Interaction as enquiry- learning with layered dynamic media

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Abstract: The interactivity afforded to the learner by the computer based media is often fairly restricted. This may be by design choice but is often brought about by resource constraints. The new layered media forms give educational media developers an opportunity to provide richer forms of interactivity, and some of the issues related to changes in the way that interactive materials might be created are discussed. The distinction is made between the interface viewed simply as an information source and the interface regarded as an environment to be manipulated and explored.

Keywords: dynamic interactivity, layered media, MPEG-4

1 Interactivity

Despite the hype, the user's interaction with educational interactive media (i-media) is seldom a dynamic experience. Whilst they may passively watch dynamic elements such as video clips or animations the dominant experience for the learner is still one of 'point, click and then see something else'. In distinct contrast to the position with educational i-media, the goal of the games culture has always been to facilitate fast dynamic interactivity. It could be argued that the concerns and goals of the games industry are quite different from those of the developers of educational i-media, but it would be a mistake to ignore the focus and motivational levels that gaming produces. How might the educational i-media author create the same feeling of immediacy and active control, and the same sense of involvement and motivation that follows from it, without the technical and financial resources of the games industry? One possibility is through the application of Laurel's (1991) dictum to 'focus on the action', in combination with the layered and scripted media technologies (Koenen et al. 1997).

Laurel was one of the first to suggest that the interactive media designer should think of the interface as a representational medium rather than just as a tool, and moreover to think of of it as a medium where the focus should be on action and experience. This requires the i-media author to move from a view of the interface as simply a source of information to be passively acquired, to one where the interface is seen as being an environment to be actively explored and purposively manipulated by the learner. The simple 'click to control' technologies are quick and easy to implement, particularly for the current web-based media development software. However the change in thinking suggested by Laurel requires more complex interactions than the educational i-media author has traditionally been able to create with this software. Designing an interface to be an efficient tool can be difficult, but is still a relatively straightforward process of prototyping and testing. Designing the interface to facilitate active exploration, and the development of new competencies, is more difficult because the interactivity designed into the interface becomes central to the learning processes that it is intended to facilitate.

2 Interface as transitional object

The notion of the computer interface as a *transitional object* takes the issue of what the interface is actually representing to the learner a stage further, and raises the question of what the 'action' is really for. Is it simply a motivational device or does it have a deeper pedagogic purpose? The idea of the transitional object derives from Winnicott's (1971) conception of a heuristic field, a potential space of 'room to become'. Hodgkin's (1985) model of the creative cycle represents a synthesis of Winnicott's ideas and Polanyi's (1958) concept of *tacit knowledge* and the way that it is acquired. Polanyi discusses the way that we develop a subsidiary awareness of tools and probes and of how "We pour ourselves out into them and assimilate them-" (1958, p59). Papert later provided a related example of a transitional object that is well known

to the HCI community when he described how as a child he essentially *became* a gear system as he made mental manipulations of gear wheels in order to understand their workings (1980, p viii).

Within Hodgkin's model the interface (as transitional object) can be seen as both a probe when exploring new ideas, and as a tool when reinforcing competencies through practice. These duel roles have to be taken into account within the interface design, and this may be aided by a layered approach. It is worth noting that the error is often made of thinking of the physical 'turtle' in Papert's (1980) *Logo* system as being the transitional object when really it is the whole *system* of mathematical thinking that he devised that should be thought of as the transitional object. Similarly in the case of the i-media interface it would be a mistake to focus on any single device, say the cursor dragging on some virtual object, and think of it as being the transitional object. A coherent learning environment will only result from considering the whole i-media system within its learning context and the problems that it puts to the learner.

3 Interactive Dynamic Media

The conventional use of movie elements within educational i-media offers an example of fairly

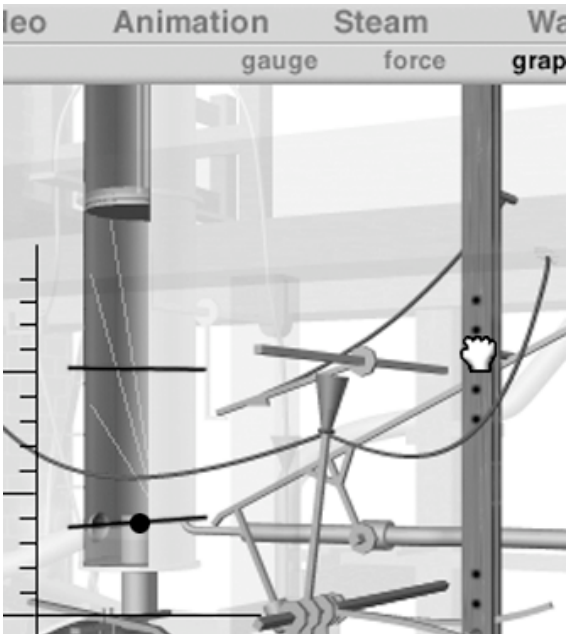

Figure 1: A Layered Dynamic Interface.

limited interactivity. The learner clicks a button to play the movie content and then simply watches. The only interaction permitted being to drag the slider to effectively control a time dimension or to click buttons to jump to critical events. The resulting interaction is only a little more advanced than that with the conventional video player. This is in distinct contrast to the learner's interaction with even one of the most simple immersive media

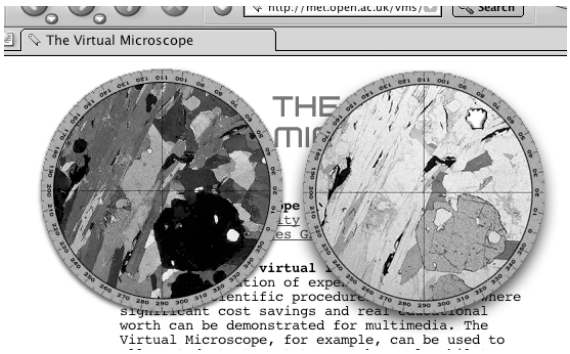

Figure 2: Linked rotating views.

formats such as Apple's QTVR (Apple Corp, 2003) software. The learner's experience with this form of media has a quite different feel to clicking through the equivalent gallery of static images and this feeling of presence is made even greater when the learner is also afforded some degree of *dynamic* control of the visual elements. The i-media designer Gould (1996) made the important distinction between the interaction that we provide "- when we give users only a single blunt appendage with which to poke the screen" and the more dynamic and richer form of interactions that are possible with only a slightly greater complexity of media scripting. The examples presented in the next section follow these ideas and are intended to suggest how the new layered and scripted media formats may change perceptions of the media interactions that are possible, and desirable, for the learner.

Dynamic forms of control are possible now with the layered media tools that allow for an underlying level of scripting, but such features are likely to be enhanced and made even more widely available by the new layered formats such as the proposed extensions to the MPEG-4 media standard (Koenen et al. 1997). The key to future developments in educational i-media will be the availability of high level authoring tools that can pass on access to these layered objects, together with scripting control of their dynamic interactivity. One significant change that may follow these technological developments in the layered media is that its dynamic elements might be reconceptualised by i-media authors as procedural objects that can be passed parameters. This would mean that instead of thinking of movies only as relatively undifferentiated and autonomous filmic blocks, they could be thought of as more complex

malleable elements that can even communicate with each other. Their behaviours could be made to adapt to the different needs of the learner and that they could even take on different forms at progressive stages of the author's exposition, rather than simply being statically embedded within an external context of text and graphic elements as at present.

4 Layered dynamic media

The interface fragment shown in Figure 1 is intended to give some idea of what is possible with the layered media formats. In this case the learner is given effective control of a complex mechanism, viewed as multiple layered representations, through the vertical movement of a timing beam. This is not simply the reorientation of the underlying time controller in that the learner's dragging movements are constrained to only allow the mechanically

Figure 3: Non-linear dragging.

correct movements of the engine. This becomes pedagogically significant where a symbolic representation, in this case the engine's indicator diagram, is being employed as an explanatory overlay and any movement must logically follow a particular sequence.

Figure 2. shows how a circular dragging motion can be used to control a virtual geological microscope. In this case the learner has to appreciate the significance of the dramatic colour changes that follow from rotating the slides with a gentle rocking motion. Virtual views within the educational i-media are often no more than simple emulations of the view presented by the conventional instrument. However in this case there is a true qualitative difference in that with a real geological microscope it is not possible to view both polarised and cross-polarised images rotating simultaneously. This of course presents some difficulty for learners. An extension of the underlying scripting control allows communication, and thus control, to extend between different media objects. In this case, although the two images still rotate together they are separate, draggable movies that are floating above a web browser. However they could equally well exist on different, internet connected, computers for the purpose of collaborative learning.

The dynamic aspects of the movement of image layers may also be controlled by underlying scripts as in Figure 3, Here the dragging movement of the pump handle has been given a realistic haptic feel by a non-linear relationship effected between the dragging motion of the learner and the actual movement of the image layer. The purpose of this example was to motivate the learner to experiment with different speeds of pumping action, and as a consequence to explore the effect that the moving air has on the flexible surface. Immediate experiences like these can directly engage the learner and encourage them to go beyond the immediate task.

The interface shown in Figure 4 takes this idea a stage further and allows the learner to make a real-time synchronised movement. This allows the learner to explore and understand the underlying dynamics of the system in a way that is not possible when they may only set parameters within a

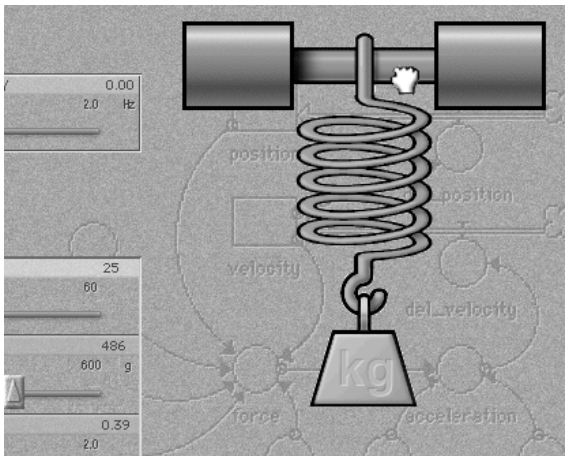

Figure 4: Real-time synchronized movement.

simulation and then simply watch the effect. It is only possible for the learner to drive this system into resonance by closely synchronising their dragging movements of the spring support with the movement of the weight, and any change to the damping setting radically changes the responsive feel

that the learner experiences. Polanyi (1958) argued for the recognition of the importance of the tacit

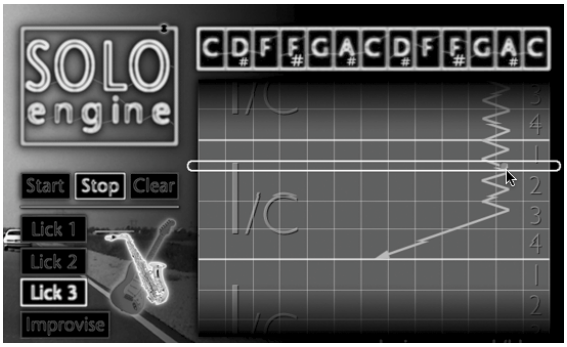

Figure 5: Real-time expressive movement.

knowledge of the scientist that allowed them to 'see' the problem, and claimed that this form of knowledge is only acquired through immersive experience. Allowing the learner to actively explore and experience the dynamic interrelationships within a system can make a significant contribution to their understanding.

The notion of the interface as transitional object is perhaps best exemplified in Figure 5. The interface was designed to encourage creative musical exploration by children who had not yet mastered formal musical notation. They can experience the feeling of performing classic Blues licks by following the simplified gestural pattern that scrolls down in real-time, and may then experiment with their own expressive patterns of notes. The trace of their own dynamic movements allows children to subsequently reflect on and practice their licks, and also to communicate their intentions to others.

5 Discussion

Moving from a view of the interface as simply a source of information to one where it becomes an environment to be explored involves viewing the interface as a dynamic object to be purposively manipulated, and this in turn requires the possibility for richer interactions by the learner. Developers of educational i-media are unlikely to ever be able to offer the learner the degree of dynamic interactivity that they are used to with commercial games. However the new layered and scripted media forms provide the opportunity to design and provide more complex forms of interactivity without great resource implications. Where there is a pedagogically significant dynamic or tactile element to the learner's interaction the investment is likely to be worthwhile.

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