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Usable Virtualization of Guided Inquiry*

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Abstract. Improvements in immersive interactive technologies have made the creation of effective educational software running in a (three dimensional) Virtual Learning Space (VLS) feasible. Applications built for these environments may leverage the inherently visual and dynamic interactivity of the technology to accelerate learning outcomes; however, a set of design principles for effective VLS application development is needed to do this optimally. One of the most important design principles is assessment followed by "Immediate Feedback" with targeted instruction–a principle which is central to many instructional design approaches, such as Inquiry-based learning, and for which an adaptive control style implementation shows promise. In this study, a guideline for effective implementation of evidence based principles of learning and memory within VLS environments, using intelligent tutoring system (ITS), is developed using the ProMethEUs methodology for domain heuristic generation.

1 Introduction

Immersive environments coupled with intelligent content delivery–commonly referred to as Intelligent Tutoring Systems (ITS)–together make for an emerging and yet to be explored area of learning design.

The practical aspects of how learning activities could best be designed within this domain, remains unanswered. A set of design heuristics is presented here to meet this need. They are the result of combining existing usability heuristics for general software design, for educational software design, and for software designed for virtual spaces. These, along with evidence based principles of human learning and memory, taken from current cognitive science literature, have been transmuted into a comprehensive guideline for VLS application development. In particular, VLS coupled with strong emphasis on feedback–as a form of guided instruction with facilitation. In future work, the current artifact will be validated and refined according to the same methodology used to generate it: ProMethEUs[2].

Problem Statement

The confluence of existing environments constitute a domain, and each new domain has its own properties which require something beyond what general or preexisting usability principles can readily manage.

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The design of content that can accelerate learning, set within the VLS environment and augmented by ITS, is an emerging domain which stands in need of a framework for guiding designers and content domain experts–regardless of their backgrounds in the learning sciences. This study seeks to meet that need.

2 Literature Review

The methodology chosen for generating the domain heuristic starts with the collection phase [2], in which existing assets (i.e., heuristics or software applications for the given domain or sub domains) are cataloged, ranked, and described.

Domain Heuristics

The term *domain heuristic* describes a set of design and evaluation rules for an application domain. Often such domains are easily described by combinations of other sub domains having preexisting design heuristics. A valid approach their construction should be identified, however.

ProMethEUs [2] is a procedural methodology for evaluation of usability heuristics that is an extension of a methodology proposed within an earlier study [3]. Both take into account all requisite steps identified in [1]: collection, transformation, validation, and effectiveness. ProMethEUs more thoroughly articulates the steps to follow, the artifacts to be constructed, and the metrics needed to generate a valid artifact.

3 Method

Design and Validation Approaches

The ProMethEUs methodology is the more robust of the two identified above, while not requiring significant additional burden of process. It is selected as the methodology of choice for this study. Currently in the explanatory stage of the methodology, the results reported here are the first iteration of the domain heuristic–after the normalization and prioritization, but prior to the validation and refinement phases.

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