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Using Video Games to Develop Graduate Attributes: A Pilot Study

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Abstract: The pilot project described here sought to explore the use of video games to develop graduate attributes and to identify suitable instruments for their measurement. A small group of undergraduate students were recruited to play selected video games for two hours per week over an eight week period. A range of psychometric tests were administered at the beginning and the end of the experiment period in order to gather empirical data relating to the participants' graduate attributes. Mean differences in the pre- and post-intervention scores associated with each measure were obtained and 95% confidence intervals calculated. Participants were also asked to discuss the games as a group following each session and to blog about their experience if they were so inclined. Despite the small scale of the pilot, the results were sufficiently encouraging to warrant a larger study, which is now underway. The challenges involved in obtaining empirical data on the effectiveness of a game-based intervention such as this are addressed and implications for subsequent work are discussed.

Keywords: Higher education, graduate attributes, undergraduate, game-based learning, video games

1. Background

It may be argued that most higher education courses are not explicitly designed to teach or develop desirable soft skills – often referred to as 'graduate attributes' (see Barrie, 2006) – such as critical thinking, communication, resourcefulness or adaptability. Many commercial video games, on the other hand, require players to exercise a range of very similar skills and competencies in order to progress (Barr, 2013).

This pilot was designed to identify those graduate attributes which might be influenced by playing commercial video games, and those which may be practicably measured. It was also intended to provide an insight into the practicalities of running game play sessions in a university lab environment.

A full list of the institution's graduate attributes may be found at [removed for blind review]. The instruments identified for the pilot, and the attributes they were intended to measure, are summarised in Table 1 below.

Table 1: Instruments used to measure specific graduate attributes

Graduate Attribute	Instrument
Adaptable	I-ADAPT-M (Ployhart & Bliese, 2006)
Effective Communicators	Self-Perceived Communication Competence Scale (SCCS) (McCroskey & McCroskey, 1988)
Effective Communicators	Communicative Adaptability Scale (CAS) (Duran, 1992)
Independent and Critical Thinkers	Ennis-Weir Critical Thinking Essay Test (Ennis & Weir, 1985)
Investigative	MI5 Investigative Challenge (Intelligence Officer Development Programme n.d.)
Resourceful and Responsible	Resourcefulness Scale (Zauszniewski *et al.*, 2006)

Other instruments administered in order to explore related phenomena included the General Self Efficacy Scale (Schwarzer & Jerusalem, 1995), the Rosenberg Self-Esteem Scale (Rosenberg, 1979) and the Big Five Inventory (John *et al.*, 2008).

2. Method

At the beginning of an eight-week programme, eight student volunteers were sought to take part in an initial survey of demographic information and gaming habits followed by a testing session using the instruments identified above. Over the course of the programme, participants were invited to play selected games in the lab, on PC or PlayStation 3, for two hours per week. At the end of the semester, the graduate attribute tests were administered a second time and the results analysed in order to identify any significant changes in individual participants' graduate attribute attainment. To ensure that testing sessions were comparable, no games were played on either testing day, resulting in a schedule that comprised a meeting in week one to conduct initial testing followed by six weekly meetings to play specified games and a final meeting in week eight to re-run attribute tests.

2.1 Game play sessions

2.1.1 *Minecraft*

Minecraft is a procedurally-generated sandbox game with construction, exploration and survival elements. In single player mode, players are free to explore the world and collect ('mine') resources such as stone, wood and metal to create ('craft') a range of buildings, tools and weapons. Multiplayer mode is similarly non-prescriptive in terms of what it permits (or requires) players to do: the main difference is that the world is shared, so players may choose to work together. *Minecraft* was thought to align with the 'Effective Communicators', 'Experienced Collaborators' and 'Resourceful and Responsible' attributes.

Students were split into pairs and the game was played in split-screen multiplayer mode, meaning each pair shared a screen and inhabited the same game world. Players were instructed to begin with the built-in tutorial world, which introduces the basic concepts of *Minecraft*, before creating and exploring a world of their own. A worksheet was provided to players, with a list of suggested tasks to be performed in collaboration with their partner. However, this list of suggested tasks was largely ignored by the players.

Progress made – however ill-defined – varied from pair to pair. An obvious factor affecting progression was experience: for example, one pair, comprising an expert and a novice player, took to the game with some relish, while other pairs experienced varying degrees of frustration. Communication within the expert-and-novice pair could be characterised as a form of peer tutoring (Topping, 1996), with the expert player guiding the novice through the tutorial. Each pair did engage in communication to some degree: occasional questions were asked of one another, while (not always successful) attempts to rendezvous within the game world were made.

From a practical point of view, few issues were encountered. What proved somewhat more problematic, however, was reliance on the expected number of student participants attending the game-based exercises. Further, for exercises that require pair-based collaboration, an even number of participants is desirable. In this case, six of the expected eight participants took part, which, at least, resulted in each player having an available partner.

After the play session had concluded, participants were asked how important a part communication with their partner played in their *Minecraft* experience. There was a consensus that communication played an important role, in that it facilitated collaboration. A more subtle point made by one of the participants was that, even if little progress was made within the game, the shared experience might be sufficient to instigate a conversation with a fellow player, acting as a kind of 'ice breaker'.

2.1.2 *The Walking Dead*

In the third week of the pilot, students were asked to play the first episode of Telltale's acclaimed *The Walking Dead* game. Suggested as a game that might relate to the 'Ethically and Socially Aware' attribute, the question posed on this occasion was: could playing games such as *The Walking Dead* provide a means of exploring or developing our ethical and social awareness?

Figure 1: Telltale's *The Walking Dead* may be played collaboratively, despite its ostensibly 'single player' nature

The Walking Dead is a narrative-driven game that asks the player to decide how to respond to a series of character interactions and in-game events by choosing from up to four possible dialogue options. Much has been made of the game's emphasis on moral or ethical choices: some of your decisions will have serious implications for the characters around you.

While *The Walking Dead* is a single-player game, students played in pairs and were left to decide between them how control of the game should be meted out. The learning curve for the game is relatively shallow and, with just a few controls to master, first-time players were not at a loss if they wished to control the game.

The post-game discussion centred around the nature of the society in which the game was set (most of the first season of the game takes place in rural Georgia, USA) and whether events may have unfolded differently in, say, a suburb of a European city where guns might be less prevalent.

The chapter's most significant moral dilemma, which sees players choose between saving one of two characters, was the source of much discussion. This choice might be reduced to one between a conventionally 'moral' decision to save a child and a more pragmatic decision to save a character that may prove more useful in terms of survival. There was no consensus within the group about whom to save, but this shared experience did provide a useful starting point for engaging debate.

The discussion also indicated that players were thinking critically about the motives of the characters they encountered and the conflicting, incomplete information the game provides about the characters' backgrounds (cf. the 'Independent and Critical Thinkers' attribute). Lee, arguably the main protagonist in this season, is first seen handcuffed in the back of a police car, but his moral standing remains – for this chapter, at least – somewhat ambiguous. Certainly, it may be argued that this short experiment with *The Walking Dead* reveals games' potential for providing rich, shared experiences that may form the basis of useful, reflective discussion of moral and ethical issues in a classroom.

It is hardly novel to suggest that interactivity is one of the gaming medium's most salient features but the responsibility for decision-making that forms the basis of the gameplay in *The Walking Dead* does result in a series of rapid-fire debates about moral and ethical choices that is not characteristic of other media. Further, despite its single-player nature, The *Walking Dead* offers myriad opportunities for collaboration and debate between multiple players (or 'player-observers'). And, as the lively group discussion here suggests, decisions made within pairs of player-observers may subsequently be challenged and debated by the wider group, as each pair has partaken in a shared, but subtly different, experience.

2.1.3 Gone Home

The Fullbright Company's *Gone Home* might be described as a first-person interactive story wherein the player, assuming the role of a young woman returning to her family home after a year-long absence, explores the apparently abandoned house. In doing so, the player may uncover a number of storylines, the most significant of which relates to the protagonist's younger sister. There are no explicit goals, and interaction is relatively limited, with plot developments uncovered by reading discarded letters and examining ephemera such as concert ticket stubs.

Gone Home was generally very well received but the title has irked some who feel it challenges their personal definition of what constitutes a video game. The pilot volunteers certainly included a small number of those who were not enamoured with the game, but the majority of players did become engrossed in the game's elusive narrative.

This situation is illustrative of another of the problems that can arise when using a prescribed game within a formal learning environment: not everyone is going to like it. Squire (2011, p.117), for example, has documented similar problems, where some proportion of the class in question isn't interested in playing video games.

Gone Home is very much a single-player experience: the game was played individually, and subsequently discussed as a group. More accurately, the game was discussed by two separate groups. It is possible to 'complete' the game – to uncover the final secret and see the credits roll, at least – in significantly less than

two hours and those participants for whom the game held little allure raced to finish the game long before the other players. A brief post-game discussion with these participants revealed that they were bored by the experience and applied their gaming literacy – their understanding of certain video game tropes and conventions – to reach the game's conclusion without exploring any of the accompanying narrative.

The intention was to examine whether playing such a game might help hone players' investigative skills, as the player is required to locate and synthesise information from a range of in-game sources in order to determine what has happened. The game might, therefore, be related to the 'Investigative' and 'Independent and Critical Thinkers' attributes.

The idea that *Gone Home's* exploratory gameplay could help develop investigative skills was met with participants' broad agreement. However, those players who enjoyed the game to a lesser extent also saw less value in its investigative aspects. Those players who became invested in the game's narrative, and were thus motivated to piece together the story from the clues scattered around the abandoned house, did feel their investigative abilities were being exercised.

In a subsequent blog post, one participant made an explicit link between the game and the use of certain investigative skills, commenting that:

> *"…in the game, you are aware that every detail is intentionally included to add layers to the story and you naturally assume that every object encountered may be significant in some way or another."*

Highlighting the need to apply critical thinking within the game, the same participant continued:

> *"…you have to focus your attention on some details whilst disregarding others in your systematic examination of the house and contents. As there is much to draw on, the player has to critically analyse what information is useful at each stage to help progress the narrative…"*

2.1.4 Never Alone

Never Alone (*Kisima Ingitchuna*) was created by Upper One Games in collaboration with Alaskan Native storytellers and elders, drawing on the traditional lore of the Iñupiat people. In addition to providing players with an insight into Iñupiat culture, the game may be played cooperatively, ostensibly requiring effective communication between players. The game was thought to be of relevance to the 'Ethically and Socially Aware' attribute (which suggests that graduates should "welcome exposure to the richness of multi-cultural and international experiences"), as well as the 'Experienced Collaborators' and 'Effective Communicators' attributes.

Figure 2: Cooperative play in *Never Alone*. One player uses a controller, the other the keyboard

Never Alone was well-received across the group, and most players took the time to watch the documentary footage and interviews with the Iñupiat elders that intersperse the game. Furthermore, engaging with these materials was generally deemed to have been interesting and worthwhile, with participants learning

something of Alaskan native culture as they played. Those players who habitually skipped the videos were driven by a desire to complete more of the game than their peers but conceded that, had this element of competition been absent, they would have taken the time to digest the educational video content.

Those who played cooperatively did communicate to some extent, but found that one character had more to do, at least in the opening hour or so of the game, meaning that the player controlling the other character was less actively engaged in proceedings. It might, therefore, be said that communication between cooperating players was not critical to their success. However, the participants did feel they had learned something of another culture as a result of playing the game.

2.1.5 Journey

Journey's developers, thatgamecompany, describe the game as "an interactive parable, an anonymous online adventure to experience a person's life passage and their intersections with other's". The other players are anonymous and communication is possible only by means of a musical chime. Once the player has established that they are playing alongside another person, the pair may choose to complete the journey together.

Journey was selected on the basis that it might relate to the 'Reflective Learners' attribute, but there are clear links to the 'Effective Communicators' and 'Experienced Collaborators' attributes. The game also provides a potentially moving experience, perhaps as a result of its reflective tone and intimate – if non-verbal – communication: according to *Journey's* lead designer, Jenova Chen, it is not uncommon for players to cry at the climax of the game (North, 2013).

One participant completed the game, and was moved to write a blog post about her experience. In her post, the player describes the nature of the communication that took place, noting that she and her fellow player could "'sing' to each other as a token of friendship and appreciation". Despite the limited nature of the communication, the participant went on to state:

> *"I would say that we were communicating mostly by sticking to each other and waiting for one another, and while it might not seem much, I believe through this we demonstrated patience, trust, gratefulness and even friendship, although the mentor-mentee relationship was more prevalent."*

This "mentor-mentee relationship" was observed on more than occasion throughout the pilot study, with the peer tutoring that occurred during the *Minecraft* session providing another example, albeit one in which both mentor and mentee were physically present in the same room.

2.1.6 Portal 2

Valve's *Portal 2* is described by the developer as "a hilariously mind-bending adventure that challenges you to use wits over weaponry in a funhouse of diabolical science". The game was identified as a candidate for developing the 'Experienced Collaborators' attribute, as it features a particularly robust cooperative mode. From a practical point of view, the cooperative portion of the game allows for split-screen play, meaning two people can play together on the same machine without the need for an internet connection to the PlayStation Network (problematic due to institutional firewall restrictions).

The first pair of pilot participants to play *Portal 2* together had both experienced the game to some extent before. Communication quickly became an integral part of play. In this case, the more experienced player took the lead and directed the less experienced player, using a mixture of verbal and visual cues to orient the latter within the game's three-dimensional space. However, this pair made limited progress together, as reflected in their conversation. The following exchange was typical:

> *"Does argument and disagreement still count [as communication]?"*
>
> *"You tried to kill me!"*
>
> *"I warned you."*

A subsequent pair of participants, however, demonstrated how communication was absolutely vital to progressing in the game. Using a similar mixture of verbal and visual communication, this pair quickly and efficiently worked their way through the puzzles with which they were presented.

Inspired by the peer tutoring behaviour observed in earlier sessions, players with differing amounts of experience of the game were paired. However, when the disparity in experience was too great, cooperation quickly gave way to frustration and, ultimately, a breakdown in communication between players.

This suggests a more general consideration when planning to use commercial video games in a formal learning environment: it may be important to ascertain students' familiarity with the games and plan groups or pairs accordingly. Based on observations made over the course of this pilot project, the experience gap between a pair of players may be significant provided progress through the game does not require explicit collaboration (as *Portal 2's* puzzle-solving does). A game such as *Minecraft*, where 'progress' is largely defined by the individual player, and players are free to work alone if they wish, provides a more relaxed environment for collaborative play. The least satisfactory combination might be a pair of players with no experience of the game (or gaming, more generally) between them. When players spend the majority of the session wandering aimlessly or struggling to grasp the controls, there is little opportunity for meaningful play or cooperation.

2.1.7 Papers, Please

Described by its developer as a "dystopian document thriller", *Papers, Please* was selected as a candidate for developing the 'Ethically and Socially Aware' and 'Independent and Critical Thinkers' attributes.

The player is cast as an immigration officer, deciding whom to admit and whom to turn away from the border of the fictional former communist state of Arstotzka. The player performs this role by critically assessing the documentation presented by each potential immigrant in light of the ever-changing rules and regulations imposed by the state. As well as exercising critical judgement and dealing with change (the 'Adaptable' attribute is also relevant), the player is presented with an opportunity to reflect on the ethical and social consequences of their in-game actions, not only in terms of the lives of the fictional immigrants and existing citizens of Arstotzka (terrorist attacks are a distinct possibility, should the 'wrong' person be permitted access to the country) but also in terms of the personal price to be paid by the family of the player's character if quotas are missed.

Like *Gone Home*, *Papers, Please* is a game that divides opinion: not everyone who plays it enjoys the experience, and some question whether it is really a game at all. However, the game's unique blend social and ethical issues with gameplay that requires critical thinking make it a strong candidate for inclusion in any subsequent study.

3. Results

The purpose of the pilot project was to trial the selected measures and to provide some preliminary indication of which attributes might be worth exploring in more detail. As a pilot project, with a small sample size and no control group, the data cannot be used to prove or disprove any hypothesis; they can, however, be described in a number of potentially useful ways.

For each measure, it is the change in score on the associated tests that was recorded, for each participant, over the course of the eight-week study. The following tables summarise the results for each of the attribute-specific measures, including the calculated 95% confidence interval. The 95% confidence interval of 2.5 to 12.2 for differences in Communicative Adaptability Scale scores, for example, indicates that the mean change in results may be expected to fall between 2.5 to 12.2 in 95% of cases, should the experiment be repeated. So, that the confidence interval, in this case, does not fall below zero would support the alternative hypothesis that "the 'true' population mean is not equal to zero".

Table 2: Communicative Adaptability Scale (CAS) scores

ID	Week 1	Week 8	Difference
A	104	113	9
B	110	116	6
C	94	99	5
D	102	114	12
E	97	109	12
F	105	105	0

Min	0
Max	12
Median	7.5
Mean	7.3
95% confidence interval	2.5 to 12.2

Table 3: Self-Perceived Communication Competence Scale (SCCS) scores

ID	Week 1	Week 8	Difference
A	77.5	90.83	13.33
B	73.33	89.17	15.83
C	69.42	65	-4.42
D	56.67	72.08	15.42
E	58.33	69.17	10.83
F	60	66.67	6.67

Min	-4.42
Max	15.83
Median	12.08
Mean	9.61
95% confidence interval	1.57 to 17.65

Table 4: I-ADAPT-M scores

ID	Week 1	Week 8	Difference
A	214	199	-15
B	197	214	17
C	182	212	30
D	190	197	7
E	178	215	37
F	205	202	-3

Min	-15
Max	37
Median	12
Mean	12.2
95% confidence interval	-8.6 to 32.9

Table 5: Resourcefulness Scale scores

ID	Week 1	Week 8	Difference
A	66	65	-1
B	61	82	21
C	62	64	2
D	85	81	-4
E	90	108	18
F	57	69	12

Min	-4
Max	21
Median	7
Mean	8
95% confidence interval	-3.0 to 19.0

Table 6: Ennis-Weir Critical Thinking Essay Test scores

ID	Week 1	Week 8	Difference
A	13	12	-1
B	17	20	3
C	5	11	6
D	21	18	-3
E	20	19	-1
F	19	13	-6

Min	-6
Max	6
Median	-1
Mean	-0.33
95% confidence interval	-4.8 to 4.15

Table 7: MI5 Investigative Challenge scores

ID	Week 1	Week 8	Difference
A	4	4	0
B	6	5	-1
C	6	5	-1
D	6	3	-3
E	6	5	-1
F	3	7	0

Min	-3
Max	0
Median	-1
Mean	-1
95% confidence interval	-2.1 to 0.15

The data may also be described in more general terms. The correlogram below indicates the degree to which the average change in each of the scores correlates with changes in the other scores, for the test results of the six participants who completed testing on two occasions (week one and week eight); i.e. the correlogram describes 12 'observations' of each test.

The correlogram summarises the strength of the correlation between each test by means of a number (the Pearson r-correlation Coefficient), with +1 indicating a perfect positive correlation between two tests, 0 showing completely random co-variance between tests, and -1 showing a perfect negative correlation between tests. For example, higher scores for self-esteem were associated with lower scores on extroversion, with a strong negative correlation (-0.76), while critical thinking test scores were higher when resourcefulness scores were higher, with a moderately strong correlation (+0.57).
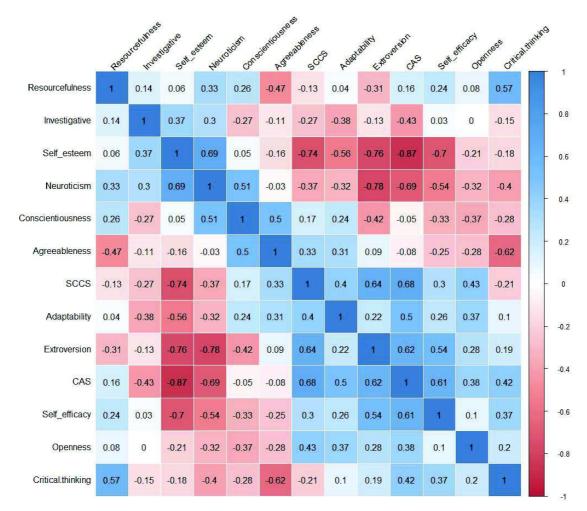
Figure 3: Correlogram comparing scores in the 13 instruments administered, as observed in six individuals at two time points. Correlation co-efficients are Pearson's r.

4. Discussion

Bearing in mind the limitations described above, the pilot study has been informative about the usefulness of the selected measures. Mean values of both communication measures (CAS and SCCS) were observed to increase between baseline and repeat testing. 95% confidence intervals for change in mean communication scores did not cross zero, suggesting this was not a chance occurrence. Although the other measures did not show significantly different change between the two time points, this is not unexpected with a small sample size, and neither proves nor precludes an effect of commercial video game playing on these attributes. The pilot study has provided useful information about the distribution and co-variation of these measures which has helped inform the design of the subsequent study.

In addition to the calculated confidence intervals, the correlations between each measure used in the pilot provide another means by which the usefulness of the measures may be assessed. The correlation between the two communication measures is moderately strong (r = 0.76), which indicates good validity but also, potentially, suggests that there is an element of redundancy in using both tests. The Rosenberg Self-Esteem Scale produced some of the strongest correlations with other measures, including a moderately strong positive correlation (r = 0.69) with neuroticism and strong negative correlations with both communication measures (-74 for the Self-Perceived Communication Competence Scale and -0.87 for the Communicative Adaptability Scale). Whether or not these correlations are intuitive is, perhaps, open to debate. For example, it may follow that extroverts might find themselves to be capable communicators, in line with the moderately strong positive correlation between extroversion and the two communication measures (0.664 and 0.62).

In general, there is little in this brief analysis of correlations between measures that cannot be reasonably explained. As the only attribute to have two tests dedicated to its measurement, communication skill was,

perhaps, likely to be best served by this pilot. However, the strong co-variance of the two measures, as well as the broadly intuitive correlation with other measures, suggest that (self-perceived) communication skill should certainly be included in any subsequent work.

From a practical point of view, the pilot highlighted a number of challenges and concerns that must be addressed in any subsequent study. Chief among these concerns – and by no means unique to this work – is the issue of volunteer recruitment and retention. Eight volunteers were sought, and seven recruited; however, only six of these completed all of the tests in time to be included in the study.

A methodological issue identified during the pilot concerns the more labour-intensive (non-multiple choice) measures. These measures, most notably the Ennis-Weir critical thinking test and the MI5 test, arguably require more concerted effort on the part of the participant to complete. It was observed that participants spent less time on these tests when encountered a second time, and audible sounds of exasperation from the cohort only added to the suspicion that the tests were not given participants' full attention. Such a response is, perhaps, to be expected but the effect is almost certainly to depress post-test scores.

Technical issues encountered during the pilot were infrequent and relatively slight. Where there were unknown factors, such as the restrictions imposed by the university's IT infrastructure, extensive testing of configurations was undertaken in advance. In summary, the pilot study did not reveal any significant technical difficulties associated with the approach taken.

5. Conclusion

This pilot project has been instructive, and offers an indication that communication skill, in particular, may be improved by playing video games. However, it also revealed a number of areas for further consideration, and questions that must still be addressed before conducting a larger study. It is unclear whether two hours per week of gaming is sufficient to produce an effect and related to this concern is the question of how best to account for games played by participants at home. Since it is the graduate attribute scores of *individuals* that were analysed here, private game play habits are partially controlled for in the design. However, a more robust approach will be taken in the larger study, wherein a randomly assigned control group with playing habits comparable to the intervention group will be used to address this concern.

As a result of this pilot, the subsequent larger study will focus primarily on measuring communication skill in players. Furthermore, efforts are being made to ensure better ecological validity and higher rates of participant retention by adopting a more flexible drop in approach to game play labs.

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