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CASE STUDY

Catastrophic Co-Production: A Student-Staff Partnership for Developing an Educational Game

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ABSTRACT

We describe the production of an educational game (*Catastrophic*) for supporting biology learning in higher education (HE) that was developed through a partnership between students and academic staff. We consider the ways in which the development project intersects with the use of game-based learning in HE and with Students as Partners (SaP) practice. We describe the rationale for the project, discussing the use of games in the context of a shift from surface to deep learning during the transition to HE. We then reflect upon the development process and the resulting game, drawing on student and staff perspectives gathered using interviews. Finally, we make recommendations for others embarking on student-staff partnerships for the co-creation of teaching and learning tools.

KEYWORDS

higher education, game-based learning

RATIONALE FOR DEVELOPING AN EDUCATIONAL GAME

Learning in higher education (HE) encompasses two key areas: autonomous learning and being able to understand, apply, and construct disciplinary knowledge (Wingate, 2007). Students moving from school to HE undergo a series of complex transformations that significantly change the way individuals understand and apply their knowledge, beliefs, and skills. Responsibility lies with HE institutions to encourage the development of desirable transitions (e.g., from directed to autonomous learning, from novice to participant) (Hussey & Smith, 2010). A key transition is the shift from "surface" to "deep" learning: approaches typified by rote memorization and "brute force" learning to meet course requirements, versus a holistic interest in, and understanding of, the subject area (Entwhistle & Peterson, 2004). However, first-year HE students tend to prioritise engagement with learning when

there are clear links to assessment, which promotes a focus on easily measurable outcomes and learning for the test (Donnison & Penn-Edwards, 2012).

This article describes the production of an educational game through staff-student partnership. The project emerged from a desire to better support student learning in a core first-year undergraduate biology module at the University of York, covering a range of topics in animal and plant biology, from the nervous system and physiology, through individuals and populations, to communities, ecosystems, and global cycles. Module evaluations over several years indicated that some students focused on memorising content rather than understanding synoptic, correlative, and causal relationships between concepts. Frequent comments referenced the amount of content delivered across the year in relation to assessment (e.g., "so many details given in lectures but so little asked in the exam"), and a lack of understanding about topic connections (e.g., "covering the same topics . . . is a waste of time").

Game-based learning approaches are increasing in prominence in education; a *Web of Science* search for "game-based learning" reveals only a handful of articles published prior to 2005, but 300+ annually by 2015. Games are not guaranteed to be successful. If a performance-based mentality is poorly aligned with learning outcomes, it may drive recall-based learning. Games should instead promote a growth mindset (O'Rourke, Haimovitz, Ballweber, Dweck, & Popovíc, 2014). Similarly, mastery of a game does not necessarily equate to long-term retention or academic achievement (Péladeau, Forget, & Gagné, 2003). However, people may learn better when information is embedded in a story rather than presented as a set of facts (Kapp, 2012) and through active engagement rather than the passive presentation of knowledge (Kolb, 1984). A well-designed game provides timely feedback, supporting progression within an engaging narrative while fostering patience and resilience following failure (Stott & Neustaedter, 2013). It can support students to develop new and critical ways of understanding. In a systematic review, Vlachopoulos & Makri (2017) found that games in HE had a predominantly positive impact on learning goals.

Playing a multiplayer game can stimulate discussion among players and build interpersonal relationships that support students beyond their game play (Nasir et al., 2013). Group work is increasingly used in HE to promote deep, active, experiential, and collaborative learning (Davies, 2009). Group work also provides opportunities for peer feedback, can build students' reflective capability and transferable skills, and can boost confidence (Scott, 2017). A multiplayer, game-based teaching tool therefore seemed an apt choice for supporting students.

CONTEXT: CATASTROPHIC CARD GAME

Catastrophic is a card game in which plant and animal "trait" cards are used to build species who live within an ecological "community" of cards. Each trait confers adaptations on its species: for example, fruit production in a plant supports seed dispersal, while animal species with fur can better survive cold conditions. Species are either well-adapted and resilient to "events" played on a community, or they are vulnerable and will become extinct as the game progresses. "Interaction" cards help players to support their communities, for example through cross-breeding species. For more details or to download *Catastrophic*, see catastrophic.york.ac.uk (Holland et al., 2018).

The mechanics of *Catastrophic* draw on biological mechanisms so that key learning outcomes are embedded within game play, stimulating discussions and reflection among players about the interplay of the content and concepts they encounter and the effect they

have on the larger biological picture. Individual cards contain "flavour" text based on key content and examples taken from module teaching sessions and hence can also be used for revision.

THE DEVELOPMENT PROCESS

Catastrophic version 1.0 was produced by five undergraduate students (three studying biology and one each studying industrial design and interactive media; hereafter the "biology students" and "design students"), and three academic staff, one each from the departments of Biology, Education, and Theatre, Film and Television. One academic led the project; this academic recruited partners and provided oversight and operational management.

We reasoned that a Students-as-Partners (SaP) approach would be a productive way to learn from students' recent experiences learning biological content and/or transitioning to studying at an HE institution. The staff-student partnership can be characterized according to the variables proposed by Bovill (2019). The co-creation was initiated by staff; the focus was learning and teaching; the context was extra-curricular for the students. The three biology students were selected from 16 applicants based on observations of their interactions during a team task, while the two design students were recruited via a competitive summer programme. The biology students would be termed "retrospective," in that they had previously completed the module in question; the design students were "other." All the students were between their first and third year of undergraduate study. The scale of the co-creation was one project that lasted two months. The student role was as pedagogical co-designers; the nature of their involvement was as partners, although they led at times. The student partners were paid in money for their time (with funding provided by institutional awards). The main motivation for staff co-creating was to incorporate student perspectives.

The development process began with students and staff playing a wide range of games together to support the development of social bonds and hence the quality of the student-staff partnership. Partners also developed an appreciation of game mechanics and features and each other's expertise. Partners were encouraged to test-play the developing game during co-production to support the development of an effective product.

The biology students worked on *Catastrophic* during the university summer vacation full-time (37 hours per week) for 4 weeks, and subsequently part-time for 6 weeks (approximately six hours per week). After 1 week, the design students joined the project, working full-time for 9 weeks. During the 3-week overlap, the students occupied the same physical working space. They had daily interactions with the project lead and had weekly or fortnightly meetings with all academic staff.

REFLECTIONS: STUDENT AND STAFF PERCEPTIONS OF THE PROCESS AND DEVELOPED GAME

York University Students' Union (hereafter, the Union) took a keen interest in this project from a SaP perspective (Matthews, 2017), as it fits with their commitment to providing educationally purposeful activities that engage students as "active collaborators" and "co-producers" (Cook-Sather, 2015; see also Dunne & Zandstra, 2011; Healey, 2019; and Neary, 2010). The Union is particularly interested in resisting neoliberal approaches to "student voice," which position students as sources of data (Fielding, 2011) or individualised consumers rather than as equal participants in learning communities (Peters, 2018). Nicholas Glover, the corresponding author of this case study, approached the Project Lead

after the production of the game and proposed the idea of collaborating on a case study exploring the processes and experiences of partnership during the production of Catastrophic. Nicholas Glover then took the lead on the design and the delivery of the research for this case study.

The methodological approach uses qualitative content analysis (Graneheim & Lundman, 2004). The focus of data collection and analysis was students and staff working in partnership. The process was informed by familiarity of the researchers with SaP work and related research literature. A representative of the Union interviewed staff and students post-production to gather reflections on the development process. First, the interviewer met with the project lead to discuss the project. Two of the biology student partners biology were then interviewed together. Notes from this interview were used to inform a second interview with one of these two students to explore further some of the issues raised. Two academic staff were then interviewed together. The detailed field notes from all three interviews were analysed to produce codes representing potentially significant experiences and perceptions. These codes were organized into categories, for example, separating staff and student perspectives, and themes were identified and described. Throughout the analysis, the interviewer's interpretations were shared and discussed with the project lead and considered in light of the research literature on SaP, leading to refinement of the analysis. Finally, the analysis was revisited in response to reviewer comments, resulting in six themes.

"Chilled partnership"

Two partnering students were initially worried that the academics would dismiss their ideas. However, they experienced what one student termed a "chilled partnership." This was not established explicitly or enforced and instead arose spontaneously during the project. The students described a relaxed working environment characterised by freedom, collaboration, and iterative dialogue with other students and academics, which was free from judgement and open-ended. Students contrasted this dialogic environment with discussion-based classes, for example, seminars, where they fear saying something incorrect, even if they believe they know the answer.

The academic staff reiterated these positive experiences. One reflected that there was no need to micro-manage the students, as they trusted what the students were producing. The same academic reflected on students feeling confident and relaxed enough to challenge staff on their use of academic language, resulting in staff reducing use of technical terms and instead focussing on the core ideas.

Working across disciplines

A key feature for the students was working across disciplines, which was underpinned by a mutual appreciation for the diverse knowledge necessary to make the game effective. The biology students particularly enjoyed teaching the design students about science and learning about game mechanics from them. Moreover, they described specific processes of co-production that required interdisciplinary negotiation. For example, on one occasion the biology students "identified that people could win without creating species. This was a problem because building species and learning about traits and surviving events was the whole point. The design students then tweaked the game mechanically." Academic partners also highlighted interdisciplinarity as a key strength of the project, although one suggested that where staff participate on the basis of their unique disciplinary

expertise and "drop in" rather than collaborate continuously, they may build less effective relationships with students.

Student-led

Students and staff commented that the students made a significant contribution to driving the project in terms of developing the game concept and mechanics and writing the rules. The students formed a strong partnership, deciding on roles and how to work together, and primarily worked independently, while academics checked in to discuss and confirm ideas and provide disciplinary expertise—for example, on biology and educational game mechanics.

The students reflected positively on the ownership they felt, describing *Catastrophic* as "their game." One biology student alluded to a disruption of the traditional power relationship between students and staff: they knew more than the academics and they enjoyed being able to explain biology to the non-biology academics.

While students were able to focus their attention on the project without distractions during working hours, time constraints for staff meant they were unable to collaborate with the students on a daily basis. This gave staff a sense of uncertainty, but they resisted the urge to take control. Staff spoke about being amazed at what the students were producing and how little staff involvement was required. Their experience supports Healey and Healey's (2018) conclusion that "partnership is messy, constrained by context, and all parties should be prepared to some degree to occupy different spaces if it is to be successful" (p. 6).

Relational experiences during co-production

Students spoke about the social aspect of game playing and the importance of getting to know each other. They reflected that the relaxed environment and relationships fostered by test-playing iterations of the game helped them challenge each other's ideas constructively, and to make decisions as a group.

One student compared the project to other group work at the University, where students do not build relationships and are not comfortable arguing points. In curricular group work, they described "going along" with ideas often articulated by stronger voices. For this student, the project moved beyond that because they formed social bonds and could challenge each other without judgement. Of particular significance for the students interviewed was the forming of relationships across disciplinary boundaries; they talked about the dynamic between the biology and design students not being about "us and them." This speaks to the work of Mercer-Mapstone et al. (2018) on partnership identity, with the students hinting at a shared space of "we" as partners, moving away from distinctions between group identities.

These reflections emphasize the importance of emotional and relational as well as intellectual and practical work involved in partnership (Healey & Healey, 2018). Positive emotions create supportive working environments and maintain social bonds (Fredrickson, 2001). Nurturing them should be central to project-based partnerships (Mercer-Mapstone & Marie, 2019), as well as group work within curricula.

Views of games and game-based learning

The biology students were initially sceptical about using games in a HE context. One student reasoned that students would not be keen because of the perception that games

are childish. Another suspected that *Catastrophic* would not be used because first-year students prioritize only what they must do, rather than anything optional. Neither student initially thought about the project in terms of learning and teaching. As they worked more closely with the gaming-focused design students, they gained insights into game mechanics, and started to think about producing a game that balanced game mechanics, correct biology, and evaluative learning. Through working in partnership with other students and staff to make the game effective, they reflected more on ways of learning, "particularly [on] promoting a healthy relationship with failure," as one of the Biology students explained.

Developing a critical pedagogical lens

The students referred to the partnership project as a "behind-the-scenes look," which had increased their understanding of the course-design process: "I'd never thought about the lecturers . . . the work they do . . . what goes into course design, choosing assessments and teaching styles." The students also spoke about "others"—how others learn and how nice it is to have an impact on other cohorts' learning. Alongside increased awareness of teachers' pedagogical choices, these reflections suggest the development of a more informed critical perspective and the recognition of themselves, their classmates, and teaching staff as a community of learners (Cook-Sather & Luz, 2015). This is reflected by the developed game, which avoids recall and instead encourages players to engage in evaluation and connect game content with the real world.

FUTURE DIRECTIONS

Catastrophic has been successful in terms of student engagement and perspectives, with positive feedback over two academic years relating to learning support and motivation. For more detail, see catastrophic.york.ac.uk/about. The game will remain a central part of teaching and learning in animal and plant biology at York and continues to evolve through staff-student partnership. The *Catastrophic* co-production process has also influenced the way in which other co-development projects are established. Projects in the Biology Department at York increasingly focus on ensuring that students form a close-knit team (often by playing games together), that lines of communication are clear among students and staff, and that the allocation of time and tasks are jointly owned and managed.

RECOMMENDATIONS FOR STAFF-STUDENT PARTNERSHIP

Drawing on our experiences, interviews, and discussions, we present four recommendations for others using a SaP approach for co-creation of teaching and learning tools:

a) Explore and develop staff expectations and resilience around sharing control with students.
b) Recognise time constraints for partners and the impact on their capacity to co-produce consistently and at every stage.
c) Recognise the opportunity project-based partnership approaches offer for students, including the space to focus on a single activity and practice negotiating targets, problems, and deadlines.
d) Train students in pedagogy and course design so they can recognise it in their teaching.

We also present two recommendations for integrating partnership approaches into a teaching activity:

a) Reframe student group work carried out as part of formal teaching as partnerships between students. The students cited better relationships and dialogue in this project environment compared to curricula group work. SaP approaches may encourage a focus on relational aspects of cooperative learning as well as learning of content and assessment output. SaP project-based approaches could support assessment tasks that involve within-group feedback dialogue, authentic co-assessment, and a sequence of learning tasks, enabling development over time rather than an isolated assessment activity (Scott, 2017).
b) Consider how an interdisciplinary partnership approach could create opportunities for a larger number of students to think "outside" their discipline, and practice building knowledge for themselves and within diverse learning communities. Interdisciplinary SaP projects inspire conversations about whether pedagogies predominantly focused on passing assessments on disciplinary content can genuinely help students explore what it means to "know" about something or to be able to find out, critique, and contextualise from and beyond their own experience and to develop their own sense of expertise (Hauke, 2019). Our students negotiated different forms of knowledge and perspectives, requiring movement and exploration beyond a single discipline (Hauke, 2019).

SUMMARY AND LIMITATIONS

We have described the process by which an educational game was developed through a partnership between students and academic staff drawn from multiple disciplinary backgrounds. Our interviews and discussions with students and staff indicate that the process allowed students to engage in rich dialogue, meaningfully engage in leadership activities, experience positive relationships, develop positive views of game-based learning, and display a sophisticated consideration of pedagogy. We suggest that the notions of partnerships and interdisciplinary projects provide suitable contexts for learning within formal HE settings such as module teaching.

Our findings are unlikely to be generalizable to all SaP contexts. Reflecting upon the variables identified by Bovill (2019) that characterised this project, working with a small group of selected students, some of whom had previous experience of the module, and all of whom were paid for their time, may have been particularly supportive of a successful partnership. The timing of the project within the summer vacation, which allowed a high degree of student focus on the project, may also have played a significant role. To transfer such a project to a curricular, whole-class setting would require careful consideration.

Ethical approval for publishing our findings was granted by the University of York's Department of Education Ethics Committee.

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NOTES ON CONTRIBUTORS

Nicholas Glover *is a student voice and insight manager at the University of York Students' Union with a background in critical approaches to student engagement in higher education. He is particularly interested in the theory and practice of SaP and the potential of student-staff partnerships to resist neoliberal approaches to "the student voice."*

Kerry Knox *is a lecturer in science education. Her research interests relate to the learning and teaching of science in undergraduate and postgraduate contexts. She is particularly interested in the application of research-based instructional strategies.*

Ben Kirman *is a lecturer in interactive media, with a background in game design, development, and creative technologies. His research includes using gameful and playful design to explore opportunities for new, educational, fun, and weird experiences.*

Matthew Topham *is an undergraduate student in biology who is interested in the interface of neuroscience and science education. He took part in the development of Catastrophic, and continues to collaborate with staff to enhance the learning experience of the 1000+ of his peers in the department.*

Katylily Westbury-Hawkins *took part in the development of Catastrophic as an undergraduate in the Department of Biology and is going on to study for an MRes in Applied Ecology and Conservation at the University of Liverpool.*

Pen Holland *is a lecturer in biology with a research background in ecological modelling. She leads the Catastrophic project, alongside other scholarship projects using game-based learning and citizen science to support learning in biology, mathematics, and computing skills, with a focus on the transition to higher education.*

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