Efficiency vs. Immersion: Interface Design Trade-offs for an Exploratory Learning Environment

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Abstract. In this poster, we present a hypothesis involving inherent the trade-offs between a user interface designed to promote immersion and a user interface designed to promote efficiency, in the context of an Exploratory Learning Environment (ELE). We consider the entire user interface, but also specifically the interface for automated, intelligent coaching. We present an example system that provides both types of interface, and present our plans for experimentation involving this system. This trade-off is relatively unexplored in the literature, and we have a unique opportunity to experiment with this important aspect of ELE design.

Keywords: immersion, exploratory learning environment, interface design

1 Introduction

Exploratory Learning Environments (ELEs) naturally promote immersive endogenous experiences [1] in which interesting mechanics (game mechanics, etc.) are intertwined with the activity, and are not simply an independent layer built on top of a tutoring system. This also means that ELEs are inherently complex, which can often lead to floundering, confusion, and/or struggle [2]. We see this as an example of an inherent fact that systems lending themselves to immersive experiences also inherently lend themselves to certain inefficiencies.

Design choices related to user interfaces can increase immersion, but we believe that immersion necessarily implies the existence of features that designed to capture engagement, and therefore are not absolutely necessary. On the other hand, interfaces that maximize efficiency remove all unnecessary elements by definition, leaving them potentially uninteresting. There is a noticeable lack of projects that directly compare immersive and efficient interfaces using a constant underlying tutoring system. We thus believe that we are uniquely positioned to contribute to the understanding of this inherent trade-off.

To explore this issue, we have created two different style interfaces for an ELE focused on inquiry learning in the medical field. We present the trade-offs we recognize between immersive and efficient user interfaces, and our plan for experimentation to investigate this phenomenon. With this work, we plan to bring attention to a serious design consideration that may deserve more focus than it is currently given.
2 Background and Related Work

While the research community has recently shown much interest in developing serious games, most games either contain only an immersion-focused interface, or an efficiency focused one (though these specific terms are rarely used). For example, there has been a great deal of research investigating how immersive 3D environments might be useful for educational systems [3, 4, 5]. Many of these projects report various benefits, but do not report a direct comparison with a less immersive and perhaps more efficient interface. Other projects focus on maintaining an efficient interface while merely adding game mechanics or specific game-like features on top of the system [6, 7]. These efforts are known in some fields as exogenous games [1][8]. Finally, some past projects strike some balance between efficiency and immersion [9, 10] by providing essential tools with trace amounts of interesting visuals, subtle animations, etc.

Our investigation into the immersion/efficiency tradeoff came as the result of parallel efforts in redesigning the user interface of the <anon> system, an inquiry learning system where students take on the role of a doctor and learn about biology through medical diagnosis [<anon>]. The prior interface was developed over ten years ago, and involved an antiquated “windowing” system wherein each tool appears in a separate window (Fig. 1). This system placed a burden on students to organize their workspace, which upon analysis supported neither efficiency nor immersion well.

![Fig. 1. The “classic” <anon> interface. Individual tools open in new windows, which can become unwieldy. While the system was used successfully for many years, this presents a clear avenue for improvement.](image)

When re-designing this user interface, we sought to create an environment to immerse students, allow them to work efficiently, allow for configuration, and offer effective coaching. We considered the interfaces of other ELEs, including those that are more focused on efficiency and general use [12, 13], and those that focused more
on immersive, game-like interfaces [3, 4, 5]. Through observation and design work, we concluded that no given interface can contain all the benefits of efficiency and immersion, and therefore we created two different interfaces, providing the opportunity to investigate their benefits and detriments.

3 Focusing on Efficiency

The first interface we present is one focused on efficiency (Fig. 2). Here we can see the tools are organized in split panes and tabs, with two distinct workspaces. This allows a user to easily navigate the different tools and consider multiple tools at once without the obvious pitfalls of the original windowed design.

![Fig. 2. The efficiency-focused interface. On the left is the home screens that appear when first loading, the right displays the interface when a user has chosen to use both the Lab tool and the Notebook.](image)

This efficiency-focused interface offers several advantages. The layout is simplistic, conforms to convention, offers quick access, and offers many tools that do not overlap or interfere with each other. This interface allows for coaching in-situ. Specific feedback and advice can be given within the tools, or an always-present panel can be displayed below the tools. In this way, coaching can be both present and non-intrusive. Finally, this type of interface is easily customized and configured. The placement of tools can be altered easily and tools can be added or removed. With such configuration, this general interface can present students with multiple varied scenarios.

However, this interface has drawbacks as well. The large number of tools and options can create a dense interface with a steep learning curve. Even after tools become familiar, students might find the experience dry and unengaging due to the lack of visuals that would help the user take on the role he or she is asked to play. Finally, the ever-present nature of coaching in this type of interface might serve to highlight the situations where the coach is unhelpful or incorrect in support, which is possible in ELEs where the system needs to interpret open-ended input from users [11]. Each of these factors could contribute to students’ boredom and frustration.
3 Focusing on Immersion

The second interface we present is a 2D game-like interface to encourage a deeper investment in the experience, at the clear expense of efficiency. The primary mechanical difference is the user’s need to manually navigate a hospital to find various tools (Fig. 3, left). The emergent dynamics and aesthetics of this experience may reveal certain benefits. Wandering around the hospital, checking various patient rooms, and exploring the labs and offices provides students an affordance for engaging in the activity the way a professional doctor might.

![Fig. 3. A prototype of the immersion-focused environment. Users can navigate the hospital to access different tools (left). For example, if the patient wants to order lab tests, they must move to the lab room in order to speak with the technician (right).](image)

The virtual world may feel more alive and natural than the previous’s menu system, and students may have an easier time imagining their patient in this world. Thus, they might be more prone to sympathize with the patient, and their actions could feel more meaningful. This interface can also potentially limit the learning curve by giving the navigation between tools a more natural metaphor, thereby creating a more intuitive experience.

Finally, automated coaching could have several advantages in this interface. The coach would appear as an embodied agent (a colleague or mentor). This again can promote immersiveness, but also accounts for the potential fallibility of an automated coach. Humans make mistakes and have gaps in their knowledge, and so the user could be more understanding if a coach provides inaccurate or insufficient information.

This interface has detriments as well. The metaphor of physical navigation slows down the process of student work, and inherently disallows working with certain tools simultaneously. Coaching is not easily offered in situ, as you will need to visit your “colleague” for advice. Finally, the design and artwork involved in making a high-quality interface in this style limits the ability to customize and configure the types of tools and scenarios available. In the given interface, all cases will need to be located in the same hospital, with the same lab technician, etc. A more generic interface allows for a greater range of scenarios.
4 Future Work and Expected Outcomes

While there are ways to mitigate the problems and highlight the advantages of either of these interfaces, they serve to highlight the hypothesized tradeoffs between efficiency and immersion in ELEs. We present above the theories about advantages and disadvantages of each type of interface. Having a constant underlying system (<anon>) with varying interfaces allows for potentially powerful experimentation, where the interface can be the true independent variable. We will use surveys and other metrics to measure user engagement and efficiency, with particular attention to the coaching interaction.

Having multiple interfaces also allows us to offer students agency over the selection of their interface. This allows observation of user preferences over time while students are learning, mastering, and finalizing their work within the system. It might be the case that students prefer different interfaces at different times during the learning process (e.g., students might prefer immersion at first as they learn the system and explore its features, but then opt for efficiency once they understand). Monitoring their choices could inform us as to their preferences towards one or the other, or potentially demonstrate that having multiple interfaces is actually beneficial.

References

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