Learning Through Rich Environments

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Abstract

Research into games in education most frequently expresses itself in the form of noting that games interest and motivate, and that we might therefore find the learning process improved if we were to use games as a vehicle for the delivery of learning content. We do not wish to take this approach, but to analyse what it is that makes games interesting and motivating and apply this in the context of designing learning scenarios.

Many papers propose taxonomies of game style and criteria for good game design, tending to list good ideas and observed issues, but meeting difficulties when trying to generalise. We review some of the more important contributions in the area, and distil these into models to help us understand what's involved by defining the concept of a "Rich Environment."

Keywords

game design, learning environments, learning models

1 Introduction

There is much published work giving analyses of games and game attributes. This can be broadly divided into two categories; analyses of game styles or genres, and analyses of game qualities.

2.1 Game genres

Although it is not of primary importance for this paper, it is still helpful to consider briefly what game genres exist. A number of different ways of categorising have been proposed. Thus Callois [1] gives four categories of competition, chance, simulation and movement, categorising by constituent elements. Alternatively, one may classify by the role of the player, or by the mode of delivery such as console or PC games. Prensky [2] suggests eight classifications based on player activity such as puzzles, sports and role-playing games. Wylin & Desmet comment that these are broad categorisations, and a single game may frequently involve two or more genres, or cross boundaries [3]. Although this is of interest, we will not return to this theme except where it helps us to contextualise further discussion about game qualities.

2.2 Game qualities

It is useful to consider the categorisation of game qualities; what is it that makes a game "good"? For now, we may define "good" as meaning popular and having lasting appeal, so Monopoly, hopscotch and chess might qualify if we were considering non-computer games. This area is also problematic in that published lists tend to give personal ideas and observed features, so they lack structure and vary widely. The following list, taken from Rollings and Morris [4] indicates the sorts of qualities that are often given.

- immersion, where the aim is to fully immerse the player in the game
- explicit goal definition, including the use of sub-goals
- integration of new knowledge, e.g. allowing the player to practice new skills

- balanced challenge, where grading and timing of increased difficulty matter
- arousal of curiosity, where the player is enticed to explore further
- feedback, including detailed analysis of performance and action replay

3 Models to Describe Learning Worlds

It has long been accepted that valuable learning occurs through game play, even though the original intention of the game may have been to amuse rather than to teach [9]. This is especially noticeable with young children, where most learning occurs through play. The spectrum of learning is also broad, so that number, language - both oral and written, and social skills are all learnt in this way, for example. It is not just young children who learn in this way.

3.1 Rich Environments

"Good" games, i.e. ones that are widely played and enjoyed, tend to be successful because they are rich in content, and because successful play involves the learning of interesting new knowledge and skills. One may posit a new concept of a "Rich Environment" which has been designed to provide a context in which students may enter as "Explorers" and learn through direct engagement with their environment. In effect this is developing Papert's idea of "microworlds" [5] although what is proposed here is more properly a "learning world" rather than a microworld. Taking this approach enables one to side-step the discussion about how to classify games, and focus instead on what would make a good learning environment. It is important that this definition should have meaning when applied to game play and to exploratory learning. Figure 1 gives a representation of a Rich Environment. Four primary criteria summarise the type of comments given when one asks what makes a good game.

Motivating

The first criterion is that a Rich Environment should be motivating. This covers a number of issues, some of which could be contentious and may depend on context. However, we may note that to be motivating, an exercise should have clear goals and procedures. It should provide a coherent experience. It may put the explorer in a competitive environment, and there will probably be rewards and encouragements to explore further. There may be surprises in the form of "unexpected delights" (or horrors!) which may be related to the encouragements to explore further.

There are then a number of issues that relate to degree of challenge. This calls into question the form of structure; it is not assumed that the environment will necessarily consist of a series of structured tasks. Rather, there could be some form of simulated world which is being explored entirely within the control of the explorer. Nevertheless, the way the world itself is structured may help to determine the degree of challenge the explorer finds as they explore. Suppose, as we enter the simulated world, we are cast as space explorers stepping out of a spaceship. Suppose that world has a poisonous atmosphere, has frequent rain showers of lethal acid, has frequent meteor showers, and a number of other challenges, all of which meet us as soon as we step out of the craft. We would almost certainly decide after the first few attempts that it would be better to fly off and try a different planet rather than to deal with the various problems presented to us. We are therefore looking to be presented with challenges that are surmountable (achievable), that are not too easy so that we get bored, but not too hard either, and that are layered, so that the more difficult challenges are presented after we have become more familiar with the environment and more proficient applying concepts we have learnt. We may also expect to be provided with a bounded area where a new skill can be practised in isolation, before being required to use it in combination with other acquired skills.

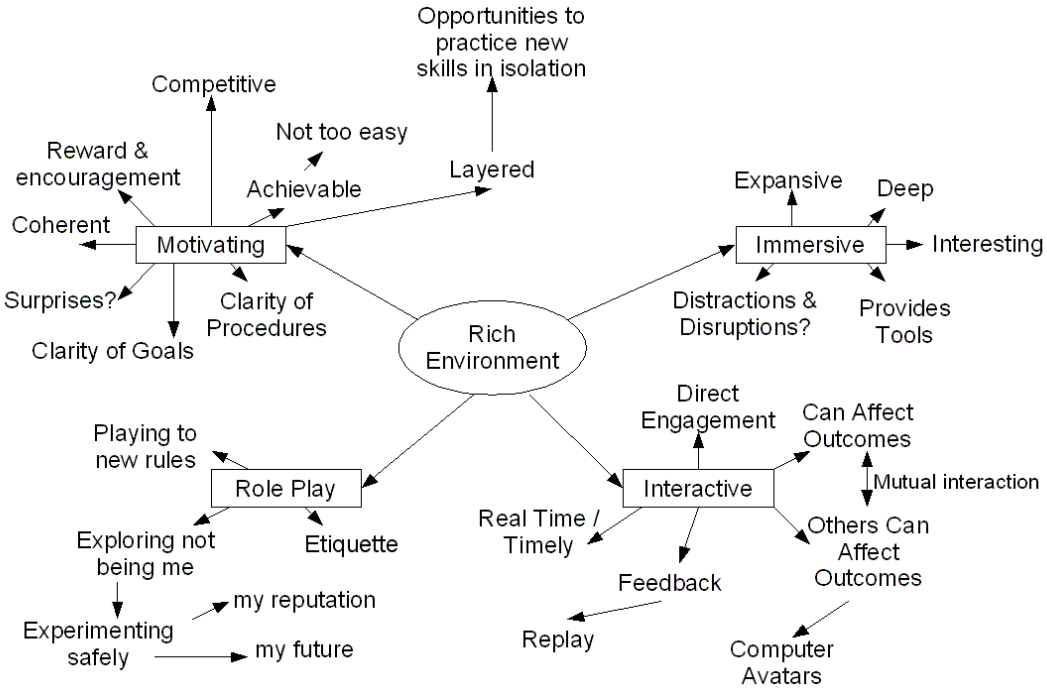

Figure 1: Representation of a "Rich Environment"

Immersive

The second criterion is that Rich Environments should be immersive. This raises some interesting issues. Immersive gaming typically tends to be linked with surround sound, 3D graphics, and multi-sensory feedback, for example. Whilst such features help to involve the participant, these are not necessarily essential for Rich Environments per se. Immersivity is really about engagement with the environment, and about believability, or at least, suspension of disbelief.

So, to be immersive, our Rich Environment should be interesting. This is linked to motivation, of course, but what we are principally thinking about here is that the environment should be expansive and deep. To be expansive, we want to construct our Rich Environment so that the "walls" are a long way away. In a driving game, this might mean that we want to be able to drive off the road and drive across the fields – and we should be allowed to do so. To be deep, we want to be able to push the simulation and not find it stops doing anything. So in a "shoot-em-up", if I shoot something that looks like a drum of petrol (gas), I expect it to explode, or if I see a representation of a computer, I expect to be able to sit down and type something at the keyboard, for example. Another aspect of immersivity is that the explorer should be provided with tools to achieve tasks. Also, there may be distractions and disruptions, for example.

Interactive

The third criterion is that Rich Environments should be interactive, encouraging direct engagement. This covers several aspects. My virtual explorer should interact with the Rich Environment, and this interaction should affect the ensuing outcomes. There may well be other virtual explorers in the Rich Environment at the same time, and these should also be able to interact. This means that there should be a rich pattern of interactions of explorers with the RE, of explorers with explorers, and of explorers with computer "avatar" explorers, all of which affect the outcomes.

Implied in this interactivity is the idea that actions need to at least provide timely responses, and it may well require real-time responses.

Role Play

If we start with the concept of computer gaming, it will be no surprise that role play is important. This involves a number of aspects, for example exploring etiquette. Entering a new game may well require the learning of new unspoken rules, as well as rules that are known and published. Game play (and chat rooms) also provides the opportunity to explore what it means to be me, but also what it might mean to not be me. It is said that, "On the Internet, nobody knows that you're a dog," and this provides the opportunity to explore identity in new and interesting ways. This means it is possible to experiment in a safe environment where my reputation and my future are not put at risk.

Whilst it may not be immediately apparent that this could be useful in a learning context, it is extremely useful to consider it. It plays a significant part in at least some game play situations – after all, there is a whole genre of games entitled "Role Play" – so we might be well advised to consider this issue in learning generally. Papert's work in "Mindstorms" [5] was predicated on the basis that he was challenging the Teacher-Pupil relationship and seeking to replace it with a "Co-researcher" model.

Putting this together, we now have a model which provides us with a detailed structure to discuss game qualities especially as applied to the construction of Rich Environments for learning.

3.2 An interaction model for Rich Environments

We have defined an Explorer to be someone who enters the Rich Environment and interacts with it, thereby occasioning learning. It will be helpful to have a model of how an Explorer interacts with the Rich Environment.

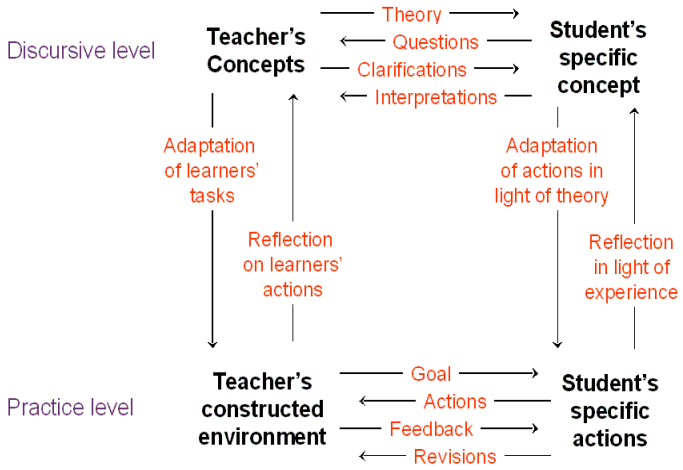

Figure 2: Laurillard's Conversational Framework

Laurillard has produced an Interaction Framework for describing learning interactions [6]; see figure 2. This is helpful, except that it tends to focus on the concept of having learning content which is delivered by an expert ("teacher") to a novice ("student") in instructional mode. It is also widely applicable, so it is possible to take the concept and apply it to learning situations in general. The expert could be a computer avatar, a conceptualisation of an inanimate object, or a peer learner, for example. Nevertheless, the focus is basically on one-to-one learning interactions, with teaching and the teacher-student relationship strongly implied. For our purposes, we require a more general model which focuses primarily on the learner and the world they are exploring.

From this point of view, Abowd and Beale's Interaction Framework [7] might seem to be a good starting point, since the context in which they were working was relevant; a user learning about a

new system and how it works. Argles has proposed a modification of this framework for learners working with virtual systems [8]. We may take this a step further for the current context as shown in figure 3.

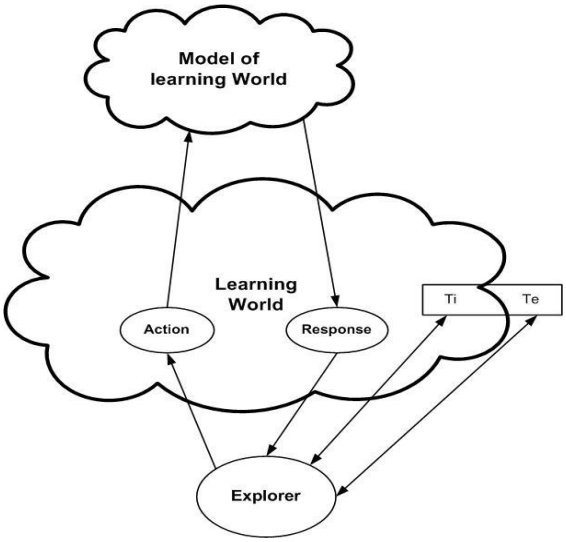

Figure 3: possible interaction model for Rich Environments

In this model, the Explorer wishes to learn about the Learning World, or Rich Environment. In order to do so, they will perform an action. As a result, they are able to observe a response, and from that response, the Explorer will build up a model of the Rich Environment. Further action-response interactions will lead to the Explorer refining their model. Ti and Te represent tutorial functions, Ti being inside the Rich Environment and Te being external. Ti might typically be on-line help, and Te might be a (human) tutor. Further details of how this model may be applied may be inferred from the two previous references.

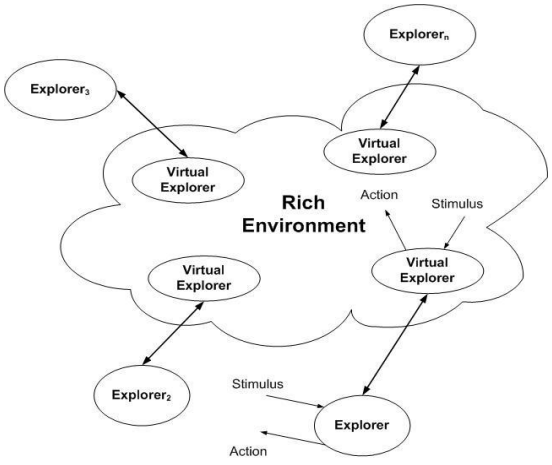

Figure 4: a model for describing interactions in a Rich Environment

This model has a prominent "tutorial function" which was considered to be a drawback with the Laurillard model, and it fails to address the concept of community, which is an essential aspect of our proposed Rich Environment. With this in mind, we propose the model given in figure 4.

In summary, then, we are proposing a model which consists of a Rich Environment as defined in figure 1. A number of Explorers enter this Rich Environment (RE) as Virtual Explorers (VEs). They interact with the RE and with each other through the RE by performing actions and by

receiving stimuli. As they do so, they build up and refine a model of the RE. Lessons learnt in this RE may then used in interactions with the real world.

This model has been developed primarily with a view to designing good learning scenarios, particularly in the context of collaborative on-line simulation. However, with the exception of the final step, where learning is applied to the real world, it should also be applicable to game design, which is where it has been drawn from.

5 Conclusions

In this paper, we began by noting that there are difficulties in agreeing terms and concepts when seeking to categorise game design attributes, and that this makes it difficult to apply such attributes to learning situations. We avoided this problem by defining a new concept, a "Rich Environment," which allows us to define attributes without contention whilst drawing from analysis of published research and experiment. This has led to a set of criteria that should be generally agreed within the defined context. From this, we have developed a set of models which help to capture this definition and which aid in analysis.

For such an approach to be useful, it must be possible to apply these models to the practical design of learning environments. What needs to happen next is for the models to be applied to real design examples, for all these designs to be implemented and assessed, and then for the models to be refined in the light of experience. A number of interesting questions remain. The proposed models are based on general research. It would be most helpful to initiate research that might, for example, analyse the characteristics of a Rich Environment and consider if the profile changes if one takes gender into account, for example. Other considerations might include age or cultural background. Might there be any gender differences different in other cultures? Do the answers vary with time (this would need a longitudinal study, of course)? Whilst research exists on some aspects of these questions with regard to games, work really needs to be undertaken in the context of the definition of Rich Environments if the concept is to be helpful.

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