Open-Source Gamification Plug-Ins: A Study on Usability and User Preferences

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Abstract: In the current educational environment, e-learning and online education have gained significant prominence, especially highlighted during the COVID-19 pandemic when their importance increased dramatically. Empirical evidence highlights the undeniable benefits of online learning, with learners globally appreciating the flexibility to access course materials at their convenience, free from geographic or time constraints. Despite many companies' efforts to support online education, some educators are hesitant to adopt this new approach fully. Their concerns revolve around whether online instruction can match traditional classroom teaching's effectiveness, coupled with worries about the financial costs involved in transitioning and the extensive work needed to digitise course materials. Despite these challenges, the integration of plug-ins such as gamification plugins emerges as a transformative force in online education. Gamification plug-ins play a crucial role in infusing gamified elements and mechanics into online courses or digital content, thereby enhancing engagement, motivation, and overall learning experiences. Gamification involves applying game design principles, such as points, badges, leaderboards, challenges, and rewards, to non-game contexts like education or business. In contemporary application, gamification has evolved to include explicit game elements such as quizzes, puzzles, narratives, and mini-game techniques as complementary components in enhancing existing online learning environments. By integrating gamification plug-ins into e-learning platforms or content, educators can create a more interactive and enjoyable learning environment, ultimately leading to improved retention and participation. Thus, in the face of the challenges posed by the transition to online learning, strategically incorporating gamification plug-ins presents a promising approach to addressing concerns regarding efficacy and learner engagement in virtual classrooms. This paper aims to explore the efficacy of specific gamification plug-ins through the evaluation of open-source gamification plug-ins from a user-centric perspective, focusing on their usability and appropriateness. By employing both qualitative and quantitative data collection methods, the research seeks to uncover the reasons behind user preferences and prioritise the plug-ins that best support engagement and functionality in their intended applications. Specifically, the study includes an in-depth review of the relevant literature on gamification in education to position the current investigation within a broader academic context. The gamification tools are assessed by VET trainers, learners, and other stakeholders across five European countries—Poland, Italy, Greece, Cyprus, and the United Kingdom (n=258)—to address the need for practical, effective, and open-source gamification solutions compatible with popular LMS/CMS platforms. This study advances the field by offering a systematic analysis of widely used gamification plug-ins and providing new insights into how these tools can be applied to foster learner engagement. By situating the findings in the context of prior research, this paper highlights how gamification contributes to learning outcomes in ways that have not been sufficiently explored, filling an existing gap in the literature. The research questions aim to identify the most user-friendly open-source plug-ins for gamification and determine their usefulness in creating interactive learning content. Ultimately, these insights can inform the design of more engaging e-learning platforms, improving retention and participation rates.

Keywords: e-Learning, Interactive content, Gamification, Plug-ins, Online tools, LMS/CMS platforms

1. Introduction

In the ever-evolving landscape of adult and vocational education and training (VET), game-based tools have emerged as crucial elements towards enhancing learning outcomes, engagement, and skills development (Anderson, Anderson and Taylor, 2009; Tay et al., 2022; Chang, 2023). This significance holds, particularly within the European context, where continuous professional development and upskilling are key priorities in nurturing a competitive and adaptable workforce. While Industry 4.0 focuses heavily on technology and digitalisation, the emerging Industry 5.0 suggests emphasis on human-centricity, sustainability, and resilience for ensuring a workforce is upskilled (Kolade and Owoseni, 2022).

As the demands of the workforce rapidly change and new skills become essential, traditional instructional approaches often struggle to captivate and motivate adult learners (Huang & Soman, 2013; Barneva, 2017). Here, game-based methodologies offer a transformative solution, creating dynamic and immersive learning environments that align with the digital competencies and preferences of today's learners. By integrating game

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elements, mechanics, and interactive features, these interventions breathe life into training programmes, fostering motivation, knowledge acquisition, and skill development. World Economic Forum (2022) emphasises that investing in education and training could add $2.54 million to the global economy and a playful approach that also includes game-based learning is key.

Game-based approaches have emerged as powerful tools in educational design, significantly influencing learner engagement, motivation, and learning outcomes. By simulating real-world scenarios, employing scenario-based learning, and leveraging virtual environments, game-based interventions provide learners with opportunities to practise and refine their skills in a safe and controlled setting (Arnab, 2020). Game-based pedagogy bridges the gap between theoretical knowledge and practical application, facilitated through a more active and experiential nature of games towards developing practical competencies, problem-solving abilities, and decision-making skills essential for professional roles.

Game-based approaches operate at the intersection of various disciplines, including education, psychology, computer science, design, and human-computer interaction (Arnab, 2020). This interdisciplinary nature is pivotal in addressing the complex challenges of adult and vocational education and training (VET). By integrating diverse perspectives and expertise, game-based approaches explore innovative pedagogical concepts, effective learning design, user experience optimisation, and assessment methodologies. This holistic understanding of learners' needs enables the development of contextually relevant and impactful interventions that resonate with diverse target groups.

Introducing game-based approaches such as serious games, game-based learning, and gamification is essential for enhancing learning experiences. Among these approaches, gamification as a technique, wraps game elements around serious contexts and activities for nudging engagement and sustain motivation to participate in activities, which is often non-content specific. Gamification leverages game techniques to facilitate, observe, and measure learning in non-game contexts (Deterding et al., 2011; Seaborn and Fels, 2015; Arnab, 2020), scaffolding and enhancing learners' experiences. It involves the use of video game elements to enhance user experience and engagement (Landers, 2014), as well as the incorporation of motivational affordances to evoke gameful experiences and behavioural outcomes (Hamari, Koivisto and Sarsa, 2014; Koivisto and Hamari, 2019). This approach focuses on two key aspects: the experiential aspect, which emphasises the gameful experience, and the game design aspect, which explores the design principles employed in gamification (Högberg, Hamari and Wästlund, 2019).

Gamification has gained significant traction in the education domain, including online learning and training contexts (Panigrahi and Srivastava, 2018; Khaldi, Bouzidi and Nader, 2023). Through interactivity, competition, rewards, and progression, gamification captivates learners' attention and sustains their engagement. The increasing digitalisation of education, accelerated by the COVID-19 pandemic, has highlighted the urgent need for innovative tools to enhance learner engagement and motivation in online learning environments. Traditional instructional methods often struggle to meet the expectations of modern learners, particularly in VET contexts, where practical, skills-based learning is crucial. Gamification plug-ins offer a compelling solution by embedding gamification characteristics—such as points, badges, challenges, and leaderboards—directly into existing Learning Management Systems (LMS) and Content Management Systems (CMS). This seamless integration allows educators to enhance the interactivity and functionality of established platforms without the need for extensive redesigns. Despite their potential, there is a significant gap in resources and evidence-based guidance to help educators and institutions make informed decisions about selecting and implementing these tools. This study addresses this critical gap by evaluating the usability, relevance, and effectiveness of gamification plug-ins, providing actionable insights to support their adoption and unlock their potential to transform digital learning experiences.

The use of plug-ins in gamification has historically been a double-edged sword, offering the potential to enhance user engagement while introducing significant challenges. In the past, technical compatibility issues, limited customisation, and resource-intensive designs often hampered their effectiveness, making gamification efforts feel clunky or irrelevant. Security vulnerabilities and poor user experiences further undermined trust and adoption. Today, these problems have evolved with the digital landscape, as privacy concerns, interoperability challenges, and the high cost of subscription-based plug-ins create new barriers. These persistent issues highlight the critical need for robust, seamless, and ethical plug-in solutions to fully unlock gamification's potential in engaging and motivating users.

In the past, plug-ins for gamification often suffered from technical compatibility issues. Many were not universally compatible across platforms, causing glitches or outright failures on certain devices or browsers.

Another common problem was the lack of user engagement; poorly designed plug-ins failed to align with user motivations or game mechanics, making them feel forced or irrelevant. Security vulnerabilities were also a significant concern, as some plug-ins introduced risks like data breaches or malware. Additionally, limited customisation options made it difficult for developers to tailor experiences to diverse audiences or unique use cases. Plug-ins were also frequently resource-intensive, slowing down websites or applications, which frustrated users.

Today, while some of these issues persist, new challenges have emerged. For instance, privacy concerns are more prominent now, with users wary of gamification systems tracking or misusing personal data. Interoperability across advanced systems remains a hurdle, especially as ecosystems become more complex with AI and machine learning integration. Lastly, the rise of subscription-based plug-ins has introduced cost barriers, limiting access for smaller developers or businesses. These evolving challenges necessitate a more thoughtful approach to gamification plug-ins.

Despite their challenges, plug-ins remain essential in gamification because they provide scalable solutions to implement game mechanics quickly and efficiently. They enable developers to add features like leaderboards, rewards, and progress tracking without building these systems from scratch, saving time and resources. Plug-ins also help standardise gamification elements across platforms, ensuring a consistent user experience. Moreover, many plug-ins come with pre-built analytics, allowing organisations to gather insights into user behaviour and optimise engagement strategies. Their adaptability to integrate with various tools and platforms makes them invaluable for creating customised and dynamic gamification solutions. While challenges like privacy and compatibility persist, the benefits of plug-ins in enhancing engagement and driving user motivation make them a critical component of gamified systems.

Plug-ins offer a myriad of features and functionalities tailored to enrich existing e-learning platforms, providing educators with the tools necessary to create dynamic and engaging learning environments. Among these plug-ins are gamification plug-ins, which serve as integral tools for improving modern e-learning platforms, i.e. Learning Management Systems (LMS) or Content Management Systems (CMS), by infusing them with elements of interactivity, motivation, and gamified learning experiences. Introducing gamification into the learning process not only creates an attractive environment for learners but also fosters skill acquisition, problem-solving, and group collaboration, resulting in a more effective educational process. In the present context, the use of gamification plug-ins opens up new perspectives for educational course developers, providing innovative tools to develop learners' skills in a way that is engaging and adapted to contemporary educational expectations. Gamification plug-ins compatible with LMS/CMS offer a promising avenue for enhancing the educational experiences of existing online learning platforms. However, their effective implementation requires a balanced approach that prioritises meaningful engagement, intrinsic motivation, and the educational objectives at hand.

With these perspectives, this paper explores and discusses the features of fifteen (15) gamification plug-ins, which can enrich the learning-teaching process. The authors understand a *gamification plug-in* as a software component designed to integrate gamification features into an existing system, platform, or application. The investigation was based on the following research questions:

- Why is it beneficial to integrate gamification plug-ins into educational material development?
- Which open-source gamification plug-ins are perceived as the most effective and user-friendly by VET trainers, learners, and stakeholders, and what features contribute to their perceived effectiveness within popular LMS/CMS platforms?

This study adopts a novel approach by reviewing gamification plug-ins with educators from five diverse European countries, offering a unique opportunity to examine how cultural, educational, and technological differences shape the perceived relevance and usability of these tools. Additionally, the focus on VET professionals introduces an innovative dimension, as most gamification research centers on traditional academic settings. This emphasis underscores the potential of gamification to address the specific needs of skills-based education effectively.

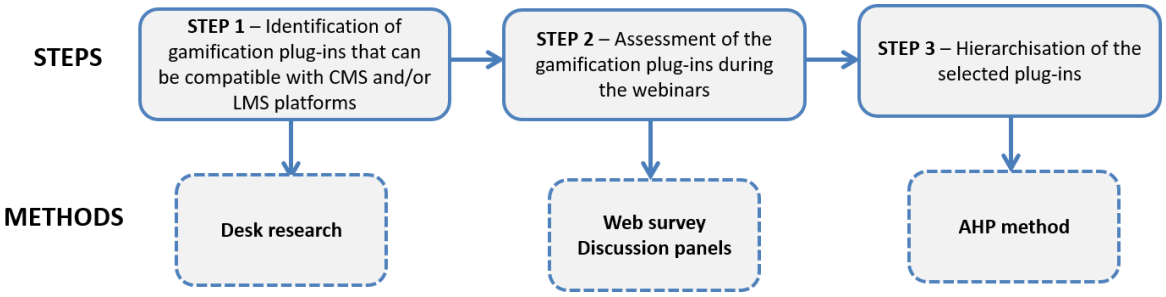
The study involved a total of 258 participants, recruited from five European countries: Poland, Italy, Greece, Cyprus, and the United Kingdom. The participants consisted of VET trainers, learners, and individuals with an interest in gamification in educational contexts. The selection process was based on purposive sampling, targeting stakeholders who have experience or interest in online learning and gamification. Recruitment took place through professional networks, educational institutions, and e-learning communities, ensuring that the

sample represented a diverse cross-section of individuals with practical insights into gamification in e-learning environments.

Data were collected using a mixed-methods approach, incorporating both quantitative and qualitative tools to gain comprehensive insights into the efficacy of gamification plug-ins. The primary instrument was a structured survey, which included both closed-ended questions to gather quantifiable data and open-ended questions for qualitative insights. The survey was supplemented by interviews with a subset of participants (n=50) to explore their experiences in greater depth.

2. Methodology

The investigation consisted of the following steps as illustrated in Figure 1.



Source: Authors.

Figure 1: A flow diagram for the research methodology used

Step 1: The initial phase involved systematically identifying gamification plug-ins compatible with CMS and/or LMS platforms. Organisations from Poland, Italy, Greece, Cyprus, and the United Kingdom were tasked with this endeavour, aiming to pinpoint at least 6 plug-ins per country. Leveraging a combination of literature review, available online documents, and website exploration, this month-long independent pursuit sought plug-ins meeting specific criteria: low-cost, free, or open-source. Out of the initial pool of thirty (30) plug-ins identified, only 15 selected were taken into account for further research, with duplicates eliminated across various countries.

Step 2: Subsequently, a thorough evaluation of the identified gamification plug-ins was conducted through a structured series of webinars. These sessions engaged a total of 258 participants from five countries, systematically designed to facilitate comprehensive plug-in assessments. The webinars were segmented into smaller cohorts, each accommodating approximately twenty (20) attendees. The process unfolded methodically: Participants with a keen interest in gamification and its educational applications were invited to the events. Plug-in presentations were delivered, featuring succinct overviews by representatives from each country, highlighting key features, functionalities, and unique benefits. Subsequent Q&A sessions allowed for nuanced exploration, enabling participants to seek clarification on plug-in capabilities and implementation details.

Participants conducted evaluations using pre-defined criteria (see Table 4) covering various aspects such as plug-in features, strengths, and weaknesses, installation guidelines, tutorials, and compatibility with LMS and CMS platforms, employing web surveys for assessment. Feedback and discussion panels further enriched the assessment process by facilitating an exchange of insights and opinions.

The categories from Table 4 were selected based on the analysis of the data collected from participants. During the survey and interview process, several themes emerged as key factors influencing the participants' evaluation of gamification plug-ins. These themes were consistently mentioned by multiple respondents, which led to the categorisation of the plug-ins under the following five areas:

- *How-to/Tutorial*: Many participants expressed the need for clear and accessible guidance on how to use the plug-ins. This category was included to assess the availability and quality of tutorials or how-to guides provided by the plug-ins, as this directly impacted usability.
- *Guidelines for Installation and Usage*: Ease of installation and initial configuration were highlighted as critical factors in the adoption of a plug-in. Participants emphasised the importance of having step-by-step instructions to streamline the implementation process.

- *Compatibility with LMS and CMS Systems*: One of the primary objectives of the study was to identify plug-ins that work seamlessly with LMS and CMS. This category was included to evaluate whether the plug-ins were easily integrated into existing educational platforms, a key concern for participants.
- *Strong and Critical Aspects*: During the interviews, participants often discussed both the strengths and limitations of the plug-ins they had experience with. This category allowed for a balanced evaluation of each tool, reflecting the participants' nuanced perspectives on what worked well and what could be improved.
- *Features*: Participants were particularly focused on the functionality offered by each plug-in. This category examines the specific features that differentiate one plug-in from another, helping to identify which tools provided the most value for enhancing learner engagement.

These categories were not arbitrarily selected; they emerged naturally from the data as key factors influencing participants' decisions and preferences.

During the discussions, the focus on 'Strong and Critical Aspects' aided the target groups in understanding the plug-in's key benefits and functionalities, while also addressing potential concerns or limitations transparently. 'Clear Guidelines for Installation and Usage' were provided to ensure a smooth user experience, guiding target groups through the process of installing and configuring the plug-in effectively. Detailed 'How-to/Tutorial sections' were offered to enhance participants' understanding and proficiency, providing practical resources for learning how to utilise the plug-ins' features effectively.

Furthermore, discussions on 'Compatibility with LMS and CMS platforms' seek to assess seamless integration and interoperability within existing digital ecosystems. This discussion enabled target groups to confidently deploy the plug-in within their preferred platforms, demonstrating its versatility and adaptability.

Additionally in Step 2, participants ranked the top three plug-ins they deemed most relevant and necessary for their work and practice, providing valuable insights into their preferences and needs.

Step 3: Building upon the results of Step 2, the features of the plug-ins underwent hierarchical prioritisation employing the Analytic Hierarchy Process (AHP) method. This methodological approach enables the delineation of crucial elements when selecting plug-ins for the incorporation of interactive content into educational materials. AHP's structured framework, hierarchical representation, pairwise comparisons, mathematical consistency, flexibility, adaptability, and sensitivity analysis capabilities render it a highly apt method for hierarchisation in decision-making processes across diverse domains, including project management, resource allocation, risk assessment, and strategic planning.

3. Findings and Discussions

In this section, we present the culmination of an extensive review process aimed at identifying and evaluating gamification plug-ins compatible with CMS and LMS platforms. Through the multi-step process (desk research, web survey, discussion panels, and the use of the AHP method), fifteen gamification plug-ins have been identified, assessed, and hierarchised. The chosen plug-ins offer unique features and functionalities aimed at promoting learner engagement, facilitating communication between educators and learners, and fostering a gamified learning environment. Among these plug-ins are *Class Dojo*, a behaviour management system designed to promote positive behaviours and communication between teachers and parents, and *WordPress* (WP) Achievements, a WordPress plugin enabling the creation and management of user achievements, quests, and ranks. Additionally, plug-ins like *Level Up!* and *GamiPress* introduce elements of gamification directly into course content, allowing teachers to reward learner progress and track their achievements. Other notable plug-ins include *Kahoot!* for interactive quizzes and games, *Bookwidgets* for creating custom interactive exercises, and *HD Quiz* for building professional questionnaires and quizzes. Each plug-in offers unique functionalities, catering to diverse educational needs and preferences, and holds promise in transforming online learning environments into engaging and interactive spaces for learners and educators alike. Table 1 further describes the gamification plug-ins.

The commonality in the research lies in the overarching goal of enhancing the teaching and learning process through gamification technologies. By focusing on LMS/CMS-compatible plug-ins, the study prioritises tools that align with institutional infrastructures while still addressing the broader aim of fostering engagement, interactivity, and learning outcomes across various educational contexts.

Table 1: The descriptions of the selected gamification plug-ins

No	Name	Short description
1	Class Dojo	An online behaviour management system intended to foster positive learner behaviours and classroom culture. Learners earn 'Dojo Points' based on their classroom conduct. Class Dojo's primary goal is to encourage positive learner behaviours and to provide a means for teachers and parents to communicate frequently and effectively about learner development. Teachers use Class Dojo to promote positive behaviours in their classroom and to strengthen lines of communication between school and home. This is done primarily through Class Dojo's 'Dojo Point' system and messaging system that connects teachers and parents. Class Dojo is fully accessible on computers, tablets, smartphones, and can even be used on interactive whiteboards and projectors.
2	WP Achievements	WP Achievements is a powerful WordPress Achievements, Quests & Ranks Plugin. It is a perfect extension for WordPress-powered website to improve the user's experiences and increase user interactivity. With WP Achievements it is possible to create and manage user achievements, quests, and ranks with ease. WP Achievements provides: to add Achievements & Quests to website for a wide range of activities; to reward users with points when they gain Achievements & Quests; to restrict content by gained achievements, solved quests, or user ranks; to publish to a user's BuddyPress components when they gain Achievements & Quests; to add and manage ranks to your website; to limit Achievements to specific Ranks; to publish to a user's BuddyPress components when they gain a new Rank; to lock content so only specific Ranks can view it.
3	Level Up!	Level up! is a customisable block that a teacher can add to a course to give experience points to learners as they progress through a course. It displays their current level and progresses towards the next level. It adds an element of gamification to a course. Exemplary features: automatically attributes points to learners for their actions; block that displays current level and progress towards next level; report for teachers to get an overview of their learners' levels; notifications to congratulate learners as they level up; a leaderboard to display the ranking of the learners; ability to customise the number of levels, the points they require, and their appearance.
4	GamiPress	GamiPress is a free WordPress gamification plugin. It enables the users to incorporate features common in gameplay into websites, such as point systems and competition between users. GamiPress is the easiest and the most effective WordPress plugin to gamify whatever is needed on the website within a few minutes. It allows the users to reward your users with different kinds of awards and badges for interacting on the website. It is also possible to easily illustrate the achievements, organise the requirements, and select from a wide range of customisable assessment options to check if each requirement has been achieved successfully or not. Thanks to GamiPress it is possible to use gamification to incentivise any kind of interaction with the site. GamiPress enables the users to create three types of digital rewards – points, achievements, and ranks.
5	Kahoot!	Kahoot!'s platform is used by educators around the world to make learning fun, vibrant, inclusive and engaging. With Kahoot!, anyone can effortlessly create, host, and participate in dynamic games and quizzes from their computers or mobile devices. Whether in a group setting or through the app's versatile player modes, Kahoot! serves as a conduit for interactive learning. Users can swiftly create and share quizzes, fostering an environment where learning is both enjoyable and accessible.
6	Bookwidgets	Bookwidgets is a tool that helps to develop interactive educational resources for the classroom. Bookwidgets enables the users to easily create custom material that will work for the class. It allows teachers to create interactive exercises and automatically grade tests in minutes. It is possible to choose from digital exercise templates that work on smartphones, tablets, and computers; transform paper tests to interactive quizzes or worksheets that work on iPads, Chromebooks or any other device.
7	HD Quiz	HD Quiz is a highly user-friendly plugin that empowers users to effortlessly create an infinite array of quizzes and seamlessly embed them into any page or post. Whether crafting professional questionnaires or entertaining Buzzfeed-style quizzes, HD Quiz offers unparalleled versatility. Its key features include the ability to generate an unlimited number of quizzes, each with customizable options. Users can enhance questions by adding featured images and tips, or even incorporate animated gifs for added visual appeal. Moreover, the plugin boasts a quiz Timer feature, enabling users to impose time limits for completing quizzes. Additionally, basic translation features facilitate global accessibility, while the option to add links or images to quiz results provides enhanced customisation.
8	Quiz Cat	Quiz Cat is the easiest way to build viral and engaging quizzes for WordPress sites. It takes just a few minutes to set up a knowledge test, trivia quiz or viral personality quiz. Main features: multiple choice answers can be added to each question; ability to add text and images to questions and answers, which makes quizzes more engaging; quiz

No	Name	Short description
		results are displayed on quiz completion, together with the 'share' button enabling them to be posted to social media.
9	Jigsaw Planet	Jigsaw Planet is a website that contains free digital jigsaw puzzles that can be assembled using any device with a web browser. With the website, users can upload their own images and create a digital jigsaw puzzle that can be shared with others. Main features: ability to select a jigsaw puzzle format and the number of pieces; Jigsaw puzzles can be published on the website or blog without the necessity to register; ability to upload own images and create digital jigsaw puzzles that can be used for educational purposes; ability to share with learners the link to previously created digital jigsaw puzzles.
10	Sticky Notes	Sticky Notes is a Moodle plugin designed to facilitate various tasks, including brainstorming, pedagogic exercises, ranking, meetings, and idea organisation. This user-friendly activity enables users to construct a virtual post-it wall where they can create, update, and reposition sticky notes across different columns, reminiscent of a kanban board. Additionally, users have the option to customise the background color of sticky notes and participate in voting processes to prioritise or evaluate ideas.
11	StudentQuiz	StudentQuiz enables students to collaboratively create their own question pools in Moodle. Students can filter these questions into quizzes, and they can rate and comment questions while working through the quizzes. StudentQuiz computes each student's contribution and learning progress and compares this with the community. The created questions become part of the Moodle question bank and can be reused in other Moodle quizzes.
12	Stash	The Stash block serves as a highly effective tool for fostering increased engagement with course activities, proving indispensable for educators seeking to gamify their teaching approach. This plugin introduces a block that displays items acquired by learners throughout the course, incentivising their participation and exploration. Teachers have the flexibility to create and distribute items within various activities and resources, encouraging learners to actively seek and collect them. These items can be configured for one-time collection, stimulating exploration of course content. Furthermore, educators can designate certain items to have an unlimited supply from specific locations, encouraging learners to revisit these areas for further collection, thereby promoting sustained interaction with course materials.
13	GAME	This is a moodle plugin that gets input from quiz, glossary or questions and converts them into games automatically. The games are: Hangman; Crossword; Cryptex; Millionaire; Sudoku; Snakes and Ladders; The hidden picture; Book with questions.
14	Real Time Quiz	The Real Time Quiz allows the users to create a quiz where each question is presented at the same time to learners. The teacher or administrator can, among others: create a quiz with a list of questions; set the time given to answer a question (30 seconds is the default); view statistics about the percentage class / individual correct answers.
15	Block Game	The Block Game plugin aims to seamlessly integrate gamification techniques into the Moodle platform with ease and efficiency. This plugin offers a range of gamification features, including the ability to customise avatars, whereby users can select or change their avatar at any time. Additionally, it provides access to player information, showcasing an overview of a user's progress across various courses within the platform. Users can also view their ranking relative to other players and engage with a scoring system that determines their rating and current level. Moreover, the plugin offers the option to display a level system, allowing administrators to configure the number of levels and the score required to progress through each level. Furthermore, a progress bar indicates the user's advancement towards the next level, enhancing their overall gaming experience.

Source: IO3 - i-CONTENT Gamification A Toolkit for the gamification of an online course.

In response to the research question, which aimed to identify the most appropriate, user-friendly, and effective open-source gamification plug-ins, we collected both qualitative and quantitative data from participants. The analysis of this data revealed the specific reasons behind the selection and prioritisation of the plug-ins listed below.

Rather than presenting only technical descriptions, we explored the reasons why participants—VET trainers, learners, and educational stakeholders—favored certain plug-ins over the others. These insights were derived from both survey responses and in-depth interviews, where participants articulated their preferences based on criteria such as usability, learner engagement, compatibility with existing LMS/CMS platforms, and ease of integration.

Throughout the interviews (n=50), participants explained their rationale for prioritising these plug-ins. For example, *Kahoot* gamifies learning, making lessons fun and engaging for students. Its user-friendly interface allows educators to create interactive quizzes and access a vast library of ready-made resources, saving time on preparation. Additionally, Kahoot fosters active participation, collaboration, and real-time feedback, enhancing the overall learning experience.

Sticky Notes are a versatile tool for teachers, allowing them to quickly jot down ideas, reminders, or feedback in an organised and accessible way. They can be used for lesson planning, tracking student progress, or highlighting key points during instruction. Their simplicity and flexibility make them ideal for fostering creativity, collaboration, and efficient classroom management.

Below are response samples:

> *"I really enjoyed how Level Up! added a sense of progression to the tasks. Earning experience points made routine activities feel more rewarding. However, I sometimes found it hard to balance the rewards with the actual goals—it's easy to chase badges and lose sight of priorities."*
>
> *"I appreciated how BookWidgets allowed me to create interactive assignments. It made learning feel hands-on and fun. That said, it took some time to get used to the interface, and some advanced features weren't as intuitive as I'd hoped."*
>
> *"WP Achievements integrated seamlessly with my existing WordPress setup. It was satisfying to see users engage more with the site because of the reward system. My only critique is that the achievements sometimes felt too generic—I wish there were more tailored options out of the box."*

The plug-ins were positively assessed. Some of them ate used more often than the others, but one of the most important aspects for the participants was that they have choice which plug-in to choose for an individual lesson.

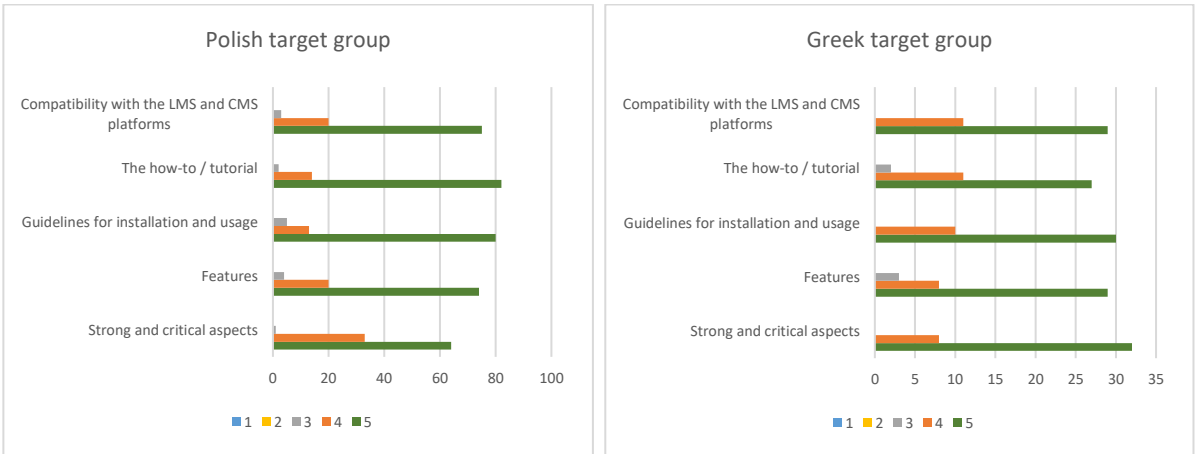
The plug-ins were then reviewed with VET trainers, students (mainly IT and pedagogics faculties), and other interested individuals (especially HR representatives of the companies) across multiple European countries (n=258, Table 2).

Table 2: Participant demography

Country	Poland	Greece	Italy	Cyprus	The UK
Number of respondents	98	40	40	40	40
Type of respondents					
VET trainers	44	30	25	21	21
Students	47	0	8	15	15
Other interested in the topic	7	10	7	4	4

Source: Authors.

As depicted in Figure 2, all elements were rated at either 5 or 4 on the scale, indicating their significance in the selection of each individual plug-in.

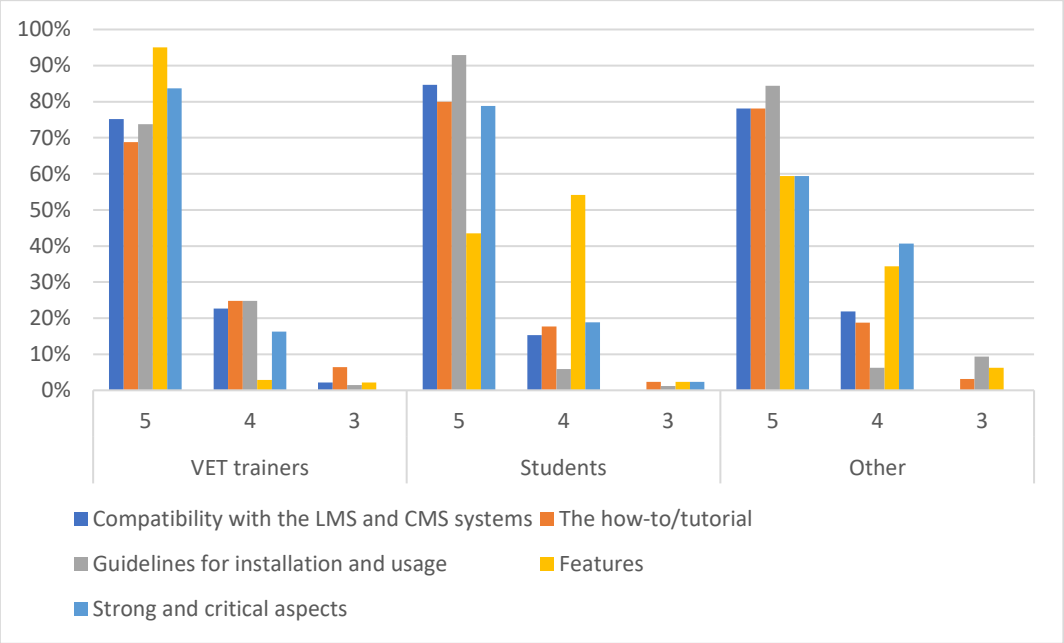


Source: Authors.

Figure 2: Overall evaluation of selected plug-ins by the participants from five European countries

The importance of various elements varies depending on the specific needs, goals, and preferences of different target groups. For instance, in Poland, participants placed significant emphasis on aspects related to "how-to/tutorial" (82) and "guidelines for installation and usage" (80). Similarly, the Italian group prioritised "guidelines for installation and usage" (34), while the Greek, UK, and Cypriot groups highly valued "strong and critical aspects" (34). Interestingly, unlike the Polish group, other groups rated "how-to/tutorial" as the least important aspect.

Figure 3 presents a comparative analysis across participant types, including VET trainers, students, and other individuals interested in the topic, represented in relative percentages. VET trainers showed the strongest assessment toward plug-in features and identified both strengths and critical aspects. However, they placed less emphasis on "how-to/tutorial" compared to other aspects. In contrast, students rated "guidelines for installation and usage" and "compatibility with LMS and CMS systems" most highly, although they still valued "features" relatively highly. Overall, examining responses across different target groups reveals consistent high appraisal of elements associated with identified plug-ins.



Source: Authors.

Figure 3: Evaluation of selected plug-ins across the participants types [in %]

Participants were also requested to specify their preferred individual plug-ins in a two-step activity. Initially, they rated each plug-in on a scale from 5 (excellent) to 1 (poor) based on its perceived value. With this data collected, the authors determined which plug-ins received an average rating above 4.0: *WP Achievements*, *Level Up!*, *GamiPress*, *Kahoot!*, *BookWidgets*, *GAME*, and *BlockGame*. In the second step, participants were asked to select their top three plug-ins. The results are presented in Table 3.

Table 3: Combined frequency of times software is collectively ranked in top 3

Plug-ins with the rate above 4.0	Frequency (number of times)	Relative Frequency [%]
WP Achievements	98	13
Level Up!	154	20
GamiPress	190	24
Kahoot!	137	18
BookWidgets	76	10
GAME	84	11
BlockGame	35	4

Source: Authors.

According to the target groups, *GamiPress* emerged as the most relevant plug-in, offering a comprehensive suite of gamification features, including points, achievements, and ranks. Its versatility enables site owners to craft engaging experiences tailored to their specific needs. With active maintenance and regular updates, *GamiPress* ensures compatibility with the latest *WordPress* versions and promptly addresses reported issues. Moreover, a supportive community with forums and resources enhances user experience, while its user-friendly interface accommodates varying levels of technical expertise.

Following closely is *Level Up!*, which encourages increased interaction with websites through task completion, discussions, and content consumption. This heightened engagement fosters higher retention rates and a vibrant community. *Level Up!* seamlessly integrates with other *WordPress* plugins and platforms, ensuring smooth operation with regular updates to maintain compatibility.

Kahoot! ranks as the third most preferred plug-in, offering educators a fun and interactive platform for engaging learners in quizzes, surveys, and discussions. Its accessibility across devices facilitates convenient participation

from anywhere with internet access. Real-time feedback during activities aids educators in assessing learner understanding instantly, enabling timely intervention where needed.

The feedback items and elements underwent further analysis using the AHP method to establish a hierarchy. The results revealed that three elements were deemed crucial by the target groups: 'strong and critical aspects,' 'compatibility with LMS and CMS platforms,' and 'guidelines for installation and usage' (see Table 4).

Table 4: The hierarchisation of the analysed elements related to the gamification plug-ins

Preference matrix for criteria	C1	C2	C3	C4	C5	$\overline{K_g}$	Eigenvector
C1: Strong and critical aspects	1	3	3	5	5	1,719	0,305
C2: Features	1/3	1	1/3	4	3	1,029	0,183
C3: Guidelines for installation and usage	1/3	3	1	5	1/2	1,096	0,194
C4: The how-to / tutorial	1/5	1/4	1/4	1	1/4	0,562	0,100
C5: Compatibility with the LMS and CMS platforms	1/5	5	2	4	1	1,231	0,218
Suma	2,067	12,250	6,583	19,000	9,750	5,637	1,000

Method 1 (with calculation of lm for consecutive lines)						
Matrix product	3,02627	1,40286	1,45126	0,30949	1,97977	
λ_m	9,9247	7,68332	7,46414	3,10589	9,06429	
$\lambda_{m\ śr}$	7,44847					
CI	-0,2835					
CR (RI=1,49 dla n=10)	-0,1903	<10%				

Metoda 2 (indication of λ_m for the whole matrix)		
λ_m	8,16966	
CI	-0,2034	
CR (RI=1,49 dla n=10)	-0,1365	<10%

Normalised matrix	C1	C2	C3	C4	C5	average C
C1: Strong and critical aspects	0,484	0,245	0,456	0,263	0,513	0,392
C2: Features	0,161	0,082	0,051	0,211	0,308	0,162
C3: Guidelines for installation and usage	0,161	0,245	0,152	0,263	0,051	0,175
C4: The how-to / tutorial	0,097	0,020	0,038	0,053	0,026	0,047
C5: Compatibility with the LMS and CMS platforms	0,097	0,408	0,304	0,211	0,103	0,224

Criterion weight value	0,392	0,162	0,175	0,047	0,224

Normalized values of weights	5,0	2,1	2,2	0,6	2,9
scope (1 ÷ 5)					
Proposed weights	5	2	3	1	4

Source: Authors.

Table 4 presents a structured Analytic Hierarchy Process (AHP) analysis to prioritise five criteria (C1 to C5) for decision-making, with a focus on evaluating preferences and ensuring consistency in judgments. The preference matrix shows pairwise comparisons among criteria, where higher values indicate stronger relative importance. From these comparisons, eigenvectors (priority weights) are calculated, with C1 (Strong and critical aspects) emerging as the most important criterion, followed by C5 (Compatibility with LMS and CMS platforms). Consistency checks using Consistency Index (CI) and Consistency Ratio (CR) confirm that judgments are reliable, as both CR values fall below the 10% threshold, indicating consistent assessments. The normalised matrix further refines each criterion's weight by averaging its relative importance across comparisons. Finally, these weights are scaled to a 1–5 range, producing proposed weights that highlight C1 and C5 as primary decision factors, with secondary emphasis on features (C2) and guidelines (C3), while tutorials (C4) hold minimal influence. This structured weighting guides decision-makers in prioritising essential factors, promoting a balanced and reliable decision outcome.

The eigenvector in the preference matrix is crucial for calculating ranks and determining which options are preferred, which supports the decision-making process. It allows to mathematically establish a hierarchy of preferences and check that the evaluations are consistent, which is invaluable in multi-criteria analyses.

The analysis in this table provides clear insights into the relative importance of each criterion, guiding decision-makers on where to focus their attention. The Strong and critical aspects (C1) are identified as the most crucial factor, reflecting the need to prioritise robust and essential features in whatever solution or tool is being evaluated. This is followed by Compatibility with LMS and CMS platforms (C5), indicating that seamless integration with existing systems is also highly valued. Together, these two criteria carry the most weight, suggesting that they should be the primary focus when evaluating options.

The Features (C2) and Guidelines for installation and usage (C3) hold moderate importance, suggesting that while desirable, they are less critical than C1 and C5. Thus, these factors should influence the decision but can be considered secondary priorities. The how-to/tutorial (C4) is the least significant criterion, implying that the presence of user guides or tutorials, while helpful, should not strongly impact the decision relative to the other factors.

The Consistency Ratios (CR) for both evaluation methods are below the 10% threshold, confirming that the pairwise comparisons made in the preference matrix are consistent. This consistency adds credibility to the results, as it indicates that the judgments used to prioritise criteria are reliable and not arbitrary.

In summary, this analysis suggests a decision-making strategy that prioritises core functionality and compatibility with existing systems (C1 and C5), while still considering features and usability (C2 and C3) as valuable but secondary. Tutorials (C4) should be viewed as a minor factor. This structured approach enables decision-makers to focus on what truly matters, facilitating a well-balanced and effective choice.

The strong and critical aspects of gamification plug-ins play a pivotal role in shaping engaging, effective, and sustainable learning experiences that empower learners and align with educational objectives. Participants consistently identified these elements as crucial, underscoring their significance in understanding the potential benefits and considerations associated with each plug-in. Prioritising these aspects enables educators to unlock the full potential of gamification, thereby enhancing teaching and learning outcomes.

Integration with Learning Management Systems (LMS) and Content Management Systems (CMS) emerges as a vital consideration for seamless implementation within educational environments. Compatibility ensures that gamified elements can seamlessly integrate into existing systems, thereby minimising technical barriers for educators and learners alike. Notably, this aspect garnered particular attention when evaluating individual plug-ins, notably *GamiPress*, *Kahoot!*, and *Level Up!*, which emerged as the most popular choices among participants.

Equally important is the provision of clear Guidelines for Installation and Usage, as educators and administrators require straightforward instructions for installing, configuring, and utilising plug-ins effectively. Accessible documentation, tutorials, and support resources are instrumental in facilitating smooth adoption and utilisation of gamified elements in educational settings. While this aspect received less attention in the evaluation of more obscure plug-ins such as *Stash*, *Sticky Notes*, or *Bookwidgets*, it remains essential for ensuring successful implementation and management.

4. Conclusions

This study set out to explore the integration of gamification plug-ins into educational material development, addressing two central research questions: (1) Why is it beneficial to integrate gamification plug-ins into educational material development? and (2) Which open-source gamification plug-ins are perceived as the most effective and user-friendly, and what features contribute to their effectiveness within popular LMS/CMS platforms?

The findings underscore the multifaceted benefits of gamification plug-ins. By incorporating game mechanics such as rewards, challenges, and interactivity, these tools significantly enhance learner engagement and motivation. They create immersive learning environments that foster skills such as problem-solving, critical thinking, and collaboration. Importantly, gamification also facilitates continuous feedback and progress tracking, allowing educators to tailor their strategies to the specific needs of learners. This aligns with the needs of vocational education and training (VET) professionals, addressing the skill-based and applied nature of their training environments.

In response to the second research question, the analysis of fifteen gamification plug-ins revealed that features such as ease of use, compatibility with existing LMS/CMS platforms, and clear installation guidelines are critical to their perceived effectiveness. Tools like *GamiPress*, *Level Up!*, and *Kahoot!* were identified as the most effective, owing to their versatility, user-friendliness, and capacity to create engaging and dynamic learning experiences. For example, *GamiPress's* ability to reward learners with points and badges, coupled with its seamless integration into WordPress platforms, makes it highly adaptable for diverse educational contexts. Similarly, *Level Up!'s* gamified progression system fosters sustained engagement, while *Kahoot!'s* interactive quizzes promote collaboration and real-time feedback.

However, the study also highlights several challenges and areas for improvement. While gamification plug-ins enhance engagement, reliance on extrinsic motivators such as points and badges may risk undermining intrinsic motivation (Nicholson, 2012) if not carefully balanced with meaningful deep learning experiences (Reid, 2011).

Additionally, the study revealed varying priorities among different target groups, with VET trainers emphasising the importance of robust features and learners prioritising compatibility and usability. This suggests a need for more customisable solutions that can cater to diverse user needs.

From a critical perspective, the findings emphasise that the mere inclusion of gamification elements is insufficient to guarantee meaningful engagement or improved learning outcomes. Meaningful gamification requires thoughtful integration of play, challenge, and emotional resonance to sustain engagement and foster deeper learning (Reid, 2011; Nicholson, 2012; Arnab, 2020). Furthermore, the study was limited to the evaluation of plug-ins in controlled settings, and their real-world application within authentic educational contexts remains untested. Future research should focus on longitudinal studies to evaluate the long-term impact of these tools on learner outcomes and explore how gamification can be tailored to diverse cultural and educational contexts.

In conclusion, this study contributes to the growing body of literature on gamification in education by providing a systematic evaluation of gamification plug-ins. It highlights their potential to revolutionise digital learning environments while calling for a more nuanced and context-sensitive approach to their implementation. By addressing both the opportunities and limitations, the findings pave the way for more effective and impactful applications of gamification in education.

AI Statement: The authors state that Artificial Intelligence tool was not used in this study.

Ethics Statement: Ethical approvals have been obtained with precautions taken to ensure participants' informed consent and confidentiality.

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