**, *115*, 1–47. [CrossRef]
7. Crawford, T.; Candlin, S. A literature review of the language needs of nursing students who have English as a second/other language and the effectiveness of English language support programmes. *Nurse Educ. Pract.* **2013**, *13*, 181–185. [CrossRef] [PubMed]
8. Rungta, K. 100+ must know online learning statistics in 2022. *Retrieved Oct.* **2022**, *25*, 2022.
9. García, E.; Weiss, E. *Education Inequalities at the School Starting Gate: Gaps, Trends, and Strategies to Address Them*; Economic Policy Institute: Washington, DC, USA, 2017.
10. Sun, Y.; Suzuki, M. Diagnostic assessment for improving teaching practice. *Int. J. Inf. Educ. Technol.* **2013**, *3*, 607. [CrossRef]
11. Coleman, M.; Berge, Z. A review of accessibility in online higher education. *Online J. Distance Learn. Adm.* **2018**, *21*, 1–7.
12. Banks, J.A. *Cultural Diversity and Education: Foundations, Curriculum, and Teaching*; Routledge: London, UK, 2015.
13. Hockings, C.; Brett, P.; Terentjevs, M. Making a difference—Inclusive learning and teaching in higher education through open educational resources. *Distance Educ.* **2012**, *33*, 237–252. [CrossRef]
14. Palvia, S.; Aeron, P.; Gupta, P.; Mahapatra, D.; Parida, R.; Rosner, R.; Sindhi, S. Online education: Worldwide status, challenges, trends, and implications. *J. Glob. Inf. Technol. Manag.* **2018**, *21*, 233–241. [CrossRef]
15. Vigevano, L.; Mattei, P. The challenges of distance learning in Italy: New inequalities and implications for inclusive education. *Int. J. Incl. Educ.* **2023**, 1–15. [CrossRef]
16. Jeyaraj, A. Pedagogy for business analytics courses. *J. Inf. Syst. Educ.* **2019**, *30*, 67.
17. Vittorini, P.; Menini, S.; Tonelli, S. An AI-based system for formative and summative assessment in data science courses. *Int. J. Artif. Intell. Educ.* **2021**, *31*, 159–185. [CrossRef]
18. Liebowitz, J. *Data Analytics and AI*; CRC Press: Boca Raton, FL, USA, 2020.
19. Rabia, M.A.B.; Bellabdaoui, A. Simulation-based analytics: A systematic literature review. *Simul. Model. Pract. Theory* **2022**, *117*, 102511. [CrossRef]
20. Alharbi, S.M.; Elfeky, A.I.; Ahmed, E.S. The effect of e-collaborative learning environment on development of critical thinking and higher order thinking skills. *J. Posit. Sch. Psychol.* **2022**, *6*, 6848–6854.
21. Alam, A. Should robots replace teachers? Mobilisation of AI and learning analytics in education. In Proceedings of the 2021 International Conference on Advances in Computing, Communication, and Control (ICAC3), Mumbai, India, 3–4 December 2021; pp. 1–12.
22. Salas-Pilco, S.Z.; Xiao, K.; Hu, X. Artificial intelligence and learning analytics in teacher education: A systematic review. *Educ. Sci.* **2022**, *12*, 569. [CrossRef]
23. Asamoah, D.A.; Sharda, R.; Hassan Zadeh, A.; Kalgotra, P. Preparing a data scientist: A pedagogic experience in designing a big data analytics course. *Decis. Sci. J. Innov. Educ.* **2017**, *15*, 161–190. [CrossRef]
24. Eckroth, J. A course on big data analytics. *J. Parallel Distrib. Comput.* **2018**, *118*, 166–176. [CrossRef]
25. Allil, K. Integrating AI-driven marketing analytics techniques into the classroom: Pedagogical strategies for enhancing student engagement and future business success. *J. Mark. Anal.* **2024**, *12*, 142–168. [CrossRef]
26. Ng, C. Teaching Advanced Data Analytics, Robotic Process Automation, and Artificial Intelligence in a Graduate Accounting Program. *J. Emerg. Technol. Account.* **2023**, *20*, 223–243. [CrossRef]
27. Maher, M.L.; Tadimalla, S.Y.; Dhamani, D. An Exploratory Study on the Impact of AI tools on the Student Experience in Programming Courses: An Intersectional Analysis Approach. In Proceedings of the 2023 IEEE Frontiers in Education Conference (FIE), College Station, TX, USA, 18–21 October 2023; pp. 1–5.
28. González-Carrillo, C.D.; Restrepo-Calle, F.; Ramírez-Echeverry, J.J.; González, F.A. Automatic grading tool for jupyter notebooks in artificial intelligence courses. *Sustainability* **2021**, *13*, 12050. [CrossRef]
29. Moloney, R.; Saltmarsh, D. 'Knowing your students' in the culturally and linguistically diverse classroom. *Aust. J. Teach. Educ. (Online)* **2016**, *41*, 79–93. [CrossRef]
30. Guo, P.J.; Reinecke, K. Demographic differences in how students navigate through MOOCs. In Proceedings of the First ACM Conference on Learning@ Scale Conference, Atlanta, GA, USA, 4–5 March 2014; pp. 21–30.
31. Tomlinson, C.A. *The Differentiated Classroom: Responding to the Needs of All Learners*; ASCD: Alexandria, VA, USA, 2014.
32. Fitria, T.N. Artificial Intelligence (AI) in Education: Using AI Tools for Teaching and Learning Process. In Proceedings of the Prosiding Seminar Nasional & Call for Paper STIE AAS, Surakarta, Jawa Tengah, 2021; pp. 134–147. Available online: https://www.researchgate.net/publication/357447234_Artificial_Intelligence_AI_In_Education_Using_AI_Tools_for_Teaching_and_Learning_Process (accessed on 1 June 2024).
33. Chen, Y.; Jensen, S.; Albert, L.J.; Gupta, S.; Lee, T. Artificial intelligence (AI) student assistants in the classroom: Designing chatbots to support student success. *Inf. Syst. Front.* **2023**, *25*, 161–182. [CrossRef]

34. Mageira, K.; Pittou, D.; Papasalouros, A.; Kotis, K.; Zangogianni, P.; Daradoumis, A. Educational AI chatbots for content and language integrated learning. *Appl. Sci.* **2022**, *12*, 3239. [CrossRef]
35. Jordan, M.; Ly, K.; Soosai Raj, A.G. Need a Programming Exercise Generated in Your Native Language? ChatGPT's Got Your Back: Automatic Generation of Non-English Programming Exercises Using OpenAI GPT-3.5. In Proceedings of the 55th ACM Technical Symposium on Computer Science Education V. 1, Portland, OR, USA, 20–23 March 2024; pp. 618–624.
36. Gonda, D.E.; Chu, B. Chatbot as a learning resource? Creating conversational bots as a supplement for teaching assistant training course. In Proceedings of the 2019 IEEE International Conference on Engineering, Technology and Education (TALE), Yogyakarta, Indonesia, 10–13 December 2019; pp. 1–5.
37. McHaney, R. Simulation education in non-simulation courses. In Proceedings of the 2018 Winter Simulation Conference (WSC), Gothenburg, Sweden, 9–12 December 2018; pp. 4038–4045.
38. Tvrdoň, L.; Jurásková, K. Teaching simulation in logistics by using witness and captivate software. *Procedia-Soc. Behav. Sci.* **2015**, *174*, 4083–4089. [CrossRef]
39. Jackson, G.C.; Taylor, J.C. Administering the MIT Beer Game: Lessons learned. In Proceedings of the Developments in Business Simulation and Experiential Learning: Proceedings of the Annual ABSEL Conference, 1998. Volume 25. Available online: https://absel-ojs-ttu.tdl.org/absel/article/view/1049 (accessed on 1 June 2024)
40. Lawson, B.; Leemis, L.M. Structuring a simulation course around the simEd package for R. In Proceedings of the 2021 Winter Simulation Conference (WSC), Phoenix, AZ, USA, 12–15 December 2021; pp. 1–12.
41. Doddavaram, R.; Corlu, C.G. Teaching risk analytics using R. In Proceedings of the 2020 Winter Simulation Conference (WSC), Orlando, FL, USA, 14–18 December 2020; pp. 3272–3281.
42. Perkins, K.; Adams, W.; Dubson, M.; Finkelstein, N.; Reid, S.; Wieman, C.; LeMaster, R. PhET: Interactive simulations for teaching and learning physics. *Phys. Teach.* **2006**, *44*, 18–23. [CrossRef]
43. Sandita, A.V.; Popirlan, C.I. Developing a multi-agent system in JADE for Information management in educational competence domains. *Procedia Econ. Financ.* **2015**, *23*, 478–486. [CrossRef]
44. Pires, V.F.; Silva, J.F.A. Teaching nonlinear modeling, simulation, and control of electronic power converters using MATLAB/SIMULINK. *IEEE Trans. Educ.* **2002**, *45*, 253–261. [CrossRef]
45. Bernát, P. Modelling and simulation in education and the NetLogo simulation environment. *Teach. Math. Comput. Sci.* **2014**, *12*, 229–240. [CrossRef]
46. Yalin, C.; Xiaofang, Q.; Cancan, J.; Yao, Z.; Qifei, H. Optimization Management System Simulation Teaching by Task-Driven. In *Proceedings of the 2021 2nd International Conference on Mental Health and Humanities Education (ICMHHE 2021), Qingdao, China, 28–30 May 2021*; Atlantis Press: Amsterdam, The Netherlands, 2021; pp. 315–318.
47. Chwif, L.; Pereira, W. Simulation Teaching During the Pandemic: Report of an Experience in a Higher Education Private Institution. In Proceedings of the 2022 Winter Simulation Conference (WSC), Singapore, 11–14 December 2022; pp. 1–11.
48. Barba-Guaman, L.R.; Quezada-Sarmiento, P.A.; Calderon-Cordova, C.A.; Sarmiento-Ochoa, A.M.; Enciso, L.; Luna-Briceno, T.S.; Conde-Zhingre, L.E. Using wolfram software to improve reading comprehension in mathematics for software engineering students. In Proceedings of the 2018 13th Iberian Conference on Information Systems and Technologies (CISTI), Caceres, Spain, 13–16 June 2018; pp. 1–4.
49. Velázquez-Iturbide, J.Á.; Debdi, O.; Paredes-Velasco, M. A review of teaching and learning through practice of optimization algorithms. In *Innovative Teaching Strategies and New Learning Paradigms in Computer Programming*; IGI Global: Hershey, PA, USA, 2015; pp. 65–87.
50. Akundi, A.; Edinbarough, I. Text Mining-Based Qualitative Student Assessment of Interactive Simulation Learning Using SIMIO Tool—A Work in Progress. Edinburg, USA, 2020. Available online: https://scholarworks.utrgv.edu/mie_fac/2/ (accessed on 19 June 2024).
51. Chernikova, O.; Heitzmann, N.; Stadler, M.; Holzberger, D.; Seidel, T.; Fischer, F. Simulation-based learning in higher education: A meta-analysis. *Rev. Educ. Res.* **2020**, *90*, 499–541. [CrossRef]
52. Pirker, J.; Gütl, C. Educational gamified science simulations. In *Gamification in Education and Business*; Springer: Cham, Switzerland, 2015; pp. 253–275.
53. Majgaard, G.; Weitze, C. Virtual experiential learning, learning design and interaction in extended reality simulations. In Proceedings of the I 14th European Conference on Games Based Learning, ECGBL, Brighton, UK, 24–25 September 2020; pp. 372–379.
54. Uzun, C.; Uygun, K. The Effect of Simulation-Based Experiential Learning Applications on Problem Solving Skills in Social Studies Education. *Int. J. Contemp. Educ. Res.* **2022**, *9*, 28–38. [CrossRef]
55. Mirchi, N.; Bissonnette, V.; Yilmaz, R.; Ledwos, N.; Winkler-Schwartz, A.; Del Maestro, R.F. The Virtual Operative Assistant: An explainable artificial intelligence tool for simulation-based training in surgery and medicine. *PLoS ONE* **2020**, *15*, e0229596. [CrossRef] [PubMed]
56. Pacheco-Velazquez, E. Effects of the use of simulators and an online platform in logistics education. *Int. J. Interact. Des. Manuf. (IJIDeM)* **2022**, *16*, 439–457. [CrossRef]
57. Kuiper, S.; Sturdivant, R.X. Using online game-based simulations to strengthen students' understanding of practical statistical issues in real-world data analysis. *Am. Stat.* **2015**, *69*, 354–361. [CrossRef]

58. Kim, A.Y.; Hardin, J. "Playing the whole game": A data collection and analysis exercise with Google calendar. *J. Stat. Data Sci. Educ.* **2021**, *29*, S51–S60. [CrossRef]
59. Bulmer, M.; Haladyn, J.K. Life on an Island: A simulated population to support student projects in statistics. *Technol. Innov. Stat. Educ.* **2011**, *5*. [CrossRef]
60. Arinze, B. Teaching Experiential Data Analytics Using an Election Simulation. *J. Stat. Data Sci. Educ.* **2023**, *31*, 273–285. [CrossRef]
61. Haleem, A.; Javaid, M.; Qadri, M.A.; Suman, R. Understanding the role of digital technologies in education: A review. *Sustain. Oper. Comput.* **2022**, *3*, 275–285. [CrossRef]
62. Febriana, A.D. Microsoft 365 Digital Classroom Tools and the Development of English Teacher's Self-Efficacy in ICT. Ph.D. Thesis, Universitas Muhammadiyah Surabaya, Surabaya, Indonesia, 2022.
63. Gauthier, N.H.; Husain, M.I. Dynamic security analysis of zoom, Google meet and Microsoft teams. In *Proceedings of the Silicon Valley Cybersecurity Conference: First Conference, SVCC 2020, San Jose, CA, USA, 17–19 December 2020*; Revised Selected Papers 1; Springer: Berlin/Heidelberg, Germany, 2021; pp. 3–24.
64. Biletska, I.O.; Paladieva, A.F.; Avchinnikova, H.D.; Kazak, Y.Y. The use of modern technologies by foreign language teachers: Developing digital skills. *Linguist. Cult. Rev.* **2021**, *5*, 16–27. [CrossRef]
65. Osawa, K. Integrating Automated Written Corrective Feedback into E-Portfolios for second language Writing: Notion and Notion AI. *RELC J.* **2023**, 00336882231198913. [CrossRef]
66. Lopez, I.; Padilla, M.; Juarez, M.; Chauca, M.; Ramirez, W. Characterization of disruptive education in a public university based on the use of digital tools on the cisco WebEx digital platform. In Proceedings of the 2021 4th International Conference on Education Technology Management, Tokyo, Japan, 17–19 December 2021; pp. 59–66.
67. Tang, X.; Wong, S.; Pu, K.; Chen, X.; Yang, Y.; Chen, Y. VizGroup: An AI-Assisted Event-Driven System for Real-Time Collaborative Programming Learning Analytics. *arXiv* **2024**, arXiv:2404.08743.
68. Zulfiqar, S.; Zhou, R.; Asmi, F.; Yasin, A. Using simulation system for collaborative learning to enhance learner's performance. *Cogent Educ.* **2018**, *5*, 1424678. [CrossRef]
69. Stevens, G.J.; Bienz, T.; Wali, N.; Condie, J.; Schismenos, S. Online university education is the new normal: But is face-to-face better? *Interact. Technol. Smart Educ.* **2021**, *18*, 278–297. [CrossRef]
70. Łuszczek, K. Pedeutological aspects of using new technologies in education. In *Proceedings of the Forum Pedagogiczne*; Cardinal Stefan Wyszyński University: Warsaw, Poland, 2020; Volume 10, pp. 263–272.
71. Taskiran, C.; Salur, M. Analysis of the Opinions of Social Studies Teachers on Digital Literacy Skills. *World J. Educ.* **2021**, *11*, 72–84. [CrossRef]
72. Macakoğlu, Ş.S.; Peker, S. Web accessibility performance analysis using web content accessibility guidelines and automated tools: A systematic literature review. In Proceedings of the 2022 International Congress on Human-Computer Interaction, Optimization and Robotic Applications (hora), Ankara, Turkey, 9–11 June 2022; pp. 1–8.
73. Caldwell, B.; Cooper, M.; Reid, L.G.; Vanderheiden, G.; Chisholm, W.; Slatin, J.; White, J. Web content accessibility guidelines (WCAG) 2.0. *WWW Consort. (W3C)* **2008**, *290*, 5–12.
74. Hersh, M.; Leporini, B.; Buzzi, M. A comparative study of disabled people's experiences with the video conferencing tools Zoom, MS Teams, Google Meet and Skype. *Behav. Inf. Technol.* **2023**, 1–20. [CrossRef]
75. Parrondo, M.; Rayon-Viña, F.; Borrell, Y.; Miralles, L. Sustainable Sea: A board game for engaging students in sustainable fisheries management. *Appl. Environ. Educ. Commun.* **2021**, *20*, 406–421. [CrossRef]
76. Kunc, M.H.; Morecroft, J.D. Competitive dynamics and gaming simulation: Lessons from a fishing industry simulator. *J. Oper. Res. Soc.* **2007**, *58*, 1146–1155. [CrossRef]
77. Gradinaru, C.; Toma, S.G.; Catana, S.A. Marketing Simulations in Education: A Brief Overview for the Markstrat Simulator. *Ovidius Univ. Ann. Econ. Sci. Ser.* **2021**, *21*, 737–742. [CrossRef]
78. Campomar, M.C.; Ikeda, A.A.; Falcão, R.F.; Mazzero, S. Active Learning in Marketing: Does It Work? Our Experience Combining Markstrat and Marketing Planning in Brazil. *Int. J. Educ. Res.* **2013**, *1*, 1–8.
79. Grijalvo, M.; Segura, A.; Núñez, Y. Computer-based business games in higher education: A proposal of a gamified learning framework. *Technol. Forecast. Soc. Chang.* **2022**, *178*, 121597. [CrossRef]
80. Solanes, J.E.; Montava-Jordà, S.; Golf-Laville, E.; Colomer-Romero, V.; Gracia, L.; Muñoz, A. Enhancing STEM Education through Interactive Metaverses: A Case Study and Methodological Framework. *Appl. Sci.* **2023**, *13*, 10785. [CrossRef]
81. Campos, N.; Nogal, M.; Caliz, C.; Juan, A.A. Simulation-based education involving online and on-campus models in different European universities. *Int. J. Educ. Technol. High. Educ.* **2020**, *17*, 8. [CrossRef]