Investigating User Requirements: Design of Computer-based Anatomy Learning Modules for Multiple User Groups

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Introduction

A key objective of the Visible Human Project at the University of Michigan is to facilitate the use of medical images from the Visible Human (VH) Dataset in anatomy learning. It is our observation that anatomy teaching differs from one group to another in heath sciences due to their unique requirements in the class and professional goals in the field. We are interested in how appropriate and useful content can be provided in the specific context where anatomy is learned. The intent is to use user data of contextual information about anatomy education to improve iterative design (Boyle, 1997), and thus create a learning environment that is efficient and effective.

However, no efficient methods of transforming user requirements to concrete designs have been suggested in previous research. Hence, this study attempts to begin to fill an important void by describing how user requirements, associated with users' learning experiences, were systematically collected and analyzed and then transformed into guidelines informing the iterative design.

Methods

One or multiple focus group (Morgan, 1997) sessions were conducted with each group of target users: students and faculty in professional schools of nursing, medicine, dentistry, kinesiology and surgery. All eleven researchers then met as a group to share and discuss information gathered in the different focus group sessions. One team member created a matrix for pooling user requirements from all focus groups. After each researcher rated the matrix independently, a summary containing the mean rating from all evaluators for each cell was generated. Examination of these rating data using cluster analysis and multidimensional scaling (MDS) (SYSTAT, 1989) was performed to find target groups who received similar scores in all requirements. Two kinds of hierarchical algorithms, the Complete Linkage and Ward's Method, were used to compare the similarity of all requirements across different users and further group comparable requirements into clusters.

Results

The results from the MDS (see Fig. 1) show that different user groups are distributed into the four quadrants based on their requirements. We observed that users who share similar experience and training objectives in their health care education became a natural group. The two optimized dimensions were interpreted by comparing the attributes of the groups on the opposite ends along each dimension. Thus, the vertical dimension was conceptualized as anatomical scope or breadth of focus; the horizontal dimension was interpreted as level of professional development, novice versus expert (right versus left). These results indicate at least four clusters of users that the design should accommodate.

Results from the hierarchical algorithm show clusters of similar requirements. Each cluster of requirements was composed of numerous related functions and features that should be integrated simultaneously into the learning environment. To make the results in the summary matrix more informative to the interface design, clusters were categorized by level of demand and correlated with characteristics of the users who requested them (see Table 1).

Conclusions

In interpreting the requirement clusters and user clusters resulted from the analysis, we suggested at least two sets of functions and features should be used in the anatomical learning modules. One set of core components used as the base design and framework would be common across groups. Their content was identified in the focus groups as important requirements for learning anatomy by faculty and students across the different disciplines. The second set of functions and features would not be universal across all groups but would fulfill the needs of self-selected users groups that parallel their specialties. To design learning modules with both unified core components and user-specific applications, the program should be flexible, allowing for dynamic insertion of different learning tools for different users. One possible way to achieve this goal is to provide an interface that users can employ to select and enable suitable learning materials.

Interpretations of ideas and feedback from users are powerful in designing and polishing the VH user interface system. In this study, the research design combines both quantitative and qualitative research methods and does not rely solely on one or the other. Through these methods, we were able to (1) identify the group of users who share similar content, (2) suggest the general design framework and special components suitable for specific users, and (3) discern the priority of implementing each requirement. The design described in this paper will continue to evolve throughout the software development process, enabling the research team to link users' needs with the ability to construct an appropriate and customized instructional design.

Figure 1. Multiple dimensional scaling: natural groups of target users with like requirements. The vertical dimension was conceptualized as anatomical scope or breadth of focus; the horizontal dimension was interpreted as level of professional development, novice versus expert (right versus left).

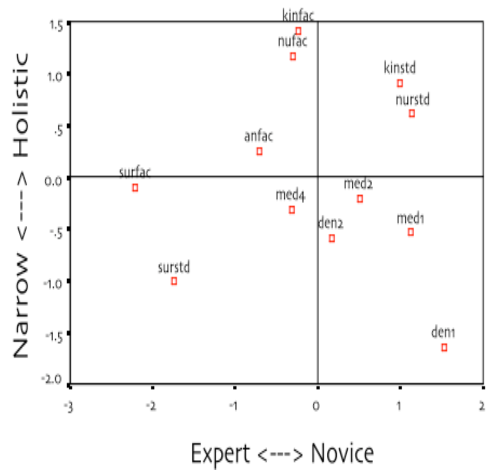

Table 1. Clusters of user requirements sorted by level of demands, design categories and theme of clusters.

Requirement Clusters	*Degree of Request*	*Design Guidelines*
• 2D – 3D Mapping • 3D Visualization • Whole-Part Integration by Location • Relationship among Parts	Strongly Required	*General features and functions* *Theme:3d visualization /relationship reconstruction*
• Knowledge Integration • Problem Based Learning • Structure- Function	Required	*General features and functions* *Theme: Knowledge inquiry*
• Navigation Map • Concept Map • Connection to other Coursework • Multilevel of Support • Macro-Micro	Required	*General features and functions* *Theme: Information navigation*
• Innervation • Follow Structure • Blood Supply • Dynamic Visualization	Degree of request diverse among users	*Domain specific applications* *Theme: Visualization and simulation*
• Simulate Surgical Procedure • Haptic Interaction • Tactile Feedback • Dissection Process • Dissection Skills	Degree of request diverse among users	*Domain specific applications* *Theme: Professional skills*
• Learning to learn • Pronunciation • Mnemonic Devices • Support for team interaction	Degree of request diverse among users	*Users' Tool* *Theme: Learning aids*
• Instructor selectable modules and features	Degree of request diverse among users	*Users' Tool* *Theme: Instructor's Tools*

References

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