

# wConnect: A Facebook-Based Developmental Learning Community to Support Women in Information Technology

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## ABSTRACT

The under-representation of women in computer and information science (CIS) has created a crisis in availability of qualified CIS professionals and diversity of perspectives. Many interventions are being explored but these are primarily institutional programs like curriculum enhancements and mentoring. We describe *wConnect*, a developmental learning community that leverages social relations and social networking software to support women in CIS. This is a practical issue of some urgency that presents an opportunity for community informatics to impact the CIS profession. We report our progress and lessons learned, so that other organizations can initiate similar outreach activities.

## Categories and Subject Descriptors

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

## General Terms

Design.

## Keywords

Learning communities, women in computer science, social networking.

## 1. INTRODUCTION

Many girls entering their teenage years lose interest in computer and information science (CIS). By the time girls consider college options their interest in CIS majors falls far below that of their male counterparts [7]. One consequence is that in the U.S. the number of women graduating with CIS degrees has dropped by almost 25% in the past ten years [18]. This trend threatens the future availability of qualified CIS professionals, and particularly the diversity and vitality of the profession.

Researchers have explored a variety of interventions to address this tendency among young women to avoid CIS topics. For example, pair programming activities are offered as more socially engaging activities for gaining programming skills [20]. Departments sponsor female student groups to provide peer support and mentoring for classmates [9]. Universities often offer summer enrichment experiences for pre-college girls [2,12].

One limitation of these approaches is that they target girls who have

already expressed interest in computers or information technology – enough, for example to apply for a summer technology camp. It is much less obvious how to attract the middle and high school girls who have deliberately turned away from enrichment opportunities like these, but we must find a way to do just that.

Our project has shifted the emphasis from institutional outreach to community building, leveraging the social links and activities people create and maintain in their daily lives. Many young women hold a stereotypically narrow and negative view of the computer and information science as a field populated by “geeks” who work alone on boring computer programming tasks [19]. We are building on friendship networks to introduce a broader, more socially connected, and more personally meaningful view of CIS. By so doing we hope to attract, recruit, engage, and retain a more diverse population of female students and professionals.

In the balance of the paper, we summarize our experiences with *wConnect*, a community of women who share interests and goals related to CIS. Because we intend to link women across many physical locations, and who enjoy rather different lifestyles, we are building online community support for *wConnect* [30]. To now we have focused on recruiting members and engaging them in online activities using a social networking application built using the Facebook API. Prior to describing the application and activities, we introduce our goals for *wConnect* as a developmental learning community, and review related research on social networking. Following this, we describe the requirements for, design of, and preliminary experiences with the *wConnect* community application. We close with a discussion of open issues and more general implications.

### 1.1 Developmental Learning Communities

Research over the past two decades has shown the value of learning communities – self-organizing groups of learners who work together on authentic tasks, describing, explaining, listening to, and interpreting one another’s ideas. Learning communities structure their learning using social and tool-based scaffolding [5]. Learners develop by participating in the discourse of their community, where they encounter and contribute to the situated negotiation and re-negotiation of meaning [6]. A *developmental learning community* is a group of learners who organize their learning into phases and their members into roles [27]. The learning in these communities is developmental in that members successively traverse phases and roles. Examples are a university research group containing undergraduate students, graduate students, post docs, and faculty; or a virtual world containing newbies, members, experts, and administrators.

**Table 1. Features of a Developmental Learning Community**

*Phases:* The community is grounded on a sequence of phases that members pass through as they develop community-specific knowledge and skills.

*Roles:* Members of the community understand the role(s) they should take on given their developmental level, and what this implies with respect to interactions with others

*Motivation:* By joining the community, members express their commitment to traversing and helping others to traverse the developmental phases.

Table 1 summarizes several key features of developmental learning communities. Members understand – either implicitly or explicitly – the phases that correspond to development. These phases often may involve skill mastery (as in a martial arts community), with transitions formally acknowledged to mark progress (e.g. “apprentice”, “practitioner”, “master”). Progress may be achieved by meeting a community standard or practice, for example a skill test, a body of knowledge or experiences evaluated by other members, a prescribed level of insight that is expressed by the member, or an episode that demonstrates progress.

Another characteristic is the roles that members enact at different developmental phases. They understand what is expected from them at different phases – for example, how to help less-expert members (outreach, scaffolding, other forms of mentoring); reinforce skills at their own level (sharing, comparison, synthesis of experience); and gain support from higher levels (modeling, requesting advice).

Finally, members of developmental learning communities share an orientation toward their own and others’ development. By joining such a community an individual commits to its developmental goals – willingness to “bring others along.” Social ties among members reinforce this commitment; the ties lead members to care about others in the community, so that they put out effort to enlist new members and encourage the growth by existing members. A developmental community may also provide rewards for its to promote co-members’ learning, such as increased social capital or more explicit forms of recognition.

We envision *wConnect* as a developmental learning community. The phases in the community might start at very low levels of knowledge and commitment, perhaps as early as elementary or middle school, and continue throughout a girl’s education into her career activities. However while such phases can clearly be mapped to real world developmental levels in CIS, the social ties and commitment necessary to motivate the developmental supports are either very dispersed, weak, or not in place at all. Thus we began our project with the goal of instantiating and activating a social network that could be energized and transformed into a developmental learning community.

## 1.2 Social Networking

Our research approach leverages the emergence and popularity of social networking as pervasive activity. We are harnessing the energy that many young women already put into building and maintaining social ties, but attempting to redirect some of this energy toward developmental activities within a community.

Social networking sites (SNSs) like MySpace, Facebook, and LinkedIn have attracted millions of users in a variety of social

groups, including high school teenagers, college students and young professionals. These systems create and reinforce connections among people by making it easy to share content and post and receive reactions to the content [3]. For example, Facebook and MySpace make it easy for users to share profiles, status, social connections and other content, so that they will log in frequently to check for updates related to their own or their friends’ content.

Research on SNS behavior suggests that the systems are used primarily to stay in touch with friends [15,16,17]; surveys of users indicate that they use these systems more for maintaining existing social relations than for building new connections [10,16]. This reinforces our intention to form *wConnect* by activating and inter-connecting existing friendship groups or other social networks.

In conjunction with research on Facebook and other SNSs, other researchers have discussed “connectedness” as a general goal in human behavior that may be facilitated by online interactions that can take place across time and space [21,22,25,31]. The goal of staying connected may be supported by communication that is not task-based. For example, Nardi and colleagues [22] found that IM users monitor the colleagues’ status and exchange greetings even when they do not need to share information. By so doing they maintain active links to people outside their current tasks, sustaining a sort of “readiness” for future communication and collaboration [23].

The pervasive use of SNSs and related technologies raises many issues for research, including privacy, management of one’s self presentation, and social capital implications. Individuals create online profiles and share personal information in Facebook not only with friends but also content with strangers on their networks (e.g., college or town’ [13]). Nonetheless, users reveal considerable personal data, apparently trusting in their ability to control what and how information is shared [1]. Dwyer et al. [8] suggested that users may have generalized trust feelings that affect what they are willing to share - Facebook users express more trust about other members and are more willing than MySpace users to share personal information.

Self-presentation is another research issue for SNSs. In contrast to real world interaction, online behavior tends to rely on selective self-presentation strategies [3,11]. People often manage multiple self-presentations for different social groups using the same SNS. However, DiMicco and Millen [7] noted that users had trouble crafting online identities that meet both professional and personal goals. They suggested that multiple user profiles and access controls may help users to manage their multiple online identities.

Finally, researchers have discussed social capital benefits of SNSs. An individual’s social capital lets him or her draw on resources provided by other members of a group (e.g., information, personal relationships, or business affiliations). Putnam [24] distinguishes between bridging and bonding social capital; the former refers to loose connections between individuals that might be useful for exchanging useful information and perspectives, while the latter exists among individuals in close relationships that include emotional support. We hope to energize *wConnect* with relatively strong ties, using these ties to expand the network.

The growing body of research on social computing provides a starting point for creating *wConnect*. For example, we expect to encounter and address issues related to privacy, self-presentation, and social capital. The concept of connectedness is an interesting thread, suggesting that simple mechanisms for staying in touch may be just as important in building community as explicit activi-

ties. The research also points to a preference for pre-existing social ties in online socializing; this increases confidence in our plan to create the developmental learning community by recruiting and linking women’s pre-existing social networks.

## 2. GATHERING REQUIREMENTS FOR WCONNECT

The core membership for *wConnect* will be university students, the young women in our college’s baccalaureate program. Even within this context, the women operate at rather different levels of development with respect to CIS knowledge and careers. However we must also engage women on the “edges” of the university population: high school students who are just starting to consider career interests, and university alumni now working as CIS professionals.

The target users of *wConnect* live, work and play in rather different settings – home, high school, university, business. To design an online community system that could might serve such a diverse community, we first needed to understand the interests and preferences of these three different age groups (high school, undergraduate, alumni).

Our primary method for this has been focus groups. Meeting with groups of 3-6 individuals, we have conducted semi-structured interviews to learn about current use of technology, especially social networking, and reactions and suggestions to the idea of an online place for interacting with other women about CIS interests and concerns. Thus far we have conducted three sessions with high school students, five with undergraduates, and three with alumni.

Note that these discussions have been initiated on different footings. For the high school girls, we deliberately recruited students *not* currently interested in CIS. In contrast our undergraduates and alumni are by definition the young women who have developed such interests. We made this distinction because we wanted to sample the developmental levels we hoped to support within the online community.

Because the high school girls had no particular interest in CIS topics, we conducted these sessions in a brainstorming mode. After learning about the girls’ use of online tools and extra-curricular activities, we demonstrated an online activity and asked them to envision similar activities that could be of personal interest. We guided them to focus on web applications that access and manipulate data, because we were searching for project concepts that we could use in a series of hands-on high school workshops. Table 2 summarizes the findings from these discussions, with a wide range of online tools in regular use and many examples of interest-specific online activities.

**Table 2. Features of a Developmental Learning Community**

Current online tools	Instant messaging, MySpace or Facebook, web browsers, email, wikis or blogs
Extra-curricular interests	Volleyball team, TV series, science olympiad, community theatre, marching band and orchestra, theme movie nights
Personal ideas for data-oriented websites	TV DVD inventory; shopping comparisons; theatre props schedule; band marching scripts; science projects

One result of these focus groups has been a series of hands-on workshops that have been designed and delivered by undergraduate women for high school girls. For instance we have used activities that teach high school girls how to use a simple database to create a web-based shopping “notes” base, and a college application inventory. These workshops serve three goals for *wConnect* – the undergraduate designers and leaders enhance their own understanding and skills in dynamic web development; the high school girls learn that even young people with no programming background can create “real” web applications; and these same girls are recruited as members of the *wConnect* online community. The details of workshop development, delivery, and evaluation are reported in a related paper [29].

Our discussions with undergraduates and alumni have been more specific and directed at the goal of building an online community system for *wConnect*. After first learning about their current online social networking patterns, we probed them for ideas about features of online communities that would attract or detract from their own participation. The results for both age groups are summarized in Table 3.

**Table 3. Attractors and Detractors for Participation in Online Community: Undergraduates and Alumni**

Attractors	Detractors
<i>Undergrad:</i> Networking with other women in the major; email alerts; fresh content; interview advice; contact information; profiles for friends; attractive and easy user interface; can post stuff	<i>Undergrad:</i> No regular updates; but also email or newsletters that are too frequent; auto-alerts with no new info; lack of response to posts; no interactivity; hard to use; unwanted external ads
<i>Alumni:</i> Increasing student awareness of firms; describing interesting projects and jobs; make suggestions based on courses enjoyed; helping with targeted resumes and interviews; help with web presence; company recognition for participation; finding a class project match	<i>Alumni:</i> One-on-one mentoring requirements; students expect personal influence on internship/job decisions; no interest in projects; lack of separation between personal and professional identities online; virtual footprints that colleagues or others may discover; lack of anonymity

As the table documents, the focus groups led to a rich set of ideas about how to make an online community more attractive and effective for individuals at these two developmental level, as well as characteristics to avoid if at all possible. A major challenge will be to meet the needs of both levels. For example, the college women wanted support for job and internships postings; at the same time the alumni worried that they would be viewed as personally responsible for recruiting (e.g., handling requests for information, acting as an advocate for *wConnect* members). The focus groups also revealed that neither the undergraduates nor the alumni desired 1:1 mentoring relationships. We were surprised to hear this as mentoring is often used as a support mechanism for women in computing [19,26]. When we probed the participants who spoke against mentoring, we found that they or their friends

had been paired with mentors in the past, and ended up feeling “guilty” when the relationships did not develop or become useful.

### 3. CREATING PLACES FOR ONLINE COMMUNITY

In parallel with the focus groups we began to develop ideas for an online community system. Initially we built a prototype website with our Bridgetools collaborative tool suite ([bridgetools.sourceforge.net](http://bridgetools.sourceforge.net)). However as we learned more about the community we were trying to reach, we came to realize that we should instead meet them online in a place where they already hang out – Facebook.

#### 3.1 A Bridgetools Community Site

Our first community site was built with tools that are designed to be used collaboratively by any project team. The Bridgetools environment is a Java-based suite of tools that includes support for both synchronous and asynchronous navigation and editing, using a mix of web browsers and object-specific editors. We had used this in prior research on community building [28] and expected to follow a similar approach here: each young woman who joined *wConnect* would receive a Bridgetools account to access and directly edit community content. Every object in Bridgetools has its own set of permissions that are set by the object’s creator, so community members can generate and compose a flexible mix of private and shared objects.

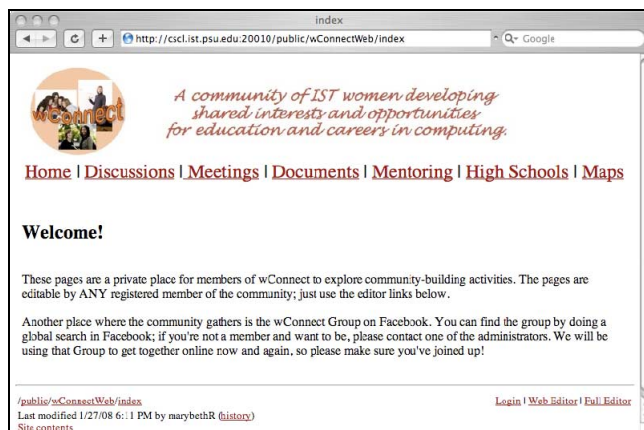


Figure 1. A *wConnect* website built using Bridgetools.

The homepage for the initial Bridgetools website appears in Figure 1. The website was built by the research team, but was deliberately modest and incomplete, with many “stub” pages; we expected community members to enhance, revise or otherwise enrich the site. Each page can be edited in place (using a wiki editor), or by accessing a real-time environment with tools can be invoked (see [28] for these tools in use by public school teachers).

Despite our efforts to offer a simple and incomplete initial website to the undergraduates we had recruited into *wConnect*, they were hesitant about editing and extending it. The Bridgetools environment has a different look and feel from other SNSs, and it seemed to be seen as a “research” system, not an online place that belonged to them. When early members interacted with the website, it was as if they were leaving their normal online life behind.

Access to the Bridgetools website was another issue. The focus groups had highlighted privacy as an important enabler of serious career-oriented discussions. We thought that Bridgetools would help to address this concern, as it offers powerful and flexible authentication options (adapting the hierarchical privileges paradigm of Unix). Unfortunately, to benefit from these options users must understand and manage permissions at the level of objects or folders. They must also acquire and maintain Bridgetools accounts and passwords. This authentication scheme combined with the unfamiliarity of website navigation and authoring was enough to dampen participation.

Although reactions to the initial prototype were disappointing, we learned an important lesson. Joining *wConnect* is voluntary and discretionary, so prospective members have little motivation to participate until something of interest or benefit to them is happening; this is a variant of the classic problem of critical mass discussed by CSCW researchers [14]. We needed a bootstrapping paradigm, making members’ first steps toward participation as simple and pleasant as possible. Thus we adopted a new approach: embed *wConnect* activities within social activities that members enjoy in their everyday lives, and use those interactions to bootstrap the developmental learning community.

#### 3.2 A *wConnect* Group in Facebook

Not surprisingly, it was the undergraduates working as research assistants who suggested creating a Facebook group for *wConnect*. Facebook allows “closed” groups, so although any Facebook user might stumble across the our group, he or she would not be able to join without permission from group administrators. We would also be able to use all the built-in Facebook features to support community interaction, for example writing on a group wall, setting up discussion boards, planning and sending invitations to events, and so on. Finally, these students were eager to explore the repository of third-party Facebook applications for online activities that would be fun to do as a group.

However, while the rest of the research team was generally enthusiastic about moving our online focus to Facebook, we also had several concerns. First, we would lose considerable control over the system’s functionality and user interface. Second, we had low confidence in the privacy of any data created in a Facebook group. Another serious concern was that we ran the risk of making our online community inaccessible to prospective members who (for whatever reason) did not use Facebook. This was a particular issue for the alumni population, as members of alumni focus groups had mentioned that their companies preferred them *not* to have an online presence in Facebook. Eventually however we decided to move in this direction, with an understanding that we would develop alternate online community places for non-Facebook users.

Figure 2 contains a screenshot of the *wConnect* Facebook group. It presents our developmental vision, announcements, and a list of members (with profiles inherited from Facebook). The undergraduates also discovered a Facebook chat application that the group could use for online chats.

Our Facebook group has been effective in reaching out to prospective members and building a core. It is easy to advertise the group with email that includes a link back to the group; if the person receiving the email is already a Facebook member, all she needs to do is follow the link and request membership in the

group. Several community members monitor these requests; they often know the name of the requestor and approve her request right away. On rare occasions we receive requests from people not in our target audience (e.g., random Facebook users “collecting” group affiliations) and the administrators simply re-emphasize the goal of the group and why it is closed to outside members.

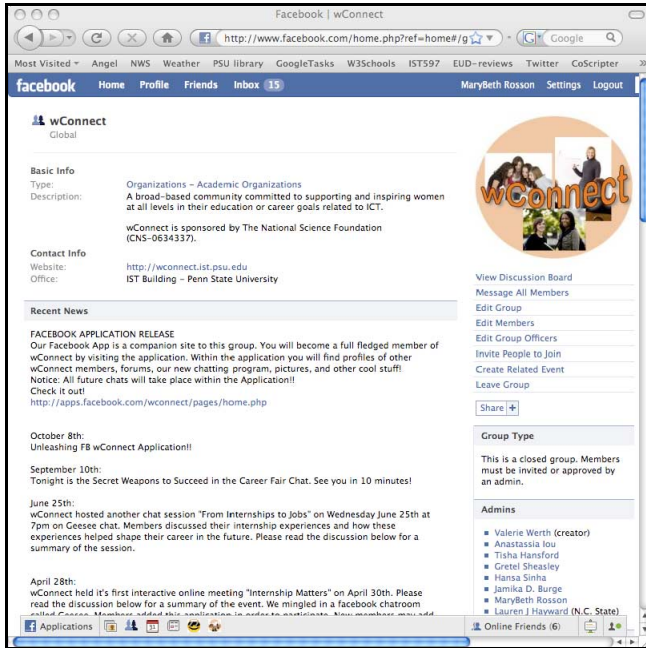


Figure 2. The wConnect Facebook group.

The *wConnect* group achieved an important design goal, making the act of community affiliation a simple extension of everyday social networking. At the same time it introduced the limitations we had anticipated: the semantics of a Facebook group is quite shallow; groups are simply a collection of individuals, with the same features and privileges. As a result, we cannot extend the group with richer activities that are grounded in members’ developmental roles and commitments; a member’s *wConnect* identity is identical to her Facebook identity. Finally, because this is a research project, we wished to gather data about community activities, and this is difficult to do within Facebook. We needed a mechanism for authenticating members as research participants and for building an archive of *wConnect* identities and behaviors. Fortunately, Facebook provides a public API that enabled us to build our own application as an extension of normal Facebook functionality.

#### 4. THE WCONNECT APPLICATION

Our design of *wConnect* as a community system had three high-level design goals: We wanted the application to retain the look and feel of Facebook, so that members would still experience it as a natural add-on to normal SNS activities. But we also wanted to convey its developmental nature, that its members participate at different levels of knowledge and personal engagement with CIS education and careers. Finally we wanted women who are *not* Facebook users access to the online community. That is, the application must create and use its own data, and it must be execu-

table outside the Facebook environment. We knew that this would be critical for alumni who choose not to use Facebook for professional reasons. We expected that the resulting modularity would also increase members’ perceptions of *wConnect* as a distinct online place, with the privacy they wanted for personal discussions and professional networking.

With these goals in mind, we adopted a two-phase approach: first create an application to attract and engage Facebook users, then leverage their involvement and activities to recruit other non-Facebook members.

#### 4.1 wConnect: A Facebook-based Application

The new application was designed to be similar to Facebook, but also conveys that it is a distinct online place; Figure 3 shows the home page. The visual design uses a Facebook-like grid for organizing page elements, and component headings with grey background. The member profile widget was deliberately modeled on the Facebook Friends list, with a brief preview of a few members and a single-click invitation to view all. The tabs at the top are also familiar elements of the Facebook user interface style.



Figure 3. Homepage of the new wConnect application.

The logo and visual theme for the application are graphically subdued but unique (a logo and a pattern of colored squares); the intent was to make the application seem familiar and comfortable for Facebook users, but at the same time to be clearly outside of the scope of the parent system. The homepage includes a full version of the header, and secondary pages present a reduced version (e.g., see Figure 4).

#### 4.2 Developmental Phases in wConnect

Prior to building the application, we had begun to maintain a database of *wConnect* members. We created this database for research purposes, with participant names, research IDs, and contact information for women we had reached out to through any activi-



ity (focus groups, email, high school workshops), or who had contacted us after hearing about *wConnect*. We maintained information about their status with respect to the project’s research goals, in particular whether they had signed a consent form and taken the background survey we asked all new members to complete.

However while this database was a comprehensive list of members and prospective members, we needed a richer database for the online application. We needed to store member-specific information for use by the application, and to grow it as the activities of the community evolved.

Initially we conceived of this problem as a member profile database holding personal descriptions that members posted to share with other *wConnect* members. In other words, we were deliberately encouraging a different online identity within the privacy of this community [7]. We pre-initialized this database with our Facebook group, because we could able to extract their photos and friend status from the Facebook API. Importantly, we built in developmental distinctions between high school, undergraduate, graduate student, or professional members. We did this by creating a profile editor that first asked the user for their level, then activated a level-specific profile template with fields that made sense for each level. For instance, undergraduates described their college pursuits, while professionals described their current professional context. Through this simple mechanism we hope to promote the emergence of developmental identities, roles and activities as the community expands.

Figure 4 illustrates the *wConnect* member list. Following Facebook style, the profile items expand in place; the faint widget in the upper right of each brief listing is used to “open” the details. The sub-menu on the right is used to filter the list to include all or one developmental levels, a low-key reminder of community’s composition.

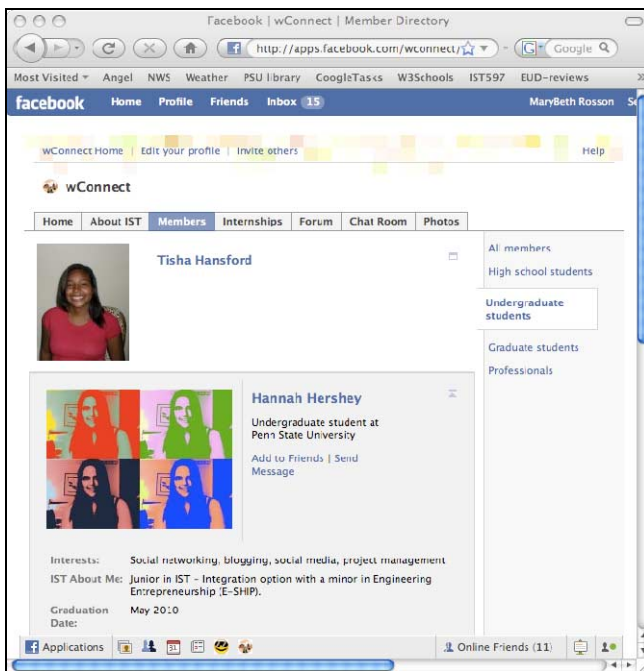


Figure 4. Profiles browsable by developmental level.

The new application was launched about two months ago, and we are already learning that it uses too much of Facebook’s API. The member database grabs information from Facebook during registra-

tion (e.g., friendship links, profile images). But recently a few members have begun to *reduce* their Facebook accessibility (these are more advanced students who are grooming themselves for a career transition). A side effect is that they also appear with “absent” images in their *wConnect* profiles. This is not because they are trying not to be known within *wConnect*, but rather because we have provided no alternate mechanism for introducing replacement images. Thus we are building a mechanism that links to images from Facebook when available, but also allows members to upload images that they wish to share as part of their community identities.

### 4.3 Authenticating Members

A research challenge from the start of the *wConnect* project has been the enlistment and authentication of members. Because we are a research project, new members must agree to serve as research participants before we can collect or analyze any information about their background or behavior in *wConnect*. We learned early on that linking research consent with recruiting was awkward and interfered with the overall intent of the community – to welcome and support young women with a diverse range of interests and commitment to CIS-related topics. Thus we began to “just recruit”, treating requests to join the Facebook group as a simple affiliative step. However, because our research goals include experimenting with and evaluating online community activities, we still need to ensure that users of the new application were consented research participants.

Our solution is to run an initial authentication dialog during first use of the application. A screenshot of the dialog appears in Figure 5. When a member or prospective member opens the application for the first time, we check the database. Often the user is already be in the member database. For such a user, if the database shows that she has completed a consent form, she is invited to edit her profile to launch the application. Once she has made any edits to her *wConnect* profile, she will never see this dialog again.

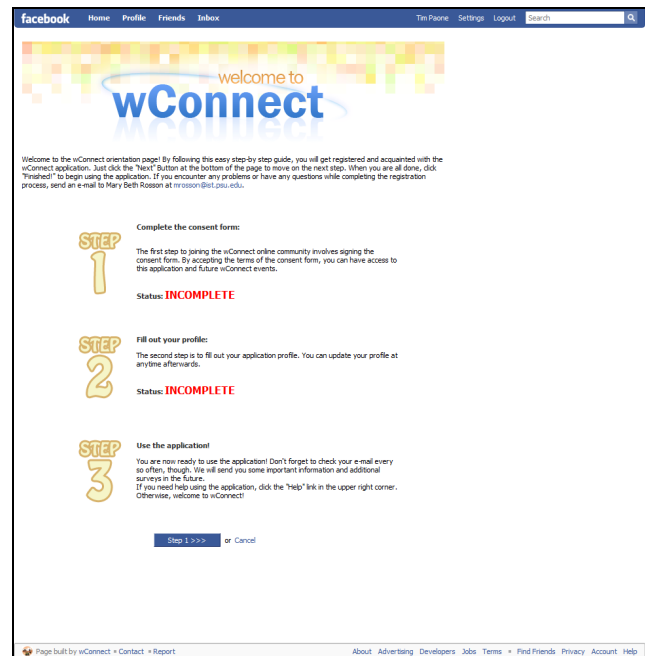


Figure 5. Authentication and enrollment dialogue.

In the member is not in the database, we create a record for her and she is invited to complete an online version of the consent form. Once this happens, a group member can approve her as a new member, just as we do for the Facebook group requests. Once she is approved, she is directed back to the rest of the enrollment process. Users who are in our database but have not yet consented to be a research participant are asked to complete the online consent, then immediately invited to edit profiles and launch the application. We cannot currently enroll non-Facebook users, but are working on a mechanism to support this as well.

Although the authentication dialog may seem heavyweight as an entry to the application, in practice it members work through it quickly and seem unphased by the various steps. Informal reports indicate that college students are quite used to completing multi-screen registration procedures for Facebook applications and other modern web services, so our dialog is not viewed as unusual. And in contrast to the Bridgetools website, once the women have enrolled, they can access the application directly from Facebook. A convenient side effect of the dialog is that our research team is notified when new members seek to add the application, so that we can follow up with them individually to assign a participant ID and gather the background research data we need for the project.

#### 4.4 Developmental Activities in *wConnect*

While we expected that creating a familiar Facebook-style application would be engaging, we have also begun to model developmental activities that convey and reinforce the community vision. Again, we have begun by adapting established activities in Facebook and other social networking sites. For example, we began hosting *wConnect* chats in the Facebook group, and we simply shifted these to take place within the new application. Figure 6 shows the *wConnect* chat page.

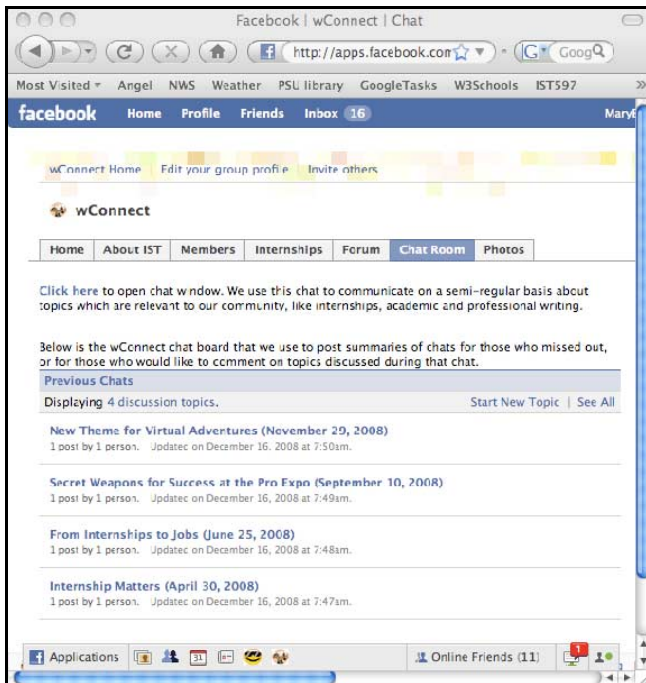


Figure 6. The *wConnect* chat board.

By embedding the chat in the application, we can ensure that the online interactions are private, because only people with access to *wConnect* can join the chat. Furthermore, because *wConnect* is a distinct application that manages its own data, we have been able to create our own concept for a community chat, by integrating the chat tool with a “chat board” (lower half of page). This is a Discussion board that invites members to post or comment on summaries of previous chats. The board enables new members to review earlier events, or for any member to refine or elaborate a topic raised during a chat. Currently, these summaries are created and posted by research team members, but we hope that eventually this will be a normal task for the group, much as clubs often have members who post minutes. In this online community, we expect that chats will act as a substitute for group meetings, and we are encouraging the group to schedule chats on a regular basis, just as club meetings are scheduled.

As suggested by the undergraduate focus groups, we have also initiated an internship forum: any member can post an internship description, and members are invited to comment if they know something about a company or location. To eliminate the feeling of personal responsibility for opportunities that an alumna may post, the template makes it very clear that the posting should tell interested students who to contact for more information.

Other community-building activities include a photo gallery and a discussion forum. The photos have been particularly well received, because they include pictures of *wConnect* members conducting high school workshops that are another aspect of the group, advertising this as an enjoyable and rewarding developmental activity [29]. We are also exploring ideas for activities aimed at building social ties, from informal interactions like sharing trips or favorite movies, to network visualizations that can uncover shared interests or experiences within the community.

## 5. GROWING THE WCONNECT COMMUNITY

We have used a variety of methods to recruit members from varying developmental levels to *wConnect*, and have had some success with each. Some of the methods rely on advertising or broadcasting information, whereas others engage prospective members in a more direct activity. Thus far our efforts include:

- A survey distributed broadly to undergraduates in our college, with an option to indicate interest
- In-person invitations given to members of a college organization for female undergraduates
- Email and slides shared in college classes, timed to be just before an online meeting of *wConnect*
- Focus group invitations emailed to female alumni through contacts maintained by the college development office, timed to occur with recruiting events
- Workshops delivered by college members to students at their former high schools
- Workshops delivered as part of a larger university outreach program to high school girls
- Personal invitations by members to other women who they know and think might be interested.

Through these mechanisms we have contacted more than 150 females across developmental levels. Some have explicitly joined

the community (for us this is signified by them completing an informed consent as we are a research project, and submitting a survey that collects background data); others have simply expressed interest in doing so at some point but have not yet followed through with explicit actions.

Our most active efforts to enroll women expressing interest have been focused on high school and college students, but we are now beginning to reach out on female alumni. For example, we have names of 34 alumni who have shared a general interest in our project but who we have not yet recruited into the online community. We have ongoing events at our college that will help us to contact even more individuals and are exploring ways to offer them a more active community role (e.g., serving as a “keynote” in an online chat aimed at advanced undergraduates). We have yet not issued a general invitation to the female graduate students or faculty in our own college, because we expect that these individuals will be much easier to engage and we want to first establish a core community of active undergraduate members.

As conveyed in Figure 7, the *wConnect* online community has already developed into a diverse group with respect to developmental levels. The figure counts separately the members who are part of the research team, those who are part of the new *wConnect* application, and those who have only joined the Facebook group. As of this writing in fall 2008, the total membership numbers 50; 12 high school students, 27 undergraduates, 4 graduates, 5 alumni and 2 faculty.

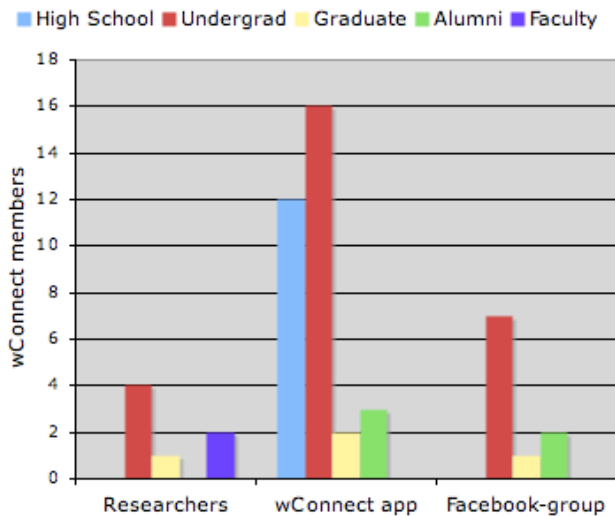


Figure 7. Members of *wConnect* online community.

Although we have no analogous tabulation of social connections among community members, our informal conversations with undergraduate members suggest that *wConnect* is also diverse with respect to social networks. One view of this is to ask which members are Facebook friends. These “friend” links can be seen as forming sub-networks of pre-existing social relations in the community; for instance the first author of this paper is a Facebook friend of seven of the 50 members. Friend links are obtainable through the API and we are currently exploring visualizations that might make it fun to browse this information.

Now that we have created a basic infrastructure for online interaction, we are designing activities that might help to engage different segments of the community, and in particular looking for ways to support and reinforce activities that involve interactions *across* developmental levels. An early example has been a series of chats we have held on internship experiences and on making the most of a career fair. In each of these a more experienced member has served as a source of tips and advice for the undergraduate members who participate by asking questions. We are currently investigating topics for other chat sessions that might attract high school members who are seeking advice or other support from college students. More generally we will investigate similar plans for the asynchronous interaction that is possible through the built-in discussion forums.

We are also considering other sorts of online activities. For example, one of the primary outreach activities of *wConnect* is a series of workshops that the undergraduate members plan and hold for high school girls. However at this point these high school workshops and the online community are supported by separate elements of the project. The workshops rely on the suite of tools available through Bridgetools, while the community activities take place in the Facebook application. Thus a current direction is techniques that might enable us to plan and conduct similar hands-on software development workshops “within” *wConnect*. For example, in these new workshops, the high school girls might use tools we are building to access and “program” Facebook data.

The focus groups have also generated ideas about online activities that would be attractive to members at different developmental levels. For instance the college students said that email alerts (when interesting things are happening) would be useful; we already have a prototype of a “messaging” mechanism that members can use to invite friends to join the community. We plan to extend this to support a range of messaging and to develop support for a modest amount of automatic alerts. The alumni raised the idea of matching their comments or project descriptions to the undergraduates’ interests, and we are exploring ways to process profile information as a starting point for this.

Finally, we are working on ways to reach out to members who do not use Facebook. Currently, we rely on Facebook to initialize and authenticate members in our new application. However we are building an independent web-based authentication scheme that can substitute for the one summarized in Figure 5. This will allow us to advertise the application more broadly, for example among female alumni, who will visit a web page to go through the consenting process and initialize their entry in the member profile database. In response, they will be sent a *wConnect* user account and password that they can use in lieu of obtaining a Facebook account. For these individuals, the log-in experience will be similar to that for the original Bridgetools prototype, but once they log on, they will interact transparently with members who arrive via Facebook.

## 6. DISCUSSION

The crisis created by the disproportion of women in CIS is not a concern for the future, it is here now. Many solutions have been proposed and in this paper we have proposed a new approach – a developmental learning community. We have described our vision and the steps we have taken to achieve this vision in *wConnect*. While the community is clearly still a work in progress, we offer our experiences analyzing the community requirements, the evo-



lution of a community system, and the resulting *wConnect* system characteristics and developmental activities for consideration and adaptation by other organizations.

One important lesson from our work concerns techniques for initiating developmental learning communities. It is not enough to identify individuals who share your belief in the community's vision. If you expect to engage and energize people who are already busy and occupied with everyday activities, you need to find a way to insert the community's activities *into* these everyday activities. The Facebook group – and more recently the Facebook-based application – provided a simple mechanism for doing this.

Our community is centered around its mid-level members, i.e. the female college students who are pursuing CIS education and careers. But we recognize that mid-level members may not have sufficient expertise or perspective to organize and implement developmental activities on their own. It has been important for us as researchers to help in brainstorming and organizing these early community-building activities (e.g., chats in which professionals take questions from students, workshops in which undergraduates provide hands-on programming experiences to high school students). Now that several example activities have been implemented and documented, the members have models that they can use for their own planning. A critical question will be the sustainability of the overall project – what will these core community members do once the external stimulus of the research project is over? Will they simply continue to enact the activities we have already established (e.g., the invited chats, the high school workshops)? Or will they continue to generate and pursue new ideas?

Note that the evolutionary process could have been quite different if *wConnect* had been centered on the more expert women who are CIS professionals (i.e. the alumni). But if we had done that, we would have likely encountered constraints from the companies these professionals work for, and we would have decreased our emphasis on the important developmental connection from college to high school. For logistic reasons, it is also much more difficult to locate and to establish and maintain connections with the alumnae, who by definition have moved on to the critical early phases of their personal career trajectories. An interesting question that we have not yet been able to pursue is whether and how a community like *wConnect* can support these young professional women who are distributed across many different industries and who are fulfilling many different job responsibilities. As we move on to engage more of our alumnae (and especially as our current undergraduate members matriculate and change roles), we hope to investigate this question more directly.

Thus far we have not emphasized the social ties “underneath” the *wConnect* community, even though the logic of developmental communities gives them a critical role. We know that many of the young women who join the community already know one another; in fact we rely on this as a recruiting mechanism. Thus far though we have not tried to analyze these linkages, at least in part because it seems to be a more “personal” aspect of these young women's lives. However as we move forward, we do plan to explore ways to highlight implicit social networks so that we might be able to more strongly interconnect community members who share different sorts of interests. For instance current members have no way of becoming aware of “real world” overlaps (e.g., they may share an interest in music). But they are already ex-

pressing interest in learning more about unfamiliar members, for example where they have lived, and what they do for relaxation. We will keep developmental goals in the foreground, but also enable informal social exchange to can enliven or reinforce those goals.

We have been surprised at the paucity of work investigating the role of community in addressing under-representation of women and minorities in CIS. The longtime success of the Systems email list is good evidence that women in CIS enjoy and may benefit from peer interaction (<http://anitaborg.org/initiatives/systems/>). Yet most outreach efforts are institutional programs, for instance, summer camps or workshops, or perhaps course topic modifications aimed at attracting a more diverse population of young people to CIS careers. The premise of *wConnect* is that these efforts can and should be complemented by work aimed at creating and nurturing developmental learning communities.

This short paper has offered a snapshot of the work we have done thus far in initiating and supporting an online developmental community for women interested in CIS education and careers. Clearly we are far from offering a summative view of whether and how well our community-building techniques will succeed. By design *wConnect* will form and grow according to the interests and energies of its members. This makes its difficult to predict its trajectory. As researchers, our job is to ensure that the activities and tools we provide are engaging, useful and usable, but to let the members discover their own developmental paths.

## 7. ACKNOWLEDGEMENTS

This work was supported by The National Science Foundation (CNS-0634337). We are grateful to many current and prior team members in the *wConnect* project: Craig Ganoë, Tisha Hansford, Lauren Hayward, Sam Lolla, Anastassia Ioujanina, Jan Mahar, Nick Oja, Gretel Sheasley, Hansa Sinha and Valerie Werth. We also thank our many participants across levels of development.

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