

Transforming learning and assessment through didactic games in virtual calculus classroom

eSTeEM Final Report

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Executive Summary

This eSTeEM project explored the effectiveness and reception of didactic games as a teaching and learning tool in an online calculus classroom. The motivation stemmed from growing interest in gamification across higher education, combined with the unique challenges faced by distance learners in engaging deeply with abstract mathematical content. The project set out to design, deliver, and evaluate a set of digital calculus games that could enhance students' conceptual understanding, increase intrinsic motivation, and support assessment for learning within STEM modules at The Open University.

The project created three bespoke online games—**Maths-jong**, **Calculus Wizard**, and **Time Traveler**—each targeting specific aspects of calculus learning. These games were integrated into a dedicated project website and made available across several modules (MST125, MST224, T272). To assess student perceptions, a multi-phase online survey was conducted across three academic periods: Spring 2024, Fall 2024, and Spring 2025, yielding 91 complete responses.

Findings revealed that students appreciated the interactive and engaging nature of the games, with **Maths-jong** consistently emerging as the most popular. Students highlighted the benefits of repetitive pattern recognition, visual layout, and gamified reinforcement of calculus rules. Conversely, the primary sources of dissatisfaction were the rigid timed elements and unclear instructions, particularly in **Time Traveler**. Despite these issues, over 50% of respondents supported the permanent integration of games into course

content, and more than one-third indicated they would recommend the games to peers.

This project demonstrates that online games—when designed with clarity, appropriate difficulty, and accessibility in mind—can be a valuable asset in the digital learning ecosystem. The results provide a strong foundation for future development and integration of gamified tools in mathematics education.

Recommendations include: improving user interface accessibility, offering adjustable pacing and feedback mechanisms, and extending the game library to encompass broader calculus topics. These outcomes contribute directly to the University's strategic objectives of enhancing student engagement, promoting innovative assessment strategies, and embedding technology-enabled learning across disciplines.

The project delivered a freely accessible suite of three online calculus games hosted on the Unity WebGL platform, offering an open resource for students and educators exploring game-based learning in distance education. A scholarly article based on the project's findings is in preparation for submission to a high-profile peer-reviewed journal, further contributing to research on gamification in STEM teaching. Additionally, international dissemination through the 2024 Shanghai Open University Visiting Scholar Program led to new global collaborations, including a game co-development partnership with Uttarakhand Open University, India.

Aims and scope of the project

Recent tendency

Over the past two decades, a substantial body of research has shown that digital game-based learning (GBL) can enhance both cognitive and affective outcomes in mathematics and wider STEM subjects. Early meta-reviews (Randel, Morris, Wetzel, & Whitehill, 1992) and motivation models (Garris, Ahlers, & Driskell, 2002) established that games can equal—and often exceed—traditional instruction for retention and transfer when feedback, challenge, and narrative are tightly integrated. Offenholley (2012) demonstrated how embedding mathematical structures inside gameplay fosters deep conceptual engagement, while Kiili (2005) proposed an experiential model that unites flow, feedback, and reflection—principles now common in modern STEM games. Large-scale syntheses by Clark, Tanner-Smith, and Killingsworth (2016) and by Kebritchi and Hirumi (2008) report consistent, moderate positive effect sizes for digital math games on achievement, with particularly strong gains in problem-solving and higher-order thinking when learning content is intrinsically tied to gameplay. Hui and Mahmud (2023) confirm that motivation and engagement are the most consistently improved affective variables. Shute (2011) further extends the evidence base into assessment, showing that “stealth assessment” embedded in gameplay can provide continuous formative diagnostics without adding test anxiety. Despite these advances, most studies have been conducted in face-to-face or blended settings; comparatively few interrogate how such benefits translate to fully asynchronous distance-learning environments. Addressing that gap, the present project deploys and evaluates

a suite of online calculus games within The Open University's virtual ecosystem, systematically analysing student perceptions of usability, motivation, and learning value across three mathematics modules.

The Project's aim

The aim of the project is to explore students' perception of online calculus games used by students for both studying calculus concepts and for reviewing calculus techniques at the next learning level. The context of perception here is how they like a game as a learning tool as well as a tool for motivating learning calculus in a distance learning framework.

The objectives are

1. Create a pool of games in calculus (through adaptation of developed games, digitalization of board games, and scholarship exchange) and develop web-resources, where students can comfortably access and navigate the games and communicate with the project's team.
2. Design effective tools for measuring students' perception of online calculus games. We need to develop a sustainable system of game-playing engagement and obtaining student feedback by collaborating with proposed module teams.
3. Formulate the principles of usage of online games designed to teach the tenets of calculus in a distance learning environment based on obtained results from studied modules.

Scope and Pedagogical Framings

To investigate the intersection of GBL and distance education, the project was implemented across three key modules at The Open University: MST125

(Essential Mathematics 2), MST224 (Mathematical Methods), and T272 (Core engineering B). These modules span foundational to intermediate levels of calculus instruction and represent a broad cross-section of the OU's student population, from STEM beginners to engineering undergraduates.

Collectively, the modules enroll over 2,000 students annually.

Our strategy was threefold:

- First, we **curated and developed a portfolio of online calculus games**, drawing from the project lead's prior work, legacy board games from the School of Mathematics & Statistics, and external partnerships.
- Second, we **created a project [website](#)** to host and embed games using WebGL (Unity Play), enabling browser-based, no-install access for all users.
- Third, we **designed and deployed a multi-stage feedback mechanism**, allowing students to reflect on their experience and rate each game across dimensions such as enjoyment, difficulty, usability, and perceived value for learning.

The three games included in the pilot study reflect diverse pedagogical designs:

- *Maths-jong* is a matching game focused on visual repetition of calculus identities (e.g., derivative rules), allowing for low-pressure skill reinforcement.

- *Calculus Wizard* embeds rule recall into a narrative, time-bound format, combining light storytelling with math problem-solving.
- *Time Traveler* simulates timed challenges to test concept application under pressure, inspired by assessment-like conditions.

These games offer varied interfaces, difficulty curves, and instructional alignments, allowing the research to capture a spectrum of learner responses. Importantly, all games were designed with accessibility, low bandwidth, and cross-platform compatibility in mind.

Institutional and Strategic Alignment

This project contributes directly to two of the University's strategic priority areas:

1. **Assessment and Feedback:** By studying how games function as both formative practice tools and potential low-stakes assessment formats, we offer insights into non-traditional feedback mechanisms. The inclusion of score tracking, worked solutions, and in-game error correction suggests a pathway to assessment that is timely, diagnostic, and student-controlled.
2. **Technology-Enabled Success:** Through the use of Unity, the project demonstrates how open-access game engines and collaborative development workflows can be leveraged to scale innovation across modules. The digital-first approach supports inclusive and flexible participation, and it may serve as a model for future integration with AI-based learning systems.

Moreover, the project builds on a limited but growing number of gamification initiatives within eSTeEM and addresses a gap in STEM-related scholarship at the OU. Previous projects—such as *The Project Game* in Arts & Humanities—have shown that educational games can generate enthusiasm and promote discussion. Our project extends this model to a quantitatively rigorous domain and addresses the challenge of independent study within technical subjects.

Finally, by bringing together module teams, tutors, developers, and scholarship leaders, the project reinforces the OU's commitment to interdisciplinary collaboration and pedagogical experimentation. If the outcomes suggest improved student motivation and engagement, this approach could inform wider implementation not only in calculus but also in linear algebra, statistics, and numerical methods modules.

Activities

The project unfolded in four major phases from January 2024 to June 2025, involving the development, deployment, refinement, and evaluation of three educational calculus games. Each phase was shaped by iterative feedback from students, close coordination with module teams, and broader eSTeEM and STEM community engagement.

Phase I: Game Design, Technical Development, and Platform Setup (Jan – May 2024)

The project began with the design and digital deployment of three interactive games—**Maths-jong**, **Calculus Wizard**, and **Time Traveler**—each built in Unity and hosted online via the Open University-affiliated [project site](#). The games were designed to emphasize specific skill sets in differential calculus and to offer a novel, engaging alternative to traditional passive learning methods.

- **Maths-jong** is a tile-matching puzzle game styled after Mahjong Solitaire. Each tile displays either a calculus expression or a simplified form. The player must correctly pair matching expressions under a time limit. The core learning goal is visual reinforcement of common differentiation patterns.
- **Calculus Wizard** combines rapid-fire symbolic simplification with arcade-style feedback. Students "cast spells" by choosing the correct simplification of derivatives from multiple options while racing a countdown. The game increases difficulty with each level, offering both intrinsic challenge and skill recognition through animation and scoring.

- **Time Traveler** presents students with branching-choice storylines that integrate calculus tasks as obstacles to progression. Timed multiple-choice questions must be answered correctly for the player to “advance through time.” While innovative, this game raised accessibility concerns due to its pressure-based design and mixed instructional clarity.

All games were implemented using Unity Engine and embedded on a mobile-friendly webpage. The games required no login or installation and were compatible with most desktop browsers and touchscreen tablets. Accessibility testing was initially informal but helped flag issues with font scaling and visual contrast on smaller devices.

Phase 2: Pilot Launch and Survey Instrument Design (May – June 2024)

In the first official trial window (Spring 2024), students from all three modules were invited to play the games and complete a survey hosted on Microsoft Forms (see Appendix C). The survey design consisted of:

- **Four Likert-style ratings:** on perceived difficulty, enjoyment of time limits, usefulness for revision, and interface usability.
- **Checkbox prompts:** on which games were tried and which was most/least enjoyed.
- **Four open-ended prompts:** exploring likes, dislikes, outside game comparisons, and general feedback.

Between **May 30 and June 25, 2024**, 34 completed responses were received.

These informed several immediate changes:

- The instructions for **Calculus Wizard** were reworded for clarity.
- Font sizes in **Maths-jong** were slightly increased.
- A simplified “Start Here” navigation was introduced on the main game portal.

Feedback indicated high student appreciation for **Maths-jong**’s layout and pacing, while **Time Traveler** polarized students—some enjoyed the challenge, others found the interface overwhelming. This first round validated the games’ appeal and identified improvement areas for scaling.

Phase 3: Broader Dissemination and Iteration (Oct – Dec 2024)

In the second phase, the project expanded to a fresh cohort of students. The website and survey were redistributed via module forums and email campaigns between **October 15 and December 9, 2024**, yielding the largest cohort (n = 40).

Notable enhancements during this phase included:

- Increased mobile responsiveness via Unity’s WebGL updates and layout tweaks.
- Revision of survey wording to better distinguish between cognitive load and enjoyment.

Students’ qualitative responses were richer in this round, with more detailed insights into gameplay barriers and comparisons with commercial game

formats (e.g., “reminded me of *Brain Training*” or “a bit like *Duolingo* for derivatives”).

Phase 4: Final Sample and Analytical Consolidation (Apr – May 2025)

A third round of feedback collection was carried out from **April 6 to May 31, 2025**, timed with Spring module cohorts. Though the smallest group (n = 13), responses were more targeted—many students discussed game-to-module alignment and requested expansion into topics like integration or parametric curves.

Throughout the data collection periods, responses were monitored and downloaded from Microsoft Forms into Excel, then imported into Python and R for statistical analysis. Thematic coding of open responses followed Braun & Clarke’s (2006) model. Survey analysis focused on:

- Distribution of preferences across games
- Thematic clusters (visual clarity, stress, repetition value)
- Shifts in sentiment and perception over time

Out of the 91 complete responses, 87 fell within the three academic windows used for term-based comparison. Four were submitted outside the designated periods (e.g., between phases) and excluded from comparative temporal analysis, though their qualitative insights were retained for recommendations.

Institutional Engagement

- Preliminary results were reported to **eSTeEM in June 2024**.

- Preliminary results were presented during the international **meeting of Visiting Scholars at Shanghai Open University, China** (July 2024) through an interactive session showing gameplay clips and annotated student quotes.
- Module leaders were briefed digests with links to survey summaries and participant sentiment.
- Plans are underway to submit the results to the **2025 eSTeEM Annual Conference** and publish in a peer-reviewed journals.

Findings

This section presents the core results of our eSTEEeM scholarship project evaluating online calculus games across three undergraduate mathematics modules. The project gathered 92 responses through voluntary surveys between May 2024 and May 2025, with representation from MST125, MST224, and T272. Through quantitative analysis, visual reporting, and qualitative thematic coding, we identified key patterns in game engagement, usability, pedagogical value, and student motivation.

Cohort Demographics and Module Participation

As shown in **Panel A**, the surveyed cohort included a diverse age range, though only adult learners (18+) were analyzed in the final statistics. The age distribution was as follows: 18–35 years (56.7%), 35–65 years (40.0%), and 70+ years (3.3%). Module representation broadly reflected actual enrolments: 55% of respondents were from MST125, 26% from MST224, and 11% from T272, with the remainder from other OU modules.

This balance enabled us to examine perspectives across early-stage and advanced learners, as well as from both mathematical and engineering disciplines. The robust participation from MST125 students also allowed for more nuanced interpretations of how foundational learners perceive digital learning tools.

Panel A – Cohort Demographics

Panel A – Cohort Demographics

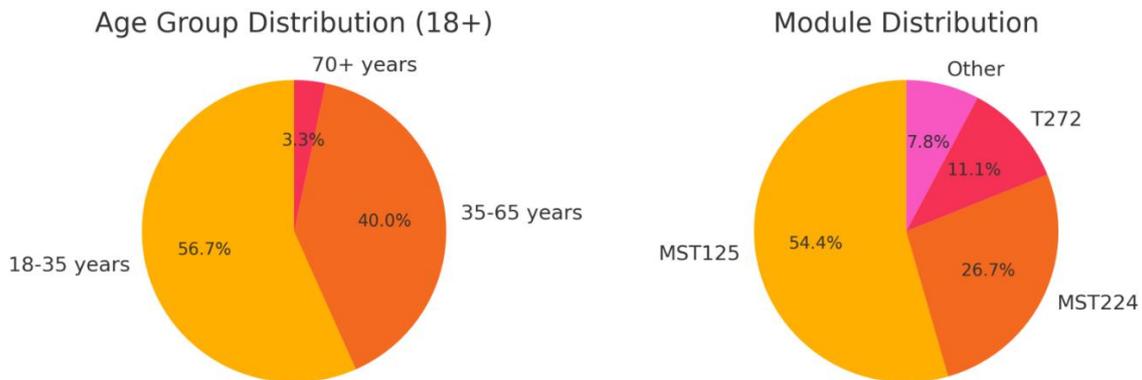


Fig. 1 Panel A: Cohort Demographics (Age and Module)

Participation Game Difficulty and Learning Value

When asked to rate the mathematical difficulty of the games, students were evenly split. As illustrated in **Panel B (left)**, 60% of students found the difficulty level appropriate ("neutral"), while 24% considered the games "easy" and only 15% found them "challenging". This suggests that the games were generally well-pitched for consolidation rather than initial instruction—a desirable feature in a revision tool. Several students noted that the games helped them "reinforce core rules" and "cement ideas", especially regarding differentiation.

Importantly, when asked whether these games should be **permanently integrated** into the learning materials, a majority responded positively. As shown in **Panel B (right)**, 56% agreed or strongly agreed with integration, 18% were neutral, and only 26% expressed concerns or resistance. This endorsement suggests that students saw meaningful pedagogical value in the game format, even if not all games were equally well received.

Panel B – Difficulty & Integration Attitudes

Panel B – Difficulty & Integration Attitudes



Fig. 2 Panel B: Difficulty Ratings and Attitudes Toward Integration

Gameplay Preferences and Mixed Reactions to Time Pressure

Students were also asked about the specific mechanics and user experience. As shown in **Panel C**, preferences regarding timed gameplay were more divided. About 37% of respondents appreciated the added challenge and energy of countdown timers, while 41% disliked them and 22% were neutral. This split was especially pronounced across age lines, with older students (ages 35–65) more likely to critique timed elements for increasing stress and reducing accessibility. A significant subset of respondents (34%) reported using the games for **revision**, while 66% did not. This suggests that although the games were available for self-directed review, their discoverability or positioning in the module structure may have limited broader uptake. Several participants commented that they only encountered the games "by chance" or "via forums", indicating room for improvement in promotion and integration.

Panel C – Gameplay Preferences

Panel C – Gameplay Preferences

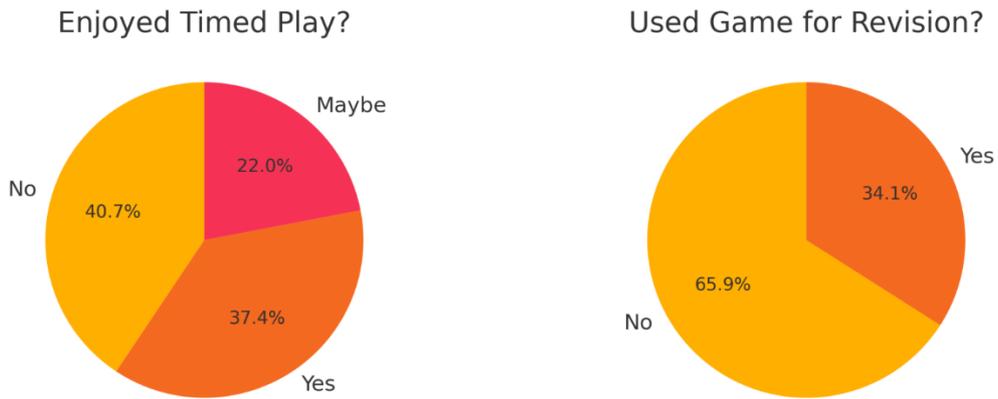


Fig. 3 Panel C: Timed Gameplay Preferences and Revision Usage

Module-Level Differences

To further understand variations in perception across modules, we generated a breakdown of attitudes toward game integration by module, summarized in

Table 1 below.

Table 1 – Integration Attitude by Module (Count + %)

Module	Positive	Neutral	Negative
MST125	24 (48%)	12 (24%)	14 (28%)
MST224	15 (62.5%)	3 (12.5%)	6 (25%)
T272	8 (80%)	0 (0%)	2 (20%)
Other	4 (57%)	1 (14%)	2 (29%)
All Modules	51 (56%)	16 (18%)	24 (26%)

The highest level of support came from **T272**, where 80% favored full integration. This may reflect the problem-solving ethos of engineering students and their appreciation of gamified practice. In contrast, MST125 participants were more evenly split, possibly due to needing additional scaffolding at the start of their learning journey. Still, nearly half of MST125 respondents were positive about integration, reinforcing that games are not exclusively useful to advanced learners.

Successes and Highlights

The strongest success story was the game *Maths-jong*, which emerged as the favorite for more than 70% of students across all modules. Students described it as “relaxing”, “easy to navigate”, and “highly memorable”. Its visual pattern-matching mechanic—used to reinforce calculus rules—proved particularly

effective for visual learners and those revising rule-based content. The clarity of layout, intuitive matching, and relaxed pace made it more accessible across devices and age groups.

Equally notable was the cross-module interest in continuing the initiative. The feedback from MST224 and T272 participants revealed enthusiasm not only for using the games but also for contributing to their development. In T272, several students volunteered to **help design new levels** or gameplay concepts as part of future coursework—an unexpected and welcome outcome that opens up new pedagogical pathways for co-creation and authentic assessment.

Unanticipated Outcomes and Design Challenges

The most consistent negative feedback was directed at *Time Traveler*, which was the least-favored game for over 50% of respondents. Critiques included “cluttered interface,” “font too small,” and “stressful”. This prompted a redesign, including increased font size, reduced color complexity, and the addition of a brief tutorial overlay to clarify the objectives and scoring.

Another unanticipated finding was the **demand for instant feedback**. At least 25 survey comments mentioned a desire for “hints,” “step-by-step solutions,” or “correct answer explanations”. This aligns with broader educational research on “stealth assessment” (Shute, 2011), and our development would respond by prototyping an auto-feedback engine for integration in the next game version.

Interestingly, **timer dislike increased with age**. Among students aged 35–65, over 50% expressed a preference for untimed play, compared to only 33% of those aged 18–35. This trend suggests that game pacing should be **adjustable**, catering to both learners who thrive on timed challenges and those who need a more reflective approach.

Differences by Phases

Spring 2024 (Launch Phase)

- Characterized by curiosity and high engagement with *Maths-jong*.
- Main criticisms involved clarity of *Time Traveler* and the lack of help functions.
- Students in this group tended to offer feedback in open, enthusiastic terms (e.g., “This was fun!”).

Fall 2024 (Expansion Phase)

- Most reflective and critical cohort.
- Stronger calls for improvement: more feedback, clearer user interface, varied difficulty.
- Emergence of constructive comparisons with commercial games or apps.

Spring 2025 (Refinement Phase)

- Smaller cohort but more mature feedback.
- Students appeared more fatigued with repeated gameplay or had higher expectations.
- *Calculus Wizard* was now seen as the most frustrating due to lack of learning scaffolding.

Reflection and Limitation

The evidence indicates strong inclusivity across age bands: engagement is not limited to younger “digital natives,” but extends to older learners as well. This suggests that usability and pacing—not technology itself—are the key factors in game acceptance.

In terms of curricular fit, the games did not attempt to replace lectures but to reinforce taught concepts. Neutral-to-easy difficulty ratings and qualitative responses confirm that they function well as tools for retrieval practice, especially in asynchronous environments.

The polarised feedback on timers makes a compelling case for flexible pacing options. Optional timers are now a design requirement to accommodate different learner needs. Meanwhile, requests for in-game feedback strongly support embedding stealth assessment tools, which can benefit both students and tutors by surfacing mastery data.

Scalability also appears feasible: no major technical issues were reported, and support for wider integration has come from both students and staff.

The response rate (~9%) introduces potential volunteer bias; it is possible that students already interested in technology were overrepresented. Furthermore, the study captures only a cross-sectional view—future research will be needed to explore longitudinal learning gains.

Another limitation concerns the gap between gameplay and survey completion. Although the calculus games were accessed over 200 times, only 91 students submitted survey responses—indicating that more than half did not return to provide feedback. This drop-off may reflect time constraints, survey fatigue, or unclear instructions. While a few students were eligible to win a gift card for participating, even modest incentives did not fully close the loop. Future iterations may benefit from embedding short feedback prompts within the games or offering clearer incentives to encourage broader response rates.

Also, as with most perception-based research, there may be discrepancies between self-reported difficulty and actual performance. Plans to integrate

analytics dashboards will allow triangulation of student perception with gameplay behaviour and mastery.

Impact

Student Experience

The integration of calculus games has demonstrably enhanced student engagement, motivation, and conceptual understanding in a distance-learning environment. Students frequently described the games as “fun,” “motivating,” and “a refreshing break from reading,” highlighting the emotional lift provided by GBL—particularly critical for asynchronous learners working in isolation. Over half of surveyed students expressed strong support for permanent integration of games into modules, reflecting not just enjoyment but perceived academic value. Additionally, more than one-third of students voluntarily used the games for revision, even though they were not embedded in assessment, demonstrating early signs of independent learning enhancement.

While the primary focus was on three mathematics modules (MST125, MST224, and T272), students in similar STEM pathways are likely to benefit from the possible rollout of improved versions (v2.0), which include accessibility upgrades and stealth-assessment features. These updates can support broader continuation and revision efforts across the STEM curriculum. The co-design invitation extended to T272 students also offers valuable employability opportunities through authentic assessment experiences.

Teaching

The project has shifted teaching practices by demonstrating how online games can be used not just as add-ons, but as purposeful instructional tools. The game data also created a space for formative feedback conversations that were otherwise difficult to facilitate in asynchronous contexts.

Module Chairs for MST125 and MST224 have expressed support for the potential integration of Maths-jong in future presentations, representing a promising step toward embedding game-based learning within OU mathematics modules. Associate Lecturers could be engaged through a school of mathematics and statistics in a scholarship seminar and may promote features such as the adjustable timer and forthcoming gameplay dashboards during tutorials.

Strategic Change and Learning Design

The project contributes directly to the OU's strategic priority of "investing in technology that enables success." By developing scalable digital resources grounded in evidence from the project, it offers a blueprint for modular, inclusive game-based learning that can be adapted to other disciplines. It also supports the university's goals around formative assessment, as stealth-assessment features embedded in the updated games align with growing demands for diagnostic tools that reduce student anxiety.

Recommendations

We recommend:

- Embedding GBL tools in Week 5 or revision weeks of relevant modules.
- Designing games with optional timers and clear visual layouts to support diverse learner needs.

- Using dashboards for tutors and AIs to interpret student gameplay as formative assessment signals.
- Engaging students in game co-design as a credit-bearing Employ My Ability (EMA) pathway to foster ownership and employability.

Other Impacts

The project has led to meaningful staff and student collaboration beyond its original scope. Two Associate Lecturers (ALs) were directly involved in reviewing games and survey design, helping to ensure alignment with tutorial practice and student needs. Additionally, one undergraduate student (Adam Wayne) joined the project as part of a short internship focused on user interface testing and feedback collection—a positive sign of student engagement in scholarship and authentic digital pedagogy development. These collaborative experiences not only enriched the project but also contributed to capacity-building within the OU’s teaching and research culture. The groundwork laid by this pilot will also support future bids for external funding aimed at scaling GBL and stealth-assessment frameworks across STEM disciplines.

Dissemination

Deliverables

The project has generated several outputs that extend its value well beyond its formal completion, with relevance for both internal OU practice and the broader international scholarship community. Key deliverables include:

1. **Playable Game Suite (Unity Platform)**

All three online calculus games (*Maths-jong*, *Calculus Wizard*, and *Calculus Time*) are freely accessible on the Unity WebGL platform and will remain available for student use, module integration, and external review.

These games are hosted at:

- [Maths-jong](#)
- [Calculus Wizard](#)
- [Calculus Time](#)

These are openly shared as a proof-of-concept demonstration of gamified calculus education in asynchronous distance learning contexts.

2. **Research Dissemination and Planned Publication**

A manuscript based on the project's methodology, student survey analysis, and design principles is currently in preparation for submission to *Computers & Education*, a leading peer-reviewed journal in the field of technology-enhanced learning. This will further contribute to the scholarly GBL in STEM education and specifically distance learning frameworks.

3. **International Presentation and Global Exchange**

Findings and pedagogical innovations from this project were presented at the *2024 Shanghai Open University International Visiting Scholar Program*, a globally respected academic forum promoting innovation in open and distance education. Participation in this program has enabled meaningful exchange with institutions from the African Council for Distance Education (ACDE), Asian Association of Open Universities (AAOU), and partners across Europe. The discussion of calculus games within this setting

contributed to raising awareness about the use of digital didactic games for adult learners in fully asynchronous environments. We established long-term collaboration on game development and design with Prof Jeetendra Pande, School of Computer Science & IT, Uttarakhand Open University, India.

Figures and tables

Figure 1. Panel A: Cohort Demographics (Age and Module)

Figure 2. Panel B: Difficulty Ratings and Attitudes Toward Integration

Figure 3. Panel C: Timed Gameplay Preferences and Revision Usage

Table 1 – Integration Attitude by Module (Count + %)

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University approval processes

If your project required specific approval from university committees, please provide the appropriate information below. This is a necessary requirement for future publication of outputs from your project.

- SRPP/SSPP – Approval from the Student Research Project Panel/Staff Survey Project Panel was obtained according to the Open University's code of practice and procedures before embarking on this project. Application number 2024/2749.
- Ethical review – An ethical review was obtained according to the Open University's code of practice and procedures before embarking on this project. Reference number HREC/ 2024/04351.
- Data Protection Impact Assessment/Compliance Check – A Data Protection Impact Assessment/Compliance Check was obtained according to the Open University's code of practice and procedures before embarking on this project. The IRA was sent to data-protection@open.ac.uk, but Samantha Mansfield, Senior Manager

Information Rights responded that in our case of the anonymous survey the registration is not required.

Appendices

Appendix A – Metrics for your project

Appendix B – Confidential commentary

Appendix C – Survey on online calculus games

Data Management Plan

All data collected during this project—primarily anonymous student survey responses and game interaction logs—has been securely stored in accordance with The Open University’s data protection policies and GDPR compliance guidelines. No personally identifiable information was collected at any stage. The survey was voluntary, and participants were informed of the purpose, anonymity, and storage of their responses.

Data analysis was conducted on local, encrypted systems and backed up to a secure SharePoint folder accessible only to the project team. Aggregate results and figures have been included in this report and will be available in accompanying dissemination materials. Any future publications based on this data will cite the data repository link and acknowledge student participation in accordance with ethical research standards.

This project commenced well before 1st December 2024 and was therefore not subject to the new Scholarship Open University Data Management Plan requirements. While not required, we may plan to upload anonymised datasets and supporting documentation to the Scholarship Exchange to enable future use by other scholarship projects.

Appendix A – Survey on online calculus games

1. The name of your undergraduate degree program:

Enter your answer

2. Year of study at The Open University:

Enter your answer

3. Module you are enrolled:

MST 125

MST 224

T272

Other: *Enter your answer*

4. Age group:

0-18 years

18-35 years

35-65 years

70+ years

5. What was your favorite game?

Maths-jong

Calculus Wizard

Time Traveler

6. Which game did you like the least?

Maths-jong

Calculus Wizard

Time Traveler

7. How would you rate the difficulty of the mathematical content in the games?

Challenging

Neutral

Easy

8. Did you enjoy the timed aspect of some of the games?

Yes

No

Maybe

9. How would you rate the user-friendliness of the interface in the online games?

Comfortable

Uncomfortable

Neutral

10. How would you rate the overall difficulty of the games, considering factors such as content, timing, complexity, and usability etc?

Difficult

Easy

Neutral

11. Was playing the game the first time you practiced the material on your own?

Yes

No

12. Did you utilize the game for reviewing materials?

Yes

No

13. Did the games help and/or motivate you to understand the material?

Yes

No

Maybe

14. How would you feel about permanently integrating the games into the module learning materials?

Positive

Neutral

Negative

15. Do you believe that the games could be utilized to assess student progress?

Yes

No

Maybe

16. Would you recommend the games to your peers?

Yes

No

Maybe

17. What aspects of the games made them enjoyable?

Enter your answer

18. What aspects of the games did you find unenjoyable?

Enter your answer

19. What specific computer/online/video games that you're familiar with would you consider using for learning Calculus?

Enter your answer

20. Any comments?

Enter your answer

