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## ***Visual Interface Design Tool for Educational Courseware \****

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# VISUAL INTERFACE DESIGN TOOL FOR EDUCATIONAL COURSEWARE

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## ABSTRACT

This paper describes a research study that focuses on analysis of different approaches used in the development of educational multimedia products. Within the study, the inherent need for the “client-centered” design approach, in the development of educational software, was noted. A new approach to user interface development, that utilizes a visual interface design tool, is discussed. The tool is used to help development teams quickly produce the first draft of the “look and feel” user interface design and discuss it with the client. This tool could potentially save time and money, which is currently being spent by educational courseware development companies on the preliminary interface design.

## KEY WORDS

Visual user interface design, educational courseware, multimedia, rapid prototyping tools.

## 1. Introduction

With the recent widespread acceptance of computer-based training and e-learning, and the development of broadband network services that allow for transmission of multimedia-rich materials over the Internet, it is now the right time to revisit the importance of multimedia, particularly visual media, in the overall success of educational multimedia products.

Educational researchers debated the efficiency of using multimedia in education for a long time. One approach to the issue is that “...simply adding multimedia elements to a bad learning program won’t improve it” [1]. Some state that: “Existing instructional authoring tools tend to emphasize delivery, games, flashy graphics, and animation rather than instruction or learning” [2]. The advocates of this view are stressing the paramount importance of instructional design in the educational products and emphasize that multimedia could potentially make the bad learning design worse [1]. They state that, in developing educational multimedia materials, the most

attention should be paid to the learning design, and not to how the product looks, is it boring, etc. The problem with this view is that when the multimedia product is developed using this approach, there is not a single person on the team that looks at the final product as a personal multimedia creation. As a result, the visual quality, and the “look and feel” of the final educational multimedia courseware suffer.

This paper discusses results of a research study focused on the description and analysis of different approaches in development of educational multimedia courseware, and their impact on the overall quality of the final product. In particular, this research study investigated what could be done to improve the overall visual quality of educational multimedia products.

One of the study’s recommendations was to utilize the “look and feel” advisor tool that can help development teams to quickly produce the first draft of the “look and feel” design. During the meeting with a client, this rapid prototyping tool could be used to effectively identify the client’s preferences for the product’s “look and feel” design. This could lead to savings in time and money. The “look and feel” advisor tool could also help to improve communication not only with the client, but also between the team members, leading to improved satisfaction with the development team environment.

## 2. Educational Multimedia Development Study

There are numerous educational multimedia products that are used in educational institutions today. Sometimes they are developed by “Lone Rangers” – educators that are experts on the subject, with the combined skills of computer programming, and graphic and computer interface design. However, most often a multimedia development team for educational materials consists of a project manager, subject matter expert, instructional designer, programmer and a graphic artist.

## 2.1 Contrasting the Instructional and Creative Approaches

These days the customary approach to the development of a multimedia product places the instructional designer as the major lead in the overall “look and feel” of the final product and gives them the last word on what material goes into the final product. This approach could be named “Instructional”.

The foreseen problem with the “Instructional” approach is that the instructional designers are, in general, not well prepared for the multimedia design and decision making task, because typically they are insufficiently trained in the art of multimedia, and, especially, in the art of visual presentation. To give some examples: in the program curriculum for Graduate Studies in Instructional Design, Development & Evaluation at the Syracuse University’s School of Education [3] there is only one course, out of more than thirty, that teaches students some basic literacy in visual communications, and this course is not a required course, but elective! The same applies to the curricula of several other university programs in Instructional Design [4, 5], where visual and media literacy are at the bottom of the course list or not taught at all.

It is interesting to note that the International Board of Standards for Training, Performance and Instruction (IBSTPI), in the Instructional Design Competencies document [6], states that the ability to effectively communicate in visual form is an essential professional foundation competency for Instructional Designers. However, after reviewing several books that are considered to be fundamental for instructional designers, the authors did not find any mention about the importance of visual communications skills [7, 8]. In addition, the authors reviewed several respectable scholarly journals such as Educational Technology Research and Development and Educational Technology, for the past three years, and found only one article remotely related to visual communication in instructional design [9]. Only recently the authors discovered a newly published book, by Lohr [8], that teaches visual literacy for educators. Lohr admits that her book is a response to the growing need for visual literacy for Instructional Designers: “...most people receive years of training in verbal communication but receive almost no assistance in the art and science of communicating visually” [10].

Let’s take a look at another, more successful, example of a multimedia development industry – the gaming industry that drives digital entertainment. Contrary to the “Instructional” development process used in educational multimedia, the gaming industry is using a “Creative” approach to develop computer games. Within the game development team, typically there is one person – a creative director, a game designer, an animator or a

graphic artist that has the overall responsibility for the “look and feel” of the final multimedia product. The creative director establishes the style guide for the entire project and facilitates the creativity of other members of the team, including graphic designers, instructional designers, animators, and programmers. Creative directors, typically, have a formal education in design or visual art and have a command of all media forms and their uses in multimedia applications [11].

## 2.2. “The Art of Multimedia in Education”

One of the authors of this paper recently conducted a research study that focuses on the description and analysis of different approaches in development of educational multimedia courseware, and their impact on the overall quality of the final product. In particular, this research study investigated what could be done to improve the overall visual quality and learning impact of educational multimedia courseware [12].

The research study was carried out as case studies involving several multimedia development projects, e-learning and multimedia companies and a University. Data collected include interview forms, observations and visual artifacts. The study included projects that involved the development of several different multimedia presentation formats, thus giving the researcher the opportunity to study the use of multimedia for different types of learning, such as online or offline (CD-ROM).

Research data collected show that the “Instructional” design approach is widespread in educational multimedia development. Instructional designers are leading multimedia development teams and are the ones responsible for internal decisions on the overall “look and feel” of the final educational product. Research also confirms that Instructional designers, in general, are not well prepared for this task.

### 2.2.1 *Who has the most impact on the final “look and feel”?*

One of the most interesting research findings of this study was that the final “look and feel” decisions for the educational courseware are, to the greatest extent, influenced not by the team’s instructional designers or graphic designers, but by the client’s preferences. Within the educational multimedia development companies, most of the time, the client makes the final decision on the “look and feel”. This pattern strongly emerged from the responses provided by employees of educational multimedia development companies, despite the original researcher’s assumption.

All the participants from the educational multimedia teams, in their statements one way or another, confirmed this pattern: “The final decision on the ‘look and feel’ of the multimedia product lies with the client. The

development team usually shares their ideas to make for the best ‘look and feel’ possible...” [12]. Several study participants expressed a great deal of frustration with the amount of time and money wasted by educational courseware development companies on preliminary interface design that is often rejected by the client during the first meeting [12].

### 2.2.2 Study recommendations

Among the possible solutions for improving the visual quality of the educational multimedia products, the first recommendation of the study was to make certain training requirements for positions that involve final decision-making. For example, visual art training should become a requirement for people who are involved in the final decision-making on the “look and feel” of the product. Instructional designers constitute a large proportion of decision-makers in this area, thus supplementing the Instructional Design Curriculum with the required visual art and multimedia content development courses could have a significant positive impact on the industry.

The research study showed that within educational multimedia development only careful consideration of client’s needs would achieve long lasting success and client satisfaction with the “look and feel” of the final product. In view of this, the client-centered approach would be the most suitable for designing visual user interfaces (UIs) for educational multimedia products.

## 3. Client-Centered UI Design

The Human-Computer Interaction (HCI) community, in order to develop UIs for software products, frequently uses several common design approaches. Palanque and Bastide [13] describe five of these approaches: “abstraction first: architectures at the forefront”; “semantic first: metaphors at the forefront”; “implementation first: toolkits at the forefront”; “process first: user centered design”, and model first: model-based approaches.

### 3.1 Common UI Design Approaches

The “abstraction first” approach is based on the description of a typical structure of an interactive system in terms of abstract functionalities to be covered. This approach is based on the Seeheim and Arch design models [14]. The “semantic first, metaphors at the forefront” approach usually involves the use of metaphors to provide the unifying view of software elements. Toolkits are used to make the life of the software designers easier; however, most of the UI toolkits are hard to master and are usually poorly documented. UI design based on the “process first” approach is an iterative, incremental, user-centered design process. Initially it involves low fidelity software prototypes, and

then moves towards high fidelity prototypes influenced by the user feedback. The last UI design approach is model-based. It supports many models, such as the domain model; task model and scenarios; the user model, the platform model that links to the toolkits and to the environment; and the presentation model that is based on the appearance of the application, etc. [13].

Model-based UI design is reviewed and thoroughly described by Szekely [15]. He describes a generic model-based interface development architecture consisting of four main components: modeling tools, a model, and automated design and implementation tools. Modeling tools may include a “design critics and advisors” component. This component provides a set of tools to evaluate UI design. Design advisors frequently use a knowledge base of design knowledge, typically represented as rules, where the condition part of the rule presents a design element and the action part presents a way of refining the matched design element.

There are some well-known difficulties with the automated UI design approach. The main concern is the quality of the interface produced using automated tools. In addition, it is frequently not feasible to produce high quality interfaces from just data and task models [16, 17]. Consequently, some of the model-based interface design environments (MB-IDEs) are moving away from automation and towards the use of computerized advisors.

### 3.2 Client-Centered UI Design Approach

In this paper, the authors focus on the client-centered UI design approach, as an application of the user-centered design to educational courseware development. User-centered design is defined in the ISO 13407 standard. It typically “entails involving users in the design and evaluation of the system so that feedback can be obtained” [18].

It is widely recognized in the HCI community, that in the case of educational courseware development the learner is the actual user of the software, and the tendency is towards the “learner centered design” approach [19]. However, based on the results of the previously mentioned study, we believe that in educational courseware development the appropriate term should be “client-centered” UI design, as the client normally has a significant impact on the UI design and, especially, on “look and feel” issues.

User-centered design, or rather customer-centered design approach, for Web applications, is described in detail by Van Duyne et al. [20]. In their book they use the term “customer-centered” design rather than “user-centered” design and argue that the term customer “evokes the fact that successful Web sites account for issues that go beyond ease of use and satisfaction...”[20].

In educational courseware development, as we mentioned previously, the “client-centered” design approach should be considered instead. This design approach is very close to the “customer-centered” design approach that is proposed for Web site design [20]. There are some obvious differences between Web site design and educational courseware design, but, considering that many courseware products are designed for the Web, and also accounting for some striking similarities with issues related to “technology-centered” design and “designer-centered” design approaches for both domains, it would be useful to discuss the arguments of the “customer-centered” design proponents. We need to look at the value of their approach by comparing it to other design styles.

First of all, customer-centered design builds on user-centered design by fusing marketing issues with usability issues. Marketing issues, indeed, are quite important in the e-learning industry, where the client is usually not buying “shrink-wrapped” software, and, from the beginning, actively participating in the courseware development process. Utilizing the customer-centered design approach should help to escape the pitfalls of the company-centered design process, where the needs and interests of the company dominate the structure and the content of the final software product. The fatal flaw in this is that what the company thinks should be in the product is not necessarily what customers, or, in case of courseware development, clients, need or want.

Products developed using the technology-centered design approach are often built with little upfront research about customer needs and business needs, resulting in products overloaded with animations, audio and graphics and often looking amateurish. This, unfortunately, is often the case with educational multimedia products where, sometimes, flashy graphics and animations substitute for educational values.

The designer-centered design approach is the one that is the most difficult to escape. Often the thinking is: “What the client sometimes doesn’t understand is the less they talk to us, the better it is. We know what’s best” [20]. In the designer-centered approach the needs of clients are placed beneath the creative and expressive needs of the designer. This approach normally will not work well in the courseware development environment, where, as mentioned before, client’s preferences have the most impact on the design outcomes.

As follows from the previously mentioned study on different approaches in developing educational multimedia [12], in educational courseware development only careful consideration of the client needs will help to achieve long lasting success. Considering the nature of the educational courseware development, it is highly appropriate for instructional designers to lead courseware

development teams. However, knowing the instructional designers’ lack of training in the art of visual presentation, it is proposed that the development team leaders be aided by with the stand-alone “look and feel” software advisor tools.

These tools will help in creating presentation models that could be used for initial meetings with clients. During the meeting, the clients would be presented with a range of professionally designed courseware interfaces that they can give feedback on and clearly express their preferences. By properly recoding the clients’ preferences and reaction to the proposed interfaces, the discussions during the meeting could be quickly translated into the successful and client-centered “look and feel” UI design.

## **4. Visual UI Design Tool**

The proposed “look and feel” advisor tool will help designers generate ideas and share them with the development team members, get feedback from the clients, and choose the best design from several design alternatives. This tool belongs to the category of online rapid prototyping tools that are used at the early stage of the design process.

### **4.1 Rapid Prototype Design Tools**

A prototype can be defined as “a concrete representation of part or all of an interactive system” [21]. Designers in creative fields, such as typography or graphic design, frequently create offline (paper-based) prototypes to express ideas and reflect on them. The advantage of offline prototypes is that a wide range of people, not just programmers, can create them quickly and inexpensively at the early stage of design. However, in the case when rapid feedback from the user is required on the interface design, online (software-based) prototypes are much more useful. In the user-centered design process, prototyping supports user involvement by allowing users to see and experience the final system before it is built.

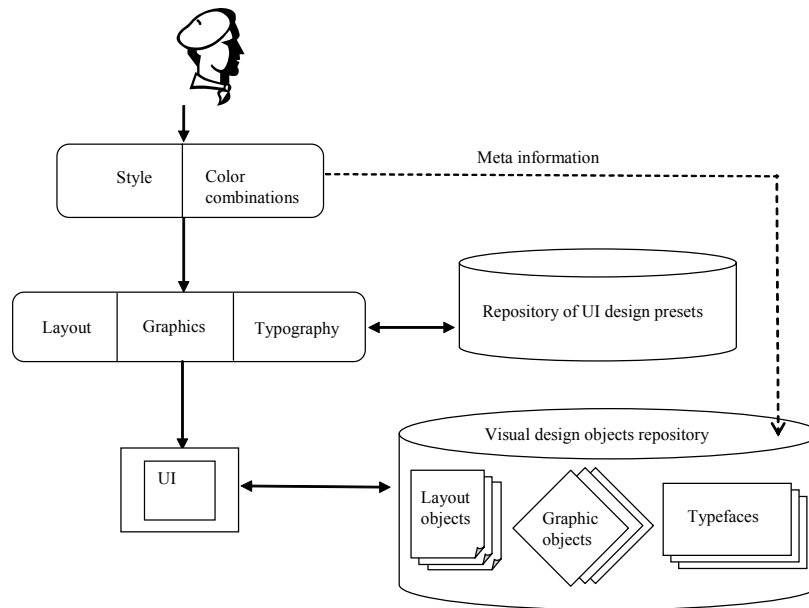
Within educational software development, a demonstration of UI design prototypes should make it easier for the clients to evaluate design ideas. Prototypes can provide concrete representations of the “look and feel” of the final product and allow the accurate capture of the client’s feedback and preferences. At the early stages of educational courseware design, a proposed rapid prototyping tool that allows to quickly creating a first draft of the visual UI design could serve as a valuable asset in the development process.

### **4.2 “Look and Feel” Interface Design Tool**

The proposed advisor tool leads the developer through a set of steps in defining the “look and feel” of the courseware interface. The steps in this process are the general design steps, starting with choosing the style, and

then selecting colors, choosing the layout and graphics, typography, etc. For example, a designer would begin by choosing from a selection of styles like Art Deco, Graffiti, Modernism, Neoclassic, Renaissance, Rave

Color, etc. (Figure 1). The advisor will then offer a choice of color combinations compatible with the style chosen, giving the designer the opportunity to select one color combination.



**Figure 1. “Look and feel” advisor tool architecture**

The choices of color combinations could be based on the existing color combination Image Scales similar to the one developed by Kobayashi Ltd. in Japan [22]. In the Image Scale developed by Kobayashi, the color combinations have some particular key words assigned to them with a defined feeling attached to a key word, for example a “cheerful” or a “fresh” feeling. Key words that convey similar feelings are grouped into broader categories and the names of these categories are taken from terms used in fashion, such as “elegant” or “romantic”.

As the next step, the designer will choose the layout, graphics and typography. The advisor tool offers a choice of layout designs based on the style chosen. Graphics choices are based on the style and the color combinations selected before, and the choice of typography is based on the style, color and graphics chosen. The typography choice, in particular, could be based on typestyles classifications, similar to the one developed by Will-Harris [23]. In his classification all typefaces are divided into two large groups, Formal Typefaces and Casual Typefaces. Each of these groups is further divided into body and display type groups and these groups, in turn, are further divided into six subgroups expressing different feelings such as “friendly”, “serious”, “cool”, “warm”, etc. The “look and feel” advisor should be designed to work with the visual design objects repository that contains graphic objects, layout objects and typefaces. The purpose of this repository is to provide extra choices and support for the design team in

refining the UI design after or during the meeting with the client. Objects in the visual design object repository shall contain “meta” information that reflects style and appropriate color combination. This will help in customizing the “look and feel” of the user interface according to client’s preferences. This approach also helps in escaping the pitfalls of the fully automated UI design that is shown to be undesired in the following context: the computer might not be as creative as a good UI designer, or there may be some problem in the design that is out of the scope of the automatic code generator [24].

## 5. Conclusions

Research shows, that in educational courseware development, only careful consideration of client needs will help to achieve long lasting success and client satisfaction with the “look and feel” of the final product. In view of this, the authors believe that the client-centered, model-based, design approach will be the most suitable in designing user interfaces for educational courseware products.

We propose a new approach to GUI development utilizing the “look and feel” advisor as a tool that helps courseware development teams to quickly produce the first draft of the “look and feel” GUI design and, during the meeting with a client, effectively identify the client’s preferences for the product interface design. This will

lead to savings in time and money, currently spent by educational courseware development companies on preliminary interface design that is often rejected by the client during the first meeting.

## References:

- [1] M. Rosenberg, *E-learning. Strategies for delivering knowledge in the Digital Age* (New York: McGraw-Hill, 2001).
- [2] D. Merrill, Effective Use of Instructional Technology Requires Educational Reform. *Educational Technology*, July-August 2002, 13-16.
- [3] University of Syracuse, School of Education, 2003, <http://soeweb.syr.edu/idde/instrucdesign.html>
- [4] University of South Alabama, College of Education, Instructional Technology Program, 2003, <http://www.southalabama.edu/coe/bset/idd/>
- [5] University of Memphis, Instructional Technology Program, 2003, [http://www.people.memphis.edu/~coe\\_icl/idt/](http://www.people.memphis.edu/~coe_icl/idt/)
- [6] ibstpi standards., The Instructional Design Competencies, 2003, <http://www.ibstpi.org>
- [7] W. Dick, L. Carey & J.O. Carey, *The systematic design of instruction, 5th ed.* (New York: Longman Publishing Co., 2001).
- [8] A.J. Romiszowski, *Designing instructional systems*, (New York: Kogan Page, 1981).
- [9] L.L. Lohr, Three principles of perception for instructional interface design, *Educational Technology*, January-February 2000, 45-52.
- [10] L.L. Lohr, *Creating graphics for learning and performance: Lessons in visual literacy* (Upper Saddle River, New Jersey: Merrill Prentice Hall, 2003).
- [11] M. Welsh, *Orchestrating Multimedia*, (Concord, Canada: Irwing Publishing, 1998).
- [12] I. Goldfarb, *The Art of Multimedia in Education*, Graduate studies thesis, Faculty of Education, University of New Brunswick, Fredericton, New Brunswick, Canada, 2004.
- [13] P. Palanque and R. Bastide, UML for Interactive Systems: What Is Missing, *Proc. of the IFIP INTERACT Workshop: Closing the Gap: Software Engineering and Human-Computer Interaction*, 2003, <http://www.se-hci.org/bridging/interact/>
- [14] L. Bass, R. Faneuf, R. Little, N. Mayer, B. Pellegrino, S. Reed, R. Seacord, S. Sheppard, and M. R. Szczur, A Metamodel for the Runtime Architecture of an Interactive System, *ACM SIGCHI Bulletin*, 24 (1), 1992, 32-37.
- [15] P. Szekely, Retrospective and Challenges for Model-Based Interface Development. *Proc. of the CADUI'96: Second International Workshop on Computer-Aided Design of User Interfaces*, Namur, Belgium, June 1996.
- [16] M. Harning, An Approach to Structured Display Design - Coping with Complexity. In: Vanderdonckt J. (ed.): *Proc. of CADUI'96*. (Namur: Presses Universitaires de Namur, 1996, 121-138).
- [17] S. Wilson & P. Johnson, Bridging the Generation Gap: From Work Tasks to User Interface Designs. In: Vanderdonckt J. (ed.): *Proc. of CADUI'96*. (Namur: Presses Universitaires de Namur, 1996, 77-94).
- [18] N.J. Nunes, What Drives Software Development: Issues Integrating Software Engineering and Human-Computer Interaction, *Proc. of the IFIP INTERACT Workshop: Closing the Gap: Software Engineering and Human-Computer Interaction*, 2003, <http://www.se-hci.org/bridging/interact/>
- [19] E. Soloway, M. Guzdial & K.H. Hay, Learner-centered design: The challenge for HCI in the 21<sup>st</sup> century. *Interactions*, 1(2), 1994, 36-48.
- [20] D. K. van Duijn, J.A. Landay & J.I. Hong, *The Design of Sites: Patterns, Principles, and Processes for Crafting a Customer-Centered Web Experience* (Addison-Wesley Pub Co; 1st edition, 2002).
- [21] M. Beaudouin-Lafon & W. MacKay, Prototyping tools and techniques, in *The Human-Computer Interaction Book* (London: Lawrence Erlbaum Associates, Publishers, 2003, 1006-1031).
- [22] S. Kobayashi, *Color Image Scale* (Kodansha International, 1991).
- [23] D. Will-Harris, *TypeStyle: How to Choose and Use Type on a Personal Computer* (Berkeley: Peachpit Press, Inc., 1990)
- [24] J. Belenguer, J. Parra, I. Torres & P. Molina, HCI Designers and Engineers: Is it Possible to Work Together? *Proc. of the IFIP INTERACT Workshop: Closing the Gap: Software Engineering and Human-Computer Interaction*, 2003, <http://www.se-hci.org/bridging/interact/index.htm>