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Learning and motivational affordances in narrative-based game authoring

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Abstract:
Authoring computer games provides children with an opportunity to create rich narratives using multiple forms of media. Employing a traditional research paradigm to investigate narrative creation in computer games might suggest a focus on *transfer*, i.e. the extent to which the narrative skills developed will also be manifested in narrative activities such as story writing. However, we believe that computer game authoring offers a substantive and innovative narrative creation experience in and of itself. In this paper, we go beyond the current enthusiasm for games in education, and the focus on games created *for* children, to pinpoint why game creation *by* children can be such a powerful experience. In particular, we look at the learning and motivational affordances of such environments, and at the potential for these environments to foster sophisticated learning, reflection and skill development.

1 Games for Learning

The use of games for learning has been attracting increasing attention, with a number of recent conference themes and workshops devoted to the topic[1]. It is not difficult to see why: while the use of computers for learning may not have lived up to its initial promise, computer games certainly have been a phenomenal success story. As Squire (2005) states, "While completion rates for online courses barely reach 50%, gamers spend hundreds of hours mastering games, writing lengthy texts, and even setting up their own virtual 'universities' to teach others to play games".

Just as there has been a phenomenal rise in game playing, there has also been a concomitant rise in game *making*: game engines are increasingly shipping with toolkits which allow game players to create their own content in the form of new modifications (known as "mods"). From a commercial point of view, this increases the game's longevity (since the original game must be purchased in order to play the mod) and may

[1] Such as the Serious Games Summit 2005, DIGRA 2005; and Sandbox: an ACM Video Game Symposium at SIGGRAPH 2006.

attract a wider range of players. Some mods created by user communities have very large player bases: a modification of Half Life was so successful that it was subsequently bought and released by Valve, the company which originally created Half Life (Hodgson, 2004).

Outwith these informal learning communities, researchers have begun to examine the educational potential of game creation in other settings. Studies have looked at the ways in which game creation can introduce children to computer programming (Kafai, 1995; Habgood, 2005), increase awareness of media literacy (Pelletier and Burn, 2005) develop story writing skills (Robertson and Good, 2005b; Szafron et al, 2005) and bolster learners' self esteem (Robertson and Good, 2005a).

We believe that game creation is an ideal environment to practice and refine narrative skills. For a start, many of the skills required to create a successful game, such as devising a compelling plot, creating characters with depth, writing dialogue for each of the characters, and weaving this dialogue into the overall plot structure, are skills that are shared by more traditional forms of narrative. However, creating a game has, we believe, additional advantages as compared to traditional forms of narrative, especially for young people. Computer games are, as stated above, an inherent part of popular culture for many young people. As such, there is an undeniable motivational appeal to creating games; we believe, however, that the interest goes beyond motivation. A game is an inherently social activity: creating a game is followed by having one's peers play the game, and interact with the game. In addition, the process is such that young people very quickly see a return on their learning investment, which in turn increases their motivation to continue, along with their feelings of self-efficacy.

We have been investigating the process of game creation in a series of "Gamemaker" workshops for children (see, for example, Robertson and Good, 2005a). In these workshops, novice game designers learn to design, implement and test their own computer games using a commercial game authoring tool called Neverwinter Nights (NWN). The workshops have taken place regularly since 2003 during school holiday periods in public venues such as the Edinburgh International Science Festival. To date, around three hundred children aged between seven and sixteen have taken part in workshop formats ranging from three hour "taster" sessions to more intensive week long events. Techniques such as storyboarding, design notebooks, group discussion, interviews, observations and talk aloud protocols during peer game testing have been used to gather evidence about the nature of learning which takes place during various stages of the computer game authoring process.

In this paper, we will describe the motivational and learning affordances which are inherent to the game creation process. Before doing so however, we describe the process of game creation in more detail. In the next section, we step through the process of creating an interactive narrative in game format, showing both the process of game creation, and the output, i.e. the game created. For illustrative purposes, we will use the *Neverwinter Nights* game, and its associated toolkit.

2 The Game Creation Process

As described above, Neverwinter Nights is a popular role-playing game based on

Dungeons and Dragons. One of the distinctive features of the game, at least from our perspective, is that it ships with the Aurora toolkit, a powerful set of features which allows members of the public to design their own games. Basic games can be created using a graphical user interface, although more complicated games require designers to use NWScript, a powerful scripting language based on the C programming language. As an indication of NWScript's scope and power, it is interesting to note that the designers of Neverwinter Nights used NWScript themselves when creating the tutorial module that serves as the introduction to the game (Brockington and Darrah, 2002).

The first stage in creating a game is to choose the setting (typically referred to as an 'area'). Neverwinter Nights provides a choice of various indoor and outdoor settings, including forests, deserts, castles, dungeons, etc. Game designers can also choose the size of the setting. At a later date, they can add in new settings to their game, and link them together, so that any given game can have many different areas, e.g. a forest connected to a castle, which contains a scary dungeon.

Figure 1 shows an area which just been created. At the bottom of the screen, various tools allow the game designer to manipulate the area, such as panning, zooming in and out, rotating the view, changing the angle of the view, and, in the case of a large area, moving up, down or sideways within the area. These tools are particularly useful for placing and modifying terrain features, objects and characters.

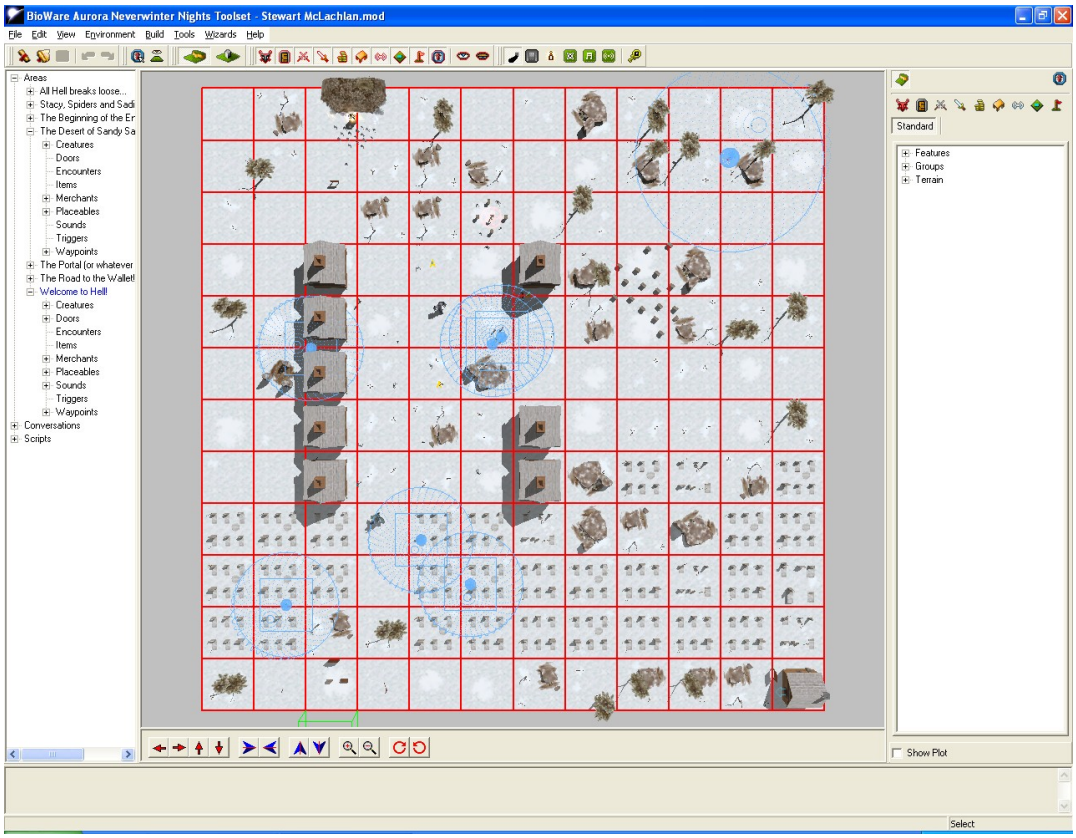

Figure 1: A Basic Area

Neverwinter Nights provides a wide range of characters, from monsters, animals of all sorts, and mythical creatures through to humans. Each character has a number of

attributes which can be manipulated by the game designer such as its name, race, appearance, costumes, abilities and skills. Once characters have been placed in the area, the game designer can begin to create conversations. These conversations will play out in the game as dialogues between the player and the NPC. Conversations are represented as "trees", where the NPC utterance is interleaved with the player's response, as shown in Figure 2, below.

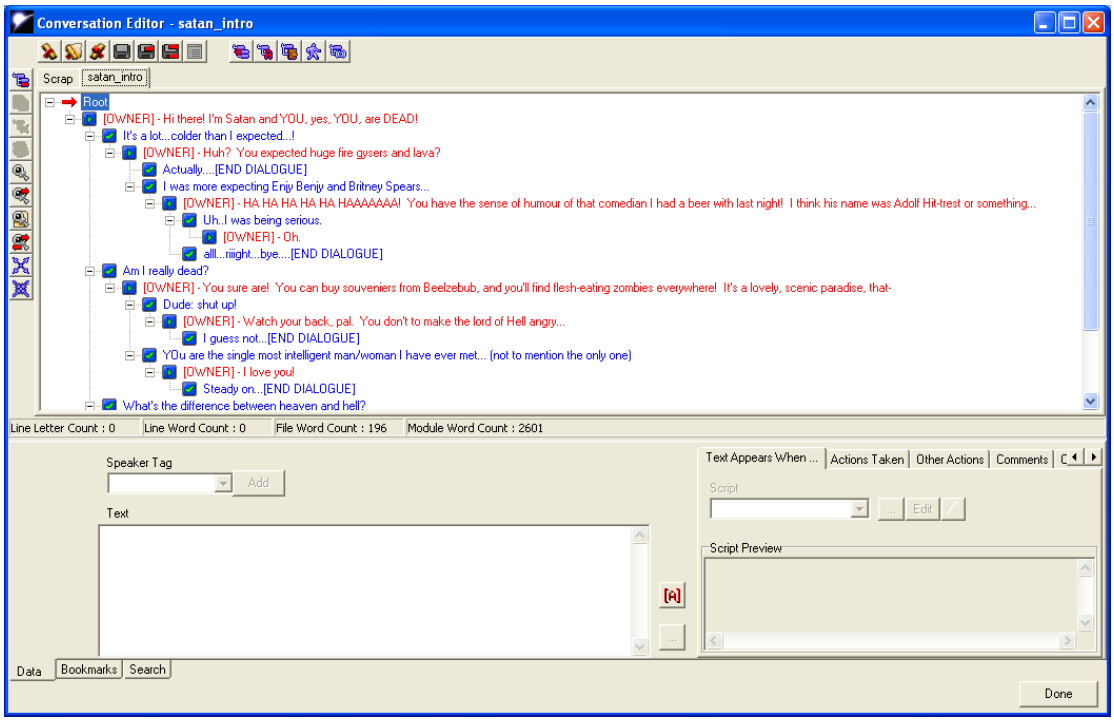

Figure 2: A Conversation Tree

Typically, conversations in this type of game have a branching structure, where the player has various options from which to choose. The choice of a particular option on the part of the player leads to a given "conversation branch" being followed: in other words, choosing, say, the first option provided may lead to a different outcome than if the second option were chosen. For example, when a player approaches an NPC in the game, the NPC typically greets the player. The player will then be offered various choices with which to reply. Each of her replies will, in turn, engender a different utterance on the part of the NPC. Similarly, the player's replies may lead to various actions being triggered such as the player being given some gold or, less helpfully, being killed.

The figures above depict the toolkit environment, in which a game is constructed. Figure 3 shows the game as it will look to an individual playing the game. The environment shown is the one which was being created in Figure 1, with the conversation on the top left hand corner being the conversation created in Figure 2.

Figure 3: The Game Being Played

In the actual process of creating a game, the game designer will frequently cycle between the toolkit environment (shown in Figures 1 and 2) and the actual game environment (shown in Figure 3), in order to test out the game elements she has created to ensure that they work as expected.

This short description of the process of game creation has only covered the basics: as alluded to above, scripting can be used to create sequences of events within the game. Furthermore, various features of the environment can be manipulated in subtle ways: the game designer can change aspects of the lighting within a scene, for example, highlighting a particular part of the scene with an eerie light. Signposting of various forms can be used either by literally placing signs of various sorts which contain informative text, or by using lighting, or sounds emanating from a certain part of the area. The game designer can experiment with changes in the weather of the area, time of day, overall mood, etc. In short, the game designer has a rich assortment of props and special effects which can be manipulated in almost endless ways to create a great variety of effects.

From an educational perspective, this description of game creation suggests that it has many aspects in common with the creation of traditional narrative such as short stories or plays. To begin with, a setting must be devised: graphically in the case of a game, or through words in traditional narrative. Characters must be created, which includes devising their appearance, their personality, possible motives, etc. Characters are typically given a raison d'être within the overall plot of the story, which can be expressed, in part, through the dialogues in which they engage.

In contrast with traditional narrative, game creation allows young people to experiment with interactive narrative, where the player of the game plays an active part in the narrative of the game. In addition, game creation permits, and even encourages, branching narrative, where options are created so that the player can take a role in determining the way in which the story contained in the game will unfold.

Taken together, the various facets of the game creation process combine to produce very powerful learning and motivational effects. However, in order to leverage these effects in an educational context, it is necessary to examine them in more detail, and to understand why they seem to occur quite effortlessly in the game creation environment. We turn to these issues below.

3 Deconstructing the Benefits of Games for Learning

Since 2003, we have conducted a number of workshops on game making. The workshops, which take place during school holidays, are always oversubscribed, with waiting lists in operation, and young people on the list frequently waiting outside the door in case a participant does not turn up. In addition, the week-long workshops typically have a 100% attendance rate. Very infrequently do we observe off-task behaviour during the workshops, and participants often arrive early, request to have lunch in front of their computers, and have to be shooed from the room at the end of the day.

An in-depth analysis of some of the games created by young people is in progress, but it is already apparent that young people invest considerable effort in creating settings, characters, and dialogue. For example, one of the participants in the 2005 workshop had no less than 958 characters in his game, while another had scripted 54 dialogues (exchanges between a player character and an NPC). The total word count of many of the games would equal a respectable essay for young people of the target age group (the average number of words being 1100, with one young person writing 3500 words of dialogue).

In addition to quantitative measures such as the above, qualitative analysis of the games shows a depth of imagination, creativity and, often, humour. As part of the Gamemaker 2005 workshop, a professional game designer was asked to come in and play the participants' games, offering constructive suggestions for improvement. The game designer made a number of positive comments with regard to young people's use of the environment to convey emotion, their attention to creating a strong story line in conjunction with compelling game play, and their dialogue. A few of his comments on Steve's game are below:

> The last one I did really impressed me. He created a lot of cultural references in it, like it was set in hell, and Johnny Cash was there. He [Johnny Cash] has made his own choice to go there so he could create music for the people down there. There were lots of very strange little dialogues. In fact the writing in it was of an excellent standard.
> But he's also managed to construct a nice game play experience as well. He had pulled the camera back, unlike everyone else. It just made it easier to

> navigate, I think. It was part of his plan and he really did have a plan. He wanted to do something and he had an idea which he wanted to get across. It was really good, a nice peaceful experience. He's really managed to put his own mark on it. Even within the framework, with the Dungeons and Dragons theme, he's really managed to show his own character through it.

Our initial analyses of young people's games (Robertson & Good, 2006) suggest that they construct very elaborate plots, rife with interesting characters, (often) witty dialogue, and intriguing plot twists. They explore a range of genres, such as: *revenge*, in which the player seeks retribution for the death of family members, *romance*, *the spiritual*, where the author explores concepts relating to death and the after life, and *satirical commentary*, in which the author expresses an opinion on aspects of modern life or the game genre itself.

So why, given the typical resistance to putting pen to paper to create a story in school, are young people so willing to spend their school holidays performing very similar activities? The obvious response would be the fact that the activity involves games. And while it is true that this may provide the motivation to begin designing a game, it is necessary to delve more deeply in order to hypothesise which factors contribute to a willingness to persevere in what is sometimes a tedious task (witness the 581 lines of dialogue written by one of the workshop participants this year).

We feel that the benefits of game creation for narrative development can be situated along two axes, which we term *motivational affordances* and *learning affordances*. The construct of motivational affordances concerns the way in which the game creation environment invites and maintains motivation. *Learning affordances* looks specifically at the way in which the environment promotes forms of learning which are desirable according to currently accepted theories of learning, and/or which are difficult to successfully implement in e-learning environments. We cover each of the constructs in depth in the sections below.

4 Motivational Affordances of Game Creation Environments

4.1 Motivation-inducing effort curve

Often, learning an academic subject requires the investment of huge amounts of time and effort before any visible returns can be witnessed. This is certainly the case with foreign languages: after many years of learning a foreign language in school, many of us are hard pressed to ask for a beer or the way to the train station in said language.
In academic subjects which are less skill based, the situation is even more dire: it can be difficult to see one's "return on investment" in subjects such as philosophy. For students who may have little intrinsic motivation for a particular area of study, i.e. they are studying a subject which is mandatory rather than one in which they have some interest, it is often difficult to persevere in the absence of some form of reward.
This phenomenon has also been observed, and documented, with regard to learning to program. Soloway (1992) has noted that learning to program involves a considerable investment of effort before it pays off in the form of a working program, as shown in Figure 4

In addition, the difficulty in programming increases exponentially rather than linearly. As Soloway notes:

> Learning to express oneself in a GPPL [General Purpose Programming Language], as they are currently conceived, requires a steep learning curve: writing a 100-line program is much harder than writing a 10-line program; writing a 1,000-line program is much, much harder than writing a 100-line program. And, let's be honest, to make the computer truly sing and dance, one needs to write significantly sized programs. (Soloway, 1993, p. 22).

On the other hand, game design offers an environment in which there is an obvious return, in the form of a completed game. Even more importantly, we think, the effort in game design has a very different profile from learning a programming language (and many other academic endeavours), as shown below:

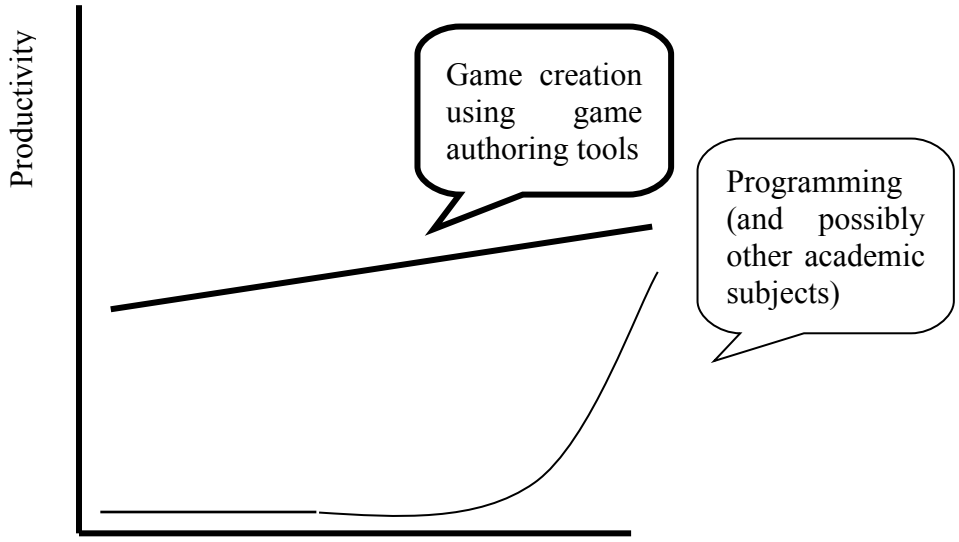

Figure 4: The Game Effort Productivity Relationship (based on (Soloway, 1992))

In other words, a substantial return on effort is possible from the very start of the game creation process. An entire game can be created with minimal effort and in a very short period of time (depending on the authoring tool of choice). In as little as 10 minutes, a novice game designer can create an area, populate it with props and characters and see the results when she tests it out. Visually, the results will have the same feel as a commercial game. In the three hour workshops that we run, all participants are able to experiment with the basic features of the game creation environment, and to create a basic game with characters, conversations and a rudimentary plot structure. The majority are keen to show off their games to siblings and parents at the end of the session. The "instant reward" of a game with graphics of commercial quality keeps motivation high, and encourages young people to continue to refine their games.

However, as noted above, the game creation environment offers almost limitless possibilities for manipulating features of the game environment, and these can be used to great creative effect. As young people experiment with these features, the task can

become more complex in a number of ways. For example, young people may decide to include certain events in their games which require them to learn the scripting language. Similarly, creative complexity may increase, as young people attempt to use special effects to convey a certain atmosphere or even an element of the plot. From a motivational point of view, this complexity arises in later stages, when confidence is likely to be much higher. This means that young people are more likely to persevere when things become difficult.

In the following excerpt, Ronald is talking to the second author about the scripts that he wrote for his game. He has obviously put a lot of effort into the scripting, but expresses confidence in the way he was able to persevere and get to grips with it:

> *Ronald*: I have worked on quite a lot of scripts, one of the main ones was I slayed the dragon. The player slays the dragon then once it's been slayed, this man comes out the door but the door doesn't open for him. He bashes it in and he walks out, greets you, then walks off and gives you a key.
> *Judy*: Uh-hmm.
> *Ronald*: And that was one of the main scripts that took up most of my time.
> *Judy*: Yeah, but you've actually got quite a lot of behaviour, because you were doing the one where you go though a door, you know the one we did this morning.
> *Ronald*: Yeah, I've also got one where you're supposed to go through a door once, and speak to Lindsay, and get the book, then go out and the second time you go through, slaying the dragon, then out.
> *Judy*: And how have you been finding the scripting?
> *Ronald*: It was hard at first. I haven't done it before but once you get the hang of it, it's easy.

4.2 Creation of a valued artifact

According to the theory of constructionism, effective learning occurs through making things. As Papert and Harel (1991) state, learning "happens especially felicitously in a context where the learner is consciously engaged in constructing a public entity, whether it's a sand castle on the beach or a theory of the universe" (Papert and Harel, 1991, p. 1). In some way, the learning is almost a "by-product" of the creation process.

Constructionism is an approach to learning that we wholeheartedly endorse, and we believe that it can have many benefits for learning. However, we feel that game creation takes constructionism one step further, and also allows us to account for the high level of *motivation* observed during the game creation task, in addition to the learning gains.

Pfaffman (2002) carried out some fascinating work on hobbyists who, as he clearly states, "spend considerable time and fervent effort learning" (Pfaffman, 2002, p. 1). Pfaffman's work looked at the factors which motivate hobbyists, with a view to investigating whether or not these factors can translate into a classroom environment. He found the following:

> Several factors were consistently rated at or near the top even across different kinds of hobbies. The number one motivation was the opportunity to produce artifacts (construed as outward productions including performances, collections, and objects). Coupled with this was the opportunity to share the artifact. Importantly, near the top was also the motivation to learn the methods

> necessary to produce the artifact. Thus, the motivation to produce artifacts appeared to be tightly linked with the motivation to learn with sufficient understanding to produce those artifacts. (Pfaffman, 2002, p. 2).

It is obvious that game design could in many ways be considered a hobby, with all of the concomitant benefits in terms of learning and motivation. Firstly, there is an artefact being produced in the form of a completed game. Secondly, the artefact is eminently sharable: it can be played by others at various stages of completion (either so that others can provide helpful criticism during the game creation process, or enjoy the completed game). As such, it provides strong social motivation, both during and following the game design process. Finally, there is a reasonably direct correlation between the skills which the young people master, and the overall quality of the game produced, which provides motivation for learning these skills. What is implicit in the research on hobbyists is that the artefact produced has some intrinsic value for the hobbyist, and this is certainly the case with games. While constructionism may suggest that the mere fact of producing *something* is likely to benefit learning, we would suggest that producing *something which is deemed to have value for the producer*, either at a personal or a cultural level, is likely to positively affect both learning and motivation even more directly.

4.3 Situated Learning

According to situated learning theory, deep and meaningful forms of learning will occur in situations in which the process or event being learned about actually occurs. As Brown et al. (1989) note, "The activity in which knowledge is developed and deployed … is not separable from or ancillary to learning and cognition. Nor is it neutral. Rather, it is an integral part of what is learned. Situations might be said to co-produce knowledge through activity" (Brown et al. 1989, p. 32). Thus, learning which is decontextualised is unlikely to be effective. For example, when learning how to program a computer, the most productive learning will occur when actually trying to write a program, rather than learning about how to program a computer from a lecturer giving a talk about programming constructs.

While this example is quite obvious, situated learning also considers the concept of *enculturation* in addition to the context of use. Enculturation involves adopting the behaviours and beliefs of social groups, and is an important part of learning throughout life. However, Brown et al. (1989) state that this enculturation is lacking in much school activity:

> Too often the practices of contemporary schooling deny students the chance to engage the relevant domain culture, because that culture is not in evidence. Although students are shown the tools of many academic cultures in the course of a school career, the pervasive cultures that they observe, in which they participate, and in which some enter quite effectively are the cultures of school life itself. (Brown et al., 1989, p. 33).

This suggests that, rather than simply teaching a subject, education should seek to give students a feel for what it is to be a practitioner of that subject. In other words, learning facts about chemistry isn't enough: students need to learn what it means to *be* a chemist, and to understand how a chemist uses her knowledge of chemistry in everyday practice.

At a broader level, students need to learn what the knowledge is *for*, and what can be accomplished with it (Gee, 2003).

The teaching of game design is situated in a number of ways. It is essentially a hands-on activity. Young people are immediately seated at a computer, immersed in the game creation toolkit, exploring software features for themselves. New information and skills are introduced gradually, interspersed with time to try them out. Once the basics have been learned, information and skills are introduced on an as-needed basis.

In terms of teaching young people about what it is to be a game designer, this process is straightforward in the sense that again, it makes little sense to teach the concepts in an abstract way. In addition, asking young people to assume the persona of game designer is not a stretch: all are ready to do so, given the "coolness" factor associated with game designers, and the sense of mastery that they gain by moving from consumers of games to actual producers. The following excerpt from a discussion between a youth worker and a workshop attendee illustrates this point. The youth worker has been asking which subject Julian studies at school.

> *Nikki*: So all the subjects you told me, is that with a view to like doing something in this line? As a job? Or is this not necessarily something that you want to do?
> *Julian*: Yeah, it is actually.
> *Nikki*: It is?
> *Julian*: …something I want to do, because I've always been wanting to be a game maker, personally.
> *Nikki*: Why do you think it would be a good job?
> *Julian*: It's something I'll enjoy, it's not something that I'll be frustrated at or anything. Because I enjoy doing it.
> *Nikki*: Do you think you could do it all the time though? How often do you play games?
> *Julian*: A lot!

5 Learning Affordances of Game Creation Environments

In addition to motivational issues, we have identified various factors relating to the creative process of game design which we term *learning affordances*. During the game development process, learners are engaged in meta-cognitive activities such as generating and selecting ideas, planning, testing and revising. The testing and evaluation stages afford many natural opportunities for learners to reflect on how to improve the products they have created. We refer to this as an *organic reflection-revision cycle*. It is organic in the sense that the learners naturally enter this cycle, not because they are instructed to do so, but because they want to know whether their game "works". In contrast, an English teacher who observed a workshop noted that it is difficult to motivate learners to produce multiple drafts of written stories in the classroom where pupils tend to regard their work complete after the first draft. She commented "And it's a very purposeful way of creating a story because when they come to test their games they find they don't work as well as they want and they go back and move things around, move characters around, move objects around and I think there is a level of sophistication involved in the storytelling here that goes beyond what

you can easily get on paper." There are two affordances of games authoring environments which support reflection and revision: *individual action-based feedback* and *collaborative action-based feedback*.

5.1 Individual action-based feedback

The designer typically spends a good deal of time playing the game herself to establish whether particular game features are working as intended in the testing phase. The tests are usually very specific and low level – does this script work correctly in all logical circumstances; is this sound audible within the correct radius; do these areas link together as they should? The designer is establishing whether her creative ideas have been expressed as she intended, rather than evaluating the artistic merit of the ideas. When playing a game to test it, the designer receives explicit, detailed performance feedback in response to her actions in the game world. For example, if the player wishes to test whether the branches in an interactive conversation work as she intended, she can systematically choose each option in turn in a series of tests. In response to her action of clicking on a character to start a conversation, the game engine supplies visual, auditory and textual feedback to indicate the current branch of the conversation in progress. It is interesting to compare the performance feedback supplied by a game authoring tool with a word processor which might typically be used to write stories. A word processor can be used to identify spelling mistakes, for example, but the representation of the spelling errors in the software interface (e.g. red wiggly lines in Microsoft Word) is not an integral part of the final written artefact. A game authoring tool enables the user to gain performance feedback directly from her creative product.

In cases where a feature of the game does not work as expected, the designer typically starts to generate hypotheses about the nature of the problem and how to fix it. For minor problems, a small change to the game in the toolset mode will be sufficient; major problems may require the designer to seek further advice or learn a new skill.
After an extended period of testing and bug fixing, the designer will be ready to evaluate a section of her game with another player.

5.2 Collaborative action-based feedback

An extremely important stage of the computer game design process is evaluation, during which the designer invites a member of the target audience to play her game. The designer observes difficulties which the player encounters in playing the game, misconceptions about the game goals, and emotional reactions to characters and narrative. She also has an opportunity to ask the player for his opinion, and for suggestions about how the game could be improved. The designer must then decide what action to take based on the evaluation information, which may cause her to return to previous stages in the creative process.

Again, the designer receives detailed, explicit feedback about the success of her design, but this time she does not control or necessarily anticipate the actions which the player will choose. This is an excellent opportunity to get insight into another player's ability and preferences, as the designer's own skills and tastes may not be representative of the "target market".

The level of detail in the feedback is significant here. Consider an analogous situation in

which a young author requests feedback on a written story. The most common form of feedback is likely to be come from a teacher, usually with some delay, in the form of brief comments written in the margin of the text. In this example, the author does not directly witness the interaction between her product and the intended audience; the activity is largely invisible. However, with the luxury of an interactive external representation of the product, computer game designers are able to observe an audience member's fine grained actions in the game world, and his reactions to changes in game state.

5.3 Organic collaboration

Another learning affordance we have identified is *organic collaboration*: given that the narrative created is interactive, collaboration results from natural interactions between learners, and does not need to be designed into the environment or associated tasks.
During game design workshops, collaboration of all types occurs. While designers of learning environments and situations manufacture tasks which force collaboration to occur, such as by giving each member of a collaborating team partial information that must be shared with the others in order to find a solution[2], collaboration in game design occurs naturally and in many guises.

Firstly, collaboration occurs during the game design phase as a result of what we have termed the "brushfire effect". Typically, one designer will ask the workshop facilitators how to achieve a particular behaviour in his game, such as, causing an event to occur at a certain point in the dialogue. Once one game designer has incorporated that feature into his game, it usually spreads from computer to computer without any direct intervention from the facilitators, as the other young people express interest in learning how to incorporate that feature, and the original game designer in question shares his newly found expertise. In a recent workshop, a spate of angels occurred in a number of the games. Although the first appearance of the angel character had an obvious role to play in the plot, her importance was less obvious in other games. Nonetheless, many other features which the designers discover through collaboration are important to gameplay – for example altering the strength of weapons to reduce the difficulty level for the player.

In the informal example below, Nikki, who works for a nearby council, is visiting the game design workshop in order to see if such an event would be an appropriate thing for her council to offer young people over the holidays. Julian, one of the workshop participants, is explaining his game to her when he is interrupted by Josh, another workshop participant:

> *Nikki*: The dragon's good, isn't it?
> *Julian*: Uh-huh. The dragons are amazing! I like dragons.
> *Josh*: Did you get your dragon to follow you?
> *Julian*: No, but I know how to do it.

[2] See for example the commercial training games Infiniteams created by TPLD: http://www.tpld.net/tpld/main.php?page=58

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6 Conclusion

Extending the scope of educational games research beyond speculation about what learners may gain from *playing* games, we have examined the benefits of computer game *creation* in terms of motivational and learning affordances. We make that case that the activity of producing and sharing culturally valued artefacts with other learners in a realistic setting is highly motivating, and encourages learners to develop their own skills in a self directed fashion. Furthermore, the learning affordances of the combination of the design process and the software tool provide rich opportunities to engage in an organic reflection-revision cycle while collaborating with their peers in a natural setting. We have drawn on extensive field work at community education game authoring workshops for young people where we use a software tool called the Neverwinter Nights Aurora Toolset. However, we believe that the arguments developed here are not dependent on this particular software: other game authoring tools are likely to provide the same type of action based performance feedback which is so beneficial for encouraging learners to reflect.

We have proposed some motivational and learning affordances of the game authoring learning environment based on currently accepted theories of learning. Further empirical and theoretical work is now required to explore and understand these concepts in greater depth. We invite the NILE participants to join us in this exploration in order that as a community, we are better equipped to design learning environments which foster learners in the development of creative interactive storytelling and game making skills.

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