Reflections on Using a Theory-Based Online Simulation in the Classroom: Unintended Consequences with Obvious and Hidden Lessons for Adopters.

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Abstract

Deploying technology to support and improve the quality of teaching, learning and assessment in higher education offers significant opportunities. The complexity of such educational interventions, however, also has the potential to create significant unintended consequences arising from the actions of and interactions among students, academics, technology designers, publishing companies and other stakeholders. Based on the experiences derived from a four-year adoption and implementation process of a theory-based online simulation game, this paper reports on and discusses three such unplanned and unexpected consequences and identifies both obvious and more hidden lessons that will be of value to academics in designing and deploying effective and meaningful technology-supported educational and assessment innovations, particularly for those which take an assessment for/as learning perspective.

Keywords: Assessment for/as learning, formal and informal feedback, game-based learning, technology adoption challenges, simulation, unintended consequences.

1. Introduction.

The transformative capabilities of new technologies appear to offer opportunities to improve teaching, learning and assessment in higher education. One of the key challenges arising for academics in this context is to understand the requirements and implications of specific technology-supported practices and interventions, as these often require the development and deployment of new skill-sets and – maybe more challenging – new mind-sets of academics as well as students (Bearman et al., 2017; Bennett, Dawson, Bearman, Molloy, & Boud, 2017). To support the planning and implementation of innovative technology use in higher education, it is highly valuable to provide in-depth information in the form of educational research designs (McKenney & Reeves, 2012). We need rich descriptive case studies, and comprehensive critical analysis that offer a better understanding of the complex interplay of technology, theoretical underpinnings, contextual influences, social interaction and individual academics' practices (Bates, 2008). We must analyse and share academic experiences (Brown, 2018; Grion, Serbati & Nicol, 2018; Sambell, Brown & Race, 2019), to avoid the temptation of re-inventing the wheel for every new technology-supported assessment intervention. Even though the complexity involved typically requires that potential implementers have to customise the educational technology deployment, few share their experiences effectively and the lessons they learn are often lost to others. This article reports on the experiences and lessons drawn from a technology-supported educational intervention. The intervention design was informed by the challenges and criticism of traditional assessments (see Sambell, 2016) and adopted the principles of assessment for/as learning with a balance of summative and formative assessment, authentic and complex assessment, opportunities for student practice and confidence building, as well as for evaluation and self-direction of their own learning (McDowell, Wakelin, Montgomery & King, 2011; Sambell, 2016; Sambell, McDowell & Montgomery, 2013). This paper contributes to a growing knowledge base that can help guide technology-supported teaching, learning and assessment for/as innovations and adaptations by identifying and discussing some of the unplanned and unintended consequences of a four-year implementation process taking an assessment-for/as learning perspective in the context of an online game-based learning intervention.

1.1. Implementing a theory-based online simulation.

The project started with the involvement of the lead author as the academic lead of a design team charged with developing a theory-based marketing simulation game to be used in higher education programmes. A leading international educational publisher contracted with an established software and game development provider and the academic lead to form the design team. The simulation game was developed with the objective to operationalize the theoretical framework of a leading marketing textbook in game format, to offer a theory-based simulation to be deployed as a teaching, learning and assessment resource in undergraduate (UG) and postgraduate (PG) marketing modules. The development process took over 12 months and a working simulation prototype was released into the market. Not all aspects of the relevant theoretical framework were fully integrated into the released simulation game due mainly to technological, financial and timing constraints. In its released form, the game allowed teams of students to design and deploy marketing strategies based on core marketing concepts and compete against each other in a simulated jeans market. A leader board provides ranking feedback in the game on the success of team strategies relative to each other.

2. Data Collection and Data Analysis.

The lead author is an academic within the business school and deployed the game in a total of six marketing modules across four years. In year one and two, the game was used by 40 self-selecting volunteers from a 3rd year UG Marketing Management module with a large cohort of students (>170). All students completed the same classroom sessions, readings, and assessment activities. In addition, the student volunteers participated in the online simulation game during 8 weeks of term. Thus, they were involved in the additional assessment for/as learning features this online simulation game provided. In both year three and four the game was deployed as mandatory for all students enrolled in the Marketing Management module at UG (>170 students, years 3 and 4) and PG level (86/96 in year 3; 67/75 in year 4).

Throughout the four-year deployment, the lead author carefully observed and noted student reactions and benefitted from student feedback, classroom discussions, informal conversations and group meetings. The mechanism of reflective diary entries was used to explore the challenges over the four years. The process was also informed by notes on discussions and shared reflections of the experiences with colleagues and at conferences.

Overall, the observations and student experiences as reported in Devitt, Brady, Lamest, Newman, and Gomez, (2015) align with reports from other studies which found that games provide a sense of a real-world competitive environment, and that they motivate students to learn (Davis, Sridharan, Koepke, Singh & Boiko, 2018). Again, similar to other studies, there was also evidence of superficial learning from games (Garber, Hayatt, Boya & Ausherman, 2012) and an impact from a high cognitive load (Schrader & Bastiaens, 2012) which can adversely affect learning and motivation (Kiili, Lainema, de Freitas & Arnab, 2014).

Rather than focusing directly on the student experiences, this paper reports on the academic reflections on the adoption and implementation, the unintended consequences experienced, and the lessons that can be drawn from this multi-year process.

3. The Unintended Consequences of Deploying an Online Simulation Game.

Initially it was expected that the online simulation game would support student learning of the theoretical framework underlying the game, and that the gaming format would add interest and motivation to further enhance active student engagement in their learning as well as providing opportunities for students to apply the marketing concepts they were learning within the module. These expectations are in line with the use of simulations and games in educational settings (Gee, 2012; Seaborn & Fels, 2015). However, the academics' observations of student reactions to the game experience led to regular adjustment of the simulation game deployment approach. This reflects a 'maturing intervention' guided by on-going exploration, construction and reflection (McKenney & Reeves, 2012: 14; Holmberg, 2014). The degree of adjustment needed was not initially anticipated although there is literature indicating both the positive and negative effects of games (Hamari, Koivisto & Sarsa, 2014). This on-going need for modifications was very challenging and increased the workload for the academic significantly.

The changes to the deployment approaches used in subsequent years were guided by extensive reflection and discussion with colleagues and influenced by attendance at conferences/seminars and workshops. This helped to identify three distinct unintended consequences of this educational technology deployment, described and discussed below. For each, there is an obvious lesson that will be of value to any academic deploying similar educational technologies. There were also more hidden lessons that can help design, deploy and direct more effective and more meaningful technology-supported educational interventions to support student learning within an assessment for/as learning lens.

The online simulation game was designed to provide authentic and complex assessment opportunities which could integrate formal and informal feedback moments. It was intended to motivate and engage students in a technology-based experiential exercise that involves teamwork, individual and joint analysis, and iterative decision-making in an online game played over successive rounds. The logic of using the simulation game as an assessment and learning tool was to provide the participating students with the opportunity to engage with a model of reality that mirrored the theoretical framework they had been introduced to in class and in their readings. They also needed to make decisions based on what they had learned and apply these within this framework and understand the linkages between different game elements (Avramenko, 2012). The pedagogical intent was for players – individually and in their teams – to use and apply their knowledge and to develop the skills necessary to make in-game decisions aligned with the marketing theories and frameworks they were familiar with. Their learning was expected to be driven by the limited (within game ranking mechanism only) feedback they received on their actions from previous rounds, and then self-evaluation informed by the theories explored in class and reinforced by the game. Based on this logic, the simulation game was introduced to participants as an interesting and engaging experiential learning opportunity.

3.1 Unintended consequence One: The "competitive pull" - mission-drift from learning to winning.

The first unintended consequence arising from the game was the immense competitive pull that the game - which at its heart is built around a competition among participating teams – exerted on the participating students. The result of this pull was that many of the students that had entered the simulation game to avail of an additional learning opportunity or for fun drifted in their orientation from one focused on learning or fun to one that prioritised winning the game. Many students increasingly adopted an explicitly competitive mind-set which they revealed in informal comments and in their module feedback. Thus, they primarily used the limited in-game feedback they received after each round not to analyse their decisions and deepen their learning, but rather through a narrow functional lens of "How will this information help us win the next round?" Clearly, it is easy to spark and difficult to avoid a competitive mind-set in game participants which can be viewed as positive when it aligns with the learning intentions of the game (see Cadotte, 2016; Saxton, 2015; Werbach & Hunter, 2012).

This unintended consequence was further exacerbated in years three and four by a decision taken by the game's owner, the publishing company, to change the internal evaluation system to make profit the central dimension of in-game performance evaluation. This change was designed to address feedback they received complaining about in-game rankings where teams could win without a cost dimension to their actions, for example they could win and be insolvent at the same time. The solution chosen created further and critical unintended consequences which are discussed below. At the same time, the academic was surprised by the considerably higher than expected workload arising from the implementation and questioned the utility of the game-based approach, and its fit within the employed teaching philosophy, as can be seen in this diary entry.

Diary entry: Year 2, end of term:

> *'Did I really want this level of competition and the vibe of winners and losers in the class. How does this align with conscious capitalism and my philosophy for the class if the winners are profit focused and ignore the customer, the company and the planet to win – much of the theory! The losers (marginal and not even sure if loser is the right term) all looked deflated. This is a real challenge for me."*

This unintended consequence highlights an obvious lesson: Academics must be aware of mission drift occurring among participants and monitor participants during the simulation game to be able to take corrective action. The dynamic of the impact on winning an educational game on subsequent student learning and academic performance also deserves further attention (Brady, Devitt, Lamest & Gomez, 2015). More immediately, however, academics can constructively address this through additional efforts to reinforce the learning intention behind the educational technology deployment, in particular, by carefully analysing the alignment of reward structures, learning intentions and teaching philosophy. Moreover, they can increase discussion and reflection opportunities for students, for example through explicit classroom discussion on what and how theoretical knowledge was helpful in game participation, and through exploring how their experience might translate into real-life marketing practice all of which aligns well with the assessment for/as learning perspective. Such reflection could be made both more interesting and more valuable by incorporating actual practitioner input that can be compared by students to their own in-game experience. These added reflective dimensions could allow the learners to refocus their attention on learning over winning.

There is also a more hidden lesson we take from this unintended consequence: Mission drift can occur not only among the participants but also the academics involved who may start to treat a game as part of the entertainment and engagement aspects of their teaching rather than as an important learning support tool. In the present case the academic encouraged and even rewarded this by providing prizes to the winning team regardless of how they won (see further discussion below). Another obvious mission drift among stakeholders was the game publisher's decision to change the internal working of the online simulation in light of student feedback. While the aim of this paper precludes us from fully exploring this aspect, the commercial interests of game developers and publishers is likely to significantly influence the actual game design in ways that can limit and even counteract the educational value of the game (Steinkuehler, Squire & Barab, 2012).

3.2 Unintended consequence Two: Analysers, guessers and code-breakers.

The formal in-game feedback could not be considered rich as it only provided a ranking (1 to 8) of the groups and a positioning map of the market showing how all 8 groups were positioned. These rankings and the market map provided the only ability to monitor their own and other students' game behaviour. Students were expected to interpret and use this limited feedback at the end of each round and align it with the theory explored in class, to inform their behaviour for the next round. The game algorithms drove this in-game feedback, which was affected by student behaviour. Three distinct groups of participants (see Robson, Plangger, Kietzmann, McCarthy & Pitt, 2016) became apparent: namely analysers, guessers, and codebreakers.

Analysers were those that used in-game feedback to make sense of their results and evaluate their decision-making in light of the underlying theoretical framework. The behaviour of this group reflected the initial expectations of the game designers and the academic that student's analytical and reflective engagement with the game would be the driver of experiential learning. However, a significant minority of students, the guessers, reverted to guessing as a decision-making strategy. Sometimes guessing is, of course, a valid strategy, especially if uncertainty is too high, theoretical elements are not fully understood, or more empirical data is needed before decision-makers can fully appreciate the relative efficacy of different action options (see March, 2010). However, just as in multiple choice tests for example, guessing can be a defensive move by students to cover up their lack of expected knowledge.

Feedback showed that many students in the guesser-subset recognised that they resorted to guessing because either they knew they did not have the relevant skills and knowledge to make well-founded in-game decisions, or because they ‘could not be bothered’. As this was a non-graded aspect of the module these students could be economising on effort, a feature common among students who are focused on grades rather than meaningful learning (Harland, McLean, Wass, Miller & Sim, 2015), or those on the lower end of the motivation spectrum. The game design in fact encouraged guessing in the early rounds because at that stage participants did not have the required knowledge for supporting good decision-making that incorporated all relevant theoretical dimensions modelled in the game. This is reflected in the diary extract below.

Diary Entry: Year 3, Week 4:

> *“I had to tell the students to guess today and there was a tangible sense in the class that they were uncomfortable with that. I was slightly uncomfortable too, but I changed the class to a discussion on research, creativity, insight and using gut instinct linking to the reading on data analytics and this appears to have rescued it. Students who like direction seemed lost.’*

A third, small but distinct group of participants, best described as codebreakers, focused not on making sense of the game through its inherent theoretical framework, but instead tried to analyse the underlying algorithm structure that constitutes the software engine driving the game dynamics. Ideally, any simulation game would fully reflect the complexity found in real-life consumer markets (the in-game context for participant decision-making), and the algorithms of the game would mirror the complexity, interdependency, variety, and residual uncertainty of real-life marketing practice. However, every model of the real world, as well as every digital-based game, inevitably represents a reduction of complexity, and astute students can reverse-engineer the underlying simulation algorithms to ascertain the relative weight of different action options by analysing available in-game feedback. Thus, instead of trying to make sense of the game results through the theoretical framework which would aid them in understanding the relationships among relevant variables in line with established theory, they focus on cracking the code of the game through a combination of analysing their own trial-and-error approaches in previous rounds and of comparative analysis of the results achieved by other groups in each round.

The codebreakers often achieved a surprisingly good understanding of the underlying in-game algorithms, but they largely failed to engage in meaningful ways with the actual theoretical framework the game was designed to help them understand (see Brady et al., 2015). This is one of the real challenges of gaming in that using this game as part of summative assessment could reward behaviours that academics do not want students to focus on – game process analysis instead of substantive engagement with relevant theory.

The obvious lesson taken from this unintended consequence is that such technology-based tools must be designed in ways that guide students to engage in the educationally relevant and valuable activities (as the analysers did) rather than in mere guessing or obvious attempts to game the system instead of learning from playing the game (Robson, Plangger, Kietzmann, McCarthy & Pitt, 2015). These aspects need to be factored in by academics deploying such technology, particularly when it comes to assessing game performance. While in this case the instructor was part of the design team and had some influence on game design and revisions, this is the exception when it comes to similar simulations and game-based educational interventions. Even with this level of influence, the complexity of the real-world context is not possible to replicate fully, and the game mechanics therefore represent a simplification of the underlying theoretical framework. To address this, there must be an accompanying development of educational supports for each type of situation rather than expecting all students to adhere to the preferred use of the ranking feedback.

The main consequence of these challenges was an increased workload for the academic in designing and then integrating additional activities and assessment elements to sit alongside the simulation game. These additional elements and activities included active reflection (both written and through in class discussion) on the process of decision-making and the integration of game-related insights into the examinable material assessed through other means. The outcome of these deliberations was in line with the tenets of assessment for/as learning and the need for formative assessment, for self-regulation and for students to evaluate and direct their own learning (Sambell, 2016; Sambell et al., 2013). Thus, the decision was made to situate the game as practice learning and to add a graded contribution aligned to the game but with a company chosen by the students or with a graded reflective essay on the theories explored within class and through the game and during group work.

A more hidden lesson emerged from decisions on possible ways to deal with the guessers and especially the codebreakers. Initially, design features such as negative consequences for obvious guesses (similar to negative marking for wrong MCQ answers) or the introduction of random elements into the simulation to hinder the analysis and reverse engineering of game algorithms were considered. However, there was a realisation that this amounted to attempts to “game the gamers” by including design elements to expose the guessers or throw off the codebreakers.

A much more constructive approach to deal with such difficulties is to consider such participant approaches as inevitable and use them to leverage student learning. In other words, the technology and associated activities must be designed in a way that leads those who try to game the system (as codebreakers try to do) to actually engage in activities that facilitate the intention of the intervention in the first place: support student learning. In this case this can be achieved by adding the requirement to justify in-game choices using the theoretical framework employed, or to ask participants to explain and critique the strategies of other participants from the perspective of relevant theory. Even if they guess or try to break the code in their actual in-game activities, participants would then still have to engage with and spend time and effort on tasks directly linked to their learning. Again, there are workload implications for such additional assessment-oriented interventions.

3.3 Unintended consequence Three: Efficiency-enhancing technology increases academic workload.

The majority of deployments of educational technology have, at least in part, an explicit or implicit efficiency motive. Typically, such technology promises efficiency gains through wider reach, automation of educational activities, more effective data capture, or other aspects. However, evidence of adoption is mixed and technology, assessment and academic issues abound (Brady, Devitt & Keirsey, 2019; Bennett et al., 2017). Similarly, the online simulation game used here promised to be largely self-explanatory with student effort on the game taking up little in-class time and requiring very little additional instructor attention. In all deployment episodes over the four-year period discussed here, however, use of the game caused a significant and initially unexpected workload increase for the academic. A range of different implementation issues arose ranging from technical (e.g., login problems) to communicative (e.g., misunderstanding between academic and students) to interpersonal (e.g., group dynamics within and among student groups). The feedback dialogue was also questioned (Nicol, 2010). The students expressed their preference for significant and on-going input or feedback on the game from the module lecturer despite the stand-alone nature of the game and the explicit instructions available for students within the game environment. Particularly noteworthy was the apparent desire for additional theoretical analysis of their own game, teacher directed rather than self-directed, despite the relevant frameworks having been fully covered in class and available in the core textbook.

In some cases, the expected self-management of student groups placed strains on the academic-student relationships due to student expectations and preferences. Any problems experienced by students resulted in flurries of emails to the module lecturer, as some students struggled and wanted and sought help with the limited feedback available from the game. This was especially obvious in the early rounds, and, in some cases, this impeded their learning and their ability to self-manage their involvement in the game.

As depicted above various designs and assessment challenges that use an assessment for/as learning framework were trialled. During the first three years students played the game outside of class, mainly over 8 weeks and closely aligned with the theory covered in class. During these deployments the length of time, degree of interaction, required reflection, level of debriefing and other modalities were varied which all lead to different but valuable learning experiences for students. In the fourth year the game was positioned predominantly within class time, which led to all groups playing the game at the same time in a dynamic, interactive, challenges classroom environment. In contrast to previous iterations, the debriefing after the game focused only on limited theoretical aspects and its application in practice, but still highlighted the complexity and interconnection between game elements. This resulted in improved linkage of learning from the game along with a different type of enjoyment and dynamic in the class. This method translated into less strain in the academic-student relationship and lower stress for both the academic and the students. However, the price of this trade off included lower levels of in-game complexity and challenge, less self-directed and reflective learning, shorter time frame for team only engagement and a narrower focus on the theoretical learning opportunities offered by game participation.

Diary entry: Year 3 Week 4:

> *'Once again I have student groups who by their body language and discussion are very unhappy with their choices within the game and have blamed the technology and/or me. The flurry of emails is quite challenging. The ranking is causing quite a level of disquiet. The losing teams keep asking – what should we do?'*

The obvious lesson from this was that the linear relationship between the effort required from both academic and students and the actual benefit the game offered as a vehicle for additional or improved student learning, can challenge and/or limit its value for academics and students alike. Had the lead author not also been the academic lead for this game, this educational intervention might not have been used as persistently and extensively during the four years. Students did really enjoy the simulation game and provided largely positive feedback on its use, and especially the novelty and its alignment with real world challenges beyond the theory. At the same time, however, their feedback on issues such as required student effort, lack of clarity, their own additional workload and issues related to requirements for success and about their own role vis-à-vis the game, and related group dynamic issues was less positive and shows the high level of ambivalence the deployment of the game caused among students.

A more hidden lesson from the workload implications discussed here is that educational technology must be carefully assessed along many different dimensions to ascertain its actual value to the stakeholders involved. Relevant dimensions here include student learning opportunities, student effort, and the impact on student motivation and the learning culture within a class setting, among others. For the academics deploying the technology, relevant dimensions include the actual workload implications which include not only the to-be-expected set-up and game management activities, but also the ensuing relationship management efforts and additional support requirements for students. Academic skill set development is needed during the designing and administering of appropriate assessments for/as learning mechanism if technology supported learning is to be achieved. Aligned to this is the need for the academic to understand and manage technology specific issues including game set up, passwords, group allocations and so on. The skill-set and mind-set development required for successful educational technology deployment, along with the actual effort required to deploy it successfully, is very difficult to ascertain in advance of actual deployment. Thus, such technology use will likely always be a risky investment for academics, with significant costs and uncertain returns for academics and students alike.

4. Discussion.

The unintended consequences discussed in this paper, and the obvious and more hidden lessons we have identified, are the result of a multi-year implementation motivated by the lead author's involvement in development and design of an online educational simulation with an assessment for/as learning perspective. Typical case description of technology deployment in higher education spans considerably shorter periods, with one-term interventions by early adopters as the most common format (see Brady et al., 2019). The deeper exploration and analysis presented here of the knowledge, expectations and the mind-set changes of the academic, which developed over the four-year process, would not have emerged without the academic's reflection on, analysing of and learning taken from each iterative set of experiences over multiple successive game deployments. The four-year cycle allowed for explicit scaffolding of learning opportunities around the game in order to capitalise on its full educational potential. However, even the intense reflection and the utilisation of the resulting insights over successive deployments did little to limit the enormous increase in academic workload that the game deployment necessitated. Such increased effort arising from teaching activities is not valued by research intensive academics focused on promotion (Bennett et al., 2017; Boshier, 2009; Lubbe, 2015). Many academics who adopt a game might not take this time and could disengage from the game rather than work to overcome these challenges (see Tao, Cheng & Sun, 2012).

Typically, it is an academic's own decision to invest this time and energy despite minimal recognition. Given the implications of such workload there is a need to develop more efficient approaches to the implementation issue of using such educational games. Recent research highlights that academics want 'shared practices' and 'innovative perspectives' for 'experiences to be diffused' (Grion & Aquario, 2018: 67). There is a need for more realistic, critical and personal accounts that show the realities of educational innovation, warts and all: the uncertainties, fear, personal and workload implications, unmeasured costs, and other negative effects. Unless publicly shared, the challenges of adopting technology will stay hidden from potential adopters. We need to heed the call for adding value by identifying and talking about the real problems that arise in such endeavours (Felisatti & Serbati, 2018).

4.1 Conclusion.

In this paper the unique perspective of the lead author, as part of the design team and then trialling various implementations showed clearly that many of the real issues and challenges only become clear over time and during the actual implementation. Yet, by exploring a number of unintended consequences and both obvious and more hidden lessons experienced during the four-year adoption and implementation experience, this paper hopefully provides insight and support while also calling for more discussion and critique. It also highlights that there are many implementation challenges that need to be overcome when new technology and new forms of assessment are introduced. Using digital games in assessment causes numerous, complex and new challenges, many of which are explored in the literature (see Ifenthaler, Eseryel & Ge, 2012) but the concern is that this depth is not shared where it is needed, at the right time and with clear suggestions and support for other academics so that the processes, issues and benefits are well developed, trialled and then shared.

An additional point is that using technology-supported game-based learning does offer distinct learning opportunities, but it also raises the danger of instilling a competitive mind-set which could contribute to and/or influence the overall approach students take to and from their educational experience into their further careers and lives (Giacalone & Promislo, 2019). If educational game deployment makes competition and winning the core lesson students take from their participation, we may unwittingly contribute to creating counterproductive outcomes. Thus, as educators we need to remind ourselves of our responsibilities to support our students in developing their ability to make responsible and accountable decisions (Fellenz, 2019). This should start in the planning, continue in the classroom, and be supported by the technologies and the assessments we deploy.

This paper challenges academics adopting similar educational technologies to understand their responsibilities, to look deeper at these technologies and to reflectively design their use, and the appropriate assessment design to support learning, rather than blindly adopting the technology supplied without reflecting on and considering the short and long-term consequences and the contextual issues. Academics need to be prepared for unexpected and unintended consequences, and space and time provided for smart failing. Academics need to experience these in an iterative manner to progress continued improvements to ensure the critical alignment of the assessment, the technology, their teaching philosophy and learning objectives. It would be worrying if knowing these things that academics choose not adopt or to discontinue using these technological resources because the workload is too great and the challenges too numerous, ignoring the major gains from these authentic, challenging and complex assessment designs which support assessment for/as learning. If we share the successes but critically the failures too, we all gain.

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