

## **Popup Workshop: Computationally Enhanced Paper Engineering for Children**

- 1. Introduction
    - 1.1. Motivating Problem
      - Pop-ups are:*
      - Something that are a part of children's culture, but are not usually made by children.*
      - A dynamic and surprising art form with both 2d and 3d components.*
      - Usually incorporated into books, with all that implies: literacy, storytelling, etc.*
      - Perhaps a computer-aided design system can help children over the first hard parts of learning to make pop-ups.*
    - 1.1.1. Computational Enhancement of Crafts
    - 1.1.2. Paper Engineering for Children
  - 1.2. Research Question
    - The research question is:*
    - Can a computer-aided design system be created that will enable children to design and make pop-ups and that will support the craft of pop-up making-its skills, knowledge and appreciation?*
  - 1.3. Approach
    - Describe the method: create the program and test with young users. Overview the system and user testing here.*
  - 1.4. Reader's Guide and Road Map
    - Outline the form of the thesis: from craft learning to the specific domain of pop-ups, then to the system, and what the user testing tells us about how the children use the system.*
- 2. Crafts, Children and Computing
  - Here I'm trying to ground my problem and approach in other work, look at crafts in general in order to approach the particular craft of pop-up making in chapter 2, and to define what it is I'm looking for in my user testing.*
  - 2.1. What is Craft?
    - Define craft. I develop the definition:*
    - 2.1.1. The Relationship Between Craft and Industry
      - Difference is hand control. We want to enhance crafts, not make them into industry.*
    - 2.1.2. The Relationship Between Craft and Art
      - Demonstrate that craft and art are in large part the same. The differentiation is often cultural and societal and shifts constantly. Will use the term craft in this work.*
  - 2.2. The Value of Craft
    - Value both as adult activity and for children in education. Particularly use references which show the value that teachers place on craft and what they feel children get out of it.*
  - 2.3. Learning and Practicing a Craft
    - Here I'll break the learning of a craft down into 3 separate parts which will be further talked about in chapter 3 for pop-up making in particular. These will also be used to examine the user tests. Use examples from craftspeople for this. I call them competencies, and use them to build a framework of craft learning.*
    - 2.3.1. Knowledge
      - Knowledge includes such things as vocabulary, and what is possible and not possible given the craft form.*
    - 2.3.2. Skill
      - Any craft has requisite skills--tool use, materials, design and planning*
    - 2.3.3. Appreciation
      - Appreciation is the understanding and enjoyment of the craft results. You don't have to do the activity to appreciate the results--but it helps. You do have to understand the craft to appreciate.*
  - 2.4. Adding the Computing Dimension
    - What is added and removed by adding computing to learning a craft? (Particularly in design and planning stages.) What are potential problems and benefits. Situate in past work.*
    - 2.4.1. Computer Enhancement of Craft Knowledge
      - Ways in which computer enhancement can help or hurt in gaining craft knowledge*
    - 2.4.2. Computer Enhancement of Craft Skill
      - Ways in which computer enhancement can help or hurt in gaining craft skills*
    - 2.4.3. Computer Enhancement of Craft Appreciation
      - Ways in which computer enhancement can help or hurt in gaining craft appreciation*
  - 2.5. Summary

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### ● 3. The Craft of Pop-ups

*This chapter discusses pop-ups as a craft--the history of the domain, and the value of doing pop-ups, particularly in children's education. Popups are also examined in light of the framework developed in Chapter 2*

#### ● 3.1. Brief History of Moveable Books

*Outline the history of all moveable books, and define pop-ups as a subset.*

- 3.1.1. The First Mechanisms (pre-1700): Wheels and Flaps
- 3.1.2. The First Movable Books for Children (1700-1820): Harliquinades and Toilet Books
- 3.1.3. Early 3-dimensional Effects (1820-1850): Slots, Panoramas, and Peep-shows
- 3.1.4. The Golden Age of Movable Books (1850-1914): Tabs, Scenes, and Transformations
- 3.1.5. True Pop-ups Emerge (1914-1979)
- 3.1.6. The Modern Pop-up Book (1979-present)

#### ● 3.2. Pop-up Making as a Representative Craft

*Talk about my previous discussion of skills, knowledge, and appreciation in regard to pop-ups. What makes pop-ups worth studying as a representative craft? What are the particular knowledge, skills and appreciation in terms of pop-ups and children?*

- 3.2.1. The Pop-up Maker's Knowledge Set
- 3.2.2. The Pop-up Maker's Skill Set
- 3.2.3. The Appreciation of Pop-ups

#### ● 3.3. The Value of Paper Engineering for Children

*Why should children make pop-ups anyway. This section is also a review of the use of pop-up making in the classroom, looking at a few representative publications in education.*

- 3.3.1. The Value of Pop-ups as a Craft
- 3.3.2. Pop-ups in the Classroom

#### ● 3.4. Summary

### ● 4. Pop-ups and Computation

*Pop-ups from a more detailed level than in Chapter 3. I discuss how pop-ups are constructed, how computing in relation to pop-ups has been approached in the past, and talk about the philosophy behind the system which I have constructed. Now that we have described pop-ups as a craft, go on to how one might handle it in a computing situation, and how it has been handled previously. Note what would be needed to help children learn the craft in a computational system, and set up for the next chapter on Popup Workshop.*

#### ● 4.1. The Composition of Movable and Pop-up Books

*Here I need to talk about the role of constraints, the different types of elements which make up pop-ups, and how they are made and combined. Present a taxonomy of pop-up and moveable forms.*

- 4.1.1. Movable Devices
  - Wheels, flaps, etc. and where pop-ups fit in the taxonomy*
- 4.1.2. Pop-up Elements

*Present a taxonomy of pop-up forms.*

*90 vs 180 and angled vs. parallel*

*Point out the problems in terminology*

*Talk about how constraints work in pop-up elements*

- 4.1.3. Combining Pop-up Elements
  - How sets of elements are used together*
  - Talk about putting elements on folds and seams*

#### ● 4.2. Previous Research in Computationally Enhanced Pop-up Design

*Talk about work done in simulating pop-ups so far, primarily Lee and Glassner. Also the Japanese software for making pop-ups.*

- 4.2.1. Mathematics of Pop-ups
- 4.2.2. Computer Based Pop-up Design Tools
- 4.2.3. Viewing the Operation of Virtual Pop-ups
- 4.2.4. Creating Physical Pop-ups from Virtual Representations

#### ● 4.3. Introduction to a System for Children's Use in Pop-up Crafts

*What does such a system need. What pop-up forms? What else? Get the needs established and present requirements and important design considerations.*

*Relate this to previous work in the area and to the craft framework.*

- 4.3.1. Supporting the Growth of Knowledge
- 4.3.2. Supporting the Growth of Skill

## **Popup Workshop: Computationally Enhanced Paper Engineering for Children**

- 4.3.3. Supporting the Growth of Appreciation
- 4.3.4. Other Design Considerations
- 4.4. Summary
- 5. The Popup Workshop System
  - 5.1. High-Level Design Considerations
 

*Expand on 4.3 above to specifically say what was done in Popup Workshop and why.*
  - 5.2. Design History of Popup Workshop
  - 5.3. User Interface
 

*Here I want to specifically talk about how the software works for the user.*

    - 5.3.1. Editor Window and Viewer Windows
 

*Discuss the depiction of folds, cuts and seams, the use of multiple windows for applied structures, the form of the tool area.*
    - 5.3.2. Menus and File Formats
 

*Discuss the menu options including the use of XML and .jpg formats.*
  - 5.4. Internal Design and the Nature of Pop-ups
 

*Introduce some considerations in the internals. Particularly distinguish the constraint system used in opening the pop-up from the geometric constraints of the elements.*

    - 5.4.1. Classes and Data Structures
 

*structure class as the basis of pop-ups, recursive nature of the domain, the plane as the class which represents a flat piece of paper which is part of a structure, the various sorts of lines (cuts, folds, seams). Give a good over-all view of how the software is structured.*
    - 5.4.2. Geometric Constraints of the Elements
 

*Discuss the 5 structures in the program and what their constraints are. Discuss how this affects the change operation.*
    - 5.4.3. Constraint Method of the Opening Algorithm
 

*Discuss the opening algorithm--the method by which a new point is found as well as the way this is incorporated in each structure.*
  - 5.5. Summary
- 6. User Testing
  - 6.1. Informal Testing
 

*Describe early testing done before the formal user tests. How these influenced the final test design*
  - 6.2. Methods and Environment
 

*Overall view of the method: case studies with pre-and post- evaluations. Making and looking at pop-ups.*

    - 6.2.1. User Sessions and Environment
 

*Talk about the questions asked before and after, the test before and after, videotaping, details about how the testing was done. Photos and files from the computer work.*
    - 6.2.2. Pre- and Post- Testing
 

*questions asked, looking at books, cognitive tests*
    - 6.2.3. Data Analysis
 

*How I scored the tests. How I looked at the videotapes and other materials.*
  - 6.3. The Users
 

*Discuss my users: age, sex, entering abilities, etc.*
  - 6.4. Results
 

*Observations from the user testing. I'll use what happens in testing for this.*

    - 6.4.1. Craft Knowledge
 

*Observations relating to craft knowledge. Look at the way the children's vocabulary changed from the first time they looked at the sample pop-ups to the final session's pop-up viewing and discussion, focusing on element names.*
    - 6.4.2. Craft Skills
 

*Observations relating to craft skills. Look at the pop-ups themselves and the way they changed over time. Age differences in the skills: differences and use of 180 degree elements, possible age differences, other*
    - 6.4.3. Craft Appreciation
 

*Observations relating to craft appreciation. Look at their comparisons of the two Alice books, the discussions of the other pop-ups in terms of understanding, and where they got their pop-up ideas.*
    - 6.4.4. Other Observations

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- 6.4.4.1. Software

*Use answers to questions asked about the program at the end, the follow-up emails. What kids want changed and how they used the software*

- 6.4.4.2. Social Dimensions of the Pop-ups

*What they did with the pop-ups they made*

- 6.5. Summary

- 7. Comparison of Two Users of Popup Workshop

*Compare and contrast the twins work.*

- 7.1. Subsections Depending on Case Results

- 7.2. Summary

- 8. Conclusions, Contributions, and Future Work

*A lot of this will depend on my results from user testing. Fill in later.*

- 8.1. Conclusions

- 8.2. Core Contributions

- 8.3. Future Work

- 8.3.1. Software Additions and Enhancements

- 8.3.2. Further User Studies

- 8.4. Conclusion

- **Appendix A** - Glossary

- **Appendix B** - Resources for Learners and Teachers

- **Appendix C** - Popup Workshop Documentation

- **Appendix D** - User Testing Materials, Books, and Tools

- **Appendix E** - Pop-ups Created by User Test Subjects