Strategic Argumentation: a method of approach

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Abstract
One of the challenges of the design process is to develop a strategy that enables designers to gain insight from practice-based research that can be used to carry the development of a project forward to its realisation. In this paper we draw on the theory of strategic argumentation as a way to reason about and plan the manner in which design products should function in a particular set of circumstances.

For the purposes of this research we focus on the creation of a social-based software system that supports the reading and learning activities of students in an educational setting. By necessity this reasoned approach involves the participation of project stakeholders and potential end-users of the system. This is an important distinction as we look to the end-user community who know the form of a product from practical experience and are guided by the knowledge garnered from user-centered experiments that examined students' readings styles and strategies.

The outcome of this research illustrates the role of argument-based reasoning as a method of passing judgment regarding the type of design decisions that *should* be made. We illustrate this method through a case study example that begins with an initial design proposal used to explore end-user activities and discuss how our research findings led the iterative development of an interactive prototype tool.

Keywords
Design methods, strategic argumentation, judgments, reasoning, issues, rationale instances.

Introduction

Two distinct elements denote the practice of design: (1) the appropriate conception and planning of a specific type of product, and (2) the ability to elucidate the results of its outcome from reasoning or principles (Buchanan 1990). Understanding the relationship between the two, however, is not a simple or straightforward matter. It requires designers to develop an understanding of the design situation, community of use and identify a set of circumstances that could benefit from closer examination due to a felt or known difficulty that arises from concrete experience. An example of this reasoning is Kunz and Rittel's (1970) theory of strategic argumentation. The theory provides an argument for how a planned or a designed resolution *should* function under certain conditions that are substantiated by warranted stakeholder claims (Cross 1984). This suggests that argumentation can be employed as a method of passing judgment regarding the type of design decisions that *should* be made. It necessitates, however, the participation of potential users of a proposed product or service. In support of this, Aristotle (in McKeon 1998) distinguishes between a user who knows the form of a product from practical experience, and a craftsman or designer who is guided by these insights in the creation of new products or services. This becomes significant when the purpose or intended function of a product is not realised to its full potential and the fundamental design of a product fails to perform in an anticipated or appropriate manner.

Nevertheless, such an approach poses certain challenges to the design of new software systems that have not yet entered into the experience of potential end-users of the system. Furthermore, conflicting research results between what people say and do impact the ability for designers to connect research findings to appropriate courses of action. The challenge here rests in forming the type of judgments and ideas that effectively guide the iterative development of design outcomes that are well suited to the context of the design situation.

The goal of this paper is to highlight the value of argument-based reasoning as a way for designers to formulate different courses of action during the creation of new products or services. We seek to illustrate how valuable research findings can be captured from design and development processes and how they can contribute to iterative design approaches. It is important to understand that this work is in application to a specific design example and in no way intends to propose a framework, design guidelines or principles that can be widely applied to different design cases. In the following we discuss the differences between design as a problem solving activity and as systematic planning, characterised by the design methods movement. We do this to provide a foundation for the design approach taken and give context to this research by situating it in a real case study example, designed and developed at Bell Labs.

By way of example we illustrate the significance of grasping end-user needs through a process of learning, understanding and negotiation with the requirements of the design situation. To achieve this we draw on the theory of strategic argumentation and show how important research findings that gave shape to the iterative advancement of a social-based prototype tool were identified. Accordingly, we conclude the paper with further directions for this research.

Systematic design methods

Design as a problem solving activity marked a ‘period of systematic design’ that Rittel (1972c) later described as ‘first generation’ design methods. The methods developed by Jones (1963; 1992), Alexander (1964) and Archer (1965) illustrate various approaches in which the elements of design problems found challenging to the resolution of an ideal solution were rigorously examined. Characteristically, this involved the systematic analysis of the underlying parts and interconnected architectures of meta-structures found in design problems that followed rational methods of investigation (Archer 1965; Jones 1963; Alexander 1963). In general, techniques of optimisation common in systems engineering, management and operations research provided a foundation for this design approach.

The work of both Archer (1965) and Jones (1963) are indicative of a method of approach in which organisation, sensibility, intuition and experience were regarded as valuable elements in the design process. For Archer (1965) design concerns the reconciliation of conflicting factors in the design situation initiated by the discord between industrial functionality, production and marketing requirements. In particular he characterises four key elements of the design process. Beginning with a need, a model, the intent to embody a solution as an object and a creative leap, a designer’s judgement and experience is again critical to the synthesis of a solution (Archer 1965). In situations where such judgement fails to achieve this, after much comparison and contrast to other fields of knowledge, a designer employs a rational method of analysis as a last resort to find an appropriate outcome (Archer 1965).

For Jones (1963) the act of designing involved the reconciliation of a supposed conflict between creativity and logic. Where the development of imagination and reason, in isolation from one another, provided a way to focus on the analysis of design elements as

distinct from their synthesis. He believed that taking a rational approach to design reduced the potential for error and worked to increase the efficiency of the designer, while the assistance of computer technology functioned as a memory aid. This provided the designer with the freedom to create more imaginative solutions by not being weighed down with numerous technicalities and details. However, the disconnection between the relationship of analysis and synthesis in this method of operation had little chance for convergence when treated so disproportionately (Jones 1963).

In contrast to Jones, Alexander (1964) worked with the uncertainty of establishing design requirements. He created an evaluative method in which the ‘fit’ or ‘misfit’ of contradicting relations between an object’s form, human need and the context of the design situation, were evaluated for their suitability to a proposed solution. A reductive approach to the analysis of design patterns or diagrams provided a way to resolve the complexity of design problems in a precise step-by-step process to achieve the desired form or synthesis of an object (Alexander 1971).

While 'first generation’ design methods subscribed to individualistic and ideal processes to solve problems, a shift in attitude that recognised the complexity involved in structuring and formulating design problems, characterised the basis of ‘second-generation’ design methods. Design as systematic planning saw the introduction of argumentation into the design process as a means to resolve conflicting interests found in the controllable and uncontrollable effects of ill-structured problems (Rittel 1972a). Rittel (1972b) suggested that participatory methods focusing on critical argument, judgment and reasoning, between stakeholders and designers involved in the design process, offered a logical way of analysing and determining the significance of challenging design issues.

Essentially, Rittel dealt with the complexity of uncertainty and their consequences in design (Krippendorff 2006). He encouraged designers to scrutinise the claims they made in the design process and brought the potential of empirical research to the fore (Krippendorff 2006). However, for Rittel (1988) there were no clearly definable moments between the definition of a design problem, its synthesis and evaluation. He believed that it was through a process of reasoning and the capability of a designer to mentally comprehend and work though a variety of design problems that contributed to their resolution. A designer's imagination was where different solutions and plans to address design issues were created and managed before their actualisation in a concrete form (Rittel 1988).

The notion of simultaneously developing a design problem and its solution created greater division among second-generation design methods. For Simon (1973; 1996) there was no real distinction between the structures of well- or ill-formed problems. They were unstructured. Primarily, Simon’s interests lay in establishing a science for design in which artificial intelligence and cognitive processes provided a rational approach to the management of complex systems. “Satisficing” and “bounded rationality” are terms used to describe the motivational constraints and imposing limitations of the human capacity to process information that he (Simon 1979:3) saw as key contributors to the resolution of less than optimal design problems. For Simon, the analysis of the least parts of a design situation provides a foundation for the construction or synthesis of a solution. This is a method in which the designer’s perspective is impartial to productive processes in order to generate what is arguably a valid scientific outcome.

The diversity of approaches stem from a sign of the times, a designer’s background, and the perspective in which they formulate a course of action to examine or resolve the elements of a design situation. Therefore, the approach taken to understand,

conceptualise and visualise a design situation is guided by the skill of a designer to devise an outcome that appropriately considers these elements and draws on a useful combination of knowledge to support its resolution. In this respect, the power of strategic argumentation lies in the ability of a designer to understand the existing circumstances of a design situation and reason about what *could* and what *should* be created in the design of products or services that fulfill a particular purpose.

Design purpose

This research concerns the practical design and early experimentation of a prototype tool designed to make active reading and sharing possible. It facilitates communication between students and lecturers in a social and digital educational setting. As mobile devices change the face of reading, writing, publishing and learning, electronic resources made available by connected devices provide the opportunity for digital information to become not only a common and shared environment for learning and teaching, but one that is fundamentally social. This in turn led us to rethink the use and function of digital books and envision new ways of engaging with informative content and leveraging social networks.

For example in the context of a classroom situation, digital tools *could* be designed to shape the delivery and accessibility of information captured as different types of annotations and multifaceted content. Annotations *could* provide a way for students to find and associate relevant content such as images, videos and other textual resources that further illustrate conceptual ideas and bring informative material to life. Resources of this nature *could* also act as real-time evaluation tools for teachers to observe student levels of understanding regarding a particular text, based on the significance of students' annotations.

Learning in everyday contextual situations, such as visiting a museum or engaging in practical hands-on experiences *could* also be addressed through the creation of annotations and conversations that make links between multifaceted content, lived experiences, physical objects and locations possible. These items as objects of knowledge become an important way to represent concrete ideas that others can follow. Our intent is therefore to design a prototype tool that effectively illustrates various types of knowledge and to make it readily accessible to a broad range of university students from diverse disciplines.

Design issues

Designing a social-based software tool with a specific purpose in mind, for use in dynamic circumstances, by a particular community of use, brings with it certain challenges. It requires designers to consider and manage a variety of known and potentially unknown variables. As Rittel (1988) suggests it becomes difficult to identify key design concerns because as the form of a problem takes shape, its consideration and treatment changes the nature of the initial problem upon its resolution.

As a way to illustrate the thinking behind a number of challenges faced in the initial design of the social-based prototype tool, we created *rationale instances* (Ebenreuter 2009; 2010) of the issues we felt would have a significant or widespread impact on the prototype's design. Each *rationale instance* provides a moment of understanding about a particular aspect or object of the design situation in relation to a whole. They are a combination of descriptive and visual design information that presents designers with an inclusive illustration of interconnected implications for the design situation. Their role in the context of this research was to capture early conceptual knowledge of the design project and

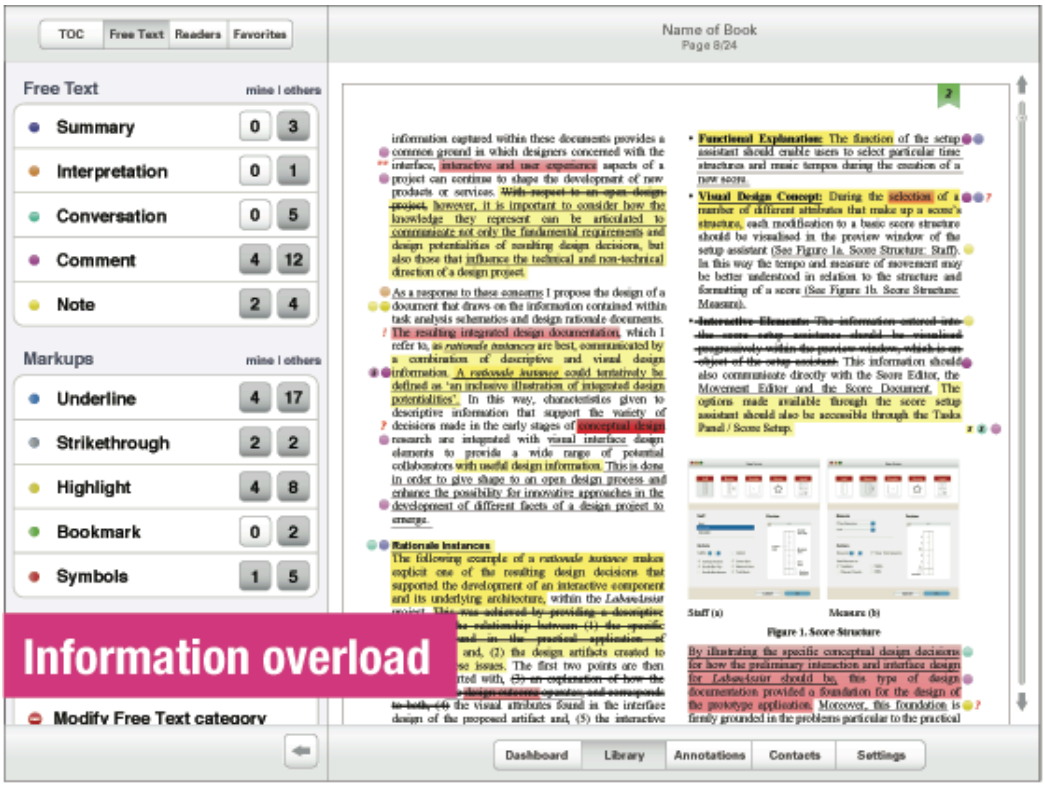
illustrate potential issues for further consideration and iterative development.

In the following, two examples of different issues that arose in the early conceptual design of the proposed prototype tool are made explicit. This is achieved by providing a descriptive account of the relationship between (1) the specific issues found in the processes of facilitating active reading and sharing in a digital environment; and, (2) the elements that design artifacts *should* make visible. The first two points are then supported by, (3) an explanation of how the design outcome *should* function to operate; which corresponds to, (4) the visual attributes found in the interface design of the problematic artifacts and, (5) the interactive considerations that the solution offered will need to address in relation to the prototype's overall design. The development of *rationale instances* in this form worked to augment the communication of design issues between experts in design, usability, engineering and education disciplines, and stimulate different arguments regarding the avenues in which a product *could* or *should* take shape.

Topic: Visual representation

- Issue: Address the tool's levels of scalability and the resulting visual effect of displaying various types of information.
- Design Artifact: Coloured markups, such as text highlights and iconic markers *should* assist the identification of different types of information.
- Functional Explanation: A lesser value in the opacity of an individual's annotations in comparison to a greater value for those created by members of the social network *should* help to distinguish them from one another.
- Visual issue: The proposed solution *should* appear legible under high levels of social communication. See Figure 1 for the worst-case scenario.
- Interactive Considerations: To address this issue the final outcome needs to be scalable and cater for complex networks of social communication, illustrated as textual markups, annotations and conversations. Visual indicators and markers need to be positioned appropriately and remain visually appealing.

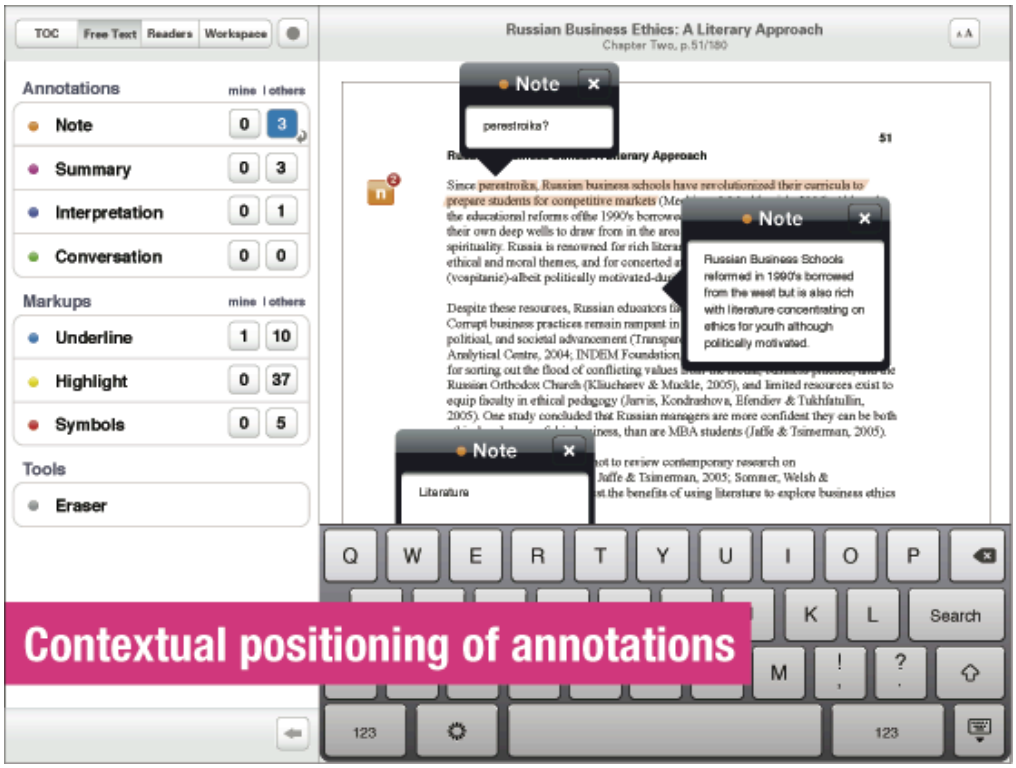
Figure 1: Visual representation



Topic: Contextual annotations

- Issue: The creation and viewing of textual annotations are limiting to the contextual view of text-based content.
- Design Artifact: The interface *should* offer end-users the possibility to view text-based content and the annotation they are manipulating while using a standard keyboard.
- Functional Explanation: The function of creating a new annotation *should* enable users to read and write annotations in the context of a specific passage of text.
- Visual Issues: During the creation of annotations, annotation popup windows *should* be displayed to best visualise the selected text being annotated and facilitate the entry of text into an annotation popup window. See figure 2 for the issues this presents.
- Interactive Considerations: To facilitate this solution text-based content and annotation popup windows need to scroll upward as the keyboard emerges from the base of the screen, if the text selection for annotation is low.

Figure 2: Contextual annotations



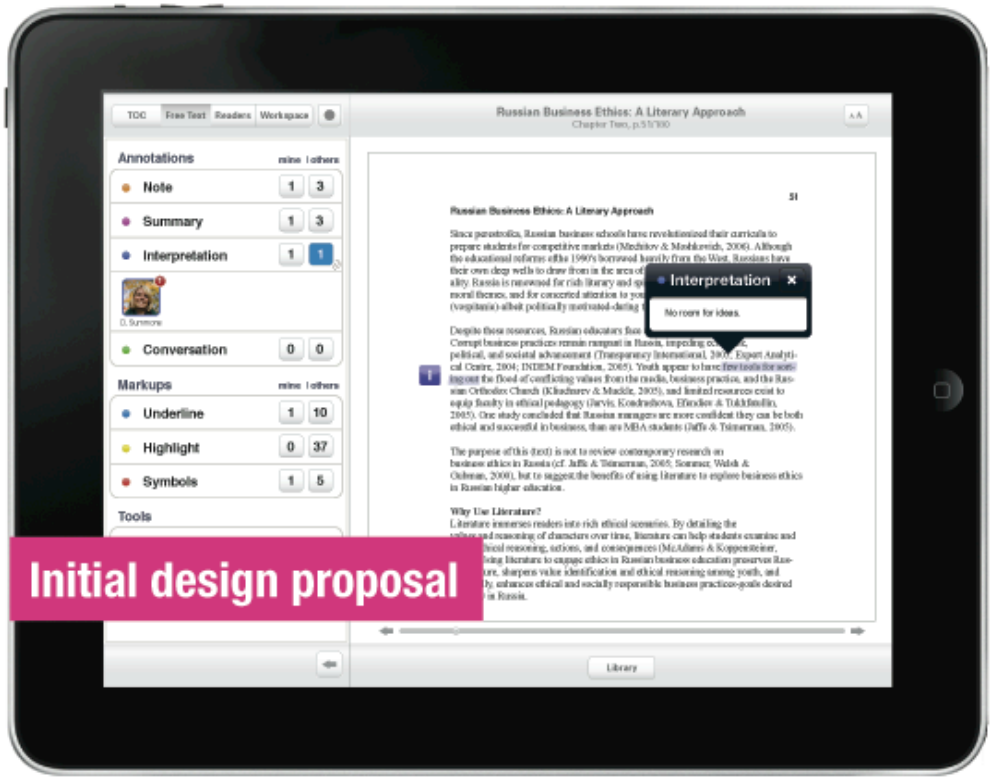
From the outset of the project we sought to understand a variety of design challenges that we *could* potentially face, in order to have a better conception of the solution in mind. This is important, as Rittel suggests:

> "You cannot understand the problem without having a concept of the solution in mind; and that you can't gather information meaningfully unless you have understood the problem but that you cannot understand the problem without information about it (Rittel 1972b:321)."

Through the method of creating *rationale instances*, we gained insight into the types of design issues we *could* experience when conducting user-centered experiments. However, to better understand the difficulties associated with facilitating active reading and

sharing it was necessary to review existing literature concerning different types of annotations and reading strategies (Marshall 1998; Marshall & Brush 2002; Marshall & Brush 2004; Marshall 1997). This provided a rich basis of understanding to draw on, when shaping the protocol for the user-centered experiments. It also led us to develop a way to gather meaningful information regarding different annotation styles during the experiments. By resolving the above-mentioned design issues, to a certain extent, the first design iterations (see Figure 3) became part of the overall design concept developed as a prototype application for the iPad and used to conduct user-centered experiments.

Figure 3: Design iteration



User-centered research approach

We conducted a number of user-centered experiments that involved the participation of eighteen students from Abilene Christian University in Texas, over the course of two weeks. Participants were recruited from a range of majors and classifications to ensure population diversity. They were asked to participate in four objectives, two of which required interactions with the developed prototype application to study and work on digital content. The overall goal of the experiments was to gather knowledge about students' learning and working behaviors in order to create a tool adapted to different annotation and reading strategies.

A social and non-social context of communication was given to the experiments. Half the participants completed four task-based objectives in a social context where a simulated social group was made available within the prototype, while the remaining participants completed their tasks in a non-social context. The goal of alternating between the two contexts was to observe if students working and sharing strategies differed according to a social or non-social context and to learn more about the approaches taken.

Two different texts were used in the experiments. The first, a scholarly text, was used for objective one. Here, students were asked to read and understand the text displayed on the

prototype application and to draft a paper about its content. Our goal in designing this scenario was to better understand the tasks associated with active reading and sharing that students perform when gathering knowledge from a digital textbook. A second textbook reading was used for objective two. In this task students were asked to study and retain information about the text displayed in the prototype application as if they were preparing for a quiz. Creating this scenario enabled us to better understand how students analyse, synthesise and memorise digital-based textbook material when preparing for a quiz at both an individual and collaborative level.

During each experiment participants followed the method of 'talking aloud' when interacting with a digital prototype application of the proposed system. They also answered a number of interview questions at the end of each task-based objective. Information garnered during the experiments was captured by (1) a video recorder, and (2) Morae 3.2.1 software (TechSmith 2010), which also assisted with the data analysis.

In addition to the first and second objectives, two paper prototype experiments were conducted. Again, they alternated between social and non-social contexts of communication and made use of the second text employed in the earlier digital-based objectives. For the third objective we asked students to describe the difference between subjective and objective annotations, in relation to the textbook material, to better understand how they were used (See Figure 4, left). We then presented each participant with a list of twenty-two possible names to describe different types of annotation categories and asked them to select a number of names they preferred above others. From their selection, we asked students to specify if they believed the names chosen were of a subjective or objective nature and to identify them accordingly. To finish we asked participants to single out the most important name for a subjective and an objective annotation, alike.

As the fourth and final objective, we created a scenario in which students needed to utilise different types of textual and symbolic annotations (see Figure 4, right). We asked students to choose six different symbols from a collection of sixteen and to use them to study for an exam. We then asked each student to describe the significance of the symbols they had chosen. We did this in order to better understand the nature of specific annotations and study the relationship between their combined or isolated use. Upon the conclusion of objectives three and four, students were also required to answer a number of interview questions.

Figure 4: Communication tools

Research findings

From the user-centered experiments we found that students frequently markup their text by highlighting sections of it while writing a paper. When studying for a quiz students

chose highlighting and underlining for 70% of their annotations. Surprisingly, students made twice as many annotations when preparing for a quiz in comparison to writing a paper. In preparing to write a paper students made one annotation every 95 words, whereas when studying for a quiz they made annotations every 45 words. Perhaps this suggests the level of detail that students expect to have in order to answer a quiz as opposed to writing a paper.

In general students:

- Commonly highlighted text that was important for them to remember,
- Used highlights, question marks and asterisk symbols for passages that were meaningful for them to remember,
- Used highlights, notes and symbols to indicate elements of a text that they found confusing, and
- Made use of social strategies regardless of their presentation in the prototype tool or not.

In terms of the significance that textual annotations held for students, we found that the word ‘comments’ suggested that students would write and also expect to read other annotations that were of a subjective nature. While the terms ‘notes’ and ‘summary’ were seen to be objective. Furthermore, our experiments revealed that ‘notes’, ‘summary’ and ‘comments’ were the names commonly preferred to describe different types of textual annotations.

With respect to the use and purpose of different symbolic annotations, we found the four following symbols, illustrated in Table 1, were often used to perform a number of specific tasks.

Table 1: Signification of symbolic annotations

Symbol	Signification
?	Indicates something not well understood that needs further clarification, reviewing or an explanation.
*	Refers to something important, interesting or to follow up. Is used as a bullet point.
!	Emphasises importance, draws attention to it and illustrates excitement or a form of agreement.
+	Shows the need for more information, the addition of ideas or a written note. Is used as a bullet point.

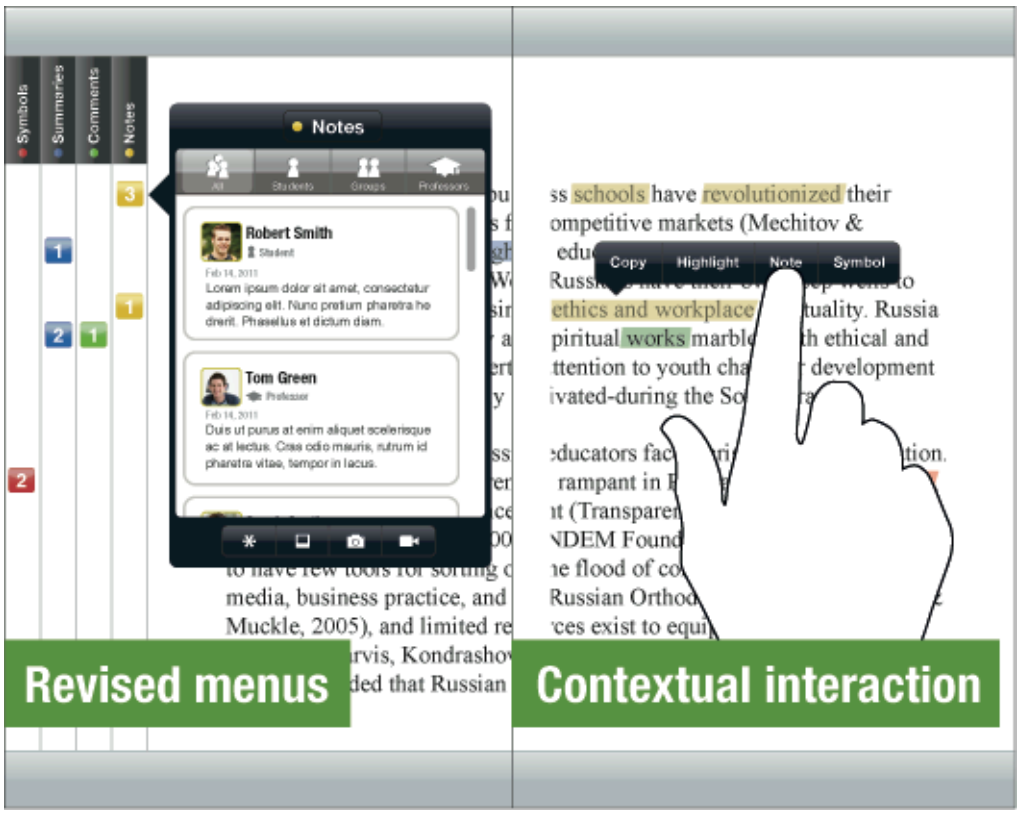
Design implications

In light of the above research findings and the purpose of the prototype tool we reconsidered the contextual nature of viewing, creating and reading annotations. To alleviate the potential for cognitive overload, annotation menu items are less visible than before (see Figure 5, left). The note annotation window now facilitates direct links to multifaceted content and enables students to view all, individual, group or expert

interactions. We envisage that this will help students to create and view annotations that do not distract them greatly from the text based information they are discussing or reading. In the contextual popup menu on the right hand side of Figure 5, students are offered the potential to create notes, which can be modified and displayed as summaries or comments.

Significant to the direction of the prototype's ongoing development was the students combined use of highlighting and underlining to recognise important items to remember. This is because students also commonly used highlights and symbols to identify meaningful passages to remember. We argue that this renders the use of underlining with highlighting to an almost redundant visual mechanism. Through a number of interviews we found that the use of underlining with highlighting held little additional importance to students. Therefore, in the revision of the visual markup tools made available in the following prototype version, underlines are no longer offered. In general, notes, summary and comments are used in conjunction with symbols and highlights to complete the offering of annotations and markups in the design revisions.

Figure 5: Design revisions



When designing tools that facilitate the creation of annotations and links to multifaceted content we argue that it is important to study how people *could* connect to one another through the content they create, or make use of and to build knowledge from their interactions. It is not enough to simply have annotations as objects of knowledge embedded in digital content and for individuals to contribute to this knowledge. We *should* create ways to tie different knowledge objects to the people who create them and share them with those who *could* potentially value from them most.

Vital to such an approach is to propose tools that statistically or semantically process and visualise different types of annotations to build new knowledge networks and ongoing relationships. This refers to topics of information that can be visualised to guide or

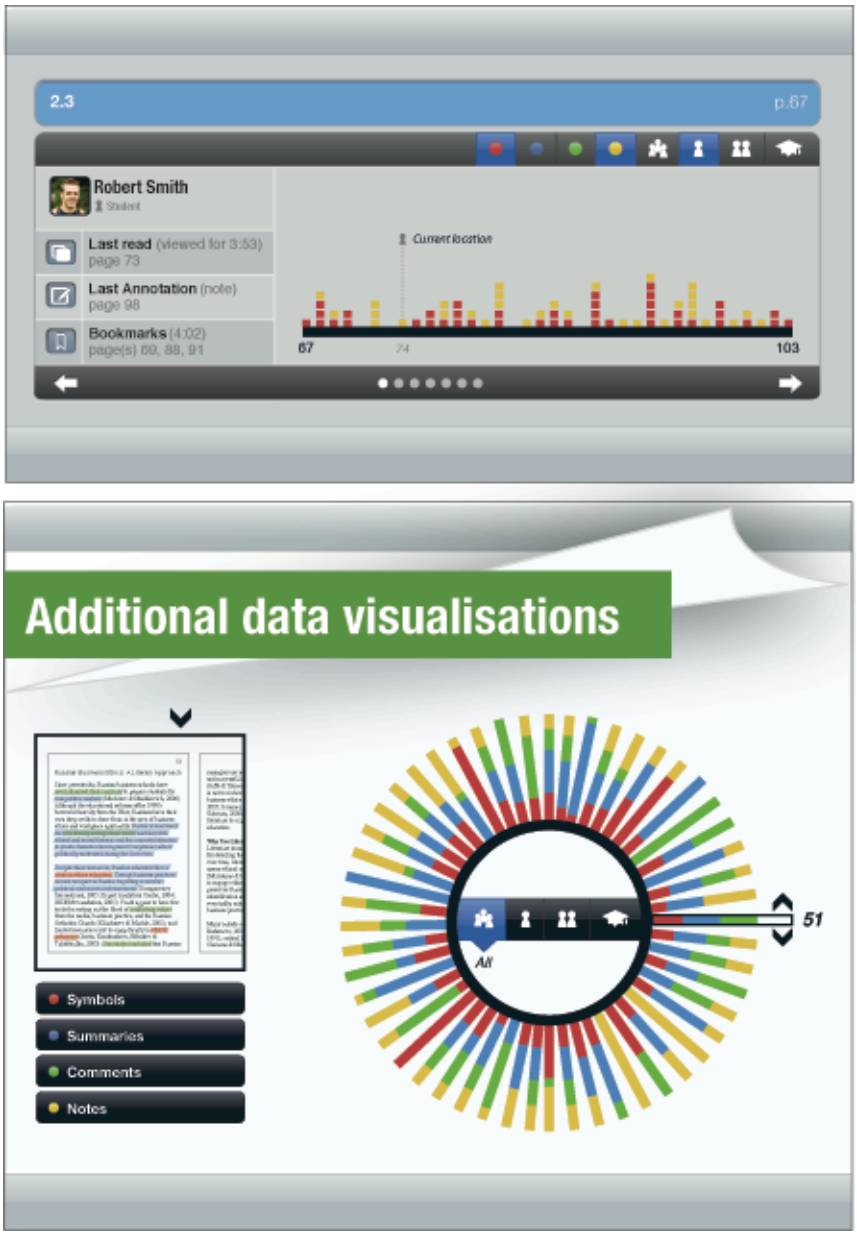
influence students to find, explore and discover new information from a wider range of end-user interactions, knowledge and experience.

As a way to augment knowledge our ongoing objectives are to:

- Represent real time objects through peoples interactions,
- Customise different types of objects, and
- Visualise interactions and objects within a larger eco-system of social communities.

Figure 6 illustrates a first step towards these goals. Data visualisations could assist end-users to search and identify different types of annotations and gain an awareness of all, individual, group or expert interactions that are similar or remarkably different to their own.

Figure 6: Future design directions



Herein lies the capability to create social networks behind different objects such as annotations, multifaceted content, physical objects and locations to open up the possibility of informal learning through multiple pervasive social networks. Further challenges we

seek to address are to understand how we can facilitate others to move from one social network (i.e. a group of images in Flickr, specific movies in YouTube, status comments or photos in Facebook) to another and make the connections between them meaningful. This is not only for the individual that creates them, but also the social network that has access to such interconnections.

Discussion

While, strategic argumentation is not a new idea it is important to highlight the significance of Rittel's (1972b) methods of argumentation and participation that introduced a what-ought-to-be approach to design. This contributed to an awareness surrounding the accountability for conflict resolution and the implications of design outcomes. It is therefore a valuable reminder that in the process of designing, it is necessary for a designer to obtain a global view of the design situation. This is because by actively formulating the elements of a design situation and proposing an approach for its resolution, there is a danger that designers may construct arguments and explanations for design outcomes that are well suited to the needs and purposes they create. What is needed in this situation, is greater understanding towards how designers can obtain useful research findings from design and development processes and utlise them to shape different courses of action that bring about the realisation of suitable design outcomes.

In this paper we illustrated through a process of learning, understanding and negotiation with the requirements of the design situation, a way to reason about and plan the manner in which a social-based software system *should* support students reading and sharing activities. It involved the participation of educators and students, the potential end-users of the system, who know the form of a product from varying perspectives and practical experience. We were also guided by the knowledge garnered from the creation of *rationale instances* and information concerning different reading styles and strategies. By looking broadly at known issues and those discovered in the process of designing with and for end-users of the system, we developed a way of passing judgments regarding the type of design decisions that *should* be made to enhance the prototype's development.

From this experience a variety of ideas, discussed throughout the paper guided the iterative development of different design outcomes. They were illustrated by: (1) an initial design proposal, (2) various design issues, (3) suggested design revisions, and (4) future design directions. It is envisaged that this research will contribute to the methods used in design research and practice by offering designers greater awareness of design as a planning activity. One that involves the reasoning of designers as a way to argue about what *could* or *should* be designed; that is a fundamentally participatory act and seriously considers the implications of designed outcomes.

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