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Understanding Presence Awareness Information Needs Among Engineering Students

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Abstract— **The flexibility and changing nature of loosely coupled work makes presence awareness crucial to promote interactions among collaborators. Undergraduate students, in their efforts to accomplish coursework-related tasks, must deal with having several available channels to interact with others, accessing and sharing educational material, and the need to optimize their time. Most of them work in a loosely coupled way as the main strategy to reduce the effort spent in the educational process. Presence awareness may help them achieve interactions among potential collaborators in this scenario. This paper aims to identify the most suitable presence awareness information to promote on-demand interactions among college students. A study was conducted for this purpose, involving undergraduate engineering students from two universities in Chile. This article also presents a classification of presence awareness mechanisms for loosely-coupled mobile group work.**

Keywords: Presence awareness, loosely-coupled mobile work, students' interactions support, educational activities, field study.

I. Introduction

Working from anywhere at any time is a real possibility due to the widespread availability of mobile computer devices and wireless networks. The educational scenario is not an exception. Currently, 31% of US mobile subscribers have smartphones [20] and college students are the fastest growing smartphone segment. Many students carry a mobile computing device that helps them access remote resources (e.g. educational material) and interact with the rest of the community at almost any time and any place. A recent study performed by [12] to engineering undergraduate students in Latin America shows the most usual strategy they used to address collaborative work was to divide complex tasks and later perform on-demand collaboration to integrate the individual work; i.e. a loosely-coupled approach. This approach involves mainly individual work and sporadic instances of on-demand collaboration [23].

The on-demand collaboration activities performed by the students as part of their loosely coupled strategy to deal with the educational process can be distributed or face-to-face. However, both of them require that a person be able to contact a potential collaborator in an easy and quick way, starting a collaboration process. Students typically have routines and therefore have some information about the location and activities of their peers. Mobile systems may be used to provide them additional awareness information in a reliable way to help them begin collaborative processes, as awareness is an important aspect of collaborative [8] and mobile work [13, 25].

This paper aims to provide understanding on useful awareness information to support loosely coupled mobile work (LCMW) for engineering college students in situations related to academic life (e.g., to accomplish a group assignment before a deadline).

The next section briefly describes the taxonomy used to classify the user interactions when they perform LCMW. Then, the article presents a review and classification of presence awareness information from current literature and practice. The usefulness of each type of presence awareness information was evaluated for each of the scenarios in the interaction taxonomy. This activity was done with a survey in which more than a hundred undergraduate students from two Chilean universities participated. The results may be interpreted to know how these students obtain awareness of their collaborators with the goal of triggering an interaction. Finally, the article states the conclusions and future work.

II. User interactions in LCMW

Herskovic et al. used a two-dimensional taxonomy to classify the interaction scenario in which two mobile users may be when one of them decides to collaborate [15]. This taxonomy considers reachability and simultaneity as the dimensions to classify and characterize each interaction scenario (Figure 1). This article uses this taxonomy as a basis to evaluate the presence awareness information that could be used to support on-demand interactions among nomad users, when they are doing LCMW.

The taxonomy establishes that two potential collaborators are *reachable* if there is an available communication channel (physical or virtual) between them and both actors are available. In that scenario, one person can try to interact directly with another with a significant success rate. However, if an actor is unavailable or if there is no communication channel, their interaction scenario is classified as unreachable. This means a direct interaction between them is highly unlikely.

Simultaneity between two actors is defined by the taxonomy as the simultaneity of the actors' presence in a virtual or physical space. Two people are simultaneous, e.g. if they are connected to an instant messenger system at the same time, regardless if they are busy or interacting between them. The same meaning is applicable to physical scenarios, e.g. people in a coffee shop or a classroom. Non-simultaneous interaction situations occur when actors may only engage in asynchronous interactions, e.g. when the potential collaborators work in different shifts.

Summarizing, at the moment that a user decides to interact with another, the interaction scenario will be in one of four possible states: Simultaneous / Reachable (SR), Simultaneous / Unreachable (SU), Non-simultaneous / Reachable (NR) and Non-simultaneous / Unreachable (NU). The interaction scenario between two people is dynamic and it may switch from one quadrant to another (Fig. 1) at any given moment, e.g. caused by mobility, connection flexibility, and changes in user availability.

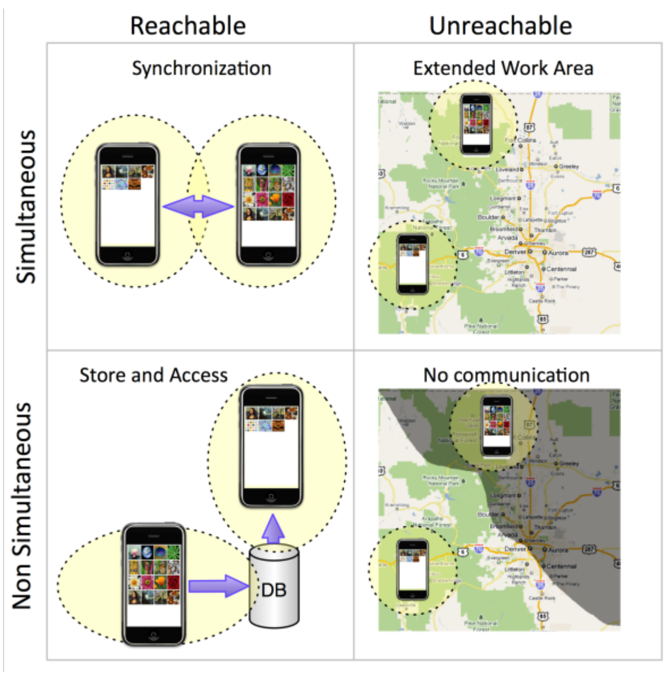

Figure 1. Classification of interaction scenarios

SR scenarios are clearly the most favorable for direct interactions, while NR scenarios do not allow direct interaction and are well suited to asynchronous work, such as store-and-access or email. In SU and NU scenarios, people cannot communicate directly with each other.

III. RELATED WORK

Collaborative systems, especially when dealing with mobility, should consider contextual information to provide collaboration to users. Context is not merely a state (e.g. a location); it is part of a process and must be treated in a holistic way [7]. Bolchini et al. [4] propose a framework to analyze existing context models according to a set of aspects: space, time, absolute/relative space and time, context history, subject, and user profile. However, systems trying to cover all contextual information are often too general and may be unsuccessful, so practical applicability is crucial [4].

Awareness in collaborative systems means actors perceive the context of their joint effort [26]. However, the word "awareness" in CSCW research has been used with several different meanings [26], so it is important to clarify the exact focus of the research presented in this paper.

Presence awareness typically informs users of the presence of others in a physical or virtual space, and they are used to ease spontaneous interactions [29]. This type of awareness may provide information such as a user's location, identity, activities and neighbors [6]. Naturally, there is a difference between providing a user with awareness information and overwhelming him/her with it, since too much information may even diminish the user's ability to perceive it [21], so awareness information should be carefully chosen to provide maximal usefulness while not impacting system usability.

IV. PRESENCE AWARENESS INFORMATION

A. Methodology

We reviewed presence awareness information and its implementation through several awareness mechanisms by studying papers published in relevant conferences and scientific journals. The literature review was conducted using systematic mapping [22]. Then, we explored applications for two popular smartphone operating systems (i.e. Android and iOS), selecting currently available and widely used applications. As a result, we built a comprehensive list of presence awareness information used to provide interaction awareness to mobile users. These types of awareness information were then classified using the classification that is presented in the next section.

B. Classification

As identified by [6], presence information is defined by location and status of the involved collaborators. The review of literature and practice allowed us to further disaggregate these dimensions, describing particular types of presence awareness information for both categories. Furthermore, we propose to consider time as another relevant dimension. Naturally, awareness may correspond to current information, but it may also include historical information or forecasts that can also be used to trigger interactions. Consequently, three temporal information categories were defined: past, present and predicted. We then classified existing presence awareness by three dimensions: *location*, *status* and *temporality*. Location and status are exclusive categories of awareness, while temporality is an attribute of the information represented through an awareness mechanism (Figure 2). The next two sections present a list of presence awareness information that inform, through suitable displays, user status and location.

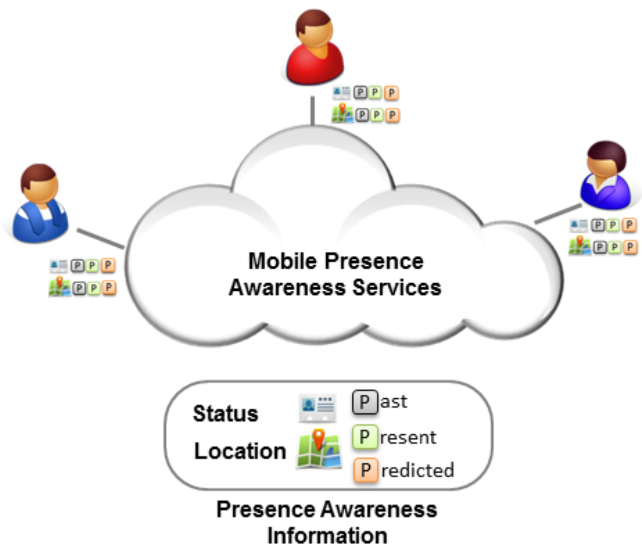

Figure 2. Presence awareness classification

C. Status Awareness Information

Information regarding the *status* of a collaborator may be used to infer the availability of a person who is a potential target for an interaction. Several specific types of awareness information related to user status have been proposed and used to decide when to trigger an interaction process with another user. Table I presents a list of such status awareness information. The first column identifies the type of information it provides to the user, the second one shows a brief definition of it, the third one presents examples of applications that deliver such awareness information, and the last one indicates the possible temporality of the information (e.g., if "Past" is not checked, this means most software and previous works do not present past information for the particular awareness type). It is important to note that the provided examples do not necessarily implement all information temporality options.

1) Connection Awareness.

Connection awareness indicates whether a user is on-line or not. This awareness information can also indicate how long a contact has been idle, and the logout time and date. Since collaboration in LCMW is done on-demand, this awareness information can help people to decide when it is convenient to try to interact with another person. This information is usually presented as a list (also known as the “buddy” list) that indicates whether each user’s contact is currently present in the system or not [28].

2) Visual Awareness.

Visual awareness supplies visual information about a remote environment, e.g. through the webcam of a potential collaborator. It can either display streaming video [3], periodic video snapshots (such as portholes [8]) or literal snapshots (such as peepholes [12]). This awareness information can be used to infer various data, e.g. the availability, activity and interruptibility of a person. This type of information is usually supplied as a live stream or the last available snapshot, so past and future information is not provided.

3) Activity Awareness.

This awareness information provides feedback about the activity the user is engaged in; whether the user is *busy*, *idle* or *engaged* in a particular activity [14]. This feedback can be as specific or general as required, e.g. “at the gym” or “today I will be out of the office”. This awareness plays a role similar to visual awareness as a promoter of users’ interactions.

4) Profile.

Profile information, such as current job, work location, interests or topics of expertise, can be used to provide awareness about the identity and preferences of a person. This type of information may help promote casual interactions between people, based on the matching of subjects included in the user profile [1]. Profile information is usually only presented in present form - it is not possible to view the past information in a profile after the user has changed it.

TABLE I. STATUS AWARENESS INFORMATION

Status Awareness	Definition	Examples	Information Temporality
Connection	Indicates whether the user is connected or not	IM such as MSN, Google Talk	Past: ✓ Present: ✓ Predicted: ✓
View	Provides visual information from a remote environment.	Skype, Tango [31]	Past: × Present: ✓ Predicted: ×
Activity	Indicates the activities the user is engaged in at his device.	ConNexus [28], CenceMe [19]	Past: ✓ Present: ✓ Predicted: ✓
Profile	Shares the user profile information with other people.	Facebook, LinkedIn, Gatsby [10]	Past: × Present: ✓ Predicted: ×

D. Location Awareness Information

Location awareness provides information about the spatial context of a user, or of a user in relation to another one. Spatial awareness may be highly relevant in mobile activities where face-to-face interaction is required. Table II presents a list of location awareness information that can be used to promote interactions among mobile users.

1) Physical Location Awareness.

This type of awareness information indicates where the user is physically located. Typically, outdoors locations are represented in a map, e.g. Google Latitude [11], and indoor locations are presented on a blueprint [30]. This awareness information may be useful to promote face-to-face interactions, since it helps decide when to trigger an interaction request based on the location of a potential collaborator. If the activity of the observed user follows a routine, this awareness information could help predict which will be his next physical location, or how long he will be in the current location. The arrival time of the user to the current location could also help to forecast his next location.

2) Place Awareness.

This type of awareness indicates the location of a user in a place, e.g. "I'm at the office". Similar to physical location awareness, if the activity of the mobile worker being observed follows a routine, then this awareness information could help another user infer the next virtual location. Both virtual and physical location awareness can inform about the past location of a person when he is not longer available; e.g. "Pedro was at his office 10 minutes ago".

3) Distance Awareness.

Distance awareness informs the distance between two users [11]. Typically, this type of information is shown in the "buddy list" or as additional information on a map.

4) Movement Awareness.

Movement awareness information is composed of the direction of movement and speed of a user, and may be used to inform the orientation of a user's movement or resource. This information may be displayed e.g. as an arrow [5] or movement of an icon representing the user. This information could be used to infer the future location of a user.

5) Physical proximity.

Physical proximity represents whether the user is in the same physical place as another [16, 24]. This awareness information is similar to physical location awareness, but simpler: it is a *boolean* value, as it only indicates whether two collaborators are in the same place.

TABLE II. LOCATION AWARENESS INFORMATION

Location Awareness	Definition	Examples	Information Temporality
Physical Location	Location of user is in a map.	Google Latitude [11]	Past: ✓ Present: ✓ Predicted: ×
Place	Location of user in a place.	Foursquare [9]	Past: ✓ Present: ✓ Predicted: ×
Distance	Location of user in relation to other users.	Loopt [17]	Past: × Present: ✓ Predicted: ×
Movement	Direction and speed with regards to other users.	Waze [32]	Past: × Present: ✓ Predicted: ×
Physical proximity	Whether the user is in the same physical place as another	Hummingbird [16], Rococo [24]	Past: × Present: ✓ Predicted: ×

V. STUDY

A. Methodology

We created a survey as a tool to assess the usefulness of the presented awareness information as support of interactions among students. The survey consisted of four hypothetical situations that could be present in an academic scenario. Each situation required interaction between two students to deal with an assignment for a course-related deadline. The interaction scenarios that are present in the hypothetical situations correspond to the quadrants of the interaction taxonomy presented in Figure 1 (i.e. SR, SU, NR and NU). For example, the SR scenario involved the following situation (originally in Spanish): "*It is 10AM and you are in class at the university. While the professor teaches, you remember you had to send a project for another course at 11AM and another group member has the document. You can't call him, but you know he is online at this moment. Assuming you have a computer or smartphone with several options to view information about other users, and that you can use it to see information about your group mate: what information is most useful to contact him afterwards?*"

The situations were meant to be short and simple to understand, and the reviewed awareness information alternatives were presented as options in simple language and using examples from the students' everyday life. The alternatives are summarized in Table III.

TABLE III. SURVEY ALTERNATIVES (SUMMARIZED)

Id		Alternative
A01	Status Awareness	Connection - Present
A02		Connection - Past
A03		Connection - Predicted
A04		View - Present
A05		Profile
A06		Activity – Present
A07		Activity – Past
A08		Activity - Predicted
A09	Location Awareness	Physical Location
A10		Place
A11		Distance
A12		Movement
A13		Physical Proximity

We may observe that the alternatives for status awareness consider all time dimensions, while location awareness alternatives only consider present awareness (discarding past physical location and past place). This decision was made to simplify the list of alternatives, considering physical location and place as the "last known" location of the user (which includes past location if current location is not known, and current location if it is known). Future research should find a way to incorporate both options, to be able to measure the usefulness of past and present information for location independently.

The survey as a tool was validated in two stages. In the first stage, five students were asked to fill out parts of the survey and interviewed about their experience. We used these results to create a second version of the scenarios and presented options. Then, we conducted a focus group with six students and presented the survey to them. Their criticism was used to further improve the alternatives and their presentation. Then, the survey was published on surveymonkey.com [27] for one week. It was sent via email, university course websites and twitter.

B. *Results*

The survey was answered by 170 persons, out of which 140 were undergraduate engineering students. Out of the 140 students, only 2 (1.4%) did not own a mobile phone, and 50 (35.7%) owned a smartphone. Moreover, 124 (88.6%) owned a laptop, 13 (9.3%) a tablet, and 12 (8.6%) reported owning other mobile devices, such as iPods and Kindles. This characterizes the students who answered the survey as having a high familiarity with mobile devices and technology.

In each situation presented in the survey, the students were asked to assume they were one of the collaborators involved in the situation. We asked students to rank the first three (or less) most useful types of awareness information in each situation. Students were not asked to rank all of the alternatives due to the results of the initial focus group, in which students were only interested in a few options for each interaction situation and were unwilling to consider the applicability of the alternatives they did not like. Also for this reason we did not require them to answer all three selected alternatives.

Since we asked students to rank (at most) three alternatives, we have to consider whether to assign the same weight to the awareness information ranked in first, second or third place by a student. Figures 3, 4, 5 and 6 present the percentage of responses each of the 13 alternatives received, using the formula $\alpha * r_1 + \beta * r_2 + \gamma * r_3$, where r_1, r_2, and r_3 represent the number of times an alternative was chosen as the first, second and third option. Alternatives are A01 to A13, and they correspond to the options presented in Table III. We tested several values of α, β and γ to see whether they influence the ordering of the alternatives and can see that generally, the values of α, β and γ do not greatly affect the results of the experiment. It is also important to observe that each of the four scenarios has a different distribution of preferred types of presence awareness information.

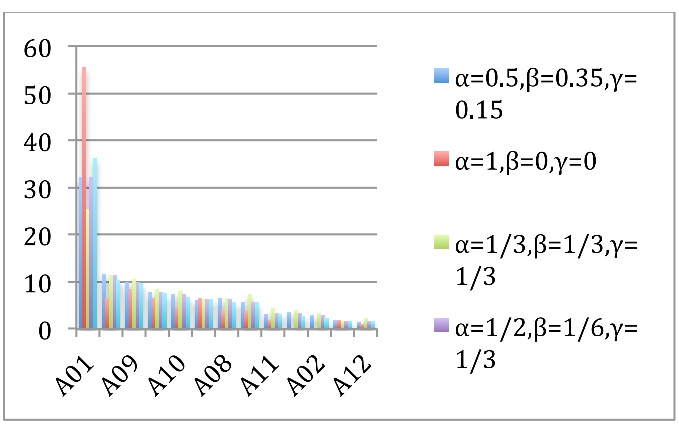

Figure 3. Awareness information for SR

We applied non-parametric Friedman tests in order to analyze differences among the selected alternatives in each interaction scenario. The results from these tests indicated that there were statistically significant differences among awareness information mechanisms (p-value < 0.05). Given this evidence, we can accept the hypothesis that students have preferences for certain types of presence awareness information in each of the four scenarios.

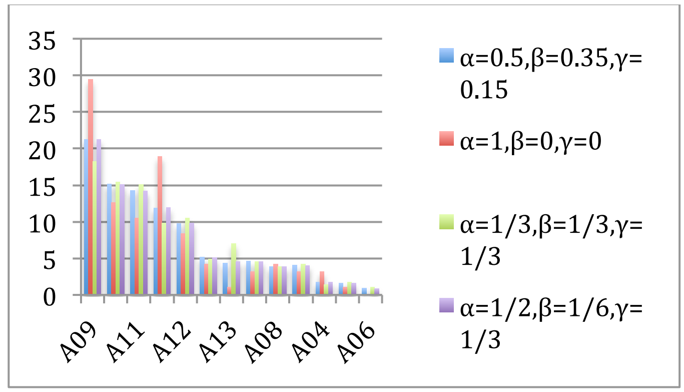

Figure 4. Awareness information for SU

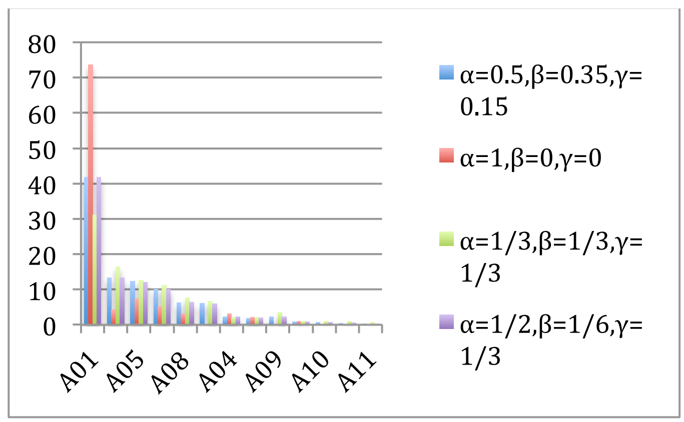

Figure 5. Awareness information for NR

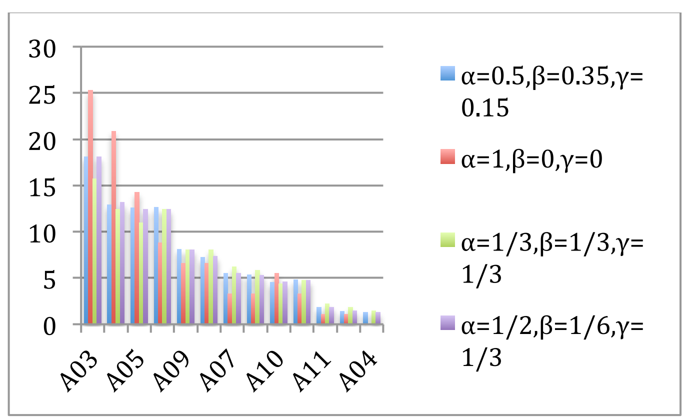

Figure 6. Awareness information for NU

From the results, we ranked the most useful awareness information for each interaction situation. The results from this ranking are presented in Table IV. The awareness information types that had more than 10% of preference for all of the tested values of α, β and γ are marked in boldface.

TABLE IV. AWARENESS INFORMATION FOR EACH INTERACTION SCENARIO

Scenario	Alternative	Awareness Information
SR	**A01**	Status: Connection (Present)
	A05	Status: Profile
	A09	Location: Physical
	A06	Status: Activity (Present)
SU	**A09**	Location: Physical
	A10	Location: Place
	A11	Location: Distance
	A01	Status: Connection (Present)
NR	**A01**	Status: Connection (Present)
	A03	Status: Connection (Predicted)
	A05	Status: Profile
	A06	Status: Activity (Present)
NU	**A03**	Status: Connection (Predicted)
	A01	Status: Connection (Present)
	A08	Status: Activity (Predicted)
	A05	Status: Profile

Figure 7 presents the results added up for each of the scenarios and overall, i.e., the awareness information that ranked as most useful in all of the scenarios. These are A01 (Status: Connection (Present)), A03 (Status: Connection (Predicted)), A05 (Profile) and A09 (Location: Physical Location).

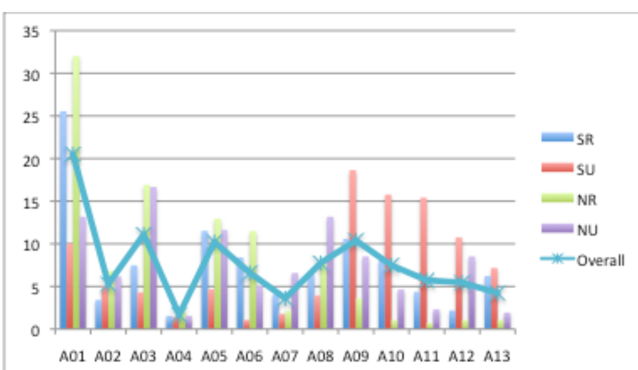

Figure 7. Awareness information for all four scenarios

C. Discussion

Students were not compensated, and there was not incentive given for answering the survey. However, random answers would have a uniform distribution, and e.g. answering the same for all questions would result in the same distribution for each scenario, so we can assume most students were careful in answering the survey.

We can observe that the required awareness information is different according to the particular type of interaction scenario. In both reachable situations (i.e. SR and NR) we can see a similar pattern: connection status is the most useful awareness information, while other types of information are generally unpopular. In SU situations, physical location is ranked higher, and in NU situations, the difficulty of this type of scenario is reflected in the fact that there is much more dispersion in the data and many alternatives seem useful (or perhaps, none of them truly are).

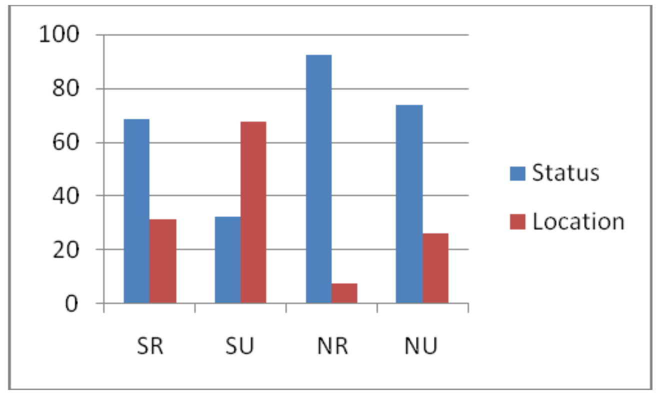

Figure 8. Status vs Location Awareness

Although eight alternatives were provided for status awareness information and only five for location awareness, so results were biased towards status-related awareness, we found in the SU scenario most students found location to be more useful in general (Figure 8). This seems natural, since if a user is unreachable (disconnected or unavailable), there is a presumption that status information will be out-of-date and it may be easier to find a user and transition to a SR scenario.

We also explored, for two particular awareness information types (connection and activity status), whether present, past or future information was more useful. Overall, present information was regarded as most useful, followed by prediction, and past information in last place. This is a relevant result for system design: even though predicted information is based on historical data (and therefore, if only presented with past data, users should be able to infer future information), users found predictions more useful than history.

Naturally, the study does have some limitations: we were focused only on engineering students from two large universities in Chile, so our study may lack from generalizability to a larger population [18]. Also, the study should be complemented with interviews, focus groups and observation, to better understand the motivations and emotions of the observed users. However, it is important to note that this is an interesting type of students to study, since technology adoption is early and high, and it may give us hints of future use of technology in other demographics.

VI. CONCLUSIONS AND FURTHER WORK

This paper analyzed four interaction scenarios and possible awareness information to support loosely coupled mobile work in a college environment. The results show that different scenarios require different awareness information as support. Users especially value information related to status and physical location, and surprisingly, profile information is highly valued. This may possibly be because of the popularity of social networking sites such as Facebook and LinkedIn, and the fact that profiles in these sites include several types of information. Moreover, the results indicate predicted information is more useful than historical information, which suggests additional awareness mechanisms based on predictions may be proposed. This type of mechanism usually has privacy issues [2], however, in case of engineering students highly used to new technology and sharing information with friends, it may be possible to find willing users of this type of information. Future work includes expanding the survey to a greater population, and finding the appropriate interaction triggers for each interaction scenario.

VII. ACKNOWLEDGEMENTS

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VIII. REFERENCES

[1] R. Beale, "Supporting Social Interaction with Smart Phones", IEEE Pervasive Computing, vol. 4, pp. 35-41, April-June 2005.

[2] J. Begole, and J. Tang, "Incorporating Human and Machine Interpretation of Unavailability and Rhythm Awareness into the design of collaborative applications", Journal of Human-Computer Interaction vol. 22, pp. 7-45, May 2007.

[3] S. Bly, S.R. Harrison, and S. Irwin, "Media spaces: Bringing People Together in a Video, Audio, and Computing Environment", Communications of the ACM, vol. 36, pp. 28-47, January 1993.

[4] C. Bolchini, C. A. Curino, E. Quintarelli, F. A. Schreiber, and L. Tanca. "A data-oriented survey of context models", SIGMOD Record, vol 36, pp 19-26, December 2007.

[5] J. Chon, and H. Cha, "LifeMap: A Smartphone-Based Context Provider for Location-Based Services", IEEE Pervasive Computing, vol. 10, pp. 58-67, April-June 2011.

[6] H. Christein, and P. Schulthess, "A General Purpose Model for Presence Awareness", Proc. Distributed Communities on the Web (DCW 02), LNCS 2468, April 2002, pp. 345-392.

[7] J. Coutaz, J.L. Crowley, S. Dobson, and D. Garlan "CONTEXT is KEY", Communications of the ACM, vol. 48, pp.49-53, March 2005.

[8] P. Dourish, and S. Bly, "Portholes: Supporting awareness in a distributed work group", Proc. ACM Conference on Computer Human Interaction (CHI 92), ACM Press, pp. 541-547, May 1992.

[9] Foursquare. http://foursquare.com/.

[10] Gatsby. http://meetgatsby.com/.

[11] Google Latitude. http:// www.google.com/latitude/.

[12] F.D. Giraldo, S.F. Ochoa, M. Herrera, A. Neyem, J.L. Arciniegas, C. Clunie, S. Zapata, and F. Lizano, "Applying a distributed CSCL activity for teaching software architecture", Proc. International Conference on Information Society (i-Society'11), IEEE Press, pp. 208-214, June 2011.

[13] C. Gutwin, and S. Greenberg, "The mechanics of collaboration: Developing low cost usability evaluation methods for shared workspaces", Proc. Enabling Technologies: Infrastructure for Collaborative Enterprises (WETICE 00), IEEE CS Press, pp. 98–103, June 2000.

[14] S. Greenberg, "Peepholes: Low Cost Awareness of One's Community", Proc. ACM Conference on Computer Human Interaction (CHI 96), ACM Press, pp. 206-207, April 1996.

[15] V. Herskovic, S. Ochoa, J. Pino, and A. Neyem, "The Iceberg Effect: Behind the User Interface of Mobile Collaborative Software", Journal of Universal Computer Science, vol. 17(2), pp. 183-202, 2011.

[16] L.E. Holmquist, J. Falk and J. Wigström, "Supporting Group Collaboration with Inter-Personal Awareness Devices", Journal of Personal Technologies, vol. 3, pp. 13-21, 1999.

[17] Loopt. http://www.loopt.com/.

[18] J. McGrath, "Groups: Interaction and Performance. Englewood Cliffs", Prentice-Hall, NJ, USA, 1984.

[19] E. Miluzzo, N.D. Lane, K. Fodor, R.A. Peterson, H. Lu, M. Musolesi, S.B. Eisenman, X. Zheng, and A.T. Campbell, "Sensing Meets Mobile Social Networks: The Design, Implementation and Evaluation of the CenceMe Application", Proc. ACM Conference on Embedded Networked Sensor Systems (SenSys 08), ACM Press, pp. 337-342, Nov. 2008.

[20] Factsheet: The U.S. Media Universe http://goo.gl/AQWwd/.

[21] C. Papadopoulos, "Improving Awareness in Mobile CSCW", IEEE Transactions on Mobile Computing, vol. 5, pp. 1331-1346, Oct. 2006.

[22] K. Petersen, R. Feldt, M. Shahid, and M. Mattsson, "Systematic mapping studies in software engineering", Proc. Conference on Evaluation and Assessment in Software Engineering (EASE 08), IEEE CS Press, pp. 1-10, June 2008.

[23] D. Pinelle, and C. Gutwin, "Loose Coupling and Healthcare Organizations: Deployment Strategies for Groupware", Journal of Computer Supported Cooperative Work, vol. 15, pp. 537-572, Dec. 2006.

[24] Rococo. http://www.rococosoft.com/.

[25] V. Sacramento, M. Endler, H.K. Rubinsztejn, L. Lima, K. Goncalves, and G.A. Bueno, "An Architecture Supporting the Development of Collaborative Applications for Mobile Users", Proc. Enabling Technologies: Infrastructure for Collaborative Enterprises (WETICE 04), IEEE CS Press, pp. 109-114, June 2004.

[26] K. Schmidt, "The Problem with 'Awareness', Introductory Remarks on 'Awareness in CSCW'", Computer Supported Cooperative Work vol. 11, pp. 285-298, 2002.

[27] SurveyMonkey. http://www.surveymonkey.com/.

[28] J.C. Tang, N. Yankelovich, J. Begole, M.V. Kleek, F. Li, and J. Bhalodia, "ConNexus to Awarenex: Extending awareness to mobile users", Proc. ACM Conference on Computer Human Interaction (CHI 2001), ACM Press, pp. 221-228, March- April 2001.

[29] K. Tollmar, O. Sandor, and A. Schömer, "Supporting Social Awareness @Work Design and Experience", Proc. ACM conference on Computer Supported Cooperative Work (CSCW 96), ACM Press, pp. 298-307, Nov. 1996.

[30] R. Vera, S.F. Ochoa, and R. Aldunate, "EDIPS: an Easy to Deploy Indoor Positioning System to Support Loosely Coupled Mobile Work", Personal and Ubiquitous Computing, vol. 15, pp. 365-376, April 2011.

[31] Tango. http://tango.me/.

[32] Waze http://www.waze.com.