2008

FACILITATING TEACHER PARTNERSHIPS FOR CROSS-CLASSROOM COLLABORATION

Ben Hazzard

FACILITATING TEACHER PARTNERSHIPS FOR CROSS-CLASSROOM COLLABORATION

(Spine title: Facilitating Teacher Partnerships)

(Thesis format: Monograph)

by

Ben Hazzard

Graduate Program in Education

A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Education

School of Graduate and Postdoctoral Studies
The University of Western Ontario
London, Ontario, Canada
October, 2008

Abstract

Collaboration between classrooms, in a digital environment, was explored using the self-identifiers of connectivity, constructivism, and collaborative comforts to partner teachers. The research question investigated was, how might emerging research on connectivity, constructivism and collaboration within the digital environment inform the design of an interactive website that enhances the ways in which teachers are able to collaborate with colleagues around the world based on the development of a more complex partnering system? The Design as Education Research Framework was used to implement the 'design as research' method and resulted in the design of the research object, an interactive website, TeachersConnecting.com. Multiple data sources that informed the design process were: the research object, a development journal, feedback from a development panel, and academic literature in the field. Reflection via a virtual convener, practical applications of connectivism and constructivism, as well as the impact of a development panel on 'design as research' were described. Cross-classroom collaboration projects were organized into a matrix that was developed based on the comforts.

Keywords: cross-classroom collaboration, collaborative projects, design as research, Design as Educational Research, collaborative comfort, constructivism comfort, connectivity comfort, partnering teachers, interactive education website design, connectivism.

Dedication

By your own soul, learn to live.
If some men thwart you, take no heed.
If some men hate you, take no care.
Sing your song. Dream your dream.
Hope your hope and pray your prayer.
- Pakenham Beatty (1855 – 1930)

The completion of this goal has depended upon the actions of others. My family is the most important connection in my world. They are my comfort and motivation. I have been able to hope my hope and pray my prayer with them.

My wife, Erica, has always supported my desire to achieve this goal. Her words, actions, kindness, and love have been continually present throughout this process. Her commitment and proofreading made it possible from the shores of Hawaii to the St. Clair River.

Liam, my son, the day that I became a father profoundly changed me. You were born as this thesis began. I watched you begin to crawl, walk, and talk as I researched and wrote. Time with you is precious.

For the past thirty-two years Jim, my father, has offered his children a standing invitation. If asked, he is willing to be my coach. For the past few years he has coached me on Sunday mornings, over eggs and coffee, at the local diner. Thank you for challenging, encouraging, and believing in me.

My mother, Anne, completed her university degree while raising three children. Her model of dedication and commitment were evident throughout my childhood and teens. I'll never forget a spring day at the University of Windsor when you graduated with a Bachelor of Education. Thank you for setting an example that valued education.

Acknowledgements

This piece of written work has been shaped and molded by many people over the past years. During the writing of this thesis existing relationships were strengthened with Kathy Hibbert and Rebecca Coulter. New connections were also forged to extend my understanding.

Two years ago Kathy Hibbert and I sat around a table in her office discussing how teachers find cross-classroom collaboration partners. The ideas discussed developed into this thesis. She encouraged me to pursue ideas that help partner teachers for collaborative work as a thesis. Kathy's ongoing efforts, patient listening, thoughtful feedback, and strategic guidance were integral to my learning process.

Nine years ago Rebecca Coulter and I met in her office during my B.Ed. year at the University of Western Ontario. She was Associate Dean and I was Students' Council President. Our discussions have ranged from farm culture to academics. I am thankful for her encouragement, guidance, and thoughtful perspective.

New connections were forged with Mike Katchabaw, Josh McCormack, and George Siemens. Mike's perspective allowed this work to embrace a virtual perspective. Josh McCormack responded to my desperate tweet for help and provided advice at critical moments during the design process. Breakfast with George Siemens allowed me to share eggs, toast, coffee and ideas about Connectivism.

Finally, members of the development panel shared their time, knowledge, and experiences. I am grateful.

Table of Contents

List of Figures

List of Appendices

Facilitating Teacher Partnerships for Cross-classroom Collaboration

Prologue

It was June 2005, the last week of school before the summer holidays, and a heat wave had taken hold of the city. The computer lab on the second floor of the school was registering temperatures in excess of 30 degrees Celsius and was packed with my class of adolescent students. Instead of the usual comments, drama, and pre-teen behaviour that accompany many grade 7 activities, the students were each focused on their writing and reading assignment. Students were writing posts for a blog (a website with individual entries that appear in reverse chronological order and allow commenting or discussion based on each entry) about their two day field trip at a local camp and posting them to an Internet site shared by their classroom in Sarnia, Ontario, Canada and a classroom in Winnipeg, Manitoba, Canada. After writing their posts, students entered the other classroom's section of the site and read each post. Students commented on these posts and explained how it connected to other texts, their own experiences, or the world. In this hot room with stale air eyes were peering into this virtual looking glass, the rhythmic tapping of keyboards accompanied the hum of ceiling fans, and the ticking of the giant clock signified that over an hour had past. The silence masked the intensely social conversations that were occurring. The conversations were not with the immediately neighbouring students. Rather, the asynchronous conversations

were occurring with students sitting half way across North America. Their conversations were within academic parameters. The reading strategy, making connections, had been taught and was now applied. Upon reflection, I realized that I was experiencing cross-classroom collaboration that fully engaged my students and myself as a professional. We made use of technology to focus on the social learning opportunities that arose.

Since the beginning of my teaching career, I have incorporated several recent technological developments in my classroom. In the summer of 2000 I purchased my first Internet address, mrhazzard.com, to set up a classroom website. This website featured student work that was captured and enabled with

- digital cameras (cameras that capture images in a digital format to a memory card instead of file),
- digital camcorders (video cameras that store movies in a digital format that can be edited using video editing software),
- interactive whiteboards (interactive devices that enable users to interact using fingers or pointing devices to control the computer and annotate with digital ink via the computer's desktop that is projected onto the large interactive device),
- publishing software (computer program that allows the creation of several different paper documents such as: brochures, posters, and greeting cards),
- web design software (computer program that allows the creation of a static

website using a "what you see is what you get" [wysiwyg] interface that can be uploaded to an internet server),

- concept mapping tools (computer programs and websites that allow ideas to be entered into symbols and linked to related symbols via arrows and grouping to indicate related concepts and ideas), and
- blogs.

Each of these tools revealed potential and limitations. However, the turning point came when I began to collaborate with another teacher, teaching 2000 kilometres away, whom I had met at an interactive whiteboards conference. This collaboration began as a professional sharing of ideas and interactive whiteboard files before including our students. Then students became engaged in cross-classroom collaboration projects that included reading groups between classrooms as well as writing and reading assignments on the joint classroom blog. Students began to display interest as they used technology in the classroom to collaborate with other students but they did not comment on the technology tool.

Instead, students commented on their relationships with members of the other classroom whom they had never met. A student in Winnipeg observed that he had made friends with members of my classroom without ever meeting them. A student in Sarnia noted that blogging was just like what the students did at night, except that they talk about different things. Anecdotally, this social connection seemed to engage and motivate my students. The value of linking

classrooms for cross-classroom collaboration began to crystallize in my professional practice.

Several questions developed through this experience. Why are more classrooms not participating in such cross-classroom collaborations? How do teachers find a collaboration partner if they do not attend a conference with teachers from many countries and geographic regions? What made the collaboration experiences within my career successful? This research explores these questions.

Chapter 1: Introduction

This study created an interactive website as a research object that considered factors beyond simple logistics and included elements of connectivity, constructivism, and collaboration when partnering teachers for cross-classroom collaboration. The research question, as described in this chapter, was explored using a 'design as research' methodology following the Design as Education Research Framework. Theoretical understanding about cross-classroom collaboration from a variety of fields was synthesized to inform potential collaboration partners about factors to consider when selecting a collaboration partner. Future research may be able to build on the understanding of the 'design research' process through the Design as Education Research Framework. The Cross-Classroom Collaboration Project matrix applies the understanding about how teachers partner for collaborative projects to the types of projects and the tools that enable these projects. The organization of collaborative projects may promote greater understanding about appropriate use and further study.

Purpose and Context

The field of education technology encourages teachers to participate in cross-classroom collaboration with students; however, the websites that facilitate these collaborations rely solely on logistical elements. For example, in 2007 the International Society for Technology in Education released its "National Educational Technology Standards for Students: The Next Generation" and

included a focus on student learning through cross cultural collaboration and project teams within a digital environment. However, students from kindergarten to grade 12 likely will not have access to cross cultural and collaborative learning opportunities during the school day unless a teacher facilitates the interaction. But, as already noted, existing opportunities for teachers to link classrooms together have focused on logistical elements, such as grade level taught and geographic location, when forming collaboration partnerships through websites and these links have not incorporated collaborative or pedagogical theories (e.g. Wagner, 2008; ePals, 2008; International Education and Resource Network, 2008). Recently there has been an expansion of global collaboration projects that organize classrooms around a singular event (Joseph, 2007) and voices in the field have reiterated the value of this learning opportunity made possible by recent technology advancements available at little financial or organizational cost. Yet, despite the encouragement of educational organizations to engage in cross-classroom collaboration, current tools to partner teachers for cross-classroom collaboration continue to focus on basic logistics and ignore more sophisticated considerations that may enable more successful professional collaboration.

The financial and organizational cost of collaborating across narrow or vast geographic distances has dropped dramatically. Technological advancement in communication and collaboration related applications have accelerated in recent years to enable these activities across vast distances (Freedman, 2005).

Traditional phone calls and long distance charges are replaced by technologies such as Skype (a computer program that enables computer to computer voice and video calls as well as instant messaging and file transfers) calls between computers that allow people to communicate at no cost using audio, video, text, and transfer files (McFadden & Price, 2007). The financial cost for global communication using Internet publishing and voice over the Internet (VOIP) calls has collapsed (Shirky, 2008). Along with the collapse in cost, technology platforms that enable the group coordination have risen to meet this opportunity (Shirky, 2008). The worldwide network and developing tools that utilize this network allow communication between teachers, regardless of geographic location, at little or no cost. Platforms have emerged that can be developed and customized to facilitate the self-organization of groups and hence collaborative endeavours.

There is a body of literature on cross-classroom collaborations. Academic writing has focused on the experiences of students within virtual classrooms (e.g. Carmody & Berge, 2005; Muilenburg & Berge, 2005), teachers of online courses (e.g. McLinden, McCall, Hinton, & Weston, 2006; Overbaugh & Lin, 2006; Molebash & Fisher, 2003), and designers of online learning experiences (e.g. Bird, 2007; Luppicini, 2003; Berge, 2004). The teacher as key facilitator for cross-classroom collaboration has not been fully explored and it is this issue my research addresses. To better understand partnering teachers within collaborations this research will be situated within a variety of theoretical

constructs introduced in Chapter 2.

Assumptions and Definitions of Terms

There are several assumptions and terms initially introduced here to clarify their use in this research. The research assumed that teachers desire to participate in collaborative projects with other classrooms. This is further explained in Chapter 2. The term 'interactive website', (elaborated in Chapter 4), is used extensively when referring to the research object to describe a database driven Internet site that allows users to enter and retrieve information. Cross-classroom collaboration signifies two or more classrooms of students that participate in some form of joint learning activity and is investigated in the review of the field within Chapter 2. The partnering of teachers to enable students' collaboration is based on the comforts of connectivity, constructivism, and collaboration further explored in Chapter 2. Each 'comfort' has emerged from an in-depth exploration of the relevant research in the area, and then distilled into a workable definition for the purposes of this research. Essentially, connectivity comfort refers to an individual's understanding of communication technologies, constructivism comfort refers to the degree to which teachers implement active learning within their classrooms, and collaboration comfort refers to previous experience and engagement with cross-classroom collaborations. 'Design as research' signifies a process of exploring a research question through the design of a research object that integrates a rigorous research and feedback panel into

the design process as further described in Chapter 3.

Research Question

Teachers are encouraged to engage in cross-classroom collaboration activities without sufficiently sophisticated tools to match teachers together. The developing academic literature about cross-classroom collaboration has not looked critically at the current matching tools available nor addressed the rapid pace of technological advancement that is dramatically lowering the cost of these collaboration opportunities. Emerging research in design technologies has suggested a need to network teachers based on the comforts (Meloncon, 2007) of connectivity (Downes, 2007b; Siemens, 2004), constructivism (Lattuca, 2006), and collaborations (Palloff & Pratt, 2007) overlaid on the familiarities of geography, function, and repeated exposure (Harris, O'Malley, & Patterson, 2003). The question then becomes, how might emerging research on connectivity, constructivism and collaboration within the digital environment inform the design of an interactive website that enhances the ways in which teachers are able to collaborate with colleagues around the world based on the development of a more complex partnering system?

Scope of the Study

A 'design as research' methodology was used to address the research problem. 'Design as research' focuses on an emergent process that creates an object through research and practitioner feedback (Bereiter, 2005; Wang & Hannafin, 2005; Stapleton, 2005; Bannan-Ritland, 2003). Educational and

technological literature informed my selection of the Design as Education Framework that guided the research process. This framework was adapted from the education design method called the Integrative Learning Design Framework (Bannan-Ritland, 2003) and drew on the field of computer science. The end result of this research process was an interactive website that serves as a virtual convener to partner teachers for cross-classroom collaboration projects through a more complex matrix of considerations than the merely logistical. The research object, an interactive website, was not designed to host collaboration projects but instead focuses on facilitating a partnership between teachers.

Organization of the Thesis

The research question introduced in this chapter is further explored in Chapter 2 by reviewing the developing area within the academic literature and the practice of educators in the field. A review of the literature and field provides both the theoretical and practical context for this research. Chapter 3 introduces the methodology and 'design as research' method, and frames the research process using the Design as Education Research Framework. The various data sources and design process are documented within Chapter 4 and I describe how the research object took shape. A further analysis of the design decisions, insights, and understanding that emerged is offered in Chapter 5. This chapter will also include a discussion about limitations, summarize the contributions and key findings of this research and offer suggestions for future investigation.

Summary

Teacher partnerships to enable cross-classroom collaboration projects are being encouraged but with little theoretical or pedagogical understanding. This research examined ways that emerging research on connectivity, constructivism and collaboration within the digital environment might inform the design of an interactive website that enhances the ways that teachers are able to collaborate with colleagues around the world based on the development of a more complex partnering system. Design as research provided the context for this study where a research object emerged in the form of an interactive website that facilitated the partnering of teachers. This research object, which was developed in collaboration with practitioners, is a synthesis of the theoretical context in response to the lack of such a tool within the field. This research led to the creation of an interactive website that enables other classrooms to participate in cross-classroom collaborations.

Chapter 2: Review of the Literature and Field

In this chapter I examine the theories and practice in the field related to the investigation. I have divided the theories investigated into six sections: comfort, connectivity, constructivism, collaboration, virtual convener, and aspects of building a digital environment. The practices of cross-classroom collaboration in the field have been divided into three sections: project focused resources, teacher connecting resources, and tools.

Setting the Context

In order to address the research question, various bodies of academic literature were reviewed before social constructivism was selected as the appropriate theory underpinning the context, design, and analysis of the research. Social constructivism focuses on understanding how individuals (Bandura, 1997) interact with knowledge in a social context (Vygotsky,1978). Within this paradigm, the emerging learning theory of connectivism (Siemens, 2004, Downes, 2005) informs the development of the concept of comfort within connectivity, constructivism, and collaboration. Understanding the factors, comforts and logistics that influence collaboration between professionals becomes important when developing a partnering system. Developing a partnering system for cross-classroom collaboration led to the conceptualization of the role of a virtual convener and the implementation of effective elements of

online communities and reflexivity within a virtual environment.

Review of the Literature

A review of academic literature also focused on the emerging theory of connectivism to inform the exploration of the research question. Connectivism, a concept developed by Siemens (2004) and later Downes (2005), helps to explain how learning networks develop within a digital environment. My investigation focused on employing the concept of connectivism as a way to first describe learning networks and then suggest how more sophisticated learning networks might be developed. A knowledge of networks led to a need for individual connectivity and thus the inquiry expanded to include elements of constructivist pedagogy and collaboration. A constructivist pedagogy focuses on active learners working collaboratively as defined by Lattuca (2006). Collaboration partnerships were understood by including how repeated exposure (as identified by Harris, O'Malley, & Patterson, 2003), teacher relationships to self, partner, and students, as well as curriculum content (Keefe, Moore, & Duff, 2004), and group dynamics (Gray, 1989, Palloff, & Pratt, 2007) enables successful partnerships. The concepts of connectivism, constructivism, and collaboration have been combined in an interactive website through a process of design as research that synthesize these concepts (Stapleton, 2005) within this emergent process (Bereiter,2005).

Comfort

Professional comfort levels were explored to understand potential impact of comfort levels when developing successful partnerships for cross-classroom collaboration. The act of selecting a collaboration partner can create discomfort because of the unknown characteristics of prospective partners (Vangen & Huxham, 2003). Vangen & Huxham (2003) explored international collaboration efforts, although not within the education sector. Nonetheless, useful lessons are offered. For example, the more clarity with which partners viewed each other, the more trust was built as initial collaboration expectations were formed. According to their research, potential collaborators found it important to decide if the 'risk of collaboration is worth taking' (Vangen & Huxham, 2003). For the purposes of this research, I have categorized the process of identifying potential collaboration partners within the term comfort.

The term comfort was drawn from the work of Melancon (2007) who studied the preparedness of teachers to teach within an electronic landscape. Drawing on the work of cultural geographers who categorize human locations within electronic landscapes that are technology rich and online, Melancon (2007) explored teacher readiness, using the term spatial comfort, and encouraged the gauging of these comforts through a self-identification process. The process of self-identifying spatial comfort assumed that practitioners would be professionally reflective when identifying their own comfort levels. Spatial comforts within the categories of classroom, location, technology, contact, and

response were seen as vital to the success of a teacher within an electronic landscape (Meloncon, 2007). She did not explore collaboration; however, her findings do translate to an understanding of how educators may attempt new practice within their classrooms. Technology facilitates cross-classroom collaboration projects so participant comforts within the elements of these partnerships may then lead to similar success as it has for teaching within electronic landscapes. Within my research, participants were not be asked to self identify within a negative context. Discomforts were not measured. Instead the self-identification of educators' positive feelings of comfort was identified within three categories: connectivity, constructivism, and collaboration.

Connectivity

The first element of comfort is connectivity, which allows a collaboration partnership to span a geographic distance. Connectivity as identified by Downes (2007b) involves the use of the internet and opens up different collaboration opportunities. That is, the amount of teacher experience using technology for educational purposes is also a factor during teacher collaboration (Hartnell-Young, 2006) and replaces the importance of geographic exposure, signifying the physical location of the partners (Harris, O'Malley, & Patterson, 2003), when collaborating. This concept of connectivity that spans geographic distance arises from connectivism, an emerging networked learning theory, initially explored by Siemens (2004) and Downes (2005).

Connectivism is an emerging field that draws on work about the

development of human networks (Barabasi, 2003), how information and influence is present within these networks (Gladwell, 2000), and how knowledge emerges within collaboration networks (Tapscott & Williams, 2006). For the purpose of this research I base my work on Downes (2005) and Siemens' (2004) structure of connectivism through their explanation of these networks' properties and how learning networks can be achieved. Connectivism is central to this research because of its link with connectivity, and because the central focus of the design object is to connect teachers for the purpose of cross-classroom collaboration.

Connectivism Described by Downes

Connectivism is premised on the understanding that learning is a social activity and applies the analogy of a network to explain the connections within communities. A network analogy led to the understanding that connectivity is important for teacher collaboration. Downes (2007a) describes learning as a social conversation occurring within a community or network. This work builds on Wenger's (1998) communities of practice and their characteristics of a shared concern and regular interaction. Downes asserts that connectivism is "a pedagogy that (a) seeks to describe 'successful' networks (as identified by their properties, which [he has] characterized as diversity, autonomy, openness, and connectivity) and (b) seeks to describe the practices that lead to such networks" (2007b, ¶ 7). This notion of successful networks revealed the need for potential partners to self identify connectivity comfort.

Forming a connection has been equated with learning by Downes; however,

the agency for this action rests with the individual. Downes states that learning "consists of the network of connections formed from experience and interactions with a knowing community" (2006, ¶ 2). We know because of our connections, while at the same time the opportunity for individual autonomy is a characteristic of learning networks (Downes, 2007c). Finding these connections organically may be problematic. The tools available may not facilitate a successful network and individual connectivity comfort may also hinder these connections. Connectivism places responsibility on the individual without concern for their level of connectivity. In this theory, consideration is not given to the problem of individuals who do not feel comfortable within this context. Technologies and tools for educators may need to emerge to apply this theory to more than a few educators with a high level of connectivity comfort.

Connectivism as Originally Conceptualized by Siemens

Connectivism originally conceptualized knowledge as resident within the connections between individual members of an information rich society. Siemens suggests that connectivism "acknowledges the tectonic shifts in society where learning is no longer an internal, individualistic activity" (2004, ¶ 21). His ideas are based on concepts of information chaos, self-organizing groups, and learning through formed connections: "The capacity to form connections between sources of information, and thereby create useful information patterns, is required to learn in our knowledge economy" (Siemens, 2004, ¶ 20). The ability to create these connections assumes a level of proficiency with communication or connection

forming tools.

My understanding of how an interactive website should function and the conceptualization of connectivity comfort were built on Siemens' emerging understanding of connectivism. Siemens (2005) pointed out that research should focus on "connection-forming tools" (p. 19). Later (2008), he addressed the role of the teacher within a classroom with communication technologies and digital communication resources. He suggested that the role of the teacher within such an environment may be to expose students to a network of resources and people within this connected environment. In other words, teachers need access to connection forming tools and this implies a need for high degree of connectivity comfort.

The understanding of connectivity changes over time as technology advances. The need for connectivity when collaborating has emerged in the literature (Virolainen, 2007). However Luke's (2003) understanding of connectivity focused on hyperlinking technology, which is the ability to link from one static webpage to another. Two years later, Smith & Potoczniak (2005) identified connectivity within the context of voice over the internet, instant messaging (internet based real time text communication between two or more individuals), blogs, podcasts (audio and video files that are syndicated, subscribed to, and delivered automatically via the internet), social media tools (software and websites that utilize the internet to share and discuss information between individuals), and other self-publishing internet platforms (websites that

allow individuals to publish various content types that are visible on the internet to a wide audience). A deeper understanding also began to emerge as they identified communication as one of the central connectivity concepts (Smith & Potoczniak, 2005). Communicating across vast distances has been identified as an important element of connectivity.

Like the term connectivity, the theory of connectivism is emerging and incomplete. However, connectivism is pivotal to my research object, the interactive website, as it is an example of Siemens' connection-forming tool. The dependency of a successful network on individuals who exhibit connectivity also informs this understanding of comfort. Connectivism provided the broad theoretical understanding of a partnering website and the connectivity element within connectivism was used as a comfort. Connectivity comfort included understanding basic communication tools, through to the ability to create communication platforms that span geographic distances (Smith & Potoczniak, 2005).

Constructivism

Within constructivist theories learners are viewed as builders of their own knowledge (Piaget, 1970; Vygotsky, 1978), and the context and environment of this constructed learning is seen as social interaction (Greeno, 1997; von Glasersfeld, 1995). For the purpose of this research the focus will be on activity theory within constructivism (Engestrom, 1999) and the learning activities that students and teachers are engaged in (Driscoll, 2000; Hung, Tan, & Koh, 2006).

Specifically, I draw on the definition of constructivist pedagogy offered by Lattuca (2006) in which "the active learner ... discusses, questions, debates, hypothesizes, investigates, and argues in order to understand new information" (p. 355). This matches the findings of Straits & Wilke, (2007) who used the binary of transmission teaching versus participatory models to identify constructivist practices. This active learner criterion was used when I asked teachers to self-identify their level of comfort with constructivist pedagogical practices. This self-identification informed the selection of collaboration partners and the interaction between these teachers. The alignment of functional duties of teachers, defined as constructivism comfort in this context, led to a more positive experience within the collaboration.

Collaboration

The comfort of collaboration was understood as an interactive process on a common issue. The understanding drew on the work of Gray who described collaboration as "an interactive process, using shared rules, norms, and structures, to act or decide on issues" (1989, p. 11), and is adapted in my research to focus on cross-classroom learning opportunities for students. Collaboration has been understood in the literatures as needing to progress through stages (Thomson & Perry, 2006), a self-interest motive (Huxham, 1996), trust (Mayer & Norman, 2004), coordination (Faraj & Sproull, 2000), and communication (Weick, Sutcliffe, & Obstfeld, 1999). Geographically distributed collaboration in education has also been understood within the concepts of social

ties, knowledge sharing, product creation, and personal satisfaction (Kotlarsky & Oshri, 2005). However this research focused on linking collaboration partners using collaborative comfort defined as repeated exposure and professional similarity as the final self-identification element.

The repeated exposure was used to build collaboration comfort from the work of Harris, O'Malley, & Patterson (2003) who drew upon a study of professionals within the legal sector to study how collaboration was influenced by characteristics of professional attraction. This study was applicable to my research as it focused on how professionals related to each other. Repeated exposure (Harris, O'Malley, & Patterson, 2003) refers to the expected frequency of contact between partners. These expectations for contact are best understood when partners have had similar past collaboration experiences. Repeated exposure was enhanced if the collaboration partners had similar professional backgrounds (Harris, O'Malley, & Patterson, 2003). Building on the understanding of repeated exposure and professional similarity, my research defined collaborative comfort as the self-identification of the number of previous experiences with cross-classroom collaboration projects.

Virtual Convener: Enabling Reflective Practice, Trust, and Empowerment

A website as virtual convener builds on the collaboration literature about trust (Gray, 1989), and the understanding of reflective professional practice (Schön, 1983) within the context of online learning communities (Palloff & Pratt, 2007). The virtual convener concept also draws on the research about

empowerment of professionals in collaborative situations (Keefe, Moore, & Duff, 2004), and how professionals make choices (Pomsom, 2005; Gardner, 2006) within the context of connectivism (Downes, 2005; Siemens, 2004). The important aspects that have emerged as a focus for the virtual convener are user self-identification and user self-selection.

Virtual Convener: Empowering User Self-Identification

The research object developed must act as a virtual convener encouraging self-reflection, empowering professional choice, and engaging participants as active community members seeking cross-classroom collaboration opportunities. Professional reflective practice develops through joining this community and developing a virtual identity. In his foundational work on professional reflection, Schön (1983) warned against teacher isolation within the work of a classroom. He encouraged linking teachers together so they can work together, share ideas, and "test them against the views of [their] peers" (p. 333). He even looks toward educational technology as providing an answer if it "does more than extend [teacher] capacity to administer drill and practice" (p. 333). Twenty four years later, with the advent of the internet and many communication technology advances, Palloff & Pratt (2007) promoted building online learning communities with teachers that would develop their electronic personalities. These personalities promote an internal dialogue and the creation of a presence online (Palloff & Pratt, 2007). Notably, researchers have found that embedding a reflective element in professional collaborative connections is important (Hartnell-

Young, 2006). Learning through complex social interactions is made possible with reflexivity, as the practitioner's intentions are understood within a framework for reflection (Siraj-Blatchford & Siraj-Blatchford, 1997). Key elements of successful offline teacher collaboration have been identified as knowing yourself, your partner, your students, and your content (Keefe, Moore, & Duff, 2004). Self-identification of teacher comfort within connectivity, constructivism, and collaboration may develop the offline collaboration practice of knowing yourself and realizing some of the education technology promise to which Schön (1983) referred. Elements of successful offline teacher collaboration need to be applied to this online environment and made visible to participants to enhance teacher learning about teaching.

Virtual Convener: Empowering Self-Selection of Partners

Professional autonomy must be built into the research object that allows teachers to choose their partner and project for a cross-classroom collaboration. Pomson (2005) notes that educators who share similarities are best aligned with each other. Pomson drew on the work of Kruse, who in several studies identified the importance of teacher responsibility, reflexivity, and agency in creating professional communities (Louis, Marks, & Kruse, 1996; Kruse, 2001; Kruse, 2003). It seems important, then, that the power for partnering and project selection be given to the educator. These concepts of empowerment, teacher responsibility, and reflexivity are echoed in the works of Downes (2007b) and Palloff, & Pratt (2007). The properties of connectivism's network dimension,

diversity, autonomy, openness, and connectivity (Downes, 2007b, ¶ 7), align with elements that build online learning communities identified by Palloff, & Pratt (2007) that include "honesty, responsiveness, relevance, respect, openness, and empowerment" (p. 228). The offline elements of successful collaboration, namely knowing your partner, your students, and your content (Keefe, Moore, & Duff, 2004), were added into this process of empowering educators when selecting partners and projects.

Empowered educators may then choose collaboration partners and projects that are within an attainable range of their current comforts. The ideas of Gardner (2006) suggests how partners and projects may be selected within this research object, an interactive website that acts as a virtual convener. Gardner (2006) asserts that successful learning experiences occur when the object is divided into small attainable steps. In the development of these concepts Gardner builds on the concepts of scaffolding and the zone of proximal development (Vygotsky, 1978; Vygotsky, 1962). Empowered educators are now able to choose the small step that is most important to them when selecting a partner and project.

An interactive website that openly empowers educators in the process of selecting partners for collaboration enables the interactive website to become a virtual convener. The most important trait of a convener is trust (Wood & Gray, 1991). Trust or 'openness' also has been identified as an essential element of successful networks within connectivism (Downes, 2007b) as well as being

aligned with the honesty, openness, and respect identified by Palloff & Pratt (2007) as important when building online community. Procedures were put in place to make the interactive website's partnering system visible and thus build the trust in this virtual convener.

Usability and Function

The research question required the exploration of a digital environment in order to partner teachers for cross-classroom collaboration. This understanding of the digital environment and its creation was informed by concepts of usability and function for the design of the research object drawn from the field of computer science. Usability has been understood in this research as "a quality attribute relating to how easy something is to use" (Nielsen & Loranger, 2006, p. xvi) within the context of the Internet. This understanding is informed by the concept of "interface layer" as one that connects people with the data they are attempting to access (Hoekman, 2007, p. 6) and examining how internet users actually use the webpage (Krug, 2006). Internet usability has developed from traditional design dialogue (Nielson, 1990) and measurement of behaviour and human factors in computer software (Nielsen, 1994). It is also intertwined with the field of information architecture in system design (Morville, 2002; Rosenfeld, 2002).

The concept of selecting the functions in the design object, an interactive website, was informed by agile software development from the field of computer science. This process focused on building key functions into a software

environment with smaller design teams (Lindstrom & Jeffries, 2004). The understanding of agile software development informed decisions about the function of the design using elements of user stories (Cohn, 2004) and making decisions to enhance simplicity (Agile Manefesto, 2001) based on user roles (Cohn, 2004). This approach was informed by inquiring systems that compare multiple data sources to make design decisions when functions are chosen (Carugati, 2008). The multiple data sources are derived from the test-driven development process (Janzen & Saiedian, 2008). The function of the research object was informed by multiple data sources and the user roles feedback as described in more detail in Chapter 3.

Review of the Field

The review of the field looked at some resources, websites, and support that assist teachers with cross-classroom collaboration. The categories explored were project-based collaboration resources, teacher connection resources, and tools that have emerged to create these types of teacher connections. Resources within these categories was compared for emerging similarities and differences.

Project Focused Resources

There are several websites that provide project based collaboration resources (International Education and Resource Network, 2008; The My Hero Project, 2008). These sites had projects that were submitted by users (International Education and Resource Network, 2008; Wagner, 2008) or created

by the website organization (The My Hero Project, 2008). The International Education and Resource Network (2008) allows users to find projects based on title, keyword, subject, age level, and language. Projects available include global writing anthologies, measuring and comparing environmental impact, and creating post cards. OnlineProjects4Teachers (Wagner, 2008) asks users for their name, school name, grade level, website, collaboration tools, school location, and desired collaboration partner classroom grade level. Projects are shared in the forum section and include blog buddies, science experiments, and a counting book. Potential collaboration partners reply to the unique conversation thread for each project. The My Hero Project (2008) focused on creating a webpage or a film about a hero. The My Hero Project (2008) and OnlineProjects4Teachers (Wagner, 2008) each achieved limited success with a few hundred active members. Each website allows users to contribute to a project and two resources identified projects according to grade level, subject, and location.

Projects from online resources, professional literature, and academic literature have generally categorized cross-classroom collaboration projects by academic level of the students, or by the technology tool that is being used. Projects that use blogs, wikis (an internet page or site that is able to be edited by a selection of users or by the public to modify, edit, and create content pages), e-portfolios (digital artifacts archived online or offline to demonstrate understanding of a concept or display a body of work), online video (video that is available

online to view, usually short clips, that often allow commenting, rating, and responding with new videos to the original clip), voice over the internet conferencing, and Internet based word processing and spreadsheets (applications that are hosted on an internet server and can be accessed through a web browser allow advanced collaboration features without running a traditional computer program for word processing and spreadsheet functions on individual users' computers) have all been identified and advocated within a variety of education settings (Loertscher, 2007; Siegle, 2008; Yan, 2008). Researchers in the literature have also discussed linking students together based on their subject or age level (Karchmer-Klein & Layton, 2006; Boss & Krauss, 2007). Beyond logistics and tools these projects have not been sorted into any hierarchy or theoretical clusters.

Teacher Connecting Resources

There are several websites, that focus on connecting teachers for collaboration, that attract thousands of teachers (Epals Inc., 2008; Hewlett-Packard, 2008; TakingITGlobal, 2008). Two of these sites collect information from each teacher based on topic, geographic location, ages, and language (Epals Inc., 2008; TakingITGlobal, 2008). Hewlett-Packard (2008) uses information such as grade level, subjects, and technology used to link teachers for the purpose of sharing classroom, technology, and life resources. Each site's purpose was to link teachers based on the profile information collected.

Multiple collaboration resources have identified logistical elements essential

for collaborative endeavors. Logistics are a common focus for resources that provide collaborative projects and that match teachers for collaborative projects. These logistic elements included grade level or age of students, geographic location, technology used, and subject taught.

Tools

Several tools have been used to facilitate connecting teachers for collaborative partnerships. There are unstructured and structured tools as well as customizable open source platforms being used to create interactive websites. A number of websites, such as Twitter and Plurk, offer unstructured tools that enable small messages to be sent to custom online networks of friends and followers (Wikipedia contributors, 2008a). A more structured tool, Ning, allows users to create customized social websites for groups of people (Wikipedia contributors, 2008b). There are also highly customizable, open source platforms for developing multiple user websites for group collaboration such as Drupal, Joomla, and Wordpress (Wikipedia contributors, 2008c). These tools provide different options based on preferences when creating interactive websites.

Summary

The review of the literature reveals that connectivism forms a significant part of the theoretical foundation informing the design and development of an interactive website that functions as a virtual convener. Collaboration partnerships have previously included comforts of classroom, location, technology, contact, and response. In this work it is necessary to expand on

previous knowledge in the field to include the categories of connectivity, constructivism, and collaboration. An interactive website was designed using several tools available in the field that addresses usability and customized functions. It is not surprising to find that websites focused on logistics dominate the current cross-classroom collaboration tools available for teachers. As a review of the literature has demonstrated, the need to expand upon earlier, limited forms of connecting teachers is needed as indicated by the limited success of the current resources in the field, evidenced by the modest number of active users on these websites. Understanding the academic literature and available resources in the field influenced the research process, design as research, discussed in the next chapter.

Chapter 3: Design as Research

In order to best explore the research question posed, I selected an emerging methodology, 'design as research' (Bereiter, 2005; Wang & Hannafin, 2005; Stapleton, 2005; Spinuzzi, 2005; Bell, 2004; Joseph D. , 2004; Ireland, 2003). I chose this methodology because design as research embeds a thoughtful understanding of theoretical constructs into the creation of an object and synthesizes academic literature into a practical application. This process of creation embeds higher order thinking into the research process as defined in the Revised Bloom's Taxonomy (Krathwohl, 2002) in order to enhance the understanding derived from the research process. Design research allows higher order thinking to emerge from a close collaboration between researcher and teacher practitioner. The methodology provides an opportunity to develop a dynamic and interactive website for teacher cross-classroom collaboration partnerships, although the opportunity to create the research object is limited by the design platform.

The original Bloom's Taxonomy (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956) identified evaluation as the highest order of thinking. However, the latest revision of Bloom's taxonomy by Anderson & Krathwohl (2001) placed creating as the highest order of thinking. Beyond just remembering or recalling knowledge, Anderson & Krathwohl state that creating is "putting elements together to form a coherent or functional whole; reorganizing elements into a new

pattern or structure through generating, planning, or producing" (2001, p. 67 - 68). Design as research is focused on creating a coherent and functional research object and hence involves the highest order of thinking. The researcher must not only understand the research concepts, but must create a new structure when assembling these concepts in a research object.

When used in education, design as research demands close collaboration between designer and practitioner, making something new, removing obstacles and finding potential, and committing to an emergent process (Bereiter, 2005). Design, research, and practice are advanced within this methodology (Wang & Hannafin, 2005). This process also focuses on the general sequence of "problem-analysis-synthesis-evaluation" (Stapleton, 2005). Information from current research is melded together with practice and a design platform. The research question provides the context and the process produces a synthesis of knowledge from the academic literature within a research object that is created.

Participatory evaluation is embedded throughout the design and creation of an object because a user group provides ongoing feedback (Spinuzzi, 2005). Users are embraced within the process of designing a solution to a problem. This leads to the synthesis of related research within the context of practice. The research design "evolves through a process that is part deterministic but also part organic" (Hasan, 2006, p. 10). Spinuzzi (2005) described this methodology as "explore, approximate, then refine" (p. 168). Understanding emerges during this close collaboration between researcher and practitioners within the context of

academic knowledge and design platform constraints.

Design as research provides a methodology for the systematic creation of a research object. This methodology incorporates higher order thinking, an emergent process, close collaboration with practitioners, and the application of my technical knowledge about creating interactive websites within the domain of education research.

The Method: Design as Education Research Framework

The research method used was the Design as Education Research Framework, (DERF). As I investigated the limited applications of design as research, two main areas emerged to match my research focus: education and computer science. The research question stems from the education context, while its response lies in computer science.

Education research has a limited history with design as research, or design-based research (Bell, 2004; Joseph D. , 2004; Bannan-Ritland, 2003) The Integrative Learning Design Framework (Bannan-Ritland, 2003), (ILD), provided an initial education based framework for this method. The purpose of this framework is to "leverage learning and teaching by making insights usable, actionable, and adoptable" (Bannan-Ritland, 2003, p. 21). This purpose is congruent with the goals of this research. In my DERF project, research theory was synthesized into an interactive website that made these insights usable, actionable, and adoptable. Despite the common goals between both models, the ILD focuses on offline solutions to offline challenges. As I worked with the ILD, I

realized that it was limited in providing a technical response to the research question and had to be adapted during the process.

The research question, while situated within an educational context, had an implied need for an online and technical solution. The design as research literature in the computer science field was examined (Hasan, 2006; Stapleton, 2005; Wang & Hannafin, 2005; Spinuzzi, 2005; Cohn, 2004), including research that overlapped with learning environments (Wang & Hannafin, 2005). This work, along with the influences from field of design (Ireland, 2003; Zimmerman, 2003; Fogg, 2003), informed the ILD and the adapted DERF emerged to address all aspects of the research question.

Data Sources and Analysis

My data sources included,

- the research object itself, that is, the resulting interactive website designed;
- a development journal, within a blog of the design process that included technical understandings of Drupal development framework, modules that provide functionality, other related frameworks such as PHP, XHTML, and databases, and documented design decisions;
- feedback gathered from a small 'development panel' of participants (see Appendix A and Appendix B), including audio recordings of conference calls and regular screen captures of development to document the refinement process;
- current literature in the field.

Through the design process, I reviewed all of the data in order to refine, revise and synthesize the development.

The DERF used three stages: exploration, design, and implementation (see Figure 1). These were based on the four sequential stages of development that the ILD contains: "informed exploration, enactment, evaluation: local impact, and evaluation: broader impact" (Bannan-Ritland, 2003, p. 21). The three stages of the DERF provide a clear beginning, middle, and end. The exploration stage began the process and set the stage for the design research. The design stage was messy and extensively documented to capture how the initial concepts were synthesized as the design was built, tested according to the concepts discovered within the exploration stage, revised, and rebuilt. In the final stage I implemented the research and feedback into the design, reflected on the resulting object using the initial context and goals of this research, and it was then published as an interactive website to be shared with the wider community.

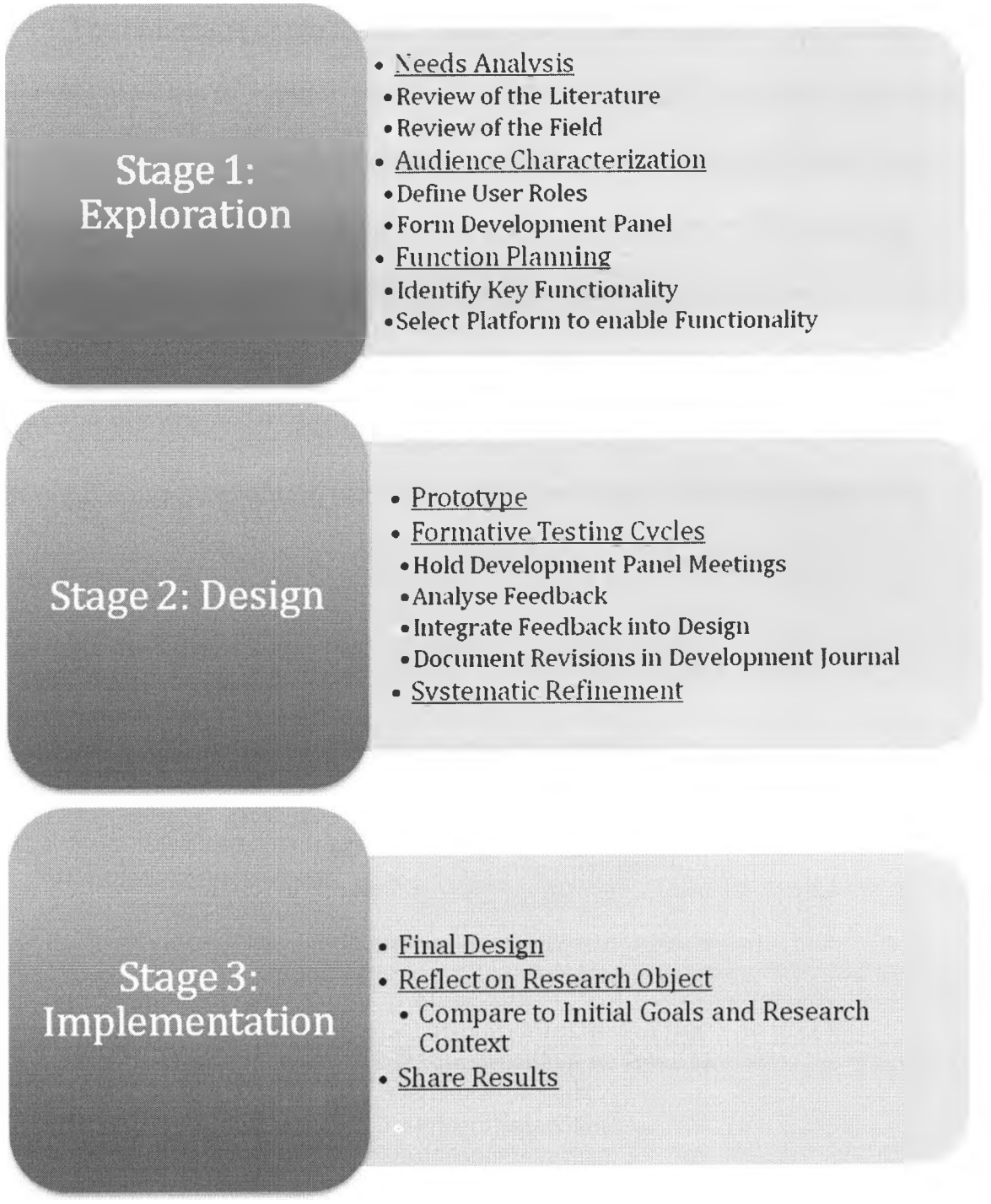


Figure 1. Design as Education Research Framework. A sequential overview of the stages used in this research.

Stage 1: Exploration

The first stage of the DERF is exploration (see Figure 2). This stage was derived from the foundation provided by ILD's first stage, informed exploration that includes the following elements: conduct a needs analysis, survey the literature, develop a theoretical framework, and characterize the audience (Bannan-Ritland, 2003). The DERF's exploration stage was important to set the theoretical framework through defining the context, purpose, and goals that directed the design as research process. This exploration was developed through a needs analysis, audience characterization, and function planning.

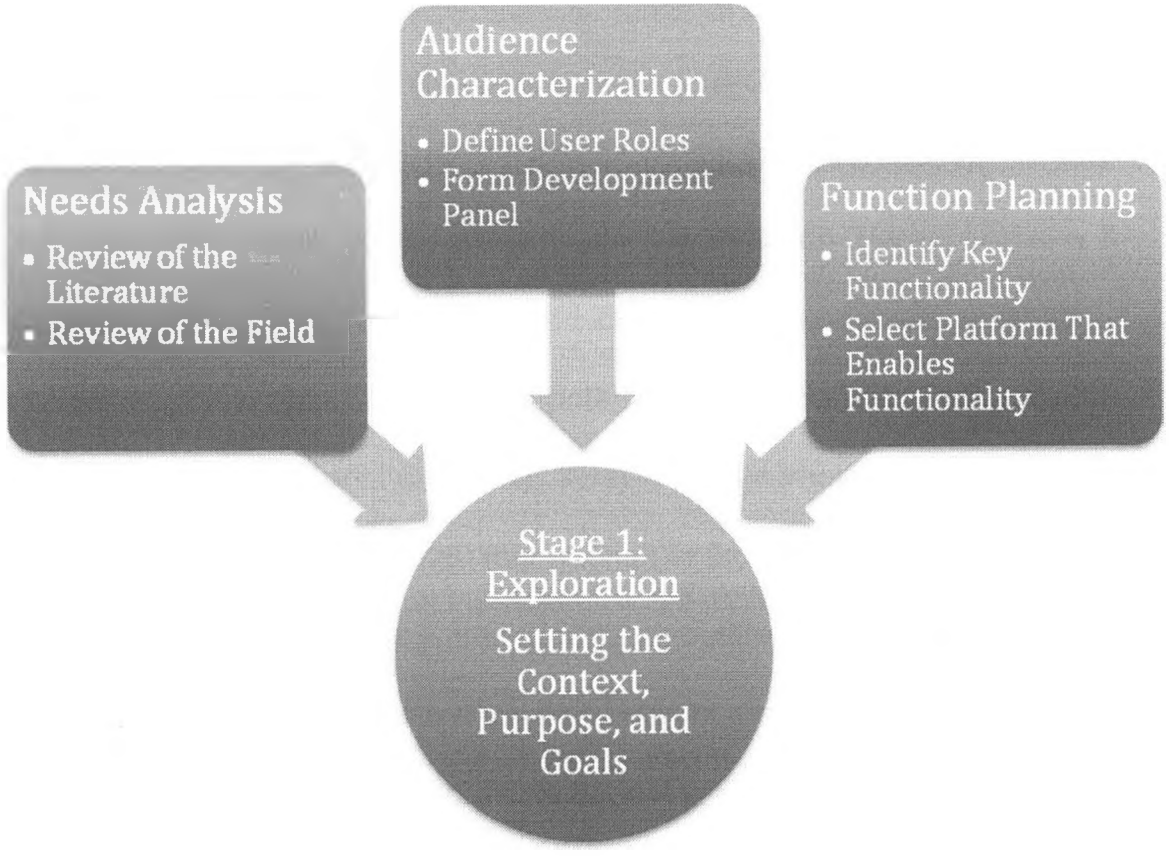


Figure 2 Elements that form the context, purpose, and goals for the design research within Stage 1: Exploration.

Needs Analysis

The needs analysis within the first stage of the DERF included a review of the literature and a review of the field. The preliminary review of the literature, discussed in Chapter 2, identified existing research about online communities (Palloff, & Pratt, 2007) along with concepts about professional comfort (Meloncon, 2007) with connectivity (Downes, 2005; Siemens, 2004), constructivism (Lattuca, 2006), and professional attraction (Harris, O'Malley & Patterson, 2003). The review of the field identified a strong focus on cross-classroom collaboration with students (International Society for Technology in Education, 2007; Joseph L. C., 2007). A review of internet websites (Wagner, 2008; ePals, 2008; iEARN, 2008) that attempt to facilitate these interactions revealed a lack of theoretical understanding as outlined during the review of the literature. This exploration of the current needs began to enable the definition of a research object. The research object became an interactive website that synthesized these research concepts to address needs of teachers of various technical and pedagogical comforts interested in cross-classroom collaboration.

Audience Characterization

The audience characterization within the first stage of the DERF included defining user roles, and forming the development panel. User roles were understood to include a variety of potential website users (Cohn, 2004). The user roles for this site included: classroom teacher, school administrator, district

technology coach or consultant, education researcher, and social networking consultant unrelated to the education field. Geographic diversity (i.e., urban as well as rural participants), a mixture of different nationalities, and a range of teaching experience were also valued. These characteristics were aligned with the characteristics of current collaborative project sites identified through the review of the field. After defining these roles, a list of individuals who matched these criteria was generated. Once ethical approval was received, these individuals were contacted, one at a time, and invited to join a development panel to provide feedback to inform the design process of the research object, an interactive website. The number of panel members was limited due to the need to receive focused and clear feedback during the design process. Each of the seven individuals contacted agreed to participate in the research, and they all requested their names be used. The selection of the development panel members was based on developing a diverse group that resembled various target users. The purpose of the panel was not to generalize to a larger population, but rather, to seek feedback to inform development of the research object. Their feedback may be representative of their group and hopefully results in an object well suited to the target population's needs.

The development panel members were divided into two groups: non-teaching and teaching. The non-teaching participants were Alec Couros and Lisa Creech Bledsoe. Their biographies provide an overview of their academic and outsider perspectives (see Appendix A). The teaching participants were Joan

Badger, Tom Barrett, Tammy Bryant, Jess McCulloch, and Katie Morrow. Their biographies provide an overview to their unique perspectives, geographic locations, and experiences (see Appendix B). The teaching group was also asked about their comfort with cross-classroom collaborations, computer hardware, software, and websites. They were also asked for any potential plans for using the resulting design object.

Function Planning

The first stage within the DERF concluded by using the understanding developed through the needs analysis and audience characterization to identify the key functionality of the research object, the interactive website, and the platform that would enable the selected functions. Before deciding on the key functionality that the design needed, the previously explored context was examined to determine a clear direction. Upon reflection I determined that the research object would be an interactive website that would be a place for K-12 teachers to find other teachers for cross-classroom collaboration. It is generally accepted practice within the interactive web design community to define the purpose of a website being designed in terms of what will be accomplished via the website, including the functions that will be designed (Nielsen & Loranger, 2006; Hoekman, 2007; Krug, 2006). The potential site was also defined according to what will not be accomplished on the site, including functions that are removed from the design.

The site was defined as a virtual convener. It facilitates a 'handshake' between teachers interested in cross collaboration projects. The virtual convener connects teachers in more complex ways than simple demographics or geography. The comforts in connectivity, constructivism, and collaboration make this 'handshake' more intelligent. Using this definition led to the identification of the necessary functions that were descriptive and would inform the design process (Cohn, 2004). The key functions are described below:

1. A user creates a unique user name and password to access the website that is verified via their provided email address.
2. Each user develops a user profile that is only viewable by other members of the site.
3. Users request friendship with other members of the site.
4. Users send messages within the site to each other, privately or publicly viewable by other members of the website.
5. Users schedule projects in a calendar that is viewable by other members.
6. Users have the ability to find other members based on their profiles for cross-classroom collaboration.
7. Users have the ability to find projects that match individual user interests for cross-classroom collaboration.

Defining what is not the site's purpose also influenced the list of functions. This site does not host tools for cross-classroom collaboration projects. These

tools change quickly and are best left to specialist in these areas (e.g., classroom blogging, voice & video conferencing, and real time collaboration on documents, presentations, & spreadsheets). On this site members can find a collaboration partner to jointly create projects that use these tools. This site does not promote a limited menu of projects. Instead, a user is encouraged to browse other projects, find a collaboration partner, and develop a project that is simple or complex, one time or ongoing, and customized for their own students, curriculum, and comforts.

The functions required to design the research object directly influenced the selection of a design platform. This interactive website platform had to support multiple users, allow for them to enter information, define relationships between users, calendar, and recall the information entered by users in several ways. The open source platform selected to accomplish these tasks was Drupal. It provided a flexible, yet powerful framework I believed that I could learn and that is supported by a large community of software developers (About Drupal, 2007; Douglass, Little, & Smith, 2006; Mercer, 2006; VanDyk & Westgate, 2007). Because Drupal is open source software the interactive website could be developed at little cost.

The first stage set the context for the research through the needs analysis, and this understanding led to characterizing the audience. The roles of users influenced the selection of the development panel, and provided the purpose for the research object that would be developed. Finally, the function planning

element of the exploration stage used the context and purpose to understand the key functions required in the development of an interactive website as a design object. These functions became the goals of the design that were informed by the theoretical context and practical context in which this research object, an interactive website, would be situated.

Stage 2: Design

The second stage of the DERF is design (see Figure 3). This stage began by creating a prototype of the design, exposing that prototype to several formative testing cycles via the development panel to produce systematic refinement of the research object, an interactive website. This stage was based on many of the elements within the second and third stage of the ILD. The key components from these steps were creating a prototype, detailed design, formative testing, and system refinement (Bannan-Ritland, 2003). The DERF enhanced the essential element for design research, collaboration between researcher and practitioner (Bereiter, 2005). The agile development process influenced the design though the incorporation of elements such as planned functionality and the development panel's feedback. This process, originating from a technical perspective, promotes designing short segments of the end product that are responsive to the functions, feedback, and design platform constraints through the design process (Cohn, 2004). Agile development process differs from a traditional develop process that preplans the entire design process before beginning development.

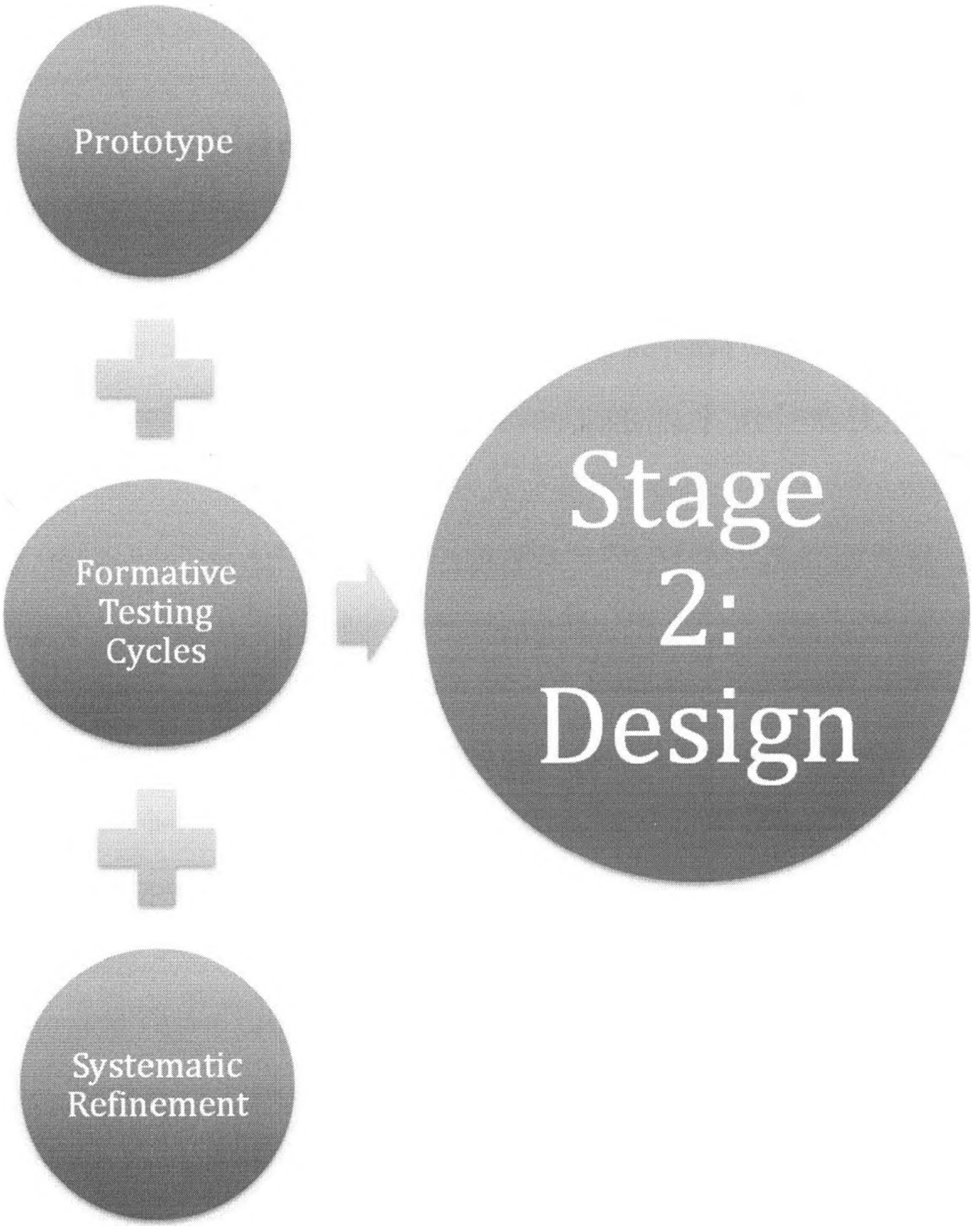


Figure 3 The initial prototype is revised through several formative testing cycles that leads to system refinement within Stage 2: Design

Prototype

The prototype of the interactive website was developed on the Drupal platform with a focus on building the functions outlined within the exploration stage into this research object. This initial version of the interactive website lacked several important key functions, but was a workable website that could begin the formative testing cycles. The Drupal platform allowed me, as researcher and designer, to customize the features and functions of the website by adding modules with different functionality to the core Drupal installation (Douglass, Little, & Smith, 2006; Mercer, 2006). The website was hosted on a private server at the publicly available address teachersconnecting.com. As researcher, I was the sole designer and author of this interactive website, and maintained full control of it. The first prototype, however flawed, provided the important foundation for addressing the context, purpose, and goals of the research.

Formative Testing Cycles Leading to Systematic Refinement

There were three distinct formative testing cycles that influenced the design; feedback was gathered from the development panel about the interactive website based on items of usability, functionality, and theoretical context (see Figure 4). The number of formative testing cycles was selected to ensure that members could commit to full participating and I, the researcher, could design the website using their feedback between meetings during the three month development

period. The selection of three formative testing cycles also enabled the ongoing collaboration, refinement, and systematic implementation of concepts between the panel and I that is a hallmark of 'design as research' (Wang & Hannafin, 2005). Three testing cycles also insured that the development panel members were able to member check (Seale, 1999) their contributions to verify the implementation of their feedback into the design. The testing cycles took place from May to July 2008. Focus questions and concepts were sent in advance to the development panel. These meetings took place using multiple mediums, including online feedback via group voice over internet protocol (VOIP) conferences, instant messaging sessions, and email conversations that documented each person's interaction with the design, as part of the Design Research process (Ireland, 2003). Participants were asked to respond specifically to the functions of the interactive website according the criteria outlined for each of the categories of connectivity, constructivism, collaboration, and logistic elements through open-ended prompts. The development panel's feedback for each website function was recorded and organized according to usability, and function. Feedback and observations were analyzed according to the theoretical context, purpose, and goals of the site as well as the ability to include or revise elements of the interactive website. Ultimately, as the researcher and designer of this interactive website, I made the final decision about which feedback elements would be incorporated, especially when the feedback was not consistent among development panel members and reflected

personal preferences. The interactive website changed greatly, and adapted during this emergent process (Bereiter, 2005) as new opportunities and limitations in the design were encountered.

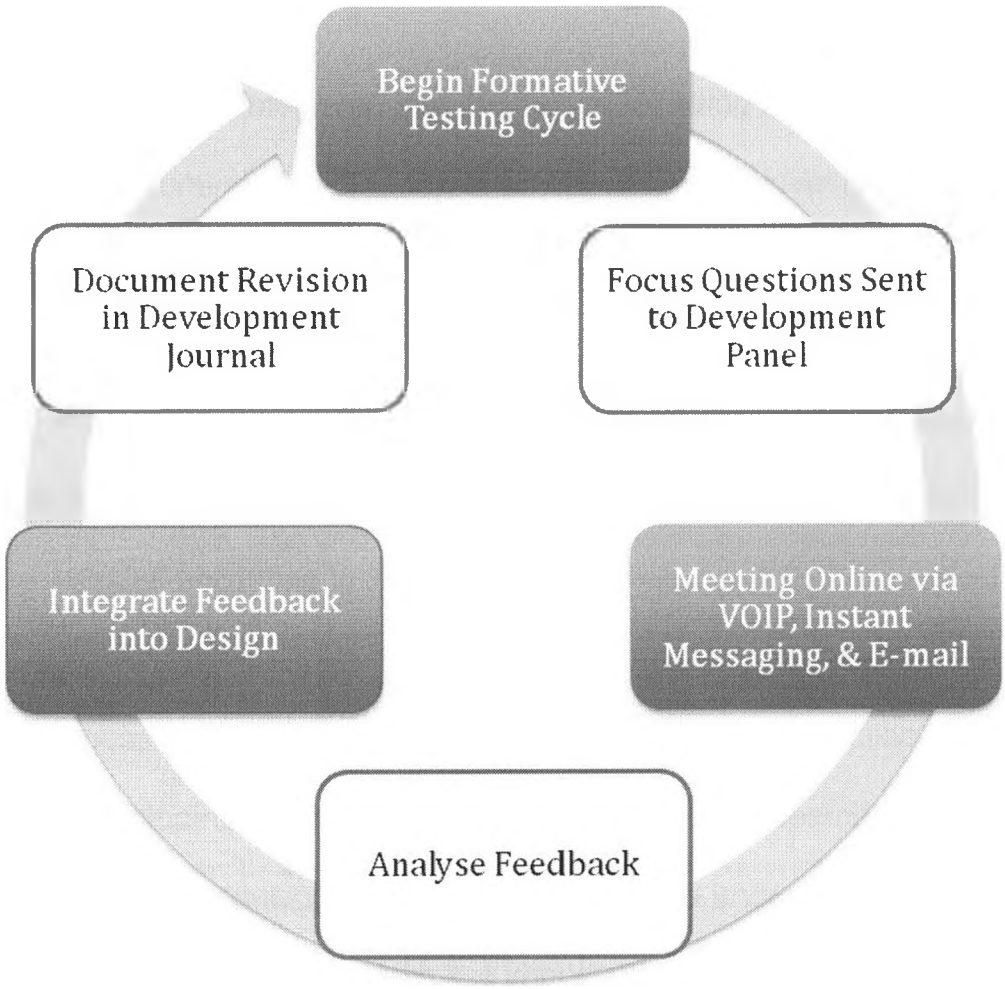


Figure 4 The formative testing cycle that incorporates feedback from the development panel into the design process.

The feedback was integrated into the design following each meeting and revisions were documented in the form of an online development journal using screen captures of the interactive website and text to explain the changes. Wang and Hannafin (2005) identified this type of collaboration, refinement, and systematic implementation as essential components of design-based research. This design process led to a systematic refinement of the research object, an interactive website, according to its situated theoretical context and practical context.

This process of formative testing cycles involved extensive collaboration between the development panel members and me, as the researcher, to change, and adapt the design resulting in the emergence of new understanding. Johnson (2003) noted that in Design Research it is important for improvisation to be performed within a design team that informs the creation of the research object. Stapleton (2005) highlighted systematic reflection through reflective conversation as an essential element of this process. During this process of collaboration, design, and improvisation I recorded the process of design by keeping a detailed research journal. This journal increased self-awareness through the design process and documented the details of the design so that I could return to in the later stages of analysis to triangulate my data sources.

Stage 3: Implementation

Stage 3 of the DERF is implementation. This stage is characterized by the final design, reflection on the research object through comparison to the initial goals and research context, and sharing the design object with a larger audience. This implementation stage of the DERF was founded on elements of the third and fourth stages of the ILD. Some of the elements identified by Bannan-Ritland (2003) in these stages are implementation, evaluation of results, and publishing. The implementation is the final design of the research object within the DERF.

As with the previous stage in the design process, the final design was reflected on by the development panel. They were asked how the final interactive website has achieved the objectives of connectivity, constructivism, collaboration, and logistic elements. The development panel also reflected on the complexity of the partnering system developed on the website and compared how this interactive website is similar to or different from other current teacher collaboration sites in the field. It was a final opportunity to revisit the designed interactive website's initial context, purpose, and goals.

The results of this design research were shared when the design object, the interactive website located at teachersconnecting.com, was made available to the public along with the development journal and screen captures taken during the research process. Elements of this research explaining the theoretical context will be available electronically from within the interactive website.

Trustworthiness

Triangulating the various data sources provided greater trustworthiness (Lincoln & Guba, 1985) in the research process. The data sources triangulated were the research object, development journal, development panel feedback, and current literature in the field. I reviewed all of the data in order to refine, revise and synthesize the development. By comparing and cross-checking the feedback from the participants with my own thoughts about the design process and positioning it next to current literature in the field, I noted the consistencies and inconsistencies in the data to deepen the analysis and the design response. The multiple meetings of the development panel through the design process also led to member checking feedback by allowing design elements that were created based on their comments to be clarified when the design was shared for further feedback.

Similarly, the development panel reflected on the completed final design. This reflection allowed development panel members to 'member check' their contributions. Member checking ensured the authenticity of the data leading to trustworthiness within the research (Seale, 1999). This authenticity was evidenced by the development panel's comments that the final design reflected their feedback.

Implications and Limitations of the Research Design

The use of Design as Research as a methodology may be somewhat limited due to the immaturity of its application, inherent bias, and technological

limitations. Design as Research to date, has seen limited use within educational research and the competing frameworks have significant differences (Wang & Hannafin, 2005). The DERF was used to maximize the consistency and clarity of method.

An inherent bias within this research begins with the premise of the value is *located in collaboration and the decision making power of the researcher.* Bereiter (2005) states that "design researchers in education have chosen to accommodate to the prevailing values" (p. 18). This research sought to use feedback to refine an object based on the previous evaluation of collaborative and constructive research instead of evaluating these ideals. I, as researcher and designer, made the final design decisions based on the development panel feedback, theoretical context, and the design platform's limitations. These decisions were guided by my prevailing preferences when faced with contradictory data.

The technological limitations of the Drupal platform and distance between development panel members prevented elements of the research to be fully understood and implemented. The research undertaken did not attempt to revolutionize a concept, but instead to evolve understanding with the synthesis of research and practical implications of a research object. The interactive website attempted to incorporate all the planned research elements. Observing development panel members interacting with the website would have provided further understanding (Nielsen & Loranger, 2006; Cohn, 2004). The oral and

written feedback of the development panel provided the most realistic and practical way to collect data from the members who were great distances from each other.

Chapter 4: Design

The development of the research object, an interactive website, produced several data sources that were triangulated to make design decisions. The data sources were the research object via screen captures, a development journal, feedback from the development panel, and current literature in the field. Feedback from development panel members was summarized to capture the consensus of the panel's perspective. Individual members are identified, as they requested, when quoted to illustrate specific ideas. Complete development journal entries and screen captures are available at http://benhazzard.com/thesis. The data were reviewed to refine, revise, and synthesize cross-classroom collaboration concepts during the website development. The design chapter documents the interaction between these various data sources during the DERF's second stage: Design. This documentation is organized into the design process milestones from the DERF. These milestones are: prototype, three formative testing cycles each with a development panel meeting, and final reflection.

Prototype

The prototype was developed before the initial formative testing cycle began. This initial version of the website provided the foundation for the design process. The functions, as identified in the DERF's Stage 1: Exploration, were built into the website at this stage and are described here.

1. A user creates a unique user name and password to access the website that is verified via their provided email address.
2. Each user develops a user profile that is only viewable by other members of the site.
3. Users request friendship with other members of the site.
4. Users send messages within the site to each other privately or publicly viewable by other members of the website.

The prototype began by installing the Drupal 5.7 website platform (see Figure 5) and adding modules to achieve the functions identified.

The key functions either utilized the basic features already included within Drupal or I added the modules that were needed for additional features. The first function indentified was for users to sign up for the site and verify their registration using their email address. This feature was built into the basic Drupal installation. The user profile function was achieved using the Advanced Profile Kit, and the Bio modules (see Figure 6). Users were then able to enter information into fields on their profile organized into basic information, comforts, and contact sections (see Figure 7). The content of these sections was based on the understanding of logistics, and comforts explored in Chapter 2. Installing the Buddy and Privatemsg modules fulfilled friendship and messaging functions within the site. Permissions based on a user's role were changed within the Drupal interface so that content created was only viewable by other members of the website.

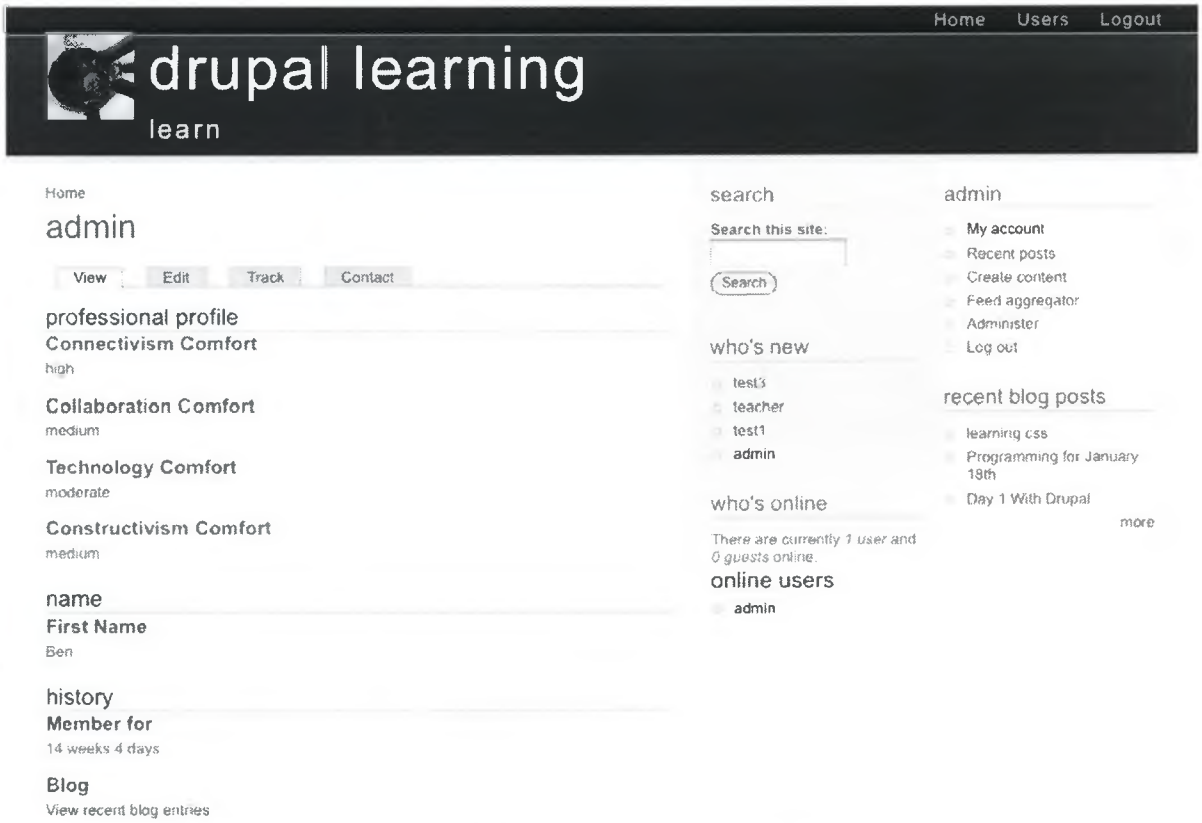


Figure 5 Initial website with basic comforts connected to an individual user.

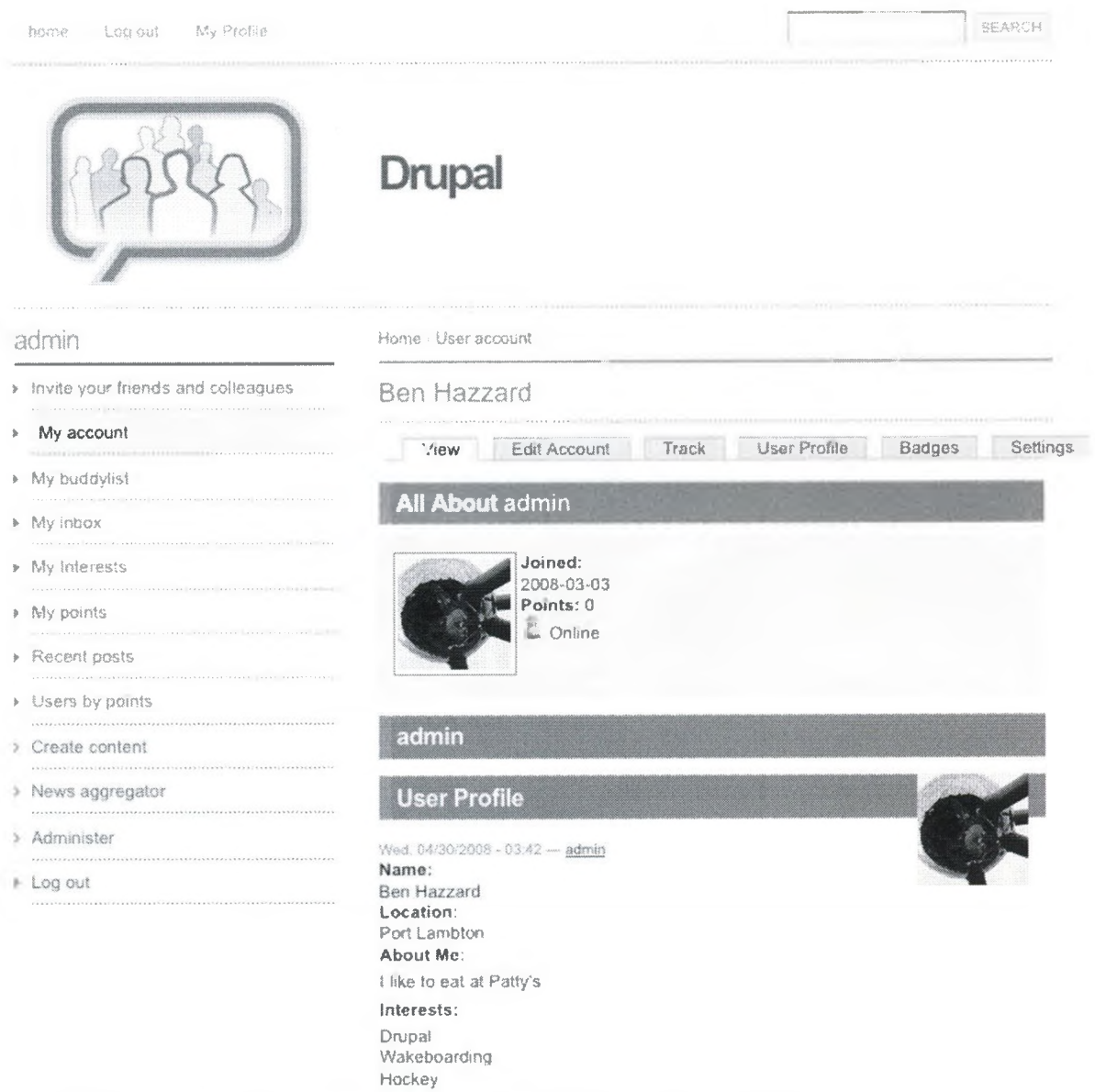
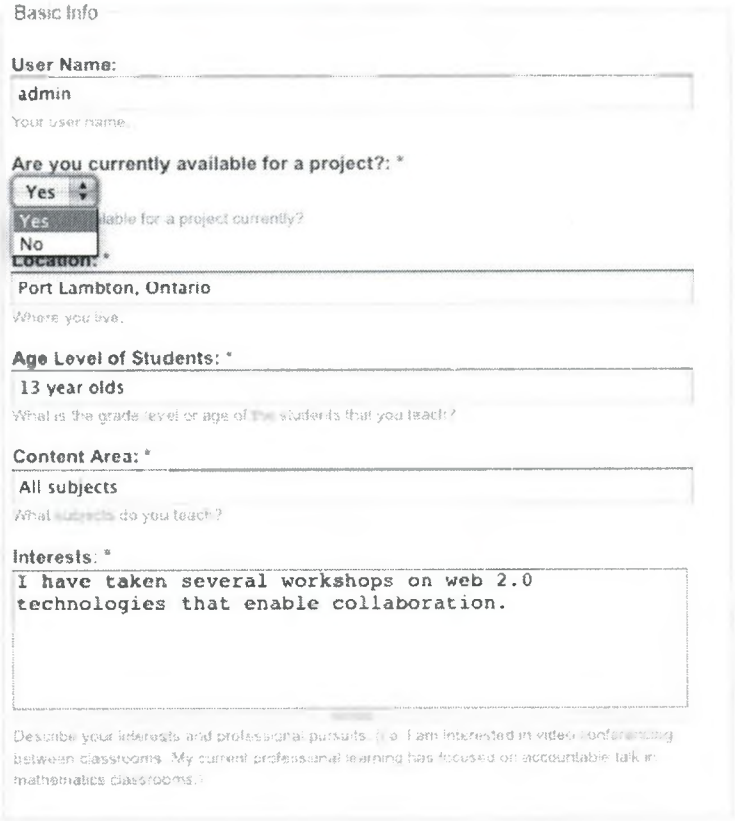


Figure 6 Basic user profile information during the building of the prototype.

Basic Information Section



Comforts Section

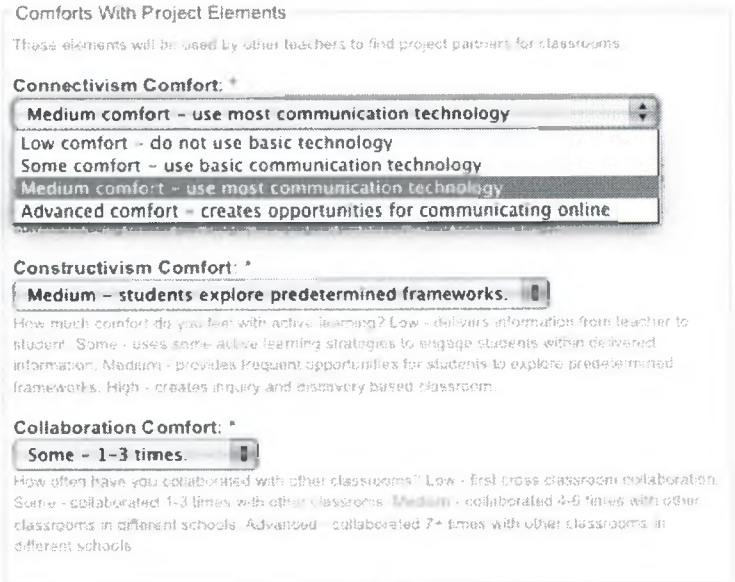


Figure 7 Basic information and comforts section of the user profile.

First Formative Testing Cycle and Development Panel Meeting

During the first formative testing cycle the development panel met online to comment on the features in the prototype. Feedback from this meeting was analyzed, and the interactive website was changed based on this feedback. Additional functions identified in DERF's Stage 1: Exploration were also added to the website. The development panel was asked to comment on specific features: user registration, private messaging between users, editing a user's profile, and using the buddy feature.

The panel's feedback suggested that user registration was similar to other websites and would be easy for novice Internet users. Alec pointed out a concern when he stated, "teachers without basic computing skills would struggle with this feature." The panel also commented on the private messaging between users feature. This feature was deemed to be limited as it was mostly text based, but consistent with other websites. Jess wondered, "[could] files be attached to the messages?" I decided to keep the registration and messaging between users features in their current form since the panel identified them as effectively achieving the functions desired.

The website feature of editing a user's profile was commented on by the panel, after viewing the whole profile and the specific aspects of the comforts and logistics sections (see Figure 7). The usability of editing the profile was called into question by the development panel when they wondered what the 'profile title', 'name', and 'location' fields meant. In response to this concern the following

design was altered. 'Profile title' was renamed 'User Name', the 'name' field was adjusted with the addition of 'Your real name' to this field's help text. The 'location' field help text was adjusted to say 'Where do you currently teach? Please identify the region, city, province/state, country'.

The development panel also commented on the comforts section within the profile. Most members wondered how accurate self-evaluation would be for each comfort's four point scale but also stated that self-evaluation according to comforts was a valuable process. The connectivity comfort options were deemed to be helpful and useful. Constructivism comfort options evoked several conflicting comments. Most panel members stated that the options and dialogue boxes were well written and fully understood when completing their own profiles. However, Joan wondered, "what [do] the options really mean?" Alec asked, "[do] these scales value constructivist teachers over teachers who use other pedagogical theories?" Collaboration comfort options were examined and the panel suggested that these options were clear, understandable, and easy to use as a self-evaluation tool. Tom expressed, "the collaboration options should be extended beyond counting the number of collaboration projects to include the quality of the collaborations." Logistics fields were deemed clear and understandable. Katie wondered, "[will] the fields and help text restrict teachers with non-typical assignments?" The contact items of iChat and Twitter were suggested additions as well. The comforts were not adjusted due to the alignment with the review of the literature from the exploration stage and the

agreement of a majority of the panel on their clarity and ease of use. Contact fields for iChat and Twitter were added to the profile form to include more tools that teachers may use.

The development panel also commented on the website's buddy feature. Elements of this feature caused confusion. Panel members were able to add a buddy but were unclear about the differences between the labels of two lists, buddy and buddy of. Users were automatically added as a buddy upon request and without confirmation. User feedback was incorporated into the design by adjusting the Buddy module. This feature was changed to create one list for buddies, and to require confirmation before being added to another user's buddy list.

After addressing the feedback from the development panel, the final functions were built into the website. The final functions, as identified in the DERF's Stage 1: Exploration, built into the website at this stage.

5. Users schedule projects in a calendar that is viewable by other members.
6. Users have the ability to find other members based on their profiles for cross-classroom collaboration.
7. Users have the ability to find projects that match individual user interests for cross-classroom collaboration.

These functions were designed by adding the Event, Event Views, Signup, RSVP, Calendar, Date Api, Fivestar, and Voting Api modules.

The Event, Event Views, Signup, RSVP, Calendar, and Date Api modules allowed the user to schedule an event using the website (see Figure 8). These events were renamed projects. The project feature provided a form to enter information about the event or project into the website. Adding the Fivestar and Voting Api modules enhanced this feature by allowing users to rate and comment on projects that had been previously entered. Users were able to browse the project through the calendar within the left hand sidebar.

Users were able to browse for collaboration partners by adding a feature that sorted users according to predetermined values. The View module was added to the website and enabled the ability to sort a list of users based on information from their profile (see Figure 9). Fields from the profile revealed to other users included availability, logistics, and comforts. Results were filtered so only individuals who had entered information into these fields were revealed. This filter eliminated irrelevant results from being displayed. The final feature added was the User Points module that assigned a value to each user based on that individual's actions on the website.

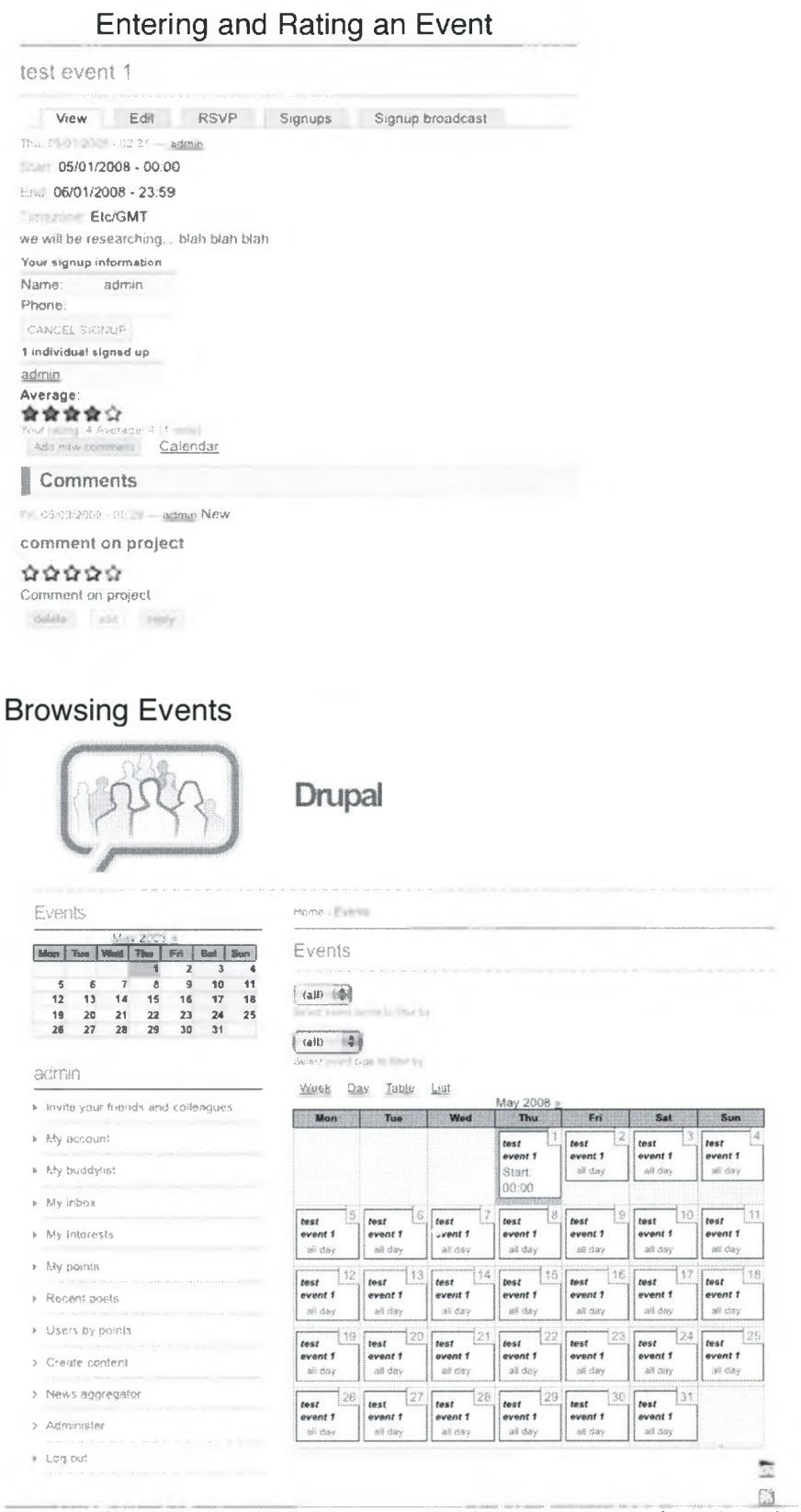


Figure 8 Calendar view for entering and rating events or projects into the website.

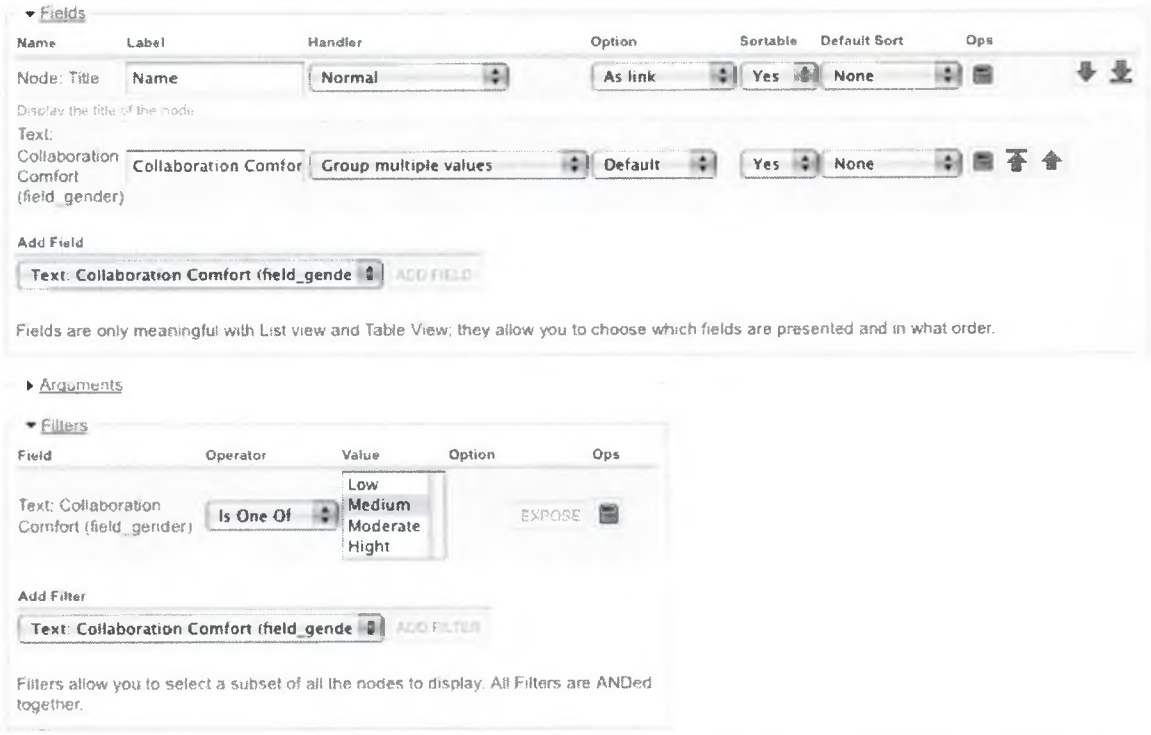


Figure 9 Ability to view users by a value in the profile (i.e., collaborative comforts) added to the website.

The first formative testing cycle incorporated feedback from the development panel about user registration, private messaging between users, editing a user's profile, and using the buddy feature into the design. Additional features were also added that allowed users to enter and browse projects, rate these projects, as well as find other users based on profile information. During this testing cycle the teacher members of the development panel fully participated (see Appendix B). However, the non-teaching members did not fully participate (see Appendix A). The independent consultant did not participate in this meeting. The education researcher, Alec, was not able to fully participate to the end of the research and sent his apologies after giving feedback in the first meeting.

Second Formative Testing Cycle and Development Panel Meeting

The second formative testing cycle began with a development panel meeting to comment on the revised and new features. Feedback from this second meeting was analyzed, and the interactive website was changed based on this feedback. The development panel was asked about revisions and the new features: searching the site, finding collaboration partners, user points, scheduling projects, and commenting and rating projects. The development panel members continuing to participate consisted of the teaching members.

The development panel commented on the revisions to the website based on their feedback and the search feature. All revisions were revisited and the panel agreed that these features had improved according to their feedback. The

search feature was also commented on. The panel agreed that search was an important way to find collaboration partners; however, they had problems with its implementation on this website. Panel members commented that some results were not seen in their searches and that the different lists of results (i.e., content and users tabs) were confusing. The search feature was then investigated and the cron, a feature that indexed the site, was adjusted to run regularly for better results. Later an additional module called Poormanscron was added to ensure that the cron ran regularly and indexed new information. The search results display was also adjusted to a single list of results.

The development panel then provided feedback about finding collaboration partners and the user points feature. A page had been added that displayed a table with columns linked to corresponding profile fields (see Figure 10). This table could be resorted based on the data within any column by clicking on the column's title. The panel approved this feature but wondered if a table with hundreds or thousands of users would be too large to be useful when the site became public. The feedback also suggested that additional help text was needed to explain and guide the users. The user points feature assigned points to users for creating profiles, scheduling projects, adding buddies, and sending messages on the site. The panel's feedback was unanimously positive. Katie wondered, "could the points be used to find the most active members of the site when in the finding a collaboration partner section?" Tammy asked, "will the point values for various actions be shared with the website users?"

Finding Collaboration Partners: Initial Table Format

Finding Users According to Logistics

View | Edit | Clone | Export

Name	Student Age	Location	Subjects	Availability
Admin	12 Year Olds	Port Lambton, Ontario	All subjects	Yes
Ben Hazzard	13 year olds	Port Lambton	all subjects	Yes
Ben Hazzard	13 year olds	Sarnia	Language	Yes
Ben Hazzard Admin	13 year olds	Port Lambton	Language	Yes
Ben3	hlep	Port Lambton	lk	Yes
jbadger	k-8	winnipeg manitoba canada	ICT	Yes
Jess McCulloch	5-17	Warrnambool, Victoria, Australia	History, Chinese	Yes
katiemorrow	10-18	O'Neill, NE, USA	IT, but have access to teachers in all content areas	Yes
Tammy Bryant	9 - 10 years	Brampton, ON	language, science, social studies, math	Yes
Tom's Profile	Year 5 (9-10 yr Olds)	Nottingham, UK	All primary curriculum	Yes

Finding Collaboration Partners: With Avatars and User

Finding Users According to Comforts

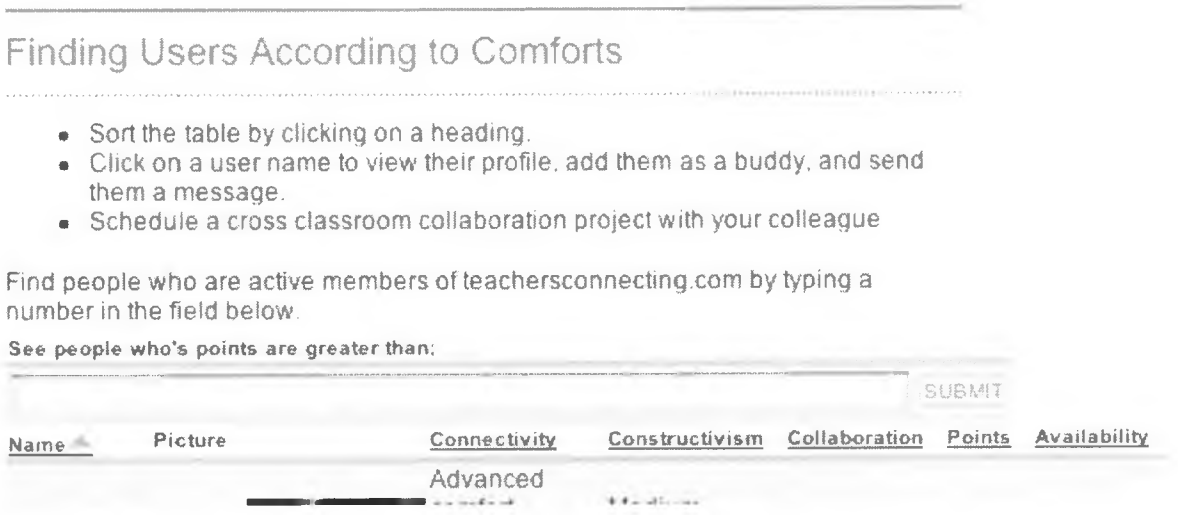
Name	Picture	Connectivity	Constructivism	Collaboration	Availability	Points
Ben Hazzard		Some comfort - use basic communication technology.	Medium - students explore using predetermined frameworks.	Advanced - 7+ previous collaboration projects.	Yes	121
jbadger		Advanced comfort - creates opportunities for communicating online.	High - inquiry and discovery based classroom.	Advanced - 7+ previous collaboration projects.	Yes	90
Tammy Bryant		Medium comfort - use most communication technology.	High - inquiry and discovery based classroom.	Some - 1 - 3 previous collaboration projects.	Yes	70
Tom's Profile		Advanced comfort - creates opportunities for communicating online.	High - inquiry and discovery based classroom.	Advanced - 7+ previous collaboration projects.	Yes	70
katiemorrow		Advanced comfort - creates opportunities for communicating online.	Medium - students explore using predetermined frameworks.	Medium - 4 - 6 previous collaboration projects.	Yes	70
Jess McCulloch		Advanced comfort - creates opportunities for communicating online	Medium - students explore using predetermined frameworks.	Some - 1 - 3 previous collaboration projects	Yes	60

Points

Figure 10 Table views to find collaboration partners.

This feedback was extensively incorporated into the design. The collaboration partner tables were revised to add two columns: one for avatars, and one for user points (see Figure 10). Text was also added to the top of each table to guide users. Additionally, the panel's concern about too many results was addressed by putting user-controlled filters on each table. On the comforts table, a field was added that allowed users to enter a number and eliminate members with fewer user points thus narrowing the results displayed (see Figure 11). In the logistics table that focused on student age, subject, and location, users were now allowed to filter the results by each comfort (see Figure 11). The design now allowed for many potential collaboration partners to be narrowed to a few based on the user filters, guided by help text, and was made more visually appealing with the inclusion of avatars.

User Point Filter for Comforts Table and Help Text



Comforts Filter for Logistics Table and Help Text

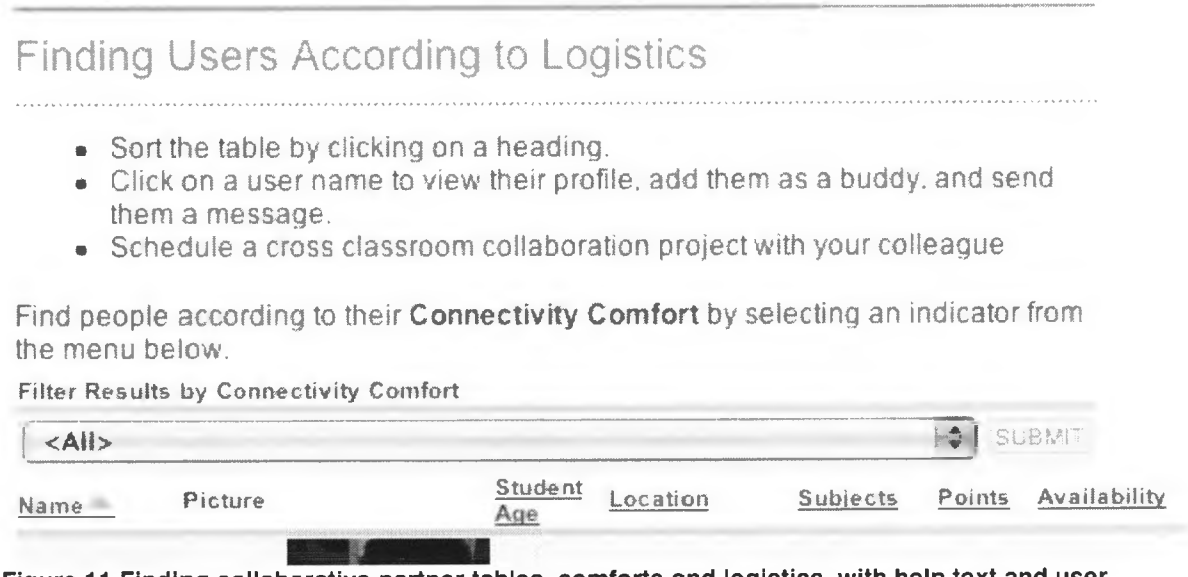


Figure 11 Finding collaborative partner tables, comforts and logistics, with help text and user controlled filters.

The development panel also commented on the features that enabled scheduling, signing up, commenting, and rating of projects. The feedback about scheduling a project focused on the ease of use. It was noted that the default project fields were too generic when entering information and too confusing to read when browsing projects. The feature that allowed users to sign up for other users' projects also received comments. The panel considered this a key feature for users looking for projects and commented that emailing them details of the selected project served as a reminder about project commitments. Commenting on and rating projects were deemed useful but slightly confusing by most of the development panel members.

The feedback about the project features was used to revise project fields and adjust the signup functions. The confusing text when scheduling a project was changed to provide more descriptive and appropriate fields (see Figure 12). Text above the fields was added to guide the user. Additional fields asked for the topic of the project, curriculum focus, tools, and other information. The process of signing up for a project was also re-organized. The option to sign up was moved into a tab available when viewing a scheduled project. Within the sign up tab, the phone number field was also removed. These design changes clarified the project section of the website based on the development panel's feedback.

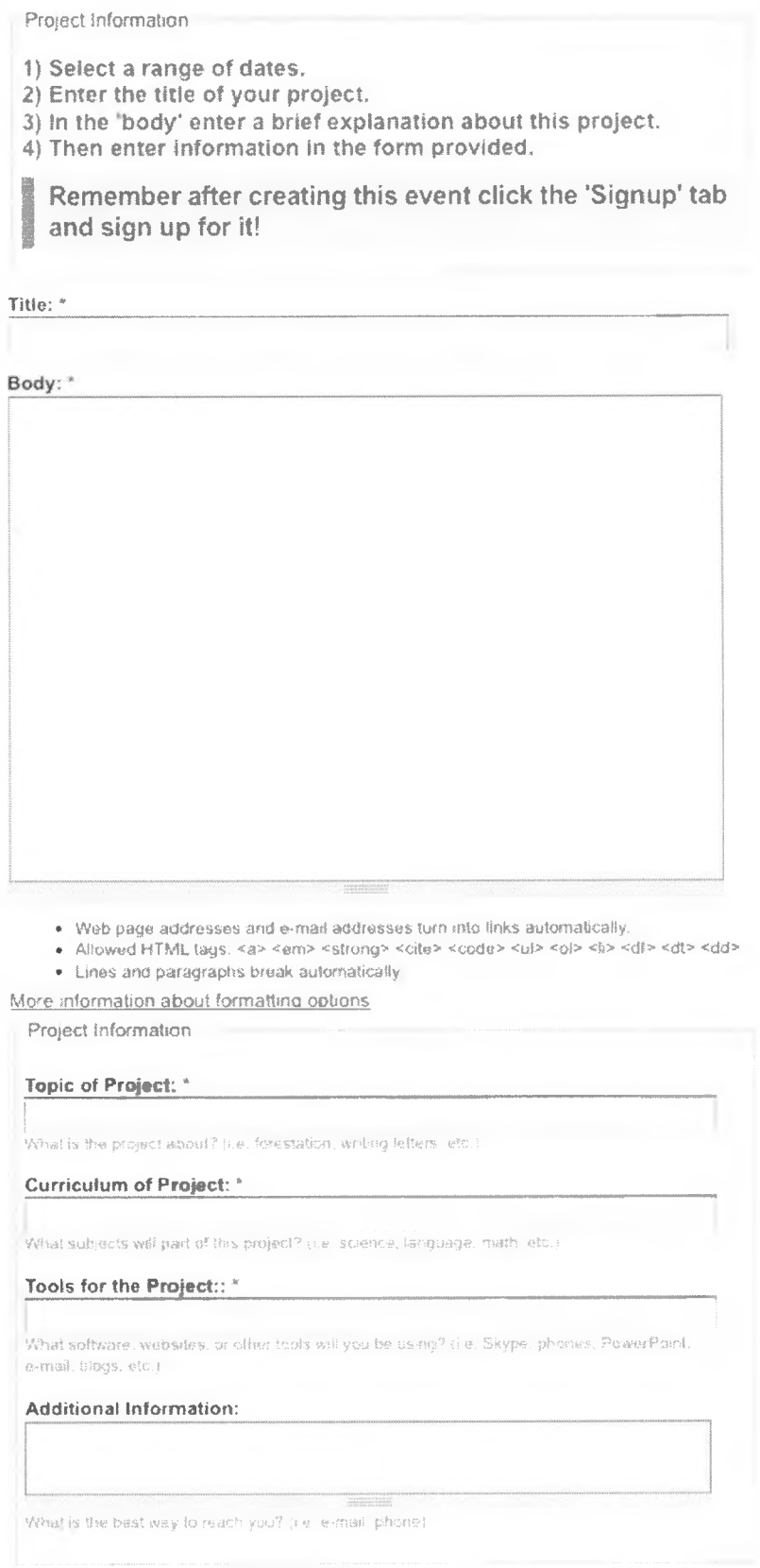


Figure 12 Revised fields available for scheduling a project.

The final comments of the development panel members during the second meeting suggested several more changes to the website. It was suggested that features be built that remember returning users, email inactive users, and add avatars to the buddy list. The Remember Me module was added to remember users when they returned to the website. This module responded to Tammy's request, "can remember me be an option on sign in?" These ideas were extended to include a one step registration procedure when becoming a member of the site. The Login Toboggan module allowed users to immediately have access to the site without waiting for an email. New users were also able to create their own password using this feature. This feature then prompted users to fill out their profile the first time they logged in. Revisions to the website also included adding the Inactive User module to email a reminder to users who had not returned to the site in three months. User avatars were also suggested for inclusion on the buddy list beside a user's name. This feature was added using a module named Avatar Selection. The addition allowed users to select preset avatars when registering for the website. It was added to ensure that beginning or novice website users could have an avatar. Finally, the front page was changed to be viewable by authorized or unauthorized users (see Figure 13).

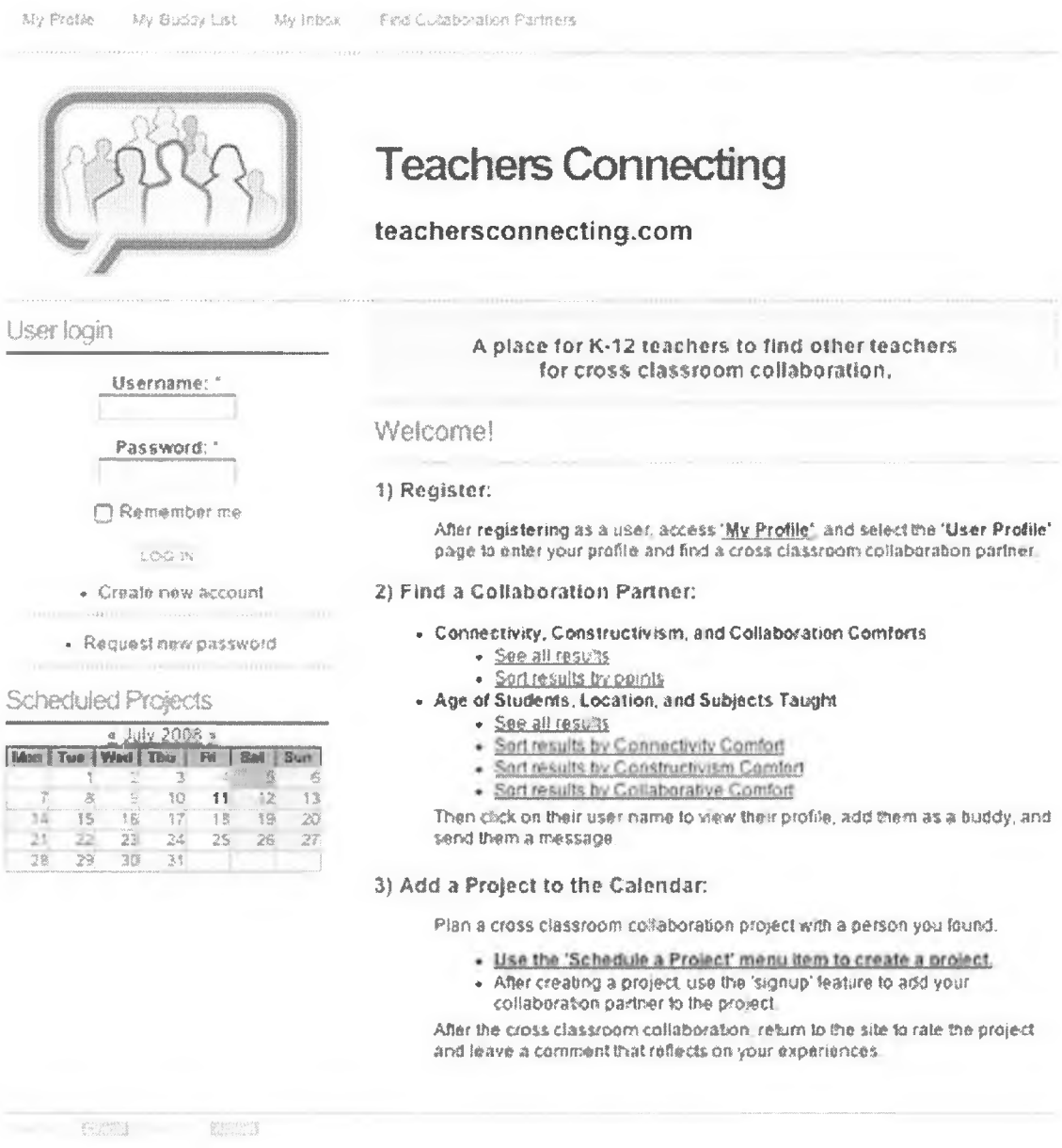


Figure 13 Front page viewable by authorized and unauthorized website users.

The second formative testing cycle incorporated feedback from the development panel about searching the site, finding collaboration partners, adding user points, scheduling projects, and commenting on and rating projects. Changes based on feedback from the first testing cycle were also reviewed to check that revisions were compatible with the panel's feedback. Additional features were also added to remember returning users, register with a one step process, email inactive users, and select avatars when registering for the site. During this testing cycle only the teaching members of the development panel participated (see Appendix B).

Third Formative Testing Cycle and Development Panel Meeting

The third and final formative testing cycle began with a development panel meeting to comment on the features added and revised. Feedback from this third meeting was analyzed, and the interactive website was changed based on this feedback. The development panel was asked about revisions and the new features: the welcome page, about page, avatars, and user controlled filters. Only teaching members of the development panel continued to participate in the research.

The members of the development panel commented on the revisions to the website based on their feedback about user points, search, and projects. The user points and search revisions were revisited and the panel agreed that these features had improved. Feedback about revisions to the projects section

focused on which new fields should be mandatory when scheduling a project. Unanimously the panel stated that the additional information should not be mandatory. Each of the other fields was selected as either important to be mandatory or not when scheduling a project. This feedback was analyzed and the additional information field was changed to optional while the rest of the project fields remained mandatory.

The development panel provided feedback about the welcome page (see Figure 14) and about page features (see Figure 15). Both pages were designed using the Nielsen & Loranger (2006) Internet writing guidelines. The feedback from the panel stated that the text was clear, easy to understand, and was logically organized into steps or sections. Joan stated, "the welcome page clearly shows the steps to access the site." The only revisions suggested were stylistic in nature, such as adding an email link and rewording a sentence.

Feedback was also received about avatars (see Figure 16), and user-controlled filters (see Figure 11). The feature to select an avatar was described as easy and appealing for all users. Katie also suggested that, "advanced users should have the option of uploading their own avatar." The user-controlled filters to narrow potential collaboration partner results were also reviewed by the panel. Each user-controlled filter was deemed to work well and narrowed the number of results presented on the page through the criteria of user points, connectivity comfort, constructivist comfort, and collaborative comfort. These features remained the same following the third meeting.

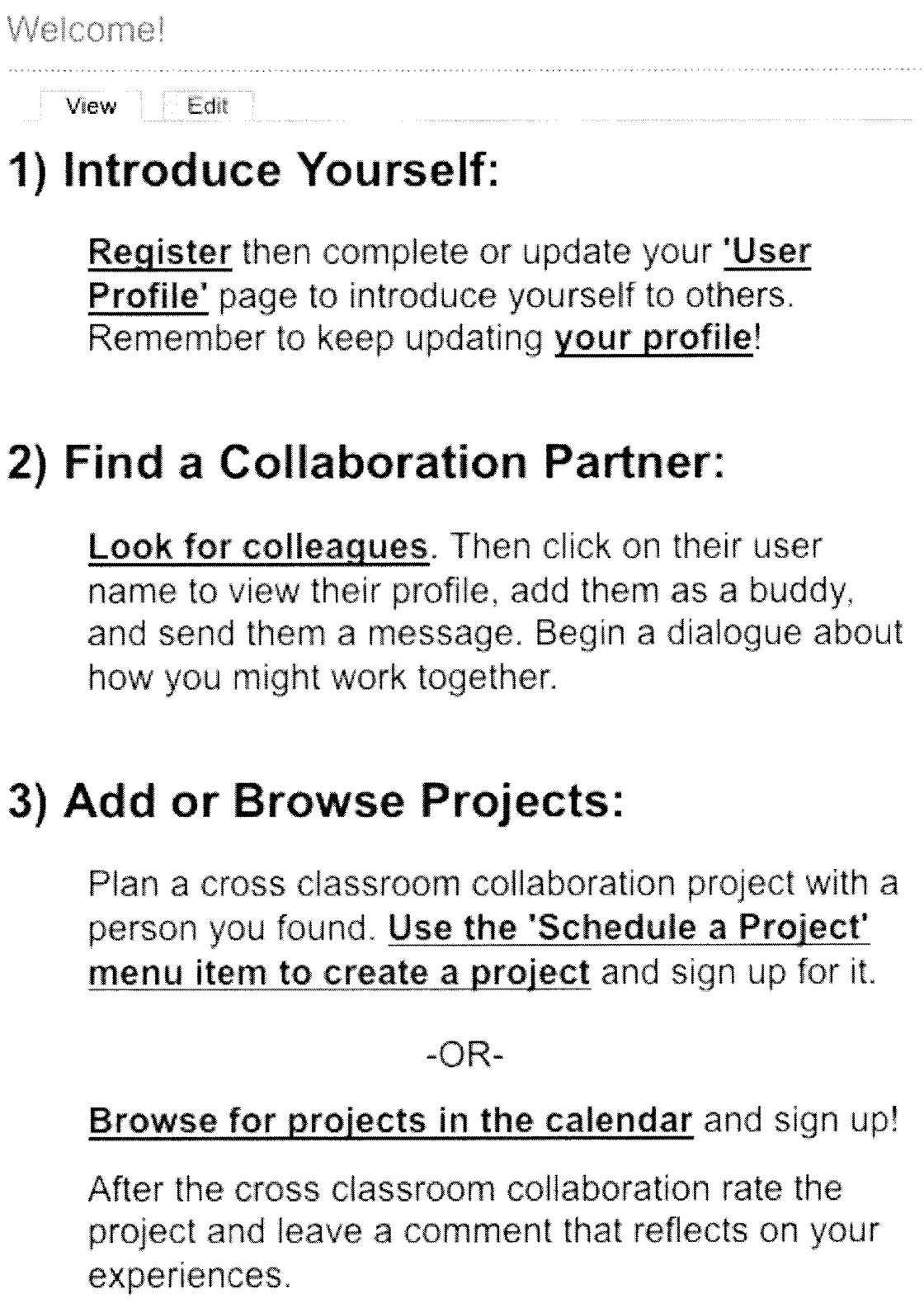


Figure 14 Text on the welcome page after the third testing cycle.

About Teachers Connecting.com

View Edit

What this site is:

This website is a virtual convener. It facilitates a 'handshake' between teachers interested in cross collaboration project. The comforts in connectivity, constructivism, and collaboration make this 'handshake' more intelligent. This virtual convener is based on connecting teachers using more than simply the grade level or location of classrooms.

What this site is not:

This site does not host tools for cross classroom collaboration projects. These tools change fast and are best left to specialists in these areas (e.g., classroom blogging, voice & video conferencing, and real time collaboration on documents, presentations, & spreadsheets). On this site you can find a collaboration partner to use these tools with!

This site does not promote a limited menu of projects. Instead browse other projects, find a collaboration partner, and develop a project simple or complex, one time or ongoing, customized for your own students, curriculum, and comforts.

Figure 15 About page text excluding sections stating website credits.

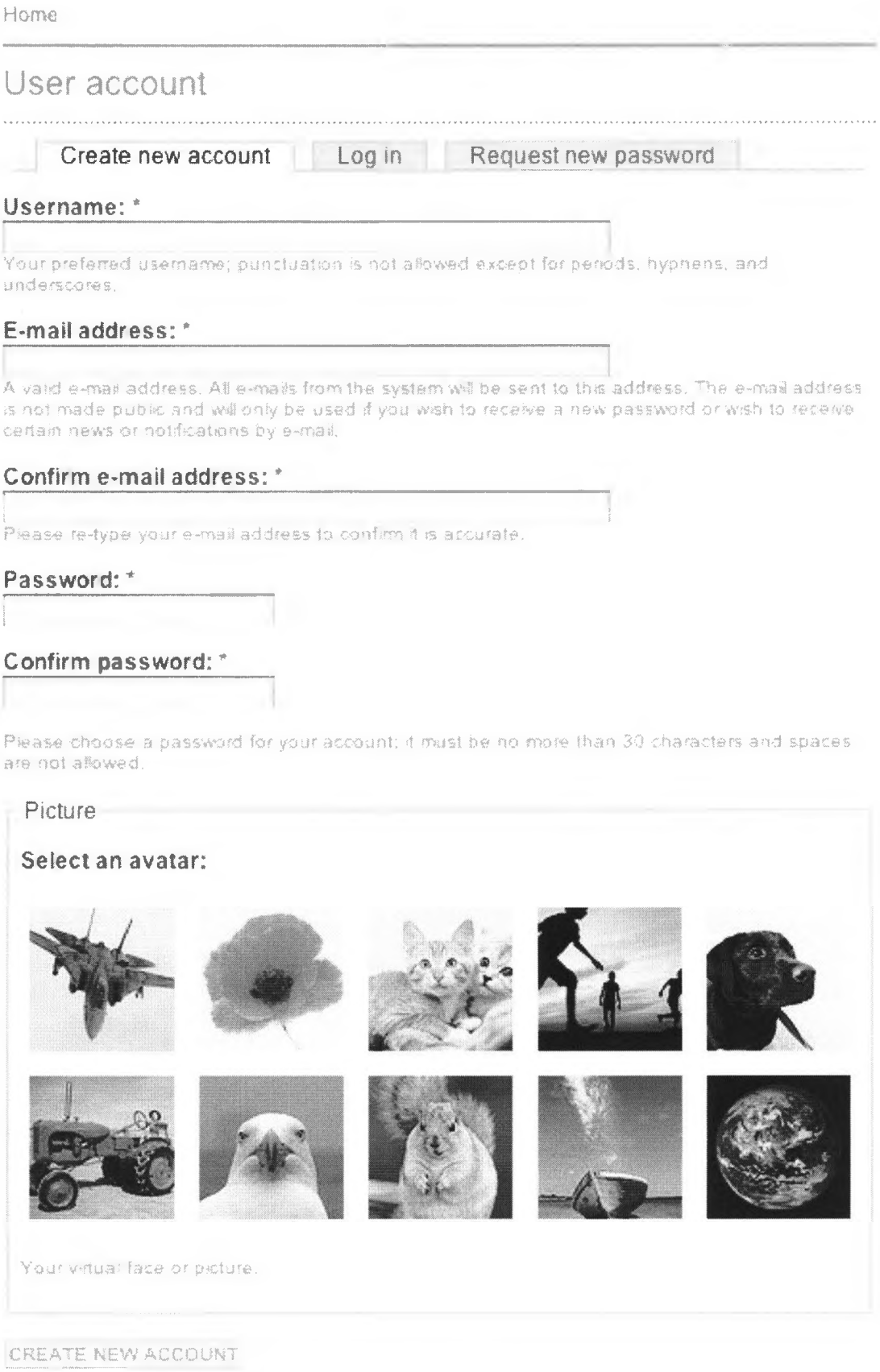


Figure 16 First registration page with avatar selection.

Following this development panel meeting a few additional design features were added including time zones, and the finding projects features. The Time Zone Handling module addressed the time zone for which a project is scheduled. The website uses the browser's local time zone setting and the users are asked to state the time zone in which each project occurs. The process of finding a project included the existing browse by calendar function and was extended to find projects scheduled by buddies (see Figure 17). This new list was created to help narrow the focus and make the buddy feature more useful.

The third formative testing cycle incorporated feedback from the development panel about the welcome page, about page, avatars, and user controlled filters. Revisions based on feedback from the second testing cycle were also reviewed to check that revisions were appropriate. Additional features were also added to set users' time zones, and display their buddies' scheduled projects.

Options When Looking For Projects

Find Projects

Browse for projects.

Sign up and participate.

Rate and comment on projects.

Calendar View:

- See Everybody's Projects

List View:

- See Project From Buddies

Wondering what to do? Here are a few suggestions.

Finding Projects From Buddies

Buddy Activities

See what your buddies are doing!

Buddy		Title	Type
admin		Development Panel Meeting #3	Project
admin		Flat Stanley	Project
admin		Development Panel Skype Meeting #2 a	Project

Figure 17 Options to find a project extended to include projects scheduled by buddies.

Reflection on Research Object

The development panel reflected on the final research object, the interactive website (see Appendix D), as outlined in the DERF's third stage implementation. The panel commented on the effectiveness of the website according to the usability of the website's functions, connectivity, constructivism, collaboration, and logistics. The partnering system was reviewed to gauge its complexity and the final site was compared to other current teacher collaboration websites. Again, only teaching members of the development panel participated in this stage of the research.

The panel commented on visuals, navigation, and complexity when reviewing the usability of the final interactive website's functions. The website was deemed clean, with a simple, uncluttered design by each member of the development panel. The majority of the development panel members stated the consistent navigation menus at the top and left hand sections of the webpage would prevent user confusion. Joan said, "[the site is] very usable, the development process listened to feedback and changed the site." However, Tom cautioned, "there are many tabs and information fields that may confuse some users with complexity."

The panel reviewed the objective of implementing the connectivity, constructivism, and collaborative comforts in the website. Each panel member clearly stated that the connectivity and collaboration comforts were fully achieved. Constructivism comfort had a variety of responses. Jess stated,

"constructivism was not promoted but understanding of this comfort would be enhanced." Tom wondered, "[would] the site enable constructivism levels to remain the same?" These ideas about the comforts were summarized by Katie who shared, "the website allows teachers to connect from different levels and for different reasons. Also, the premise of teachers starting with comfort, to self-select their collaborative partners according to comforts, will empower teachers to take action."

The logistics and partnering system were also reviewed. The logistics were deemed to be effective and important. The search box and sort features are seen to take the logistics elements and make them easy to use. The partnering system, according to the comforts and logistics, was seen as simple and complex by the development panel. The way to become buddies was seen as simple but the information used to find someone and decide to partner with him/her for collaboration was seen as complex. Tom wondered, "would additional research and literature be available to inform users about these concepts?"

When comparing this interactive website to other teacher collaboration sites in the field, the summary comment was that this site solved a unique problem efficiently. Katie stated, "there is not a site in the field that does what the research object does." Other sites focused on specific project collaboration usually revolve around a central person enacting a limited project selection and development panel members found this unsatisfactory. This site does more than

current project or teacher connection websites according to all panel members. The biggest difference was seen as the comforts and the multiple ways that teachers could interact on the website with each other such as scheduling their own project, finding a project, or finding a partner to jointly plan a project. Jess stated, "the site solves a unique problem and does so efficiently." The panel suggested that the research object created solves the problem about where to go and how to find someone for a cross-classroom collaboration project.

Summary

The development of the research object, an interactive website, beginning with the prototype, then three formative testing cycles each with a development panel meeting, and the final reflection produced several data sources that were triangulated to make design decisions. The process of design was characterized by a close collaboration between researcher and development panel. This process triangulated the various data sources: the research object, the development journal, feedback from the development panel, and current literature in the field. These data sources interacted to inform and add rigor to the design process. Teacher practitioners exclusively composed this development panel at the end of the process. The resulting data were reviewed to refine, revise, and synthesize cross-classroom collaboration concepts and resulted in a fully interactive website that the panel deemed to have achieved its objectives.

Chapter 5: Analysis and Conclusion

In this chapter, the research object is considered according to the theoretical and practical context outlined in Chapter 2, the process of design discussed in Chapters 3 and 4, and the reflection that occurred during this work. Teacher interaction with the comforts was examined and extended to organize collaborative project ideas within a context of connectivism. Understanding of the development panel's participation and influence during design as research was advanced as the research object was created. Reflective practice was evident in the research process, in the interaction of teachers with the research object, and in the consideration of the transferability of these findings. Implications, limitations, and findings were embedded through revisiting the research question during the analysis and conclusions.

Categorizing Collaborative Projects According to Comforts

As the research object was being designed, I began to wonder if teachers needed more than just connections to engage in cross-classroom collaboration projects. Teachers could select a partner for cross-classroom collaboration but may not know what type of project to plan based on a limited understanding of potential projects. Downes (2006) asserted that connectivism is illustrated by forming connections within a knowing community based on experiences. The community must have an advancing understanding of the domain, in this case collaboration projects, before the connections can truly develop. Developing a

greater understanding of collaboration projects was essential to forming strong connections when partnering teachers.

The current professional and academic literature, as identified in Chapter 2, mainly organized collaborative projects according to logistics and tools. The research object in this study partnered teachers interested in cross-classroom collaboration using the comforts of connectivity, constructivism, and collaboration. Given the unsophisticated way collaboration projects have been presented in the professional and academic literature, the structure of the comforts was extended from partnering teachers to organizing collaboration project ideas. The Cross-Classroom Collaboration Projects According to Comfort matrix (see Appendix E) organized collaborative project ideas according to the comforts and suggested tools that enable these projects. Project ideas were drawn from multiple academic sources including Loertscher (2007), Siegle (2008), Yan (2008), McPherson, Wang, Hsu, & Tsuei (2007), and Joseph (2007). The comforts of connectivity, constructivism, and collaboration were used to organize collaborative projects so teachers can match a project with the comforts of their partners.

The matrix emerged after trying several configurations to discover an organizational structure that focused on connections between collaborative projects and the comforts instead of listing specific technology tools. Originally, I organized the matrix with connectivity comfort on one axis and constructivism comfort on the other axis. Collaboration comfort was then embedded in each of

the four quadrants of the matrix. I was surprised that this organization resulted in the technology tools being the main focus of the matrix. The two axis labels were revised to be constructivism and collaboration comforts with the connectivity element embedded into each quadrant. The revision of the axis labels led to a significantly different organization of collaborative projects from what had been found in professional and academic literature. The focus of the matrix shifted from the use of technology tools to how collaborative projects can match a teacher's comfort profile.

Each quadrant was labeled based on the constructivism and collaborative comfort criteria to sort collaborative projects. Based on the work of Lattuca (2006), constructivism was defined as the sharing of knowledge for the lower comfort level and constructing knowledge for the higher comfort level. The collaboration comfort had to be adapted from the original conceptualization for the matrix. Returning to the literature, I noted that Harris, O'Mally, & Patterson (2003) defined collaboration comfort as the frequency of collaboration experience. This understanding was problematic when comparing collaborative projects and had to be adapted. Collaboration used the criteria of asynchronous and synchronous interaction to sort projects. The lower collaborative asynchronous projects would allow for greater flexibility when coordinating the classroom collaborations. The higher collaborative synchronous projects would require greater coordination of time zones, classrooms, and methods of sharing information.

The connectivity comfort was embedded within each quadrant to ensure that technology enabled collaboration but was not the central focus when selecting a project. Initially lower and higher connectivity headings were in each quadrant. As the matrix emerged, the lower connectivity headings were removed from the higher collaboration quadrants. When engaging in synchronous collaboration projects that share and construct knowledge, it became evident that only higher connectivity tools could facilitate such a cross-classroom collaboration project. The final organization of the matrix led to projects grouped according to asynchronous or synchronous collaboration, sharing or constructing knowledge for constructivism comfort, and connectivity options.

Describing the Matrix

The description of the Cross-Classroom Collaboration Projects According to Comfort matrix (see Appendix E) that follows identified the level of the quadrant, project suggestions, and technology tools. The lower constructivism comfort and lower collaboration comfort quadrant of the matrix was labeled "Asynchronously Sharing Knowledge". This section's lower connectivity project suggestion was pen pals using email or postal service to communicate between classrooms. The higher connectivity project suggestions were cross-classroom research groups (with teacher defined topics and process), joint book response logs, and digital storytelling with teacher directed concepts. Tools that would enable these higher connectivity projects include email, wikis, online documents,

online concept mapping, digital images, slideshows, digital video, and social networking tools.

The higher constructivism comfort and lower collaboration comfort quadrant of the matrix was labeled "Asynchronously Constructing Knowledge". This section's lower connectivity suggestion was parallel inquiry projects using email, postal service, and digital images to share products between classrooms. The higher connectivity project suggestions were cross-classroom inquiry groups (with student selected topics and process), joint book discussion groups, and digital storytelling with student selected concepts. Tools that would enable these higher connectivity projects include email, wikis, online documents, online concept mapping, digital images, slideshows, digital video, and social networking tools.

The lower constructivism comfort and higher collaboration comfort quadrant of the matrix was labeled "Synchronously Sharing Knowledge". Only higher connectivity options could fulfill the synchronous requirement of higher collaboration projects. The project suggestions were real time sharing research projects (with teacher defined topics and process), real time joint book response logs, and digital storytelling with teacher directed concepts using cross-classroom groups. Tools that would enable the synchronous sharing of knowledge include VOIP, video conferencing, online conferencing, wikis, online documents, online concept mapping, digital images, slideshows, digital video, and social networking tools.

The higher constructivism comfort and higher collaboration comfort quadrant of the matrix was labeled "Synchronously Constructing Knowledge". Only higher connectivity options could fulfill the synchronous requirement of higher collaboration projects. The project suggestions were real time cross-classroom inquiry groups (with student selected topics and process), real time book discussion groups, and digital storytelling with student-selected concepts using cross-classroom groups. Tools that would enable the synchronous sharing of knowledge include VOIP, video conferencing, online conferencing, wikis, online documents, online concept mapping, digital images, slideshows, digital video, and social networking tools.

Implications from the Matrix

Sorting projects using connectivity, constructivism, and collaboration comforts provide a useful frame of reference for teacher and academic understanding of cross-classroom collaboration projects. The matrix sorts project activities beyond technology tools, or logistics. By self-identifying using the comforts, teachers are able to choose projects that match their comforts or next step of professional development. Academic literature about collaboration projects is also advanced by including work that provides a categorization beyond technology tools.

The categorization of collaboration projects and the project choices of various teachers could be further examined. The categorization of collaboration projects may be limited due to the rapid advancement of communication

technology. In the future, there may be more opportunities to enable cross-classroom collaboration projects beyond the matrix suggestions. The project choices, according to the matrix, of various teacher comfort profiles could be examined to determine if there is a correlation between comfort profile and project choice. Teachers may disregard their comforts when selecting a project, only select projects and collaboration partners at their comfort levels, or select projects and collaboration partners at a slightly different comfort level.

Practically Understanding Constructivism and Connectivism

Categorization of collaborative projects according to the comforts applied a theoretical framework to practical project ideas. Key theoretical frameworks of this research were also considered according to their practical implications. Educator understanding of constructivism and the application of connectivism in the classroom emerged through the research process.

The conversation regarding constructivism comfort during development panel meetings highlighted how ambiguous constructivism was to teachers. Their comments about collaboration and connectivity comfort produced little discussion. However, the constructivism comfort was an ongoing source of dialogue and discussion at each meeting. The education researcher, Alec, seemed to have the most confidence in his understanding of constructivism. His feedback indicated that the criteria for constructivism comfort was clearly stated and well written. The teaching members of the development panel demonstrated more confusion about constructivism. Each meeting returned to constructivism

as members expressed concerns about their own misunderstandings of the term and questioned what this pedagogy actually means. In their final reflection on the design, constructivism comfort was identified as providing the greatest confusion among teachers. The comments from the development panel align with the findings of Maddux & Cummings (1999) that constructivism is often simplified and misunderstood by teachers. Presenting simplified criteria about a pedagogical model, such as constructivism, may disappoint educational researchers but a simple framework may lead to greater understanding for teachers or point out the incongruity within an individual between their assumed knowledge of a pedagogical theory and actual understanding.

Teacher understanding and emerging views of learning and knowledge need to be bridged. Connectivism learning theory as understood by Downes (2005) and Siemens (2004) assumes a propensity for connectivity by members of a network. If learning is no longer an individualist activity, as Siemens (2004) suggests, then connectivity skills are essential for educators. Developing tools that bridge the gaps between low connectivity teachers may enable them to effectively engage in their environment. Greater awareness of how these theories, constructivism and connectivism, are understood and applied by educators may promote research that connects the classroom context with theoretical understanding.

Development Panel

While the development panel was instrumental in raising questions about constructivism and developing the matrix of collaborative projects, the impact of the panel was also considered as it developed through this research. The development panel influenced the DERF's formative testing cycles by providing feedback that informed the design of the research object, an interactive website. Due to the influence of the development panel on the website, its membership should be examined to understand the limitations and benefits of the interactive website. The participation of development panel groups, non-teaching and teaching, varied during the design process. The specific profile of the development panel members could influence the research object and its suitability for a target audience.

Development Panel Participation

Collaboration between researcher and target users was embedded into the Design as Research Process. Sharing the research object as it progressed and gathering feedback were the methods used to learn from target users. When forming the development panel, both non-teaching and teaching participants were identified. Each of the first seven invited individuals agreed to be members of the panel. Two non-teaching and five teaching members composed the panel.

The non-teaching members of the development panel varied in participation levels. The social media and design consultant engaged in an active dialogue before the first meeting. She encountered a scheduling conflict

during the first meeting that prevented her participation. Subsequent communication was sporadic and she did not participate in any development panel meetings. The researcher expressed keen interest in the panel. He participated in the first development panel meeting but due to scheduling conflicts he sent regrets for the following development panel meetings. After the first meeting the non-teaching members of the development panel were no longer active participants.

In contrast, teaching members of the development panel participated throughout the formative testing cycles often adjusting their personal schedules to participate in each meeting. The Australian member of the panel participated by adapting her social plans to attend the meetings that occurred on Saturday evenings within her time zone. The British member of the panel juggled childcare commitments to participate, and North American members were often participating at early morning weekend hours to accommodate the other time zones. A consistent pattern emerged. Teaching members participated fully and non-teaching members' participation was limited.

The participation of development panel members seemed to be related to the amount of individual benefit from the research object. The social media and design consultant had no direct connection to the target audience, teachers, of the interactive website. The consultant was the most removed and did not contribute at all to the development panel. The researcher had a connection to teachers, the target audience, as a professor in a faculty of education. He

provided substantial contributions to the first development panel meeting but was unable to continue his participation in the research. The teaching members of the development panel were the target audience of the website. All five of these development panel members participated fully in all development panel meetings. The development panel members that would directly benefit from the research object participated most. The development panel members with indirect benefit from the website, participated the least.

Limitations of the Development Panel's Profile

The members of the development panel provided ongoing feedback during the formative testing cycles that influenced how the research object developed. The teaching members of the development panel were invited to participate based on mutual participation with the researcher in various online communities. The members mainly taught children aged 5 to 13 years old. Only one member had secondary school experience. No development panel members were secondary school specialist teachers. The focused input from teachers of children from 5 to 13 years old influenced the design of the research object because of their experiences. This research object, an interactive website, may be best suited to K-8 educators due to the feedback of teachers who match this profile.

The development panel may have shown inherent bias toward their own grade level teaching assignment, however, their selection may also indicate an inherent bias in the composition of the development panel. Development panel

members were invited to participate based on mutual participation between each member and myself as researcher, in online communities. Common participation in online communities indicates similar professional interest and values professional participation in online communities. A common thread with most development panel members was the use of interactive whiteboards in the classroom. Members each have similar views about the positive benefits of using technology in the classroom including interactive whiteboards. The members of the panel may have been located in diverse geographic locations, assigned to a variety of roles, and situated at different points in their teaching careers, however feedback from the members of the development panel significantly impacted the development of the research object, an interactive website, and bias from the development panel may have been transferred to the research object itself.

Implications for Future Research

The development panel feedback was integral to the design process but further research is needed to understand their participation and the level of their impact on the research object. The participation of development panel members correlated with their professional interest in and benefit from the research object. Further exploration could examine if this relationship between professional benefit and participation is evident in other design as research work. The research object as a reflection of the development panel's profile could also be reviewed. A more thorough understanding of the development panel, its makeup,

and influence would enable researchers to be more informed when constructing a development panel. Future research using 'design as research' could extend beyond the development panel to confirm that the research object achieved the purpose and goals set out during Stage 1: Exploration of the DERF.

Reflective Process

Reflective practice and research may advance the classroom practice of educators using collaborative projects and technology tools, as well as their understanding of these topics. The process of designing a research object encouraged reflective practice by the researcher using clear goals derived from the DERF's first stage of exploration, formative testing cycles, and a development journal. Professional reflection by website users was also evident during the interactions of the development panel. Participation with this website may be further explored to identify the extent to which reflective practice is promoted during cross-classroom collaboration projects.

Design as a Reflective Process

The use of design as research built reflective practice into the research. The first stage of the DERF provided the context, purpose, and goals for the research object before it was designed. A focus on the comforts of connectivity, constructivism and collaboration as well as the desired functions of the research object were embedded through the design process. Feedback on the implementation of the comforts and functions were continually embedded into each formative testing cycle's development panel meeting. The three distinct

formative testing cycles embedded collaboration between the members of the development panel and the researcher as we shared ideas and "test[ed] them against the views of peers" (Schön, 1983, p. 333). The meetings encouraged reflective practice during the design process. A development journal tracked the development, changes, and revisions to the research object. Reflective practice was built into this research by collaborating with the development panel, documenting the design process, and comparing the research object to the initial research goals. Design research is often referred to as emergent and improvisational, but this reflection kept it rigorous.

Self-Identification as a Reflective Process

It could be argued that the research object, as a virtual convener, promoted professional reflection among the development panel members when registering for the interactive website. Teachers must complete a profile when registering that asks them to self-identify according to criteria presented about the connectivity, constructivism and collaboration comforts. During the development panel meetings an ongoing discussion emerged among members about their self-identification according to the comforts. This discussion led several development panel members to change their initial identification. The majority of the discussion focused on the constructivism comfort criteria. The act of self-identification may have produced this professional reflection. However, this reflection may also be attributed to the act of talking with development panel members about the self-identification process.

In the years since Schön (1983) proposed that collaborative work between teachers would improve reflective practice, new communication tools have developed. This research showcased two types of tools that promoted increased professional reflection: an interactive website that asks individuals to self-identify to create a profile, and communication tools such as VOIP, instant messaging, e-mail, as well as online documents to facilitate a group discussion around a central theme that begin to implement Wegner's (1998) communities of practice. Instead of focusing on the function of the specific communication tools, understanding how these tools can enable reflective practice will advance the ways education and technology interact. Specifically, cross-classroom collaboration projects could also be explored as a way to promote reflection through the sharing of ideas, and by comparing views among colleagues. Using advancing communication tools may enable a greater practitioner voice in educational research and this may lead to more relevant investigations. If the educational research community does not embrace these tools, practitioners may use communications tools to share their voice circumventing the traditional relationship with education researchers. Increasingly vocal and credible practitioners will alter the traditional power relationships between researchers and practitioners.

Transferability

The transferability of this research to other areas of research depends on understanding the sending and receiving context (Lincoln & Guba, 1985). The

sending context is the domain of the original researcher. The original researcher is unable to prove current work is applicable to new research contexts but can state the context of the original work (Lincoln & Guba, 1985). For the purposes of this research, data sources relied on to construct the sending context will be reviewed. Factors that influenced the data sources and the limitations of the sources will be examined. These factors are important to identify since the work has been emergent using design as research. The sending context will be presented for future work to be built upon.

The design as research process embedded several data sources when responding to the research question. The sources included the research object, the interactive website, a development journal to document the design process, feedback gathered from the development panel members, and current literature within the field. These data sources were not evaluated but rather were reviewed to refine, revise, and synthesize the development of the research object, an interactive website that was well situated within the current literature in the field and the needs of practitioners.

The understanding that emerged from this research will define two sending contexts for transferability (Lincoln & Guba, 1985; Guba & Lincoln, 1989). The first sending context is the research object that partnered teachers for collaboration between classrooms using the online environment. The profiles of the active development panel members were English speaking teachers of 5 to 13 year old children in the countries of Britain, United States, Australia, and

Canada. Teachers used the comforts of connectivity, constructivism, and collaboration as outlined in the exploration of the academic literature to select collaborative partners. This sending context is limited by the website design platform used, Drupal 5.7. Future advancements in design platforms may produce more complex partnering systems.

The second sending context was the design as research process using the DERF. Design as research is meant to "explore, approximate, then refine" (Spinuzzi, 2005). It focused on the creation of a research object that led to synthesizing theory instead of evaluating each theory. There is little research in the design as research field with an education focus (Bereiter, 2005). The DERF adapted the limited design as research within the education field to provide a technical response to the research question.

Conclusion

In the world of education technology the encouragement for teachers to participate in cross-classroom collaboration projects has been increasing. Little attention had been given to the creation of successful cross-classroom collaboration partnerships. The research question addressed these concerns by asking how might emerging research on connectivity, constructivism and collaboration within the digital environment inform the design of an interactive website that enhances the ways teachers are able to collaborate with colleagues around the world? Exploring this question led to designing a research object, an interactive website for the field of educational practice, using a pioneering

framework within education research, the DERF. Through the use of a development panel, collaboration was used to explore a question about collaboration. An interactive website can be designed that incorporates research to create a more complex partnering system. The interactive website, teachersconnecting.com, is a partnering system using the design as research method (DERF), and categorizing collaborative project according to the comforts. Future work may examine if a more complex partnering system leads to more active users and thus more partnering opportunities to participate in collaboration opportunities beyond their own classrooms.

The process of exploring the research question also led to the consideration of how advancements in communication tools have changed learning opportunities and how reflective teaching practice may be enhanced. Communication tools may lead to greater access between researcher and practitioner to address the oft-maligned relationship between these groups. Using the comforts of connectivity, constructivism, and collaboration may enhance the reflective practice of high connectivity teachers by increasing self-awareness of their understanding of other professional factors. Low connectivity teachers may also then become aware of how existing classroom practice could be enhanced with connectivity options that lead to collaborative projects between classrooms. Applying connectivism to classroom or research interactions may enhance understanding and encourage reflection by researcher, teacher, participant, or student. The alignment of comforts within a matrix that links

communication tools may ensure that teachers have greater success when choosing to begin a cross-classroom collaboration project. Future work may examine the effects of collaboration in the classroom and how a teacher's understanding of the Cross-Classroom Collaboration Project Matrix may influence students' collaboration experience in the classroom.

This investigation originated from personally observing my students on a hot June day in a computer lab as they engaged in collaborative learning online with classes of students a time zone away. As I reflected on this cross-classroom collaboration, my teaching practice and view of teaching changed. The research process formalized my reflections and led to an interactive website to share my collaboration experiences by enabling other teachers and classrooms, via the interactive website, to have a similar collaboration opportunity. How might the interactive website, teachersconnecting.com, promote professional growth in other teachers? Will cross-classroom experiences lead to student as well as teacher reflective practice? An interactive website emerged from that hot computer lab. Now a more complex partnering system for potential collaboration partners as well as project matrix has emerged from this investigation and may lead to greater understanding of collaboration projects in classrooms.

References

About Drupal. (2007). Retrieved January 6, 2008, from Drupal: http://drupal.org/about

Agile Manefesto. (2001). *Principles behind the agile manifesto.* Retrieved 06 28, 2008, from Manfesto for Agile Software Development: http://agilemanifesto.org/principles.html

Anderson, L. W., & Krathwohl, D. R. (Eds.). (2001). *A taxonomy for learning, teaching and assessing: A revision of Bloom's Taxonomy of educational objectives* (Complete edition ed.). New York: Longman.

Bandura, A. (1997). *Self-efficacy: The exercise of control.* New York: W. H. Freeman.

Bannan-Ritland, B. (2003). The role of design in research: The integrative learning design framework. *Educational Researcher , 32* (1), 21-24.

Barabasi, A. (2003). *Linked: How everything is connected to everthing else and what it means.* Toronto: Plume.

Bell, P. (2004). On the theoretical breath of Design-Based Research in education. *Educational Psychologist , 39* (4), 243 - 253.

Bereiter, C. (2005). Design research: The way forward. *Education Canada , 46* (1), 16-19.

Berge, Z. L. (2004). Complexity and confusion in distance education. *Distance Learning , 1* (2), 1-6.

Bird, L. (2007). The 3 'C' design model for networked collaborative e-learning: A tool for novice designers. *Innovations in Education and Teaching International , 44* (2), 153-167.

Bloom, B. S., Engelhart, M. D., Furst, E. J., Hill, W. H., & Krathwohl, D. R. (1956). *Taxonomy of educational objectives: The classification of educational goals* (Handbook 1: Cognitive domain ed.). (B. S. Bloom, Ed.) New York: David McKay.

Boss, S., & Krauss, J. (2007). Real projects in a digital world. *Principal Leadership , 8* (4), 22-26.

Carmody, K., & Berge, Z. (2005). Elemental analysis of the onlin learning experience. *International Journal of Education and Development Using Information and Communication Technology , 1* (3), 108-119.

Carugati, A. (2008). Information system development activities and inquiring systems: An integrating framework. *European Journal of Information Systems , 17*, 143-155.

Cohn, M. (2004). *User stories applied: For agile software development.* Toronto, ON: Addison-Wesley.

Douglass, R. T., Little, M., & Smith, J. W. (2006). *Building online communities with Drupal, phpBB, and WordPress.* New York: Apress.

Downes, S. (2005, December). *An introduction to connective knowledge.* Retrieved November 12, 2007, from Stephen's Web: http://www.downes.ca/files/connective_knowedge.htm

Downes, S. (2006, October 16). *Learning networks and connective knowledge.* Retrieved July 28, 2008, from http://it.coe.uga.edu/itforum/paper92/paper92.html

Downes, S. (2007a). Learning networks in practice. *Emerging technologies for learning , 2.*

Downes, S. (2007b, February 3). *OCC2007: A challenge to connectivism.* Retrieved November 12, 2007, from Online Connectivism Conference: http://ltc.umanitoba.ca/moodle/mod/forum/discuss.php?d=12&parent=385

Downes, S. (2007c, February 7). *What connectivism is.* Retrieved November 12, 2007, from Stephen's Web: http://www.downes.ca/post/38653

Driscoll, M. P. (2000). *Psychology of learning for instruction.* Boston, MA: Allyn and Bacon.

Engestrom, Y. (1999). Activity theory and individual and social transformation. In Y. Engestrom, R. Miettinin, & R. Punamaki (Eds.), *Perspectives on activity theory* (pp. 19-38). New York: Cambridge University Press.

Epals Inc. (2008). *ePals global community.* Retrieved August 1, 2008, from ePals Global Community: http://www.epals.com

Faraj, S., & Sproull, L. (2000). Coordinating expertise in software development teams. *Management Science , 46* (12), 1554-1568.

Fogg, B. J. (2003). Conceptual designs: The fastest way to capture and share your idea. In B. Laurel (Ed.), *Design research: Methods and perspectives* (pp. 201 - 211). Cambridge, MA: The MIT Press.

Freedman, T. L. (2005). *The world is flat.* New York: Farrar, Stratus, and Giroux.

Gardner, H. (2006). *Changing minds.* Boston, MA: Harvard Business School.

Gladwell, M. (2000). *The tipping point: How little things can make a big difference.* New York: Little, Brown and Company.

Gray, B. (1989). *Collaborating: Finding common ground for multiparty problems.* San Francisco, CA: Jossey-Bass.

Greeno, J. G. (1997). On claims that answer the wrong questions. *Educational Researcher , 26* (1), 6-17.

Guba, E. G., & Lincoln, Y. S. (1989). *Fourth generation evaluation.* London: Sage.

Harris, L. C., O'Malley, L., & Patterson, M. (2003). Professional interaction: Exploring the concept of attraction. *Marketing Theory , 3* (1), 9-36.

Hartnell-Young, E. (2006). Teachers as designers in computer-supported communities of practice. *International Electronic Journal for Leadership in Learning , 10* (3), 1-14.

Hasan, H. (2006). Design as research: Emergent complex activity. *17th Australasian Conference on Information Systems.* Adelaide, Australia.

Hewlett-Packard. (2008). *Teacher Experience Exchange.* Retrieved August 1, 2008, from Teacher Experience Exchange: http://h30411.www3.hp.com/

Hoekman, R. (2007). *Designing the obvious: A common sense approachto web application design.* Berkeley, CA: New Riders.

Hung, D., Tan, S., & Koh, T. (2006). From traditional to constructivist epistemologies: A proposed theoretical framework based on activity theory for learning communities. *Journal of Interactive Learning Research , 17* (1), 37-55.

Huxham, C. (1996). Collaboration and collaborative advantage. In C. Huxham, *Creating collaborative advantage* (pp. 1-18). Thousand Oaks, CA: Sage Publications.

International Education and Resource Network. (2008). *Projects: Collaboration center.* Retrieved August 1, 2008, from iEARN: http://media.iearn.org/projects

International Society for Technology in Education. (2007). Retrieved October 4, 2007, from National education technology standards for students: The next generation: http://www.iste.org/inhouse/nets/cnets/students/pdf/NETS_for_Students_2007.pdf

Ireland, C. (2003). Qualitative methods: From boring to brilliant. In B. Laurel (Ed.), *Design research: Methods and perspectives* (pp. 23-29). Cambridge, MA: The MIT Press.

Janzen, D., & Saiedian, H. (2008). Does test-driven development really improve software design quality? *IEEE Software , 25* (2), 77-84.

Johnson, B. M. (2003). The paradox of design research: The role of informance. In B. Laurel (Ed.), *Design research: Methods and perspectives* (pp. 39-40). Cambridge, MA: The MIT Press.

Joseph, D. (2004). The practice of Design-Based Research: Uncovering th einterplay between design, research, and the real-world context. *Educational Psychologist , 39* (4), 235 - 242.

Joseph, L. C. (2007). Global connections. *Multimedia & Internet@schools , 14* (5), 18-21.

Karchmer-Klein, R., & Layton, V. (2006). Literature-based collaboartive internet projects in elementary classrooms. *Reading Research and Instruction , 45* (4), 261-294.

Keefe, E. B., Moore, V., & Duff, F. (2004). The four "knows" of collaborative teaching. *Teaching Exceptional Children , 36* (5), 36-42.

Kotlarsky, J., & Oshri, I. (2005). Social ties, knowledge sharing and successful collaboration in globally distributed system development projects. *European Journal of Information Systems , 14*, 37-48.

Krathwohl, D. R. (2002). A revision of Bloom's Taxonomy: An overview. *Theory into Practice , 41* (4), 212 - 218.

Krug, S. (2006). *Don't make me think: A common sense approach to web usability* (2nd ed.). Berkeley, CA: New Riders.

Kruse, S. D. (2001). Creating communities of reform: Continuous improvement planning teams. *Journal of Educational Administration , 39* (4), 359-383.

Kruse, S. D. (2003). Remembering as organizational memory. *Journal of Eduational Administration , 41* (4/5), 332-347.

Lattuca, L. R. (2006). The constructivist pedagogy we're looking for. *Journalism & Mass Communication Educator , 60* (4), 354-358.

Lincoln, Y. S., & Guba, E. G. (1985). *Natrualistic inquiry.* London: Sage.

Lindstrom, L., & Jeffries, R. (2004). Extreme programming and agile software development methodologies. *Information Systems Management , 21* (3), 41-61.

Loertscher, D. (2007). Children, tens, and the construction of information spaces. *Teacher Librarian , 35* (2), 14-17.

Louis, K. S., Marks, H. M., & Kruse, S. (1996). Teachers' professional community in restructuring schools. *American Educational Research Journal , 33* (4), 757-798.

Luke, C. (2003). Pedagogy, connectivity, multimodality, and interdisciplinarity. *Reading Research Quarterly , 38* (3), 397-403.

Luppicini, R. (2003). Categories of virtual learning communities for educational design. *Quarterly Review of Distance Education , 4* (4), 409-416.

Maddux, C. D., & Cummings, R. (1999). Constructivism: Has the term outlived its usefulness? *Computers in the Schools , 15* (3/4), 5-20.

Mayer, R. C., & Norman, P. M. (2004). Exploring attributes of trustworthiness: A classroom exercise. *Journal of Management Education , 28* (2), 224-249.

McFadden, A. C., & Price, B. J. (2007). Skype: A synchronous tool for computer-mediated collaboration. *International Forum of Teaching and Studies , 3* (2), 37-45.

McLinden, M., McCall, S., Hinton, D., & Weston, A. (2006). Participation in online problem-based learning: Insights from postgraduate teachers studying through open and distance education. *Distance Education , 27* (3), 331-353.

McPherson, S., Wang, S., Hsu, H., & Tsuei, M. (2007). New literacies instruction in teacher education. *TechTrends , 51* (5), 24-31.

Meloncon, L. (2007). Exploring electronic landscapes: Technical communication, online learning, and instructor preparedness. *Technical Communication Quarterly , 16* (1), 31-53.

Mercer, D. (2006). *Drupal: Creating blogs, forums, portals, and community websites.* Birmingham, UK: Packt.

Molebash, P., & Fisher, D. (2003). Teaching and learning literacy with technology. *Reading Improvement , 40* (2), 63-70.

Morville, P. (2002). Bottoms up: Designing complex, adaptive systems. *New Architect , 7* (12), 28-31.

Muilenburg, L. Y., & Berge, Z. L. (2005). Student barriers to online learning: A factor analytic study. *Distance Education , 26* (1), 29-48.

Nielsen, J. (1994). Measuring usability: Preference vs. performance. *Communications of the ACM , 37* (4), 66-76.

Nielsen, J., & Loranger, H. (2006). *Prioritizing web usability.* Berkeley, CA: New Riders.

Nielson, J. (1990). Traditional dialogue design applied to modern user interfaces. *Communications of the ACM , 33* (10), 109-119.

Overbaugh, R. C., & Lin, S. Y. (2006). Student characteristics, sense of community, and cognitive achievement in web-based and lab-based learning environments. *Journal of Research on Technology in Education , 39* (2), 205-223.

Palloff, R. M., & Pratt, K. (2007). *Building online communities: Effective strategies for the virtual classroom.* San Francisco, CA: Jossey-Bass.

Piaget, J. (1970). *L'Epistemologie Genetique.* Paris, France: Presses Universitaires de France.

Pomsom, A. D. (2005). One classroom at a time? Teacher isolation and community viewed through the prism of the particular. *Teachers College Record , 107* (4), 783-802.

Rosenfeld, L. (2002). Information architecture: Looking ahead. *Journal of the American Society for Information Science and Technology , 53* (10), 874-876.

Schön, D. A. (1983). *The reflective practitioner.* New York: BasicBooks.

Seale, C. (1999). Quality in Qualitative Research. *Qualitiative Inquiry , 5* (4), 465-478.

Shirky, C. (2008). *Here comes everybody: The power of organizing without organizations.* New York: The Peguin Press.

Siegle, D. (2008). Working with wikis. *Gifted Child Today , 31* (1), 14-17.

Siemens, G. (2004, December 12). *Connectivism: A learning theory for the digital age.* Retrieved November 12, 2007, from elearnspace: http://www.elearnspace.org/Articles/connectivism.htm

Siemens, G. (2005, October 19). *Connectivism: Rethinking learning in a digital age.* Retrieved July 29, 2008, from eLearnspace: http://www.elearnspace.org/media/connectivism_Web_2/player.html

Siemens, G. (2008). Learning and knowing in networks: Changing roles for educators and designers. *Paper presented at the ITFORUM.*

Siraj-Blatchford, I., & Siraj-Blatchford, J. (1997). Reflexivity, social justice and eduational research. *Cambridge Journal of Education , 27* (2), 235-248.

Smith, S. E., & Potoczniak, A. (2005). Five points of connectivity. *Educause Review , 40* (5), 30-41.

Spinuzzi, C. (2005). The metholology of participatory design. *Technical Communication , 52* (2), 163-175.

Stapleton, A. J. (2005). Research as design - design as research. *DiGRA 2005 Conference: Changing Views - Worlds in Play.*

Straits, W., & Wilke, R. (2007). How constructivist are we? Representations of transmission and participatory models of instruction in the Journal of College Science Teaching. *Journal of College Science Teaching , 36* (7), 58-61.

TakingITGlobal. (2008). *TIGed - browse collaborators.* Retrieved August 1, 2008, from TakingITGlobal: http://www.takingitglobal.org/tiged/ec/collaborators.html

Tapscott, D., & Williams, A. D. (2006). *Wikinomics: How mass collaboration changes everything.* New York: Portfolio.

The My Hero Project. (2008). *MY HERO: Participate.* Retrieved August 1, 2008, from The MY HERO project: Celebrate the best of humanity: http://myhero.com/myhero/go/participate/index.asp

Thomson, A. M., & Perry, J. L. (2006). Collaboration processes: Inside the black box. *Public Administration Review , 66*, 20-32.

VanDyk, J. K., & Westgate, M. (2007). *Pro Drupal development.* New York: Apress.

Vangen, S., & Huxham, C. (2003). Nurturing collaborative relations: Building trust in interorganizational collaboration. *The Journal of Applied Behavioral Science , 39* (1), 5-31.

Virolainen, M. (2007). Workplace learning and higher education in Finland: Reflections on current practice. *Education + Training , 49* (4), 290-309.

von Glasersfeld, E. (1995). A constructivist approach to teaching. In L. P. Steffe, & J. Gale (Eds.), *Constructivism in education* (pp. 3-15). Hllsdale, NJ: Lauwrence Erlbaum Associates.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Vygotsky, L. S. (1962). *Thought and language.* Cambridge, MA: MIT Press.

Wagner, J. (2008). *OnlineProjects4Teachers*. Retrieved August 1, 2008, from OnlineProjects4Teachers: Linking teaches together: http://onlineproj4tchrs.ning.com/

Wang, F., & Hannafin, M. J. (2005). Design-based research and technology-enhanced learning environments. *Educational Technology, Research and Development , 53* (4), 5-23.

Weick, K. E., Sutcliffe, K. M., & Obstfeld, D. (1999). Organizing for high reliability: Processes of collective mindfulness. In B. Staw, & L. Cummings (Eds.), *Research in Organizational Behaviour* (pp. 81-123). Greenwich, CT: JAI Press.

Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity.* New York: Cambridge University Press.

Wikipedia contributors. (2008a, July 29). *Micro-blogging*, 228507089. Retrieved August 1, 2008, from Wikipedia: The free encyclopedia: http://en.wikipedia.org/w/index.php?title=Micro-blogging&oldid=228507089

Wikipedia contributors. (2008b, August 1). *Ning*, 229175701. Retrieved August 1, 2008, from Wikipedia: The free encyclopedia: http://en.wikipedia.org/w/index.php?title=Ning&oldid=229175701

Wikipedia contributors. (2008c, July 30). *Open source software*, 228909430. Retrieved August 1, 2008, from Wikipedia: The free encyclopedia: http://en.wikipedia.org/w/index.php?title=Open_source_software&oldid=228909430

Wood, D. J., & Gray, B. (2001). Toward a comprehensive theory of collaboration. *Journal of Applied Behavioral Science , 27* (2), 139-162.

Yan, J. (2008). Social technology as a new medium in the classroom. *The New England Journal of Higher Education , 22* (4), 27-30.

Zimmerman, E. (2003). Play as research: The interative design process. In B. Laurel (Ed.), *Design research: Methods and perspectives* (pp. 176 - 184). Cambridge, MA: The MIT Press.

Appendix A

Non-Teaching User Profiles

Name: Alec Couros

Biography Assistant Professor, ICT Coordinator, Associate Director SIDRU at the University of Regina, maintains a research interest in open source software in education, cyber school, technology in teacher education, and First Nations' schools.

Name: Lisa Creech Bledsoe

Biography Director, Calvert Creative, freelance designer, is an independent social media, networking, technology, and design consultant. She holds degrees from Duke University and the University of Tennessee-Knoxville that include a focus on Design.

Appendix B

Teacher User Profiles

Name: Joan Badger

Biography	Taught middle school for 20 years in Winnipeg, Manitoba, Canada with a recent focus on technology and literacy. Recently appointed technology program consultant for a Manitoba school district. Co-host of a weekly podcast on interactive whiteboard integration into the classroom for three years. Has spoken at technology conferences, participated in provincial technology continuum development.
Comfort with cross-classroom collaborations	Has participated in collaborative projects across provinces. Also facilitated colleagues in developing and implementing cross-classroom collaborations.
Comfort with computer hardware, software, and websites	Very comfortable with a variety of technology tools for student and professional learning purposes. Extensive use of interactive whiteboards within classrooms along with social internet sites.
Plans for use of the resulting design object and goals for this use	The website will be used to connect Manitoba classrooms with others. Site will be frequently visited and colleagues will be coached to utilize it in similar ways.

Name: Tom Barrett	
Biography	Taught Year 3 to 6 students for 8 years in Nottingham, England. Currently he is Assistant Headteacher, Assessment Coordinator, and Year 5/6 classroom teacher. Has been an ICT Subject Leader in his school.
Comfort with cross-classroom collaborations	Created, participated, and documented several cross-classroom collaborations via his professional blog. Quite comfortable with the processes and tools to make these collaborations effective.
Comfort with computer hardware, software, and websites	Uses a wide variety of technology in his classroom including: interactive whiteboards, digital cameras, scanners, and laptop computers. Has been using socially driven online websites for a few years and feels very comfortable using these tools in the classroom. Recently recognized by Google for his classroom work.
Plans for use of the resulting design object and goals for this use	Hopes to forge a connection with other teachers in similar situations. Wants the tool to show students wider world through real class links. Will access the internet site at the beginning of every term (3 terms a year) to look for collaborative partners in specific areas.

Name: Tammy Bryant

Biography	Taught grades 4 and 2 for the past 15 years in Brampton, Ontario, Canada. Has been the school's grade 4 division chairperson, and curriculum leader.
Comfort with cross-classroom collaborations	Has comfort with collaboration projects that have taken place within her school. Participated on several projects with different colleagues. Projects have been in social studies, science, and math subject areas.
Comfort with computer hardware, software, and websites	Comfortable using technology tools that include a variety of desktop publishing applications, and internet sites by using hubs of classroom computers, projectors, and digital cameras. She showcased these ideas to colleagues as a technology demonstration teacher within her school district.
Plans for use of the resulting design object and goals for this use	Would use the website once per term to participate in projects. This interaction will focus on creating good connections for collaborations that will benefit students and professional growth.

Name: Jess McCulloch

Biography	Taught Chinese for Grades 1 to 11 over the past 3 years in a rural school located within Western Victoria, Australia. Maintains an active professional blog.
Comfort with cross-classroom collaborations	Limited experience with two cross-classroom collaboration projects. One project she joined and participated in. She created and implemented the other project.
Comfort with computer hardware, software, and websites	Highly proficient with computers, and software. Uses technology tools in the classroom and to facilitate her own professional learning by joining social networks of educators, using social bookmarking internet sites, and listening to podcasts for mobile learning.
Plans for use of the resulting design object and goals for this use	Site will be used to find more project partners twice a month and to keep in contact with existing partners. Hope to make some strong connections with teachers through this website, get ideas for new projects, and be able to work with them to create valuable projects for her students.

Name: Katie Morrow	
Biography	Taught grade 5 in O'Neill, Nebraska, USA for 10 years before becoming a technology integration specialist for her school district. She regularly presents at technology conferences and teaches graduate technology courses for teachers.
Comfort with cross-classroom collaborations	Has participated in several collaborative projects that were in her school site, within the local community, and internationally. Project content ranged from web design buddies to story development through email. Had desire for more collaboration but no connections with other classrooms.
Comfort with computer hardware, software, and websites	High level of comfort with technology tools, she has attained a master's degree in educational technology. Designated as an Apple Distinguished Educator for work with a variety of digital video, podcasting, and website development projects with students. Uses a wide variety of social internet sites.
Plans for use of the resulting design object and goals for this use	The resulting website would be used to start and sustain collaborative projects for classrooms within local school district to form global connections and understanding that is not typically possible in the small rural community. Will return to the site every 9 weeks.

Appendix C

Prototype Screen Capture

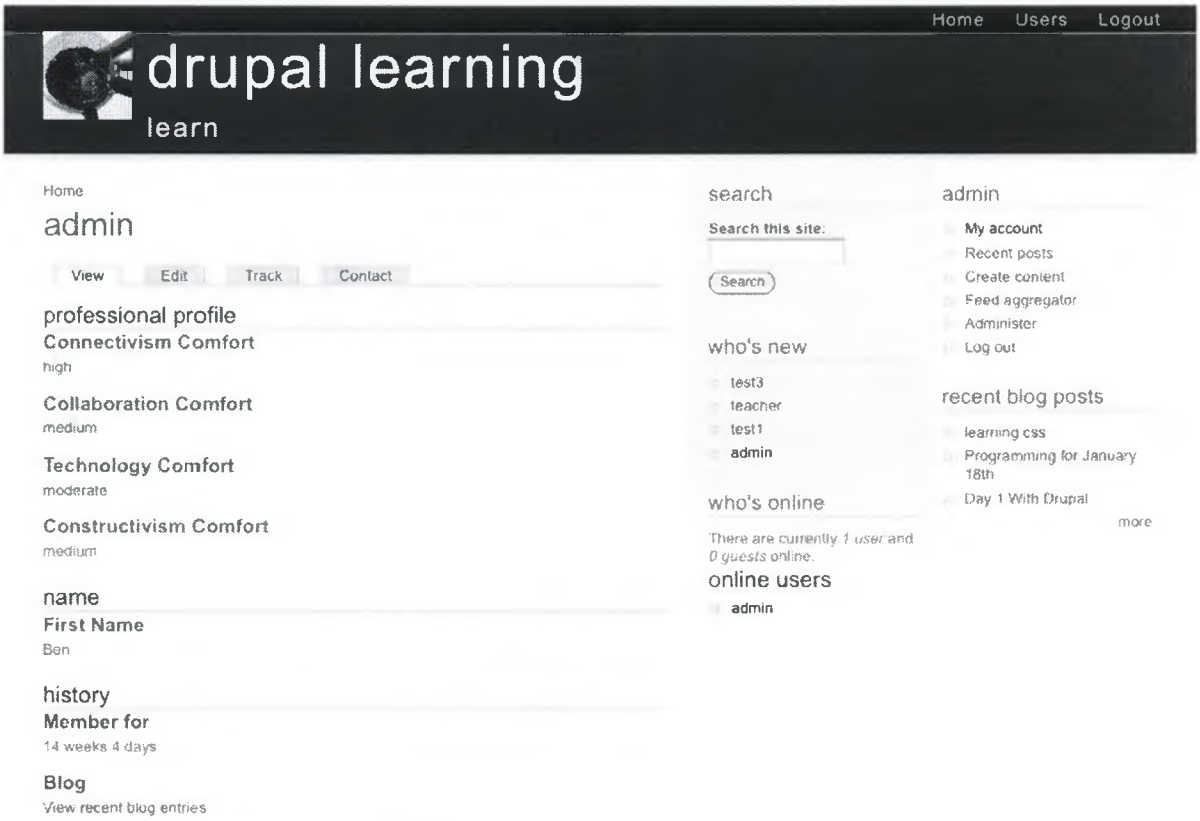


Figure C 1: Initial website with basic comforts connected to an individual user.

Appendix D

Final Screen Captures

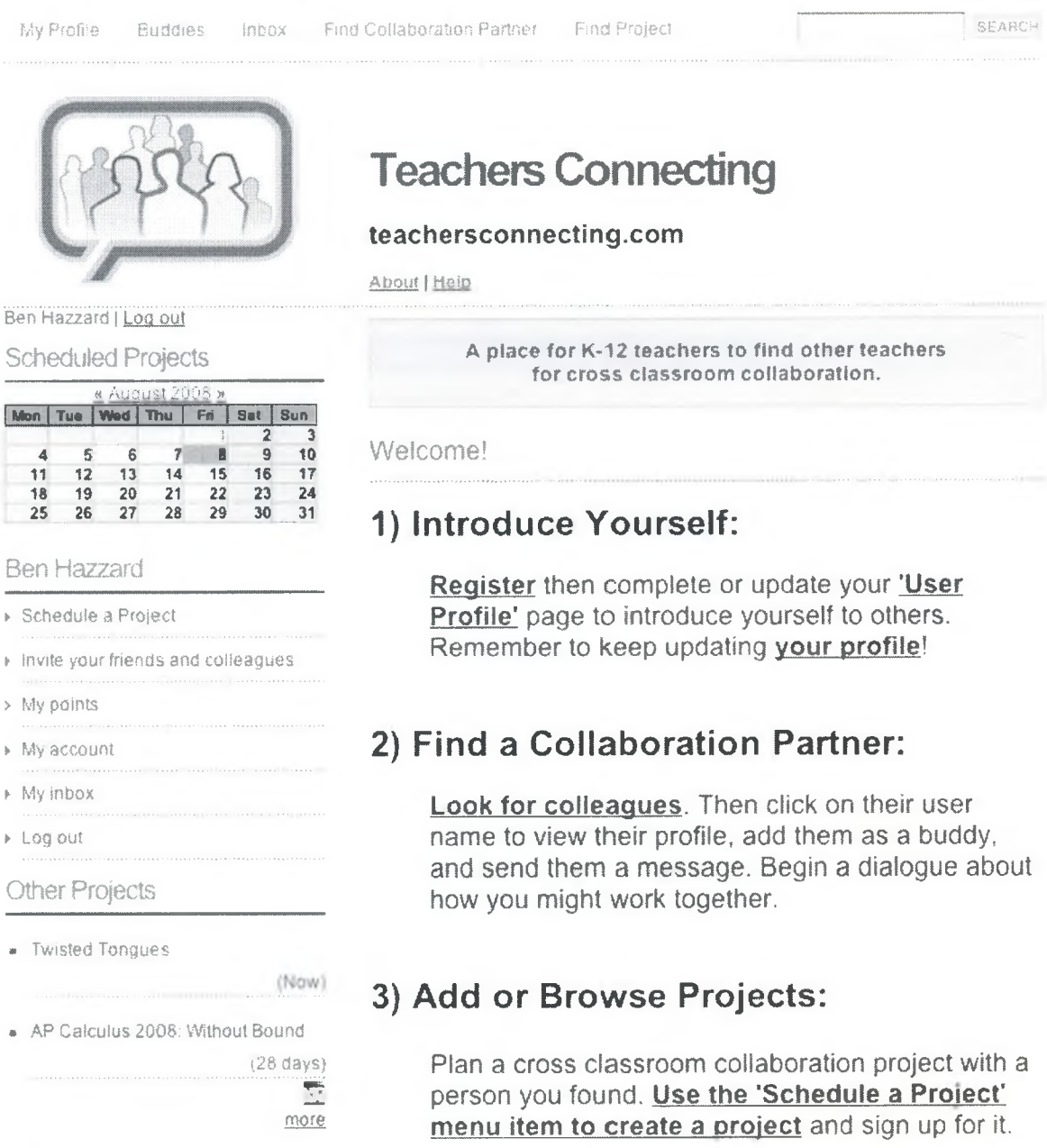


Figure D 1 Main screen when users log in.

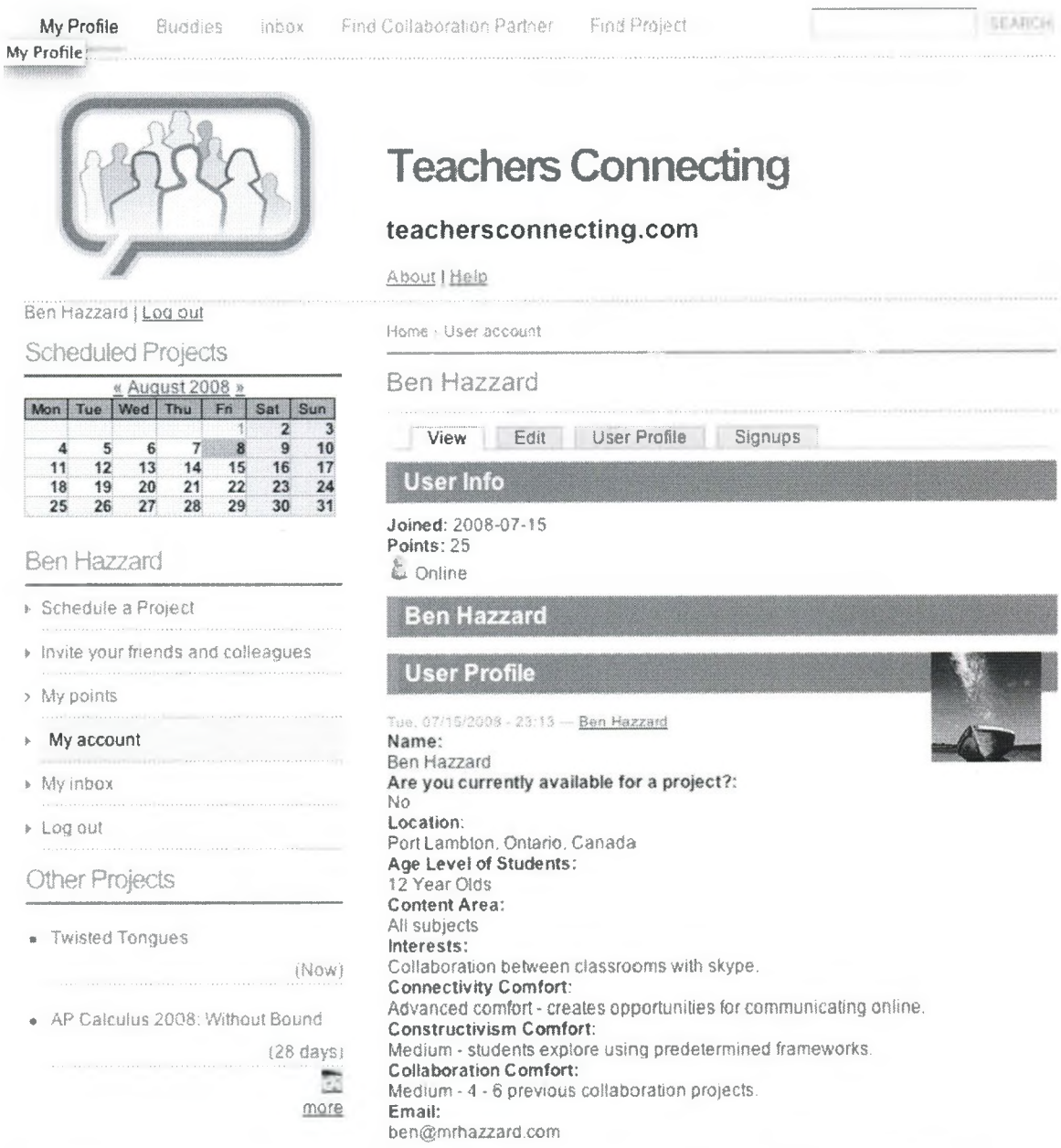


Figure D 2 User Profile screen that also allows editing accound information, user profile, and signups.

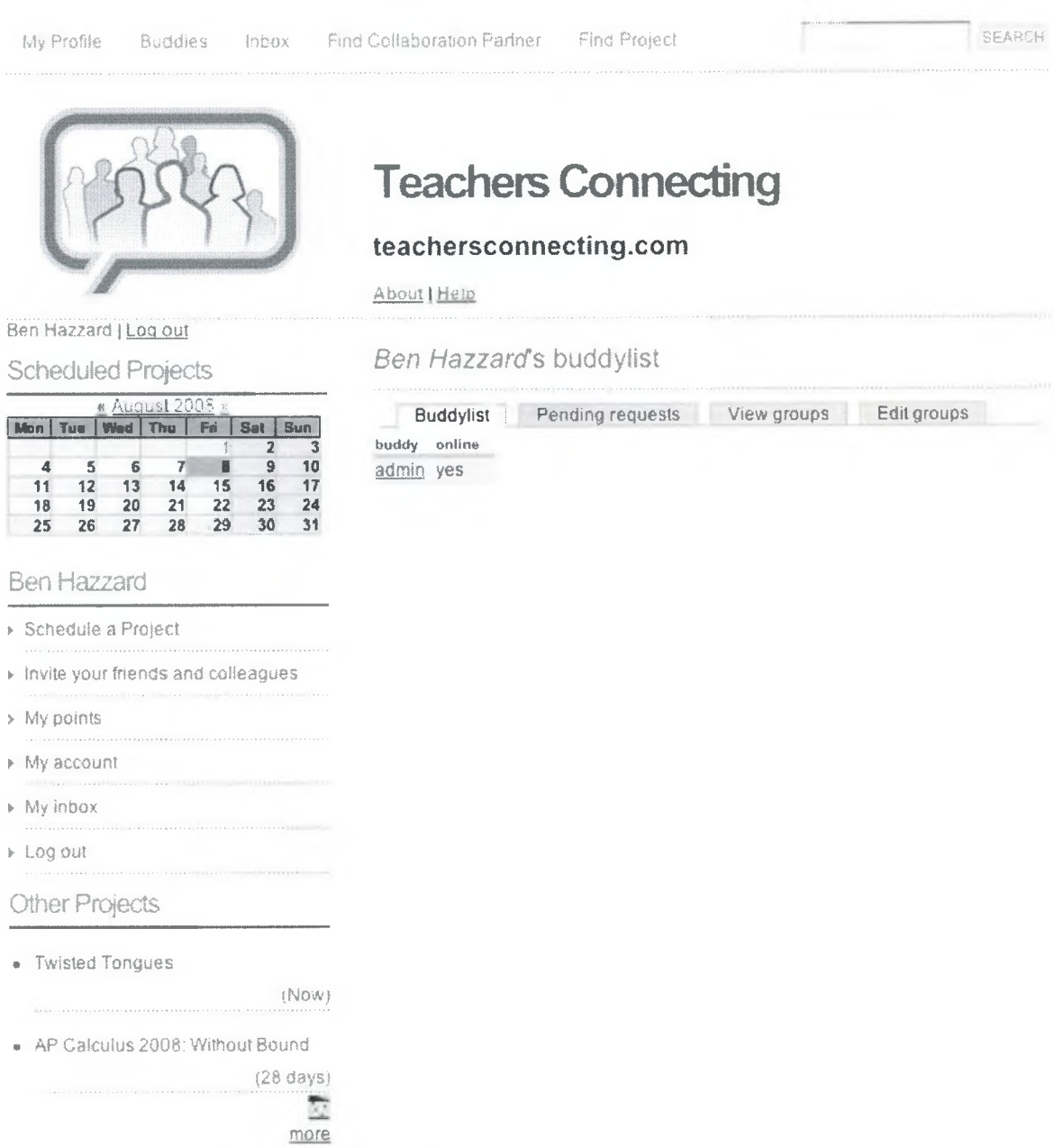


Figure D 3 Page that lists a user's buddies, pending buddies, and grouping of buddies.

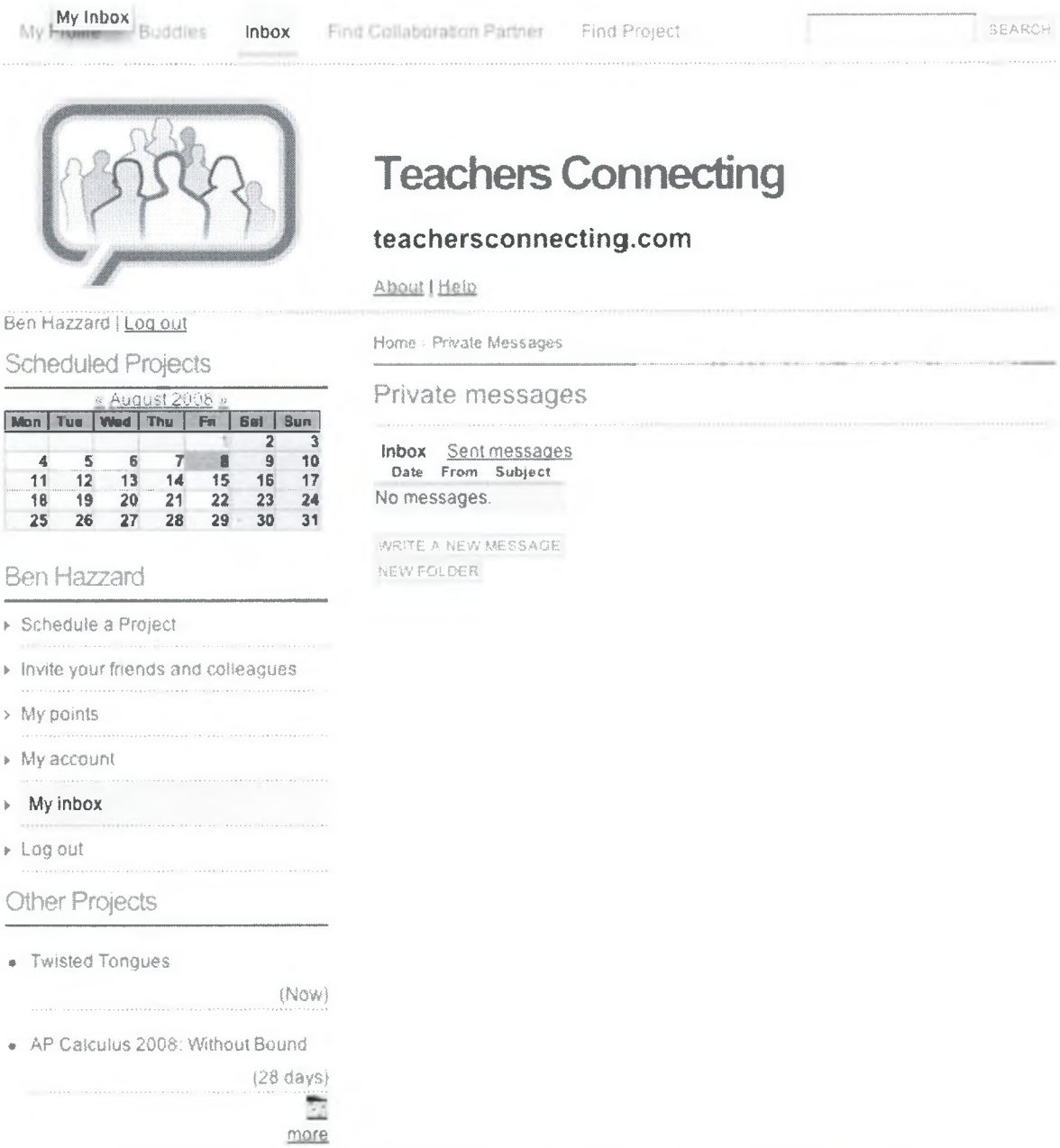


Figure D 4 User's private message page to receive and send messages to other users.

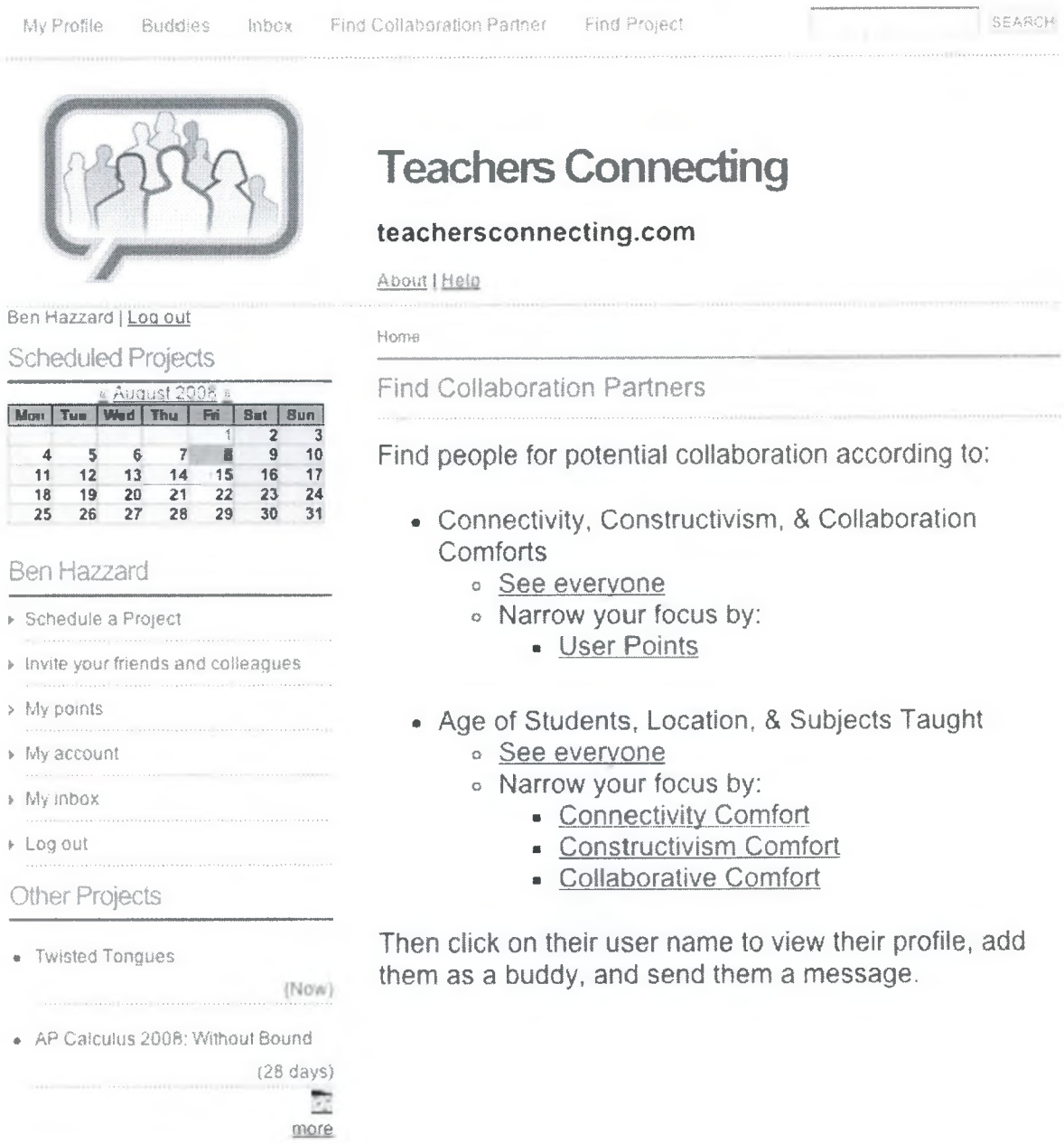


Figure D 5 Find collaboration partner page with options for the comforts and logistics as well as multiple ways to narrow results.

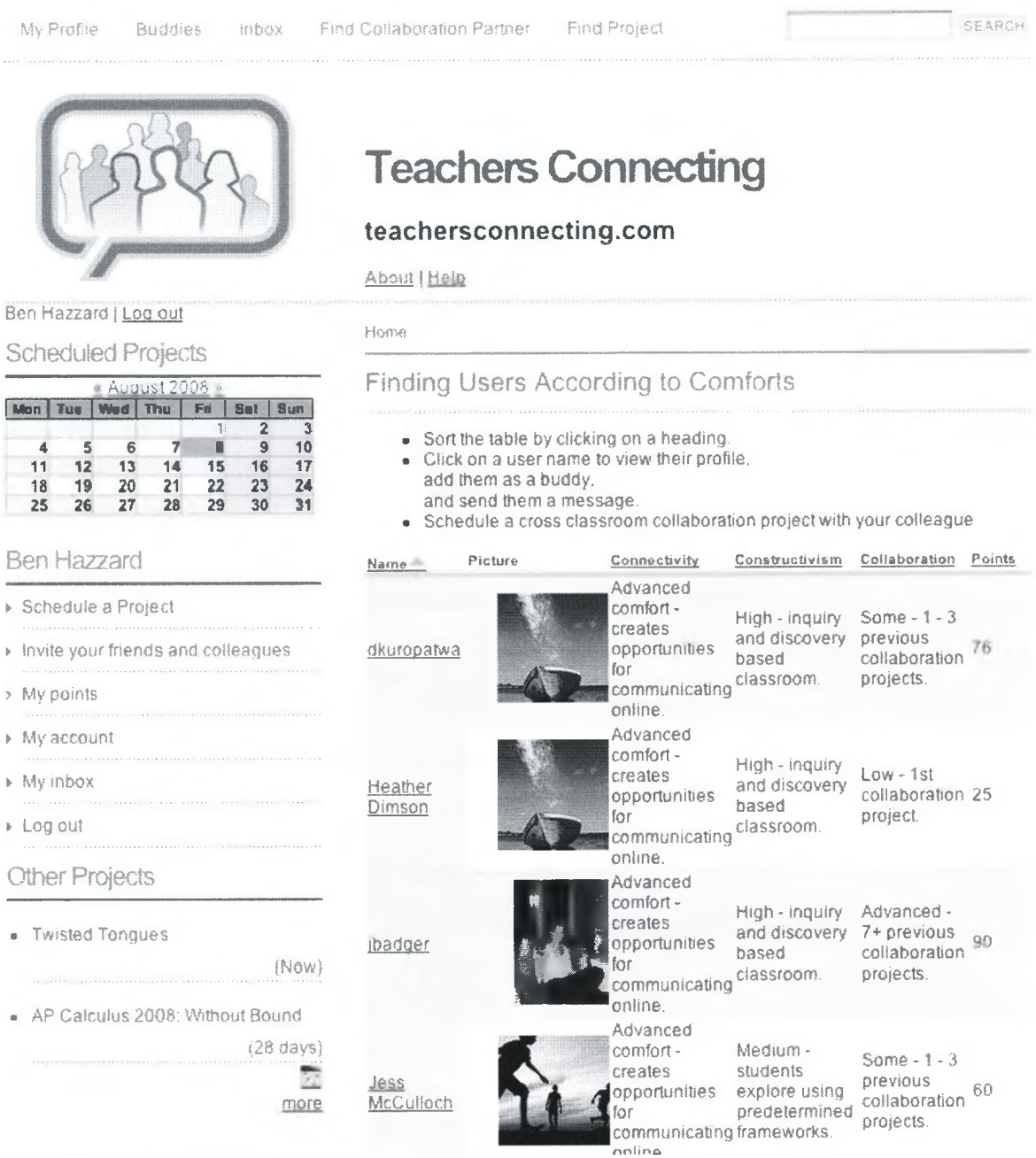


Figure D 6 Example of page for finding users according to comforts.

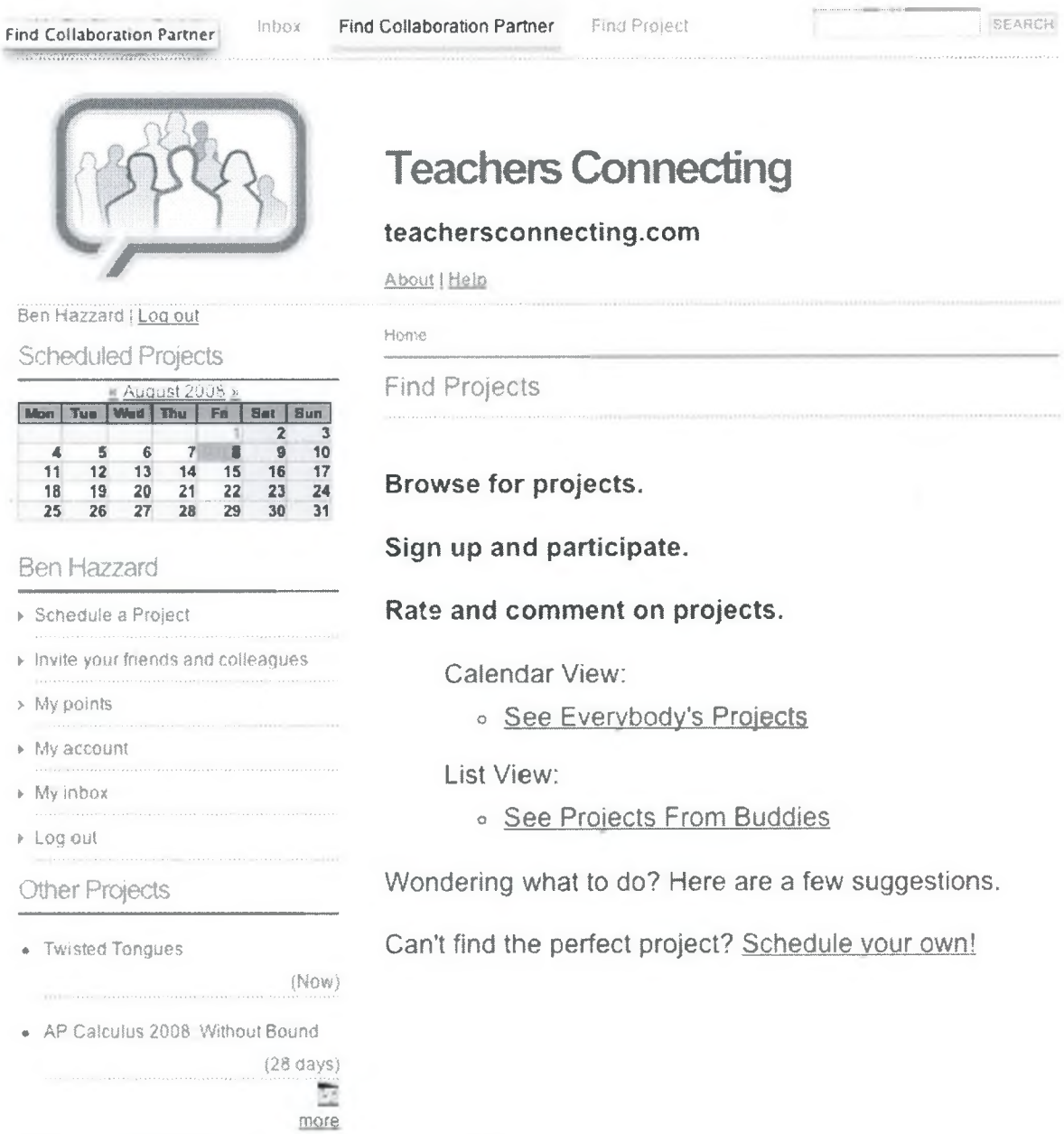


Figure D 7 Page for finding projects scheduled by other users.

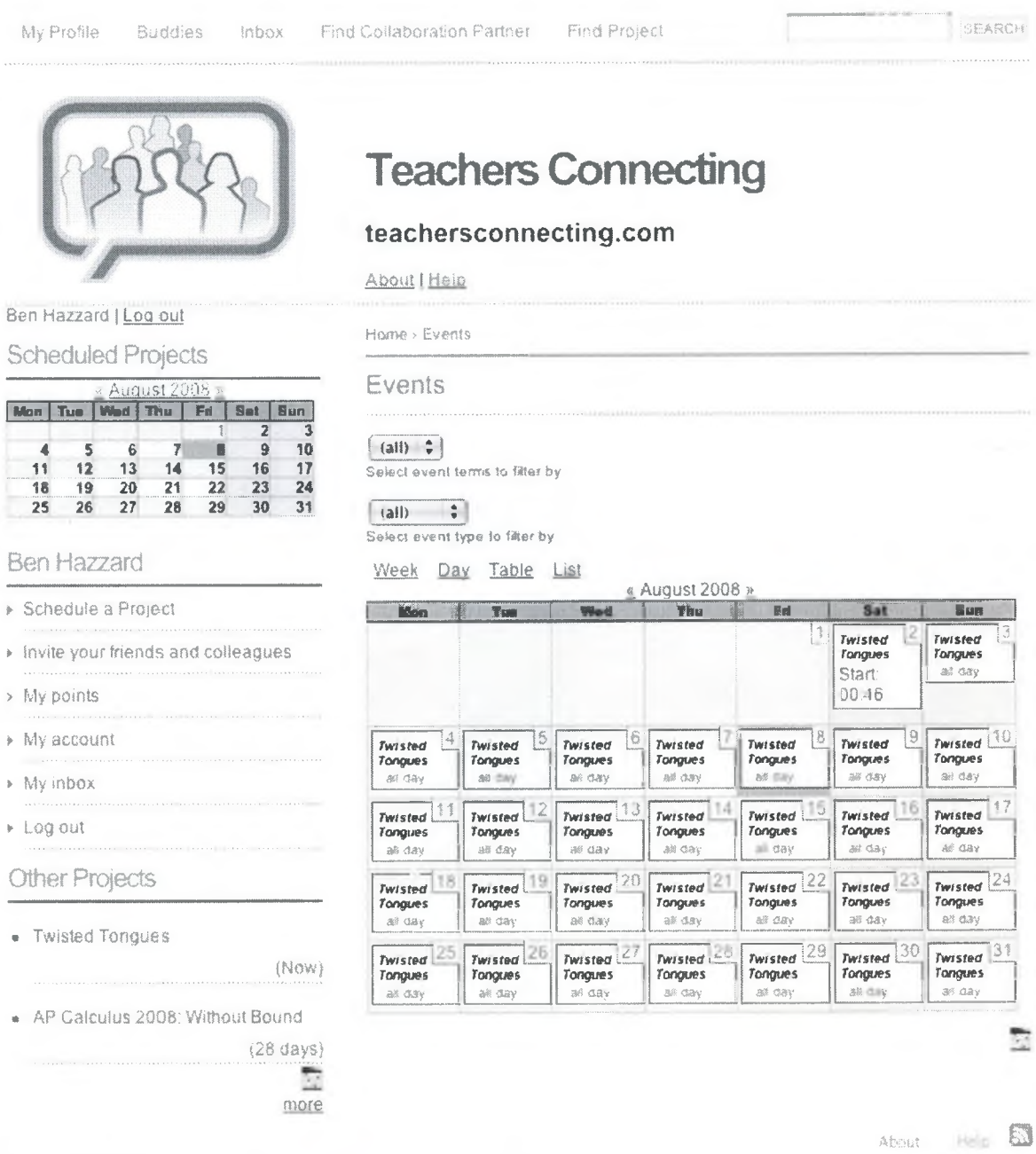


Figure D 8 Finding projects according using a calendar view.

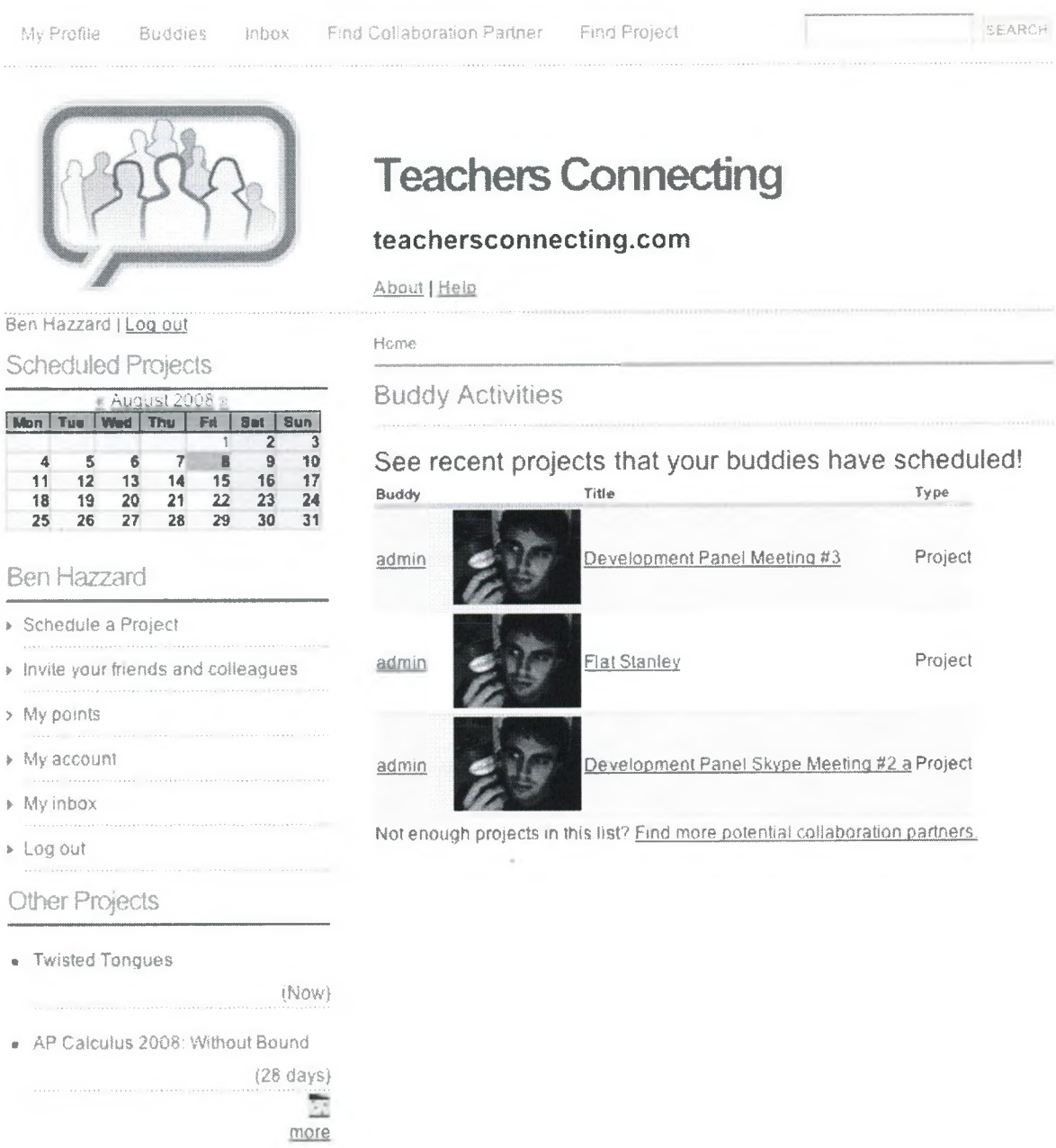


Figure D 9 Finding project that your buddies have scheduled.

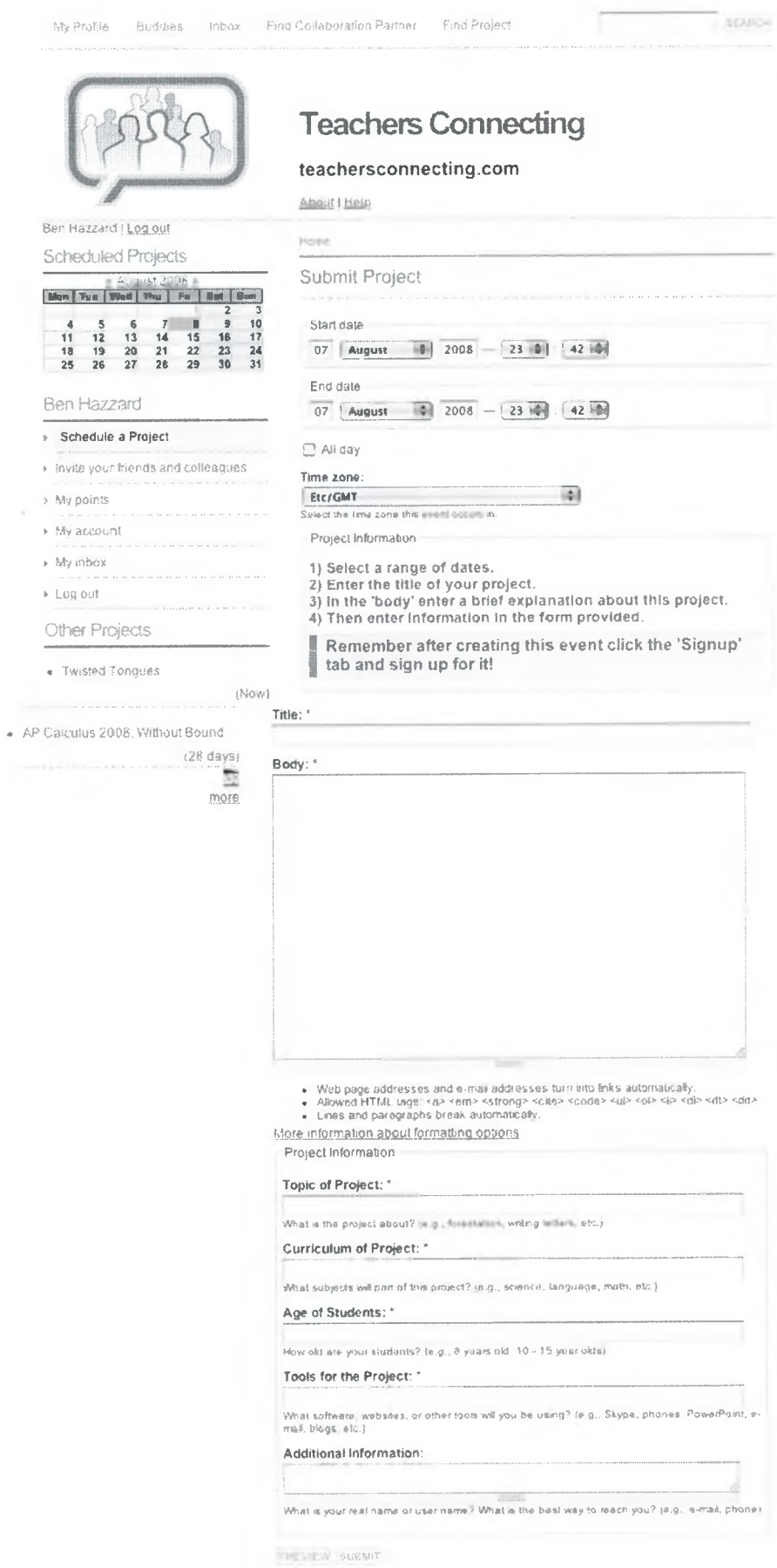


Figure D 10 Scheduling a project

Appendix E

Cross-Classroom Collaboration Projects According to Comfort

		Constructivism Comfort	
		Lower	Higher
Collaboration Comfort	Lower	**Asynchronously Sharing Knowledge** **Lower Connectivity:** • Pen Pals - Using email, and postal service. **Higher Connectivity:** • Cross-classroom Research Groups (with teacher defined topics and process) - Using email, wikis, online documents, online concept mapping, and social networking tools. • Joint Book Response Logs -Using blogs, wikis, and online concept mapping. • Digital Storytelling with Teacher Directed Concepts (products shared between classrooms) - Using digital images, slideshows, and digital video.	**Asynchronously Constructing Knowledge** **Lower Connectivity:** • Parallel Inquiry Projects - Using email, postal service, and digital images to share projects. **Higher Connectivity:** • Cross-classroom Inquiry Groups (with student selected topics and process) - Using email, wikis, online documents, online concept mapping, and social networking tools. • Joint Book Discussion Groups -Using blogs, wikis, and online concept mapping. • Digital Storytelling with Student Selected Concepts (products shared between classrooms) - Using digital images, slideshows, and digital video.
	Higher	**Synchronously Sharing Knowledge** **Higher Connectivity:** • Real Time Sharing of Research Projects (with teacher defined topics and process) - Using VOIP, Video Conferencing, Online Conferencing, and Online Documents. • Real Time Joint Book Response Logs -Using blogs, wikis, online concept mapping, VOIP, Video Conferencing, and Online Conferencing. • Digital Storytelling with Teacher Directed Concepts (cross-classroom groups and products shared between classrooms) - Using digital images, slideshows, digital video, VOIP, Video Conferencing, and Online Conferencing.	**Synchronously Constructing Knowledge** **Higher Connectivity:** • Real Time Cross-classroom Inquiry Groups (with student selected topics and process) - Using email, wikis, online documents, online concept mapping, social networking tools, VOIP, Video Conferencing, and Online Conferencing. • Real Time Book Discussion Groups -Using blogs, wikis, online concept mapping, VOIP, Video Conferencing, and Online Conferencing. • Digital Storytelling with Student Selected Concepts (cross-classroom groups and products shared between classrooms) - Using digital images, slideshows, digital video, VOIP, Video Conferencing, and Online Conferencing.

Cross-Classroom Collaboration Project Tools Referenced:

- E-mail examples include: gmail.com, yahoo.com, hotmail.com, and gaggle.net
- Postal Services include: government postal service, UPS, Fedex, and DHL.
- Digital Images include: images taken with digital cameras, photo prints digitized using a scanner, and photo sharing sites (flickr.com, picasa.com, smugmug.com).
- Blogs include: edublogs.org, 21classes.com, blogger.com, and wordpress.com.
- Wikis include: wikispaces.com, pbwiki.com, wiki.zoho.com, and wetpaint.com.
- Online Documents include: docs.google.com (word processing, spreadsheets, slideshows), zoho.com (word processing, spreadsheets, slideshows), buzzword.acrobat.com (wordprocessing).
- Online Concept Mapping including: mind42.com, gliffy.com, bubbl.us, and mindmeister.com.
- Social Networking Tools including: ning.com, and tribe.net.
- Slideshows including: previously mentioned online documents, 280slides.com, animoto.com, slideshare.net, and ed.voicethread.com.
- Digital Video includes: eyespot.com, jumpcut.com, onetruemedia.com.
- VOIP (Voice Over the Internet) and Video Conferencing: skype.com, gizmo5.com, messenger.yahoo.com, and ichat.com.
- Online Conferences include: elluminate.com/vroom, adobe.com/acom/connectnow, and meeting.zoho.com.