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Fostering the appropriation of socially collaborative technologies as a strategy to tackle third-level digital divide

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Abstract. Finding perspectives that contrast the traditional digital divide literature aiming at «bridging the technology gap», is increasingly common. In this paper, we introduce the case of Madeira, a small Portuguese island characterised by low-pace digitisation and significant socioeconomic unbalance. Through this example, we hypothesize that in a close future, facing the spread of ICT use, a lower-educated population may underestimate the downsides of capitalistic digital tools adoption. Nevertheless, we also introduce the idea that scarcely digitised environment may constitute privileged location where to facilitate the spread of socially collaborative technologies.

Introduction

In recent decades, the increasing ubiquity and economic relevance of ICTs has led to a relapse on patterns of inclusion and exclusion from digital technologies access, use and outcomes, in what is referred to as the digital divide. In this scenario, the main focus of digital divide studies shifted from different kind of concerns. First-level digital divide focused on the need to provide digital access to disadvantaged social categories to reduce socio-economic inequalities (Anderson et al. 1995). Second-level digital divide, instead, stressed the importance of digital skills (van Deursen et al. 2016) and types of activities performed while connected

(Zillien and Hargittai 2009) as key factors to take advantage of ICTs access. Despite the increasing refinement of these investigations, third-level digital divide studies highlight the persistence of a deterministic vision suggesting that ICT adoption would automatically benefit underserved communities (van Dijk 2006). Ultimately, access to ICTs, having sufficient skills and using them to improve their own life condition does not guarantee positive outcomes. While gaining importance, the internet ultimately reflected more and more cultural and socio-economic dynamics of the off-line world, strengthening pre-existing inequalities (van Deursen and Helsper 2015).

This evolution in the socio-economical reality and in the theoretical debate has been paralleled by an increasing number of projects aiming at: 1) widening the benefits of digitisation to disadvantaged categories and, 2) actively tackling current socio-economic challenges. We could look at these projects as privileging «autonomous social collaboration» (Lyle et al. 2018) instead that subordinating it to the search for profit, like many contemporary technologies do (Srnicek 2016). Hereafter, we refer to the technologies enabling these goals as socially collaborative technologies, although this definition is still a work in progress.

The aim of building socially collaborative technologies has been tackled both from a design and an organisational perspective, leading to the ad-hoc development of artefacts (e.g. Commonfare, Fairbnb[1]) as well as to the discussion of different models to organise digital labour (e.g. platform cooperativism - Scholz 2014). These initiatives are committed toward a single piece of technology and, when investigating the context of potential adoption, they tend to focus on that specific technological product, as in the case of EU funded projects (e.g. Lyle et al. 2018). Little has been done in relation to the appropriation of diverse sets of socially collaborative technologies (with notable exceptions, e.g. Bødker et al. 2017 Huybrechts et al. 2017).

Contributing to overcome this gap, this poster presents a preliminary study on Madeira island in Portugal, aiming to better understand how to support the local population in appropriating socially collaborative technologies.

Madeira socio-economic context and ICTs

Madeira is a 250k inhabitants island located 1000 km from Portugal. To understand its economic structure and digitisation level, we relied on quantitative data[2], interpreted through one year of informal observations.

Despite Madeira is the second richest region of Portugal (Eurostat 2017), 28% of the population is at risk of poverty (INE 2104). This is possibly due to the

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1 https://commonfare.net/ and https://fairbnb.coop/

2 When not differently specified, the data refer to a second level analysis that we have performed on the microdata of a survey investigating the use of ICTs in Portugal - INE 2018 from https://bit.ly/2ITMcpu

relevance of a large scale tourist industry, requiring a high number of low skilled workers. This factor possibly influences also on the low education attainment rates: 61% of Madeirans left school when finishing primary education (14 years old, in Portugal) or even before.

Madeira digitisation is below both the European, and Portuguese averages (IDR 2016). Only 79% of households have internet access vs 85% European average, and only 61% of people use it daily vs 71% of European average (Eurostat 2017). To get a deeper understanding of this generic information, we tried to determine whether ICT access and use were equally distributed among socio-economic groups. We, therefore, crossed data on internet access, frequency of use and devices ownership with the four variables most commonly considered in digital-divide studies: age, education, gender and income. In all the considered cases there is a statistically significant relationship between the variables, although the strength of this relationship varies considerably. Age, education level and income are strongly related to having ever used the internet, but their importance decreases consistently once this first barrier is overcome. Age has the strongest relation with having ever used the internet and internet access, even if it does not seem to affect too much the frequency of use. Education level has a very strong relationship with having ever used the internet, and a moderate relation with access to internet and devices ownership. Income relates primarily to internet access, closely followed by having used internet at least once. Surprisingly, income seems to be less related to digital tools ownership than education and age.

Another relevant aspect is that, despite smartphone use as the most common digital tool (57% of the population own one), our observations would suggest that they are mostly used as mobile phones: people do not type, they call. In fact, data indicates that only 37% of Madeirans smartphone plans has a data plan, suggesting the existence of economic barriers to mobile digitisation.

Discussions and conclusion

Merging the plausible scenario of increasing ICTs adoption with the data regarding economic and education inequality in Madeira, a few concerns arise, along with potential optimistic considerations.

First, its socio-economic characteristics may constitute an additional vulnerability factor toward the downsides connected to the adoption of capitalistic oriented digital tools. Indeed, a scarcely educated population that is already used to low wages may underestimate, for example, the additional risks of gig-economy platforms if compared to more traditional kind of employment.

Second, working for crowdsourcing platforms like Taskrabbit or Foodora may have some specific downside, if compared to performing the same job for a local employer. In particular, it may end official or informal forms of negotiation, and social control acted toward employers that may currently occur.

Finally, we wonder whether introducing socially collaborative technologies may be easier in this context than in more densely digitised ones. This last optimistic consideration is connected to the absence of an already saturated «digital market», and to the absence of an «installed base».

To support the appropriation of socially collaborative technologies in the specific local context, we will engage in two kind of fieldwork-based activities. First, a community study based on ethnographic methods, which serves to build in-depth knowledge of local society and identify emerging needs that could leverage participation; and second, a participatory process aiming at better understanding participants ICTs use, to support the appropriation of socially collaborative technologies that may meet participants' values and needs.

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Danwei Li, Jacob Bartel, Prasun Dewan (2018): Extending the Gmail User-Interface to Leverage Prediction of Response Times and Hieararchical Recipients. In: Proceedings of 16th European Conference on Computer-Supported Cooperative Work - Demos and Posters, Reports of the European Society for Socially Embedded Technologies (ISSN 2510-2591), DOI:10.18420/ecscw2018_p3

Extending the Gmail User-Interface to Leverage Prediction of Response Times and Hierarchical Recipients

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Abstract. Recent work has shown how the Gmail user-interface can be extended to make use of algorithms for predicting a flat list of email recipients. We build on this work by addressing how this user-interface be extended to make use of external algorithms for predicting (a) a hierarchical list of email recipients, and (b) the expected time to get a response from a recipient. We have augmented the existing view for sending messages to allow users to view predictions of response times and hierarchical recipients, and use one click to select a subgroup of predicted recipients. We have also added new folder-specific commands to the views for browsing folders that allow users to use one click to highlight, un-highlight, and select messages whose responses have not arrived or been sent within the predicted times. We have also developed a new configuration view for determining which predictions should be displayed and how often new training data should be used to change the prediction model. The user-interface is implemented as a Chrome extension that communicates with an external server to receive predictions and send training data. This architecture decouples the implementation of the user-interface and algorithms. However, our extension is intimately tied to the extended user-interface, as it reads and augments existing views and menus of Gmail.

Introduction

This work addresses intelligent support for predicting recipients of email messages (Roth, Ben-David et al. 2010, Bartel and Dewan 2012), and response times of these recipients (Tyler and Tang 2003, Bartel 2015). These two kinds of predictions are related in that choice of recipients can be a function of their response times. Hence, we address these two issues in an integrated manner, though the algorithms for these predictions, referenced above, have (so far) been independent of each other.

This paper does not address prediction algorithms, focusing instead on demonstrating a user-interface for leveraging research in these algorithms. Two previous efforts have partly addressed this issue. Gmail offers a user-interface that predicts a flat list of recipients based on the algorithm described in (Roth, Ben-David et al. 2010). Our group has previously developed a research test-bed (Hamlet, Korn et al. 2015) to experiment with predictions of hierarchical recipients and response times in which all lab subjects are given a common task involving collaboration with a built-in agent mimicking a set of other users. The test-bed, implemented from scratch, includes features of forums, social networks, and email, and is not tied to any specific client, providing only features needed in the experiment. This work combines aspects of these two efforts, demonstrating additions to the Gmail user-interface that can leverage algorithmic work in the two kinds of predictions.

Architecture and User-Interface

Extending an existing email client requires an architecture allowing addition of external user-interface elements. As Gmail is a browser-based user-interface, we were able to use the abstraction of Chrome extensions, which are zipped bundles of files such as HTML, CSS, JavaScript, and images that add functionality to the Google Chrome browser. Our Chrome extension, executing in the browser of a client computer, communicates with algorithms on a server for making recipient and response-time predictions (Figure 1). These are machine-learning algorithms that need training data to make the predictions. The extension sends these data periodically to the server. It is intimately tied to the extended user-interface, as it augments existing views and menus of Gmail - it reads the content of the loaded Gmail pages and injects functionality into them based on the data read. However, our architecture decouples the implementation of the user-interface and algorithms - the algorithms are oblivious to the ways in which the predictions are used in the user-interface, which in turn, is independent of the nature of the algorithms. Currently, our server sends hardwired synthesized data to demonstrate the capabilities of the user-interface and architecture.

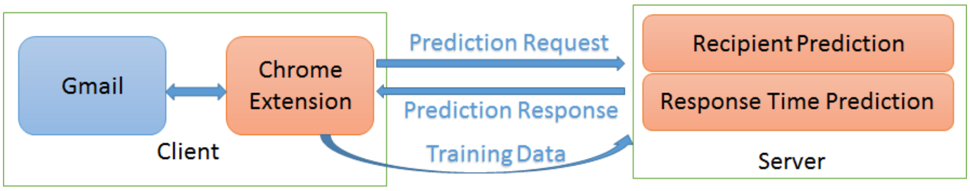

Figure 1. Extension Architecture

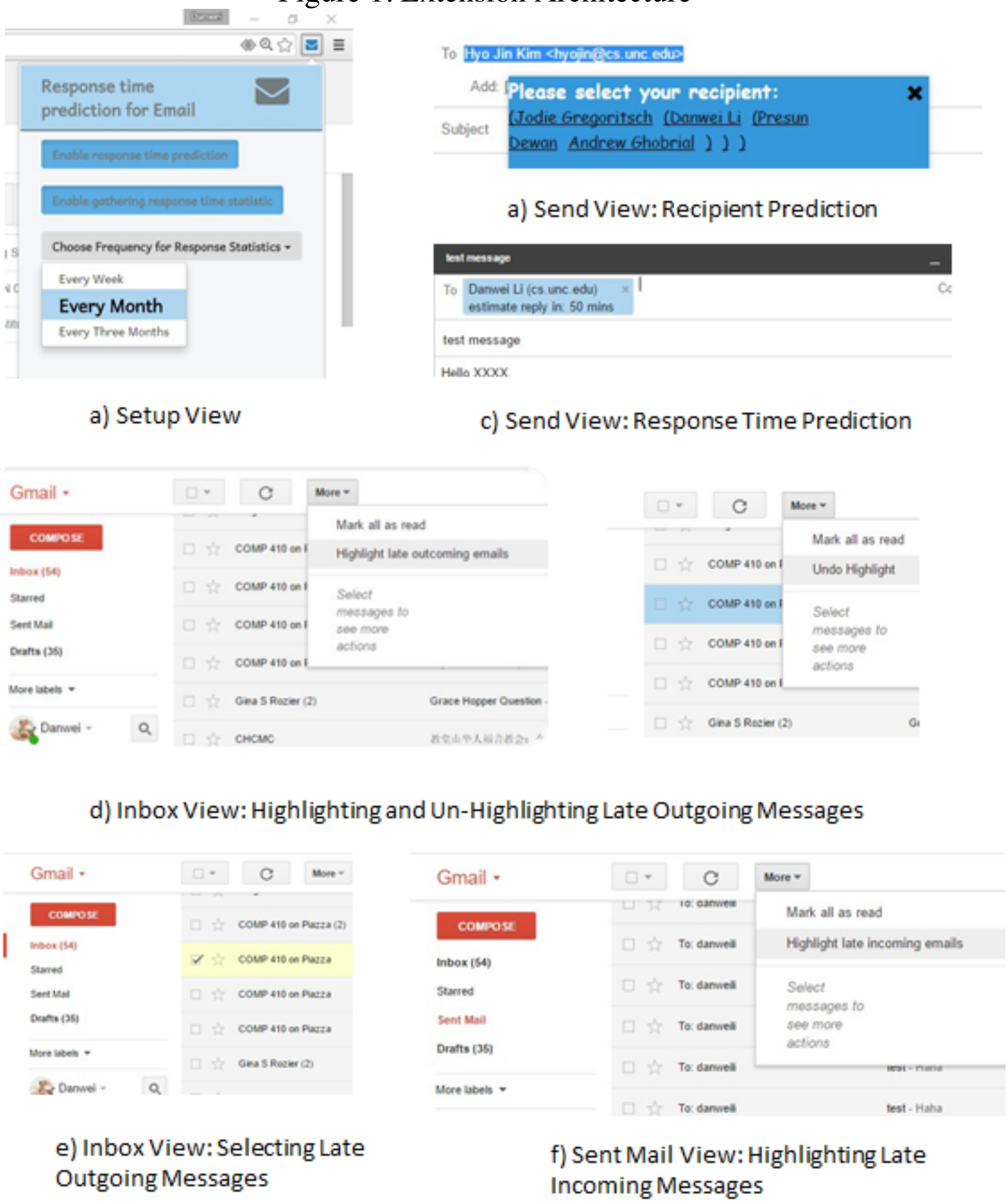

Figure 2. Preference View and Extended Send and Folder Views

Like other Chrome extensions, ours is visually represented by an icon in the Chrome browser. Clicking on it brings a pop-up window used to determine if response-time and recipient predictions are enabled, and how often training data are sent to the server (Figure 2(a)). Double-clicking on an input recipient displays a pop-up window that shows the hierarchy of predicted recipients using nested parentheses (Figure 2(b)). Clicking on a parenthesis selects all recipients in the list enclosed by the selected parenthesis and its matching counterpart. Single-clicking on an input recipient displays the expected response time from that recipient (Figure 2(c)). Email receivers may be interested in knowing whether they have replied to emails in a timely manner. Selecting the *Inbox* or *Starred* email folders adds menu items to the existing *More* menu to (un) highlight messages that have not been replied to within the time predicted to the sender (Figure 2(d)). Conversely, it may also be beneficial for senders to know which of their sent emails have not received responses within the predicted times. Selecting the *Sent* folder adds *More* items to (un) highlight these emails (Figure 2(f)). Thus, response time predictions can become self-fulfilling prophecies! We have also extended the existing Gmail selection menu with folder-specific commands to allow users to select both kinds of messages in batch (Figure 2(e)) for existing Gmail operations such as marking as important, adding stars, adding to tasks, filtering messages such as these, and deleting. The existing "None" item in this menu can be used to unselect these messages.

This is, of course, a first-cut at implementing a user-interface with our goals and further work is needed to determine its usability and usefulness. For example, as far, as we can tell, adding folder-specific commands to folder-manipulation menus is an innovation, and thus needs more feedback from potential and actual users. Presentation and publication of this implementation provide a basis for such future work. In particular, we hope conference attendees and readers of this paper will give us feedback through direction interaction and/or email about the potential uses of our predictions of response times and hierarchical recipients, our notions of late sent and received messages, and our commands to select and (un) highlight such messages.

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Pacheco, Dulce; Stevens, Scott (2018): The Role of Culturally Intelligent Team Leaders on Task Performance. In: Proceedings of the 16th European Conference on Computer-Supported Cooperative Work - Demos and Posters, Reports of the European Society for Socially Embedded Technologies (ISSN 2510-2591), DOI:10.18420/ecscw2018_p2

The Role of Culturally Intelligent Team Leaders on Task Performance

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Abstract. Workforces are becoming increasingly more diverse, as they function in disciplinary and culturally diverse environments. There is a growing need for effective leadership in these settings. Research shows that cultural values influence both role expectations and perceptions of role expectations and correlate to poor performance evaluations. We hypothesize that leaders with a better understanding of cultural values would lead their teams to higher task performance. A study was conducted with a sample of 19 students, all team leaders working in a project-based class for one semester in a disciplinary and culturally diverse graduate program. Cultural intelligence or cultural quotient (CQ) was measured by the Cultural Intelligence Scale (CQS) and experts evaluated team task performance. Results indicate that Cognitive CQ and Motivational CQ positively correlate to task performance. The outcomes of this study can be used in the selection, training, and development of leaders of culturally diverse teams.

Introduction

Cooperation between individuals from different backgrounds is frequently necessary in addressing complex tasks performed in today's workplace (Pacheco, 2015; Pacheco & Soares, 2017), especially in new product development teams (Weingart, Todorova & Cronin, 2010). Consequently, there is a growing need for effective leadership for these disciplinary and culturally diverse environments (Ng, Van Dyne, & Ang, 2009). Moreover, organizations need to consider how best to maintain these diverse teams that have exhibited exceptional innovation (Weingart et al., 2010). Research shows that cultural values play a critical role in human behavior in organizations (Stone-Romero, Stone, & Salas, 2003), as those values influence both role expectations and perceptions of role expectations (Ang et al., 2007; Shaffer, Harrison, Gregersen, Black, & Ferzandi, 2006). Moreover, findings show that cultural differences correlate to poor task performance (Stone-Romero et al., 2003). According to Campbell (1999), task performance is a function of knowledge, skills, abilities, and motivation directed at role-prescribed behavior (Campbell, 1999).

Cultural intelligence or cultural quotient (CQ) is defined as an individual's capability to function and manage effectively in culturally diverse settings (Ang & Van Dyne, 2008). CQ is conceptualized as a four-dimensional construct: two mental, metacognitive and cognitive, along with motivational, and behavioral CQ (Ang & Van Dyne, 2008). Metacognitive CQ is the capability for consciousness and awareness during intercultural interactions (Ang et al., 2007). Those high on metacognitive CQ are consciously aware and mindful of cultural preferences and norms (Ng et al., 2009). Cognitive CQ focuses on knowledge of norms, practices, and conventions in different cultural settings (Ang et al., 2007). Individuals high on cognitive CQ can anticipate and understand similarities and differences across cultures (Ng et al., 2009). They also understand better their own role and their role expectations (Stone-Romero et al., 2003). Motivational CQ is the capability to direct attention and energy toward learning about, practicing, and functioning in culturally different situations (Stone-Romero et al., 2003). Those high in motivational CQ experience intrinsic satisfaction and are confident about their ability to function in culturally diverse settings (Ng et al., 2009). Finally, behavioral CQ is the capability to exhibit situationally appropriate actions from a broad repertoire of verbal and non-verbal behaviors (Ang et al., 2007).

We hypostatize that in disciplinary and culturally diverse teams, leaders with higher cultural intelligence will lead their teams to higher task performance.

Method

Participants were 19 graduate college students (53% females, 47% males; mean age of 24.5, age range 21-33), attending a disciplinary diverse program in a Northeastern US university, in Spring 2017. A majority of the responders come from the US (53%), 26% were from China, and remaining 21% were from India, South Korea, Malaysia, and Israel. They were leaders of teams that had to develop new products. Participants were working in a project-based class for one semester.

Teams in this study go through a specific dynamic process of collaborative design and development, that is called ‘creative chaos’ (Davidson, 2016).

A survey with the Culture Intelligence Scale (CQS; Ang et al., 2007) was sent by email to the students at the beginning of the semester, with 18 responding (N=18, α=.70). CQS comprises four sub-scales to measure the four-dimensions of CQ, namely: Strategy (metacognitive; 4 items, α=.55); Knowledge (cognitive; 6 items, α=.67); Motivation (motivational; 5 items, α=.70); and Behavior (behavioral; 5 items, α=.68).

Experts assessed task performance of each team, by attending a presentation and a demo of the artifact produced and by filling a survey. The research team designed the experts’ survey based on the work of previous researchers (Plucker & Renzulli, 2014; Todorova, 2011) and with the assistance of domain experts. Other domain experts later revised the survey. The questionnaire included 12 questions (e.g., “The interactive design of this product is innovative”, and “The physical engineering of this product is of high quality”), scored on a 7-point scale (1=*strongly disagree* to 7=*strongly agree*). Experts were on average 44 years old (age range 37-55), with the mean work experience in the entertainment technology field of 23 years (years of experience in creative areas range 10-40).

Findings and Discussion

The relationship between the CQ of the leader and task performance of the team was investigated. A *Pearson Correlation Coefficient* disclosed a statistically significant positive relationship linking task performance to the CQS’ sub-scales Knowledge (r=.60, p=.03) and Motivation (r=.63, p=.02). There was no statistically significant relationship between task performance and both the CQS’ sub-scales Strategy (r=-.11, *ns*) and Behavior (r=.31, *ns*).

Results show that leaders’ cognitive CQ positively relates to task performance, which corroborates previous findings that CQ facilitates the understanding of and compliance with role expectations (Stone-Romero et al., 2003). Research mentions that individuals with high cognitive CQ are more likely to have accurate expectations and less likely to make inaccurate interpretations of cultural interactions (Ng et al., 2009), which might have helped to manage the team effectively.

Findings also confirm that high motivational CQ individuals have higher task performance, as they direct their energy toward learning role expectations and practice new behaviors and through practice, improve their performance (Stone-Romero et al., 2003). Moreover, those with high motivational CQ feel intrinsic satisfaction and are confident about their ability to function in culturally diverse settings (Ng et al., 2009), which might have influenced the dynamics of the teams.

Our study did not confirm the positive relationship between metacognitive CQ and task performance found by other researchers (Ang et al., 2007). Several factors may have contributed to the null result, including the study setting (academia *vs.* industry); age differences; and cultural diversity. Our work tends to confirm that behavior CQ is positively related to task performance, as it has been previously reported (Ang et al., 2007; Shaffer et al., 2006), but in our study these results did not meet the 95% confidence threshold. Interestingly, Ang and her team (Ang et al., 2007) found that metacognitive CQ and behavior CQ were the factors predicting task performance in work environments. Differences in these findings might be explained by the research setting (academia *vs.* industry). Additional empirical studies are needed to clarify the relationship between CQ and task performance, controlling for third variables that might mediate this connection (e.g., task conflict, relationship conflict, leadership style, personality traits of the leader or team members, academic *vs.* industrial setting).

Conclusion

The primary goal of this study was to explore the relationship between the cultural intelligence of the team leader and task performance by the team. Findings revealed that the leaders' cognitive CQ and motivational CQ positively correlates to task performance, as these CQ dimensions facilitate the compliance to role expectations. Individuals high on cognitive CQ tend to more accurately interpret cultural interactions, and individuals high on motivational CQ show more confidence in culturally diverse settings. Both these factors might have helped leaders to manage their disciplinary and culturally diverse teams better, leading them to higher task performance. Our data do not show a strong connection between the metacognitive and behavior CQ sub-scales of the leader to task performance.

Our work can have practical implications for the selection, training, and development of leaders in diverse team settings. Current findings are from a preliminary analysis of the data collected. Further analyses are planned.

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The Influence of the Leaders' Selection Method on Team Performance

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Abstract. Leadership impacts team performance. More effective leadership at the workplace may improve team performance and, consequently, increase both employees and employers work satisfaction. There is a wide array of studies on effective leadership, but the influence of the way the leader is select on team performance and is not yet clear. We discuss the relationship between the methods used to select the leader and team performance. A study was conducted with a sample of 112 bachelor students working in 17 teams during an 8-week long class project. Team performance was measured by the sub-scale Perceived Team Collaboration of the instrument Team Collaborator Evaluator (TCE) and also by the final project grade given by the instructors. Results show that teams have higher performances when their members unanimously choose the leader. Practical implications for the selection of team leaders are discussed.

Introduction

Identifying relevant knowledge, skills, and abilities of team players can affect the entire job placement process, impacting how organizations select, train, and retain their employees (Stevens & Campion, 1994). Enhancing more effective teams may improve team performance, but also both employees and employers satisfaction levels (Hogan & Kaiser, 2005; Pacheco, 2015). Team leadership influences individual learning, team performance, and the perception of team collaboration (Edmondson, 1999; Hogan & Kaiser, 2005; Shimazoe & Aldrich, 2010; Sivasubramaniam, Murry, Avolio, & Jung, 2002).

According to Robbins, Judge, and Campbell (2010, p. 316), “leadership is the ability to influence a group toward the achievement of a vision or set of goals”. Leaders can emerge from the group or be formally appointed (Robbins et al., 2010). Trait theories and behavioral theories try to determine effective versus ineffective leaders, but context plays an important role in leader’s success (Robbins et al., 2010). It has been shown that leadership is usually reserved for the most skilled and committed team player, accepted by all members (Fransen, 2012; Heckman et al., 2007; Hogan & Kaiser, 2005). Although researchers associate situational factors to predict performance (Fiedler, 1996; Robbins et al., 2010), it has been shown that the reinforcement of the team cohesion by the leader has a positive effect on performance (Fransen, 2012; Robbins et al., 2010).

In educational settings, it is frequent to have individuals working in teams (Pacheco, 2015). This learning method allows students to experience cooperation, group decision making, team leadership, and team communication (Fransen, 2012; Pacheco & Soares, 2017; Shimazoe & Aldrich, 2010). Considering the literature, we hypothesize that teams perform higher when the team members unanimously choose their leader.

Method

A convenience sample was chosen, comprised of 112 bachelor students, from two different classes, in a University in Southern Europe. Participants worked an 8-week long class project. Instructors asked the students to form teams with a minimum of 4 members (team size range = 4-8, M=5.79, *SD*=.89). A total of 17 teams were created.

Participants had the chance to work together on the project for one week to get to know each other. Then instructors asked students to appoint a team leader. Participants (*n*=99, 46% females) filled a paper-and-pencil survey that included questions about their demographics and also a question on how the leader was appointed (Elected by all members; Elected by the majority of members; Self-volunteer; Random choice; or Other methods).

At the end of the semester, students evaluated their teams’ performance using the sub-scale Perceived Team Effectiveness (PTE; 3 items, α=.89; rated using a 1 to 10 scale 1=*Low/Almost Never True* to 10=*High/Almost Always True*, e.g. “The extent to which you are satisfied about the quality of collaboration within your team.”) of the instrument Team Collaborator Evaluator (TCE; Fransen, 2012). This study also considered the final project grade given by the instructors (assessed on a 20-point scale; 1=*does do not comply with any objective*, 20=*objectives achieved entirely*) as a factor to evaluate team performance.

Findings & Discussion

The relationship between the leader's selection method and team performance was investigated using an ANOVA. An interaction effect [$F(3,79)=6.1$, $p<.01$] with an effect size ($\eta^2=.19$) was visible, linking the leaders' selection method to the final project grade. Also correlating these two variables was found a main effect [$F(4,79)=4.01$, $p<.01$], with effect size ($\eta^2=.17$]. *Post-hoc comparisons* using the *Tukey HSD test* indicated that the mean score for the leaders' selection method "Elected by all members" ($M=17.86$, $SD=1.48$) was superior (Mean difference=1.19, $SD=.35$, $p<.01$) to the selection method "Elected by the majority of members" ($M=16.67$, $SD=1.93$).

A main effect [$F(4,79)=6.17$, $p<.01$], with an effect size ($\eta^2=.24$) was uncovered, connecting the leaders' selection method to PTE. *Post-hoc comparisons* using the *Tukey HSD test* indicated that the mean score for the leaders' selection method "Elected by all members" ($M=8.77$, $SD=1.09$) was superior (Mean difference=1.04, $SD=.24$, $p<.01$) to the selection method "Elected by the majority of members" ($M=7.73$, $SD=1.25$).

The relationships between the other leaders' selection methods (e.g., Self-volunteer or Random choice) and both the final project grade and the TCE were statistically non-significant.

Data shows that teams which unanimously choose their leader get higher performance levels. It confirms the literature that has found that leaders unanimously elected are more likely to democratically lead their teams, which seems to reinforce their cohesion and, consequently, speeds up team performance (Fransen, 2012; Robbins et al., 2010). The higher team collaboration level and the democratic leadership might have led team members to commit to the success of group discussions, that later was translated into increased team performance. This higher performance will contribute to boosting both employees and employers satisfaction (Hogan & Kaiser, 2005; Pacheco, 2015).

Findings also corroborate that leadership can have a positive effect on team performance (Edmondson, 1999; Hogan & Kaiser, 2005; Shimazoe & Aldrich, 2010; Sivasubramaniam et al., 2002). Our results confirm that leaders with a team player attitude and that are accepted by all members, manage to lead their teams to better team collaboration and performance (Fransen, 2012; Heckman et al., 2007; Hogan & Kaiser, 2005).

Conclusion

Findings show that leaders unanimously choose predict higher team performance, both on the self-perceived team collaboration levels and on team performance evaluated by experts. Therefore, teams should be encouraged to select their leader unanimously, as it was shown to create higher satisfaction levels that frequently translate to more commitment to the team success and better team performances. Further research should explore the relationship between team performance and the selection method of the leader controlling for other factors, like leadership styles and the leaders' individual characteristics.

Acknowledgments

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S. Kolvenbach, R. Ruland, W. Gräther, W. Prinz (2018): Blockchain 4 Education. In: Proceedings of 16th European Conference on Computer-Supported Cooperative Work - Demos and Posters, Reports of the European Society for Socially Embedded Technologies (ISSN 2510-2591), DOI:10.18420/ecscw2018_p7

Blockchain 4 Education

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Abstract[1]**.** Certificates play an important role in education and companies, where individual learning records become essential for people's professional careers. It is therefore important that these records are stored in long-term available and tamper-proof ledgers. Until today, training facilities, educational institution or certification authorities issue paper-based certificates and certification processes are not digitized. Blockchain technology could support this transformation form paper certificates to digital certificates and it could help to generate learning histories. In this demonstration, we present the Blockchain for Education platform as a practical solution for issuing, monitoring, validating and sharing of certificates. The Blockchain for Education platform is based on the Ethereum blockchain and it uses smart contracts to support the certification process.

Introduction

Certificates confirm the achievement of certain learning outcomes. Until today, certificates are usually issued on paper, which has several advantages. For example, recipients can easily store them and present them to any person and for any purpose. In addition, it is difficult to forge paper certificates if there are built-in security features. However, third parties need extra effort to verify paper certificates. Verification is usually achieved by asking the issuing certification authority, i.e. certification authorities have to maintain a long-term archive [1].

Blockchain is a foundational technology that documents transactions in a decentralized, secure, transparent and immutable way and has a major impact on

[1] This paper is an excerpt of [17].

design and implementation of digital business processes in many application areas such as Internet of Things, smart grid, supply chain, finance or notarization [2, 3, 4]. Process automation is achieved by so-called smart contracts that are stored in the blockchain.

Blockchain technology could support the digital transformation of certification processes. The Blockchain for Education platform represents paper certificates as digital certificates and their fingerprints (unique hashes) are written on the blockchain. In addition, the identities of certification authorities and certifiers are also stored into the blockchain. Finally, smart contracts support management of certification authorities and certifiers as well as monitoring or revocation of certificates.

Related work

Blockcerts, developed by MIT media lab together with Learning Machine is an open-source ecosystem for creating, sharing, and verifying educational certificates. The educational certificates are compliant with Open Badges standard and are registered on the Bitcoin blockchain [5, 6]. Based on blockcerts, a pilot for academic and professional certifications is currently under development in Malta [7] and the Federation of State Medical Boards in the US is currently launching a pilot for the issuing of official documents [8].

TrueRec, developed by the company SAP, is an Ethereum-based blockchain system that stores professional and academic credentials [9]. TNO started recently the blockchain project self-sovereign identity framework. This framework is designed to help supply official information in digital form and only share a minimum amount of personal data [10, 11]. Sovrin is another infrastructure that aims to support digital identities on a global scale [12]. The Apostille notarization service supports use cases such as digital media licenses or car ownership [13].

System Description

In order to build the Blockchain for Education platform a minimal viable product was defined based on requirements elicited in several workshops with application partners, educational institutions and two certification authorities. The main features for certification authorities and certifiers are import of data and examination results from legacy systems, creation of digital certificates, signing and issuing them into the blockchain, monitoring and revocation of certificates as well as confirming validity and authenticity of certificates. Storing and archiving of digital certificates and the creation of application portfolios are the necessary features for learners. Employers need features to read and validate digital certificates.

After having elicited the requirements, the Blockchain for Education platform was conceptualized and a prototype system based on the Ethereum blockchain [14] was implemented. The InterPlanetary File System [15] is used to store profiles of certification authorities and the BSCW document management system [16] stores digital certificates that are represented as extended Open Badges. BSCW supports certification authorities in management of certificates and learners in the organization and sharing of application portfolios. Employers are supported by a verification service for digital certificates. Two smart contracts have been developed in Solidity. An overview of the conceptual architecture of the Blockchain for Education platform is shown in Fig. 1.
In a bootstrapping process (step 1), the smart contracts IdentityMgmt and CertMgmt are written to the Ethereum blockchain by the accreditation authority. After that, the accreditation authority could register profiles of certification authorities (2a) and at the same time their respective identities on the blockchain (2b). The certification authority could register identities of certifiers on the blockchain (3).

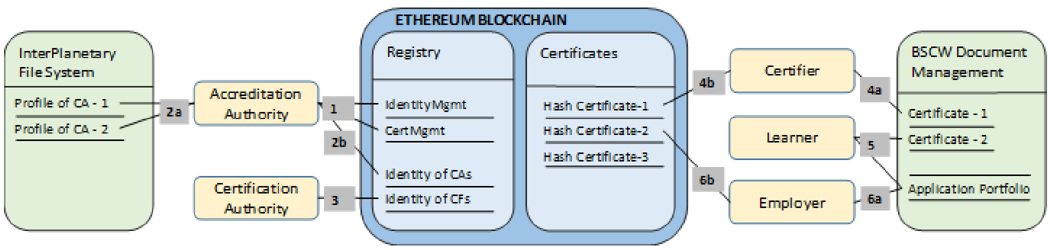

Fig. 1. Conceptual architecture of the Blockchain for Education platform.

Certifiers collect all necessary information, sign and issue the certificate. It is stored on the BSCW document management system and its fingerprint is written to the Ethereum blockchain (4a, 4b). Learners receive their certificates and can create application portfolios (5) that could be shared with potential employers (6a). Employers use a verification service to check the authenticity of certificates.

Summary

The demo demonstrates the combination of the cooperative process of issuing a certificate with a blockchain infrastructure. Furthermore it also exemplifies the interplay of the groupware BSCW with a blockchain. We hope that this demo will stipulate further discussions around blockchain and CSCW [18]. Further information on the system and its future development is available here [19].

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Lima, Y.; Souza, J. M. (2018): LABORe: Collaborative Assessment of Work-Disruptive Technologies. In: Proceedings of the 16th European Conference on Computer-Supported Cooperative Work – Demos and Posters, Reports of the European Society for Socially Embedded Technologies (ISSN 2510-2591), DOI:10.18420/ecscw2018_p6

LABOR*e*: Collaborative Assessment of Work-Disruptive Technologies

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Abstract: There are several examples of a crowd collaborating to help experts such as citizen science and human sensoring. In this paper, we present LABOR*e*, one of such efforts, a crowd-based system for the collaborative assessment of work-disruptive technologies. Our goal is to present the prototype of the system – the result of the first cycle of the Soft Design Science Research methodology – and to propose an evaluation methodology to test this system with the help of the ECSCW attendants.

Introduction

Understanding Work is one of the research themes of the CSCW community and envisioning its future is necessary to help CSCW research to keep its relevance throughout time (Lima & Souza, 2017). One of the main topics of research about the future of work is the automation which has been the subject of several studies in the field (Dogan & Yildirim, 2017; Frey & Osborne, 2017; Laboratório do Futuro, 2017; The Economist Intelligence Unit, 2018). In this work, we present the prototype of our system, Labor*e*, that allows the collaborative assessment of work-disruptive technologies, thus being an application of CSCW techniques to help a smoother transition of societies to the future of work.

Our proposed solution is based on two essential concepts. The first one is work-disruptive technologies which are those technologies that, when applied in the production, impact certain occupations, either destroying or modifying it; an application of Schumpeter’s theory of creative destruction (Schumpeter, 2014) to the world of work. The second concept is Technology Assessment which can be defined as the collective designation of the systematic methods used to scientifically investigate the consequences of technology as evaluated by the society (Grunwald, 2009). Our system seeks to support Technology Assessment.

Related Work

The proposed system shares some similarities to others that also propose a collaboration among a crowd, composed of laypeople, in order to do or help some specialized work. We can highlight successful experiences in this line of work in the field of citizen science such as EteRNA – a massive open laboratory which allowed a crowd of laypeople to test RNA structure designs (Lee et al., 2014; Treuille & Das, 2014) – and Fast Science – a platform that allows experts to set up experiments and recruit the crowd to participate (Esteves, 2016). Recruiting the crowd has also been used for human sensoring as in CrowdView, a system that allows citizens to identify and report problems in their city (Silva, 2017).

In the field of Future-oriented Technology Analysis, of which Technology Assessment is part, there are some computational tools such as Autobox, Forecast Pro, and SAS Forcast Server which are focused on Technology Forecasting, not Technology Assessment (Barbosa, 2018). Thus, the system proposed in this paper is built on the ground laden by these previous research but represents a novel application of CSCW, to the Technology Assessment field.

Problem & Requirements

The presented system is the result of the first cycle of application of the Soft Design Science Research (SDSR) (Baskerville, Pries-Heje, & Venable, 2009). We will briefly present the specific problem and its requirements, the first two steps of this methodology, to give an idea of what the system is supposed to accomplish.

The specific problem can be defined as "evaluate the disruption a group of emergent technologies will cause on a group of occupations". This particular problem can be translated into the following set of requirements. **Requirement 1**: allow the registration of emergent technologies; **Requirement 2**: build a platform for the crowd to collaboratively evaluate the disruption on work caused by the technologies registered; **Requirement 3**: allow the visualization of occupations with their disruption level and related technologies.

LABORe: Prototype of a Solution

Based on these requirements, the first prototype of LABOR*e* was created using ("Marvel," 2018), a web-based prototyping tool. In this prototype, LABOR*e* is presented as an Android application, but it will also be developed to iOS.

In order to meet the requirements, LABOR*e* is composed of three main modules: **Technology Registration**, used to register a new technology on the platform by providing its name, category – based on (IEEEE, 2017) –, description, readiness level – based on (European Comission, 2017) –, references (videos, pictures, news articles, academic papers, etc.); **Technology Assessment**, allows a user to see the details of a registered technology and visualize the assessment made by the community while being capable of making his assessment and debating with other users; **Occupations Ranking**, presents a list of occupations ranked by a series of criteria selected by the user such as disruption level and number of related technologies.

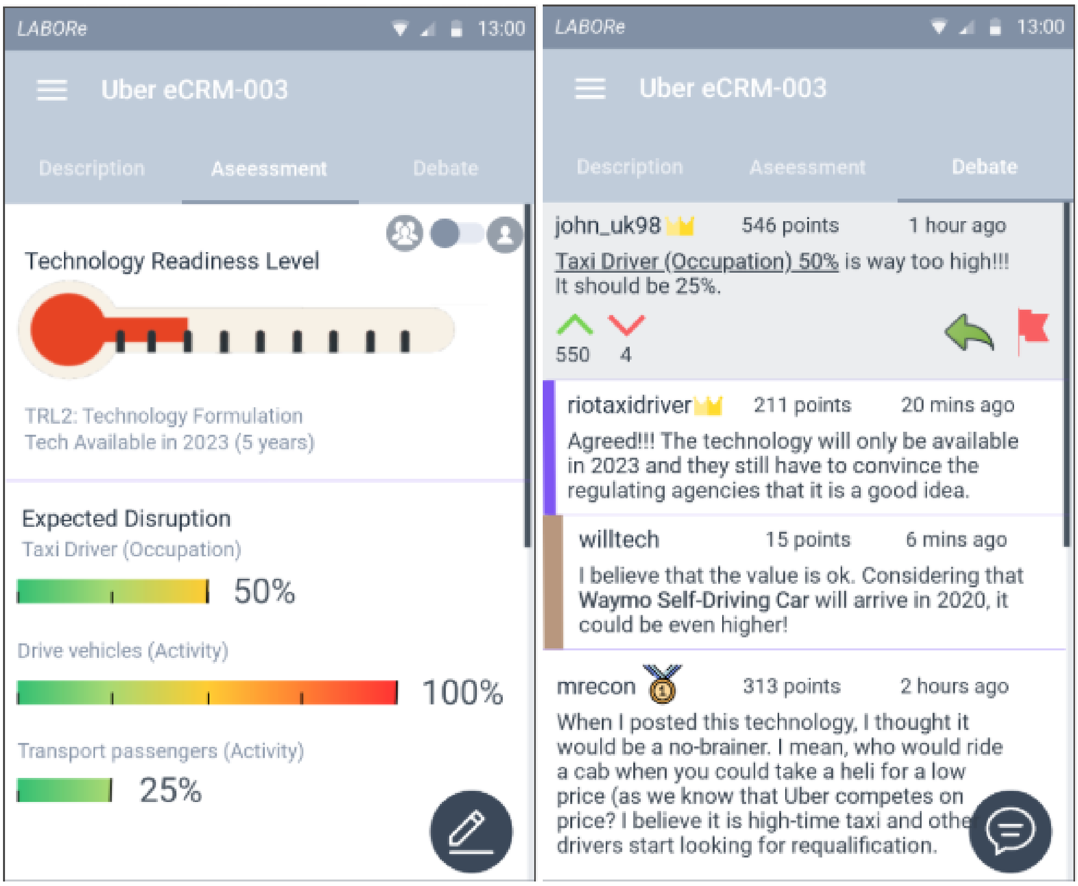

Figure 1: Screenshots of the LABORe prototype representing the Technology Assessment visualization (left) and the debate (right) of the same technology.

Given that this is a short paper, we opted to present only two screens of the second module (Technology Assessment) given that it is the one that has more collaborative elements (shown by the screens in **Figure 1**).

Prototype Evaluation Methodology

In order to evaluate the prototype, we will provide a QR Code and a short URL for the prototype and the questionnaire in our poster. By accessing the prototype link, users will be able to annotate the prototype online, providing an interesting medium for discussion. In the questionnaire, participants will be able to evaluate the system regarding its usability, functionality, and completeness using well-established metrics (Hevner, March, Park, & Ram, 2004).

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Pichiliani, Mauro C.; Dewan, Prasun; Hirata, Celso M. (2018): Lacomo: A Layer to Develop Collaborative Mobile Applications. In: Proceedings of 16th European Conference on Computer-Supported Cooperative Work - Demos and Posters, Reports of the European Society for Socially Embedded Technologies (ISSN 2510-2591), DOI: 10.18420/ecscw2018_p4

Lacomo: A Layer to Develop Collaborative Mobile Applications

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Abstract. Nowadays, there is little support for developers to transform single user applications to collaborative ones in the mobile domain. We present Lacomo, a new software layer to build collaborative mobile applications with accessibility, screen sharing, and application rewriting technologies that reduce costs to prototype collaboration features, thereby increasing the range of supported applications without deep application knowledge. We comparing it to an *ad hoc* approach. Users using Lacomo performed a testing task faster, with less effort and errors at a higher completion time.

Introduction

Mobile applications are a major force behind the explosive growth of mobile devices. While they greatly extend the functionality of those devices, they also open opportunities to enable collaboration, especially with applications familiar to users.

Leveraging single-user commercial systems to multi-user collaboration has been a persistent research topic. However, so far, related research academic work and the state of the practice approaches pay little attention to the mobile domain, and the approaches that do so either focus in resources that demand high development effort (Lin et al., 2007) or do not cope with specific characteristics of mobile devices (Picco et al., 2014).

To overcome the above limitations, we propose a Layer to develop collaborative mobile applications (Lacomo). Inspired by operating system's accessibility layers, our approach has the goal to promote collaboration through data sharing in user interface widgets found in existing applications, such as text box and buttons. This is a contrast to traditional approaches to alleviate development through source code modification, component placement, or framework reuse.

Related Work

The main supporting infrastructures, frameworks, components and other approaches are reviewed by (Roussev 2003) and presented in Figure 1.

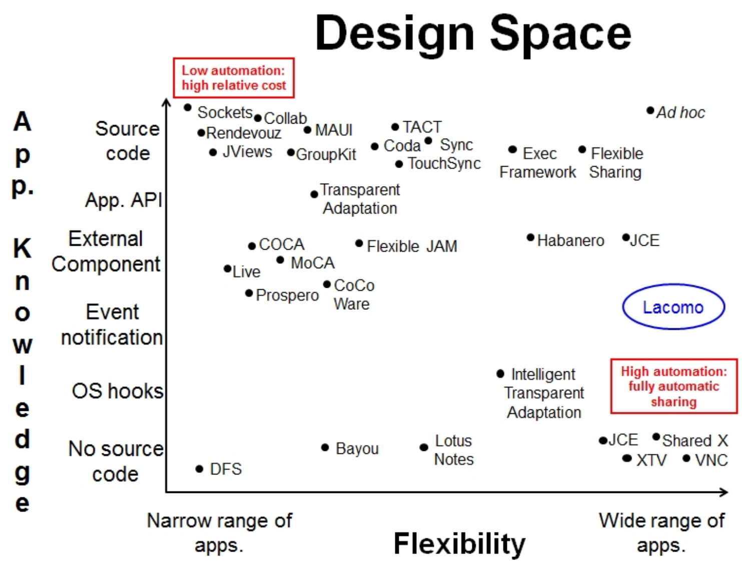

Figure 1. Design space for collaboration support.

The development frameworks, toolkits, and components found on the top left area provide low automation and demand high development relative cost. In contrast, sharing infrastructures located on the lower right provide fully automatic sharing without development effort, but with limited interaction, as to strict WYSIWIS interaction mode. The other approaches in between tend to require high effort development effort and/or constraint flexibility.

The constraints of existing systems limit the range of applications and interaction modes, thus we aim to overcome those limitations and fulfill the requirements further than existing approaches. To achieve this goal we studied the design space to find a suitable place for Lacomo in such a way that it fits most applications (flexibility), with a high level of automation to achieve a considerable amount of code reuse and be extensible to custom modifications with less development effort than previous approaches.

The challenge of designing a single mechanism to address general requirements without the constraints leads us to explore innovative technologies and combine old ones. Specifically, we were interested in providing such a mechanism that automates UI data sharing in relaxed WYSIWIS mode without the full knowledge of objects semantics and application's internal details.

After the study of previous approaches in Figure 1, we detected past systems do not explore event notification and resources provided by the OS to develop accessibility services for mobile platforms. The use of these resources combined with screen sharing, UI automation testing, and application rewriting technologies moved our attention to the area where a wide range of applications can be modified without components, APIs, source code or direct OS hooks. This is advancement over the JCE, XTV, VNC and other approaches that do not require the source code, since the resources we combine provide contextualized UI widget data and event information.

Lacomo Design

Lacomo is designed to be built on top of an API that capture user events, such as the accessibility API, thus any existing application that has widgets compatible with accessibility interfaces can benefits from its features.

The services developed with Lacomo can access events and data associated with elements of the UI interface without application source code in the same way as any accessibility service. Additionally, since Lacomo services can access the System log, every communication from the application to the OS and vice-versa is available to the Lacomo layer. The hierarchy of objects that corresponds to UI is available to the developer and every pixel shown is reachable due to screen sharing technology. These features achieve a high level of code reuse since they are available at run time and do not require the source code

User Study

The goal of the user study is to compare the Lacomo implementation with the *ad hoc* to provides non-WYSIWIS collaboration in an existing mobile application. Formally, this experiment aims to collect quantitative and qualitative evidence to verify the following hypothesis: *Does the use of Lacomo require less effort to modify an existing mobile application than the ad hoc technique?*
20 participants (2 female, 18 male), with age ranging from 22 to 53, participated in the experiments. The effort metrics evaluated were Time, LOC (Lines of Code), LOC divided by time, Calories, Mouse movements and Save events. Figure 2 shows a radar chart that compares the normalized mean values for the five effort variables and the time spent during the study.

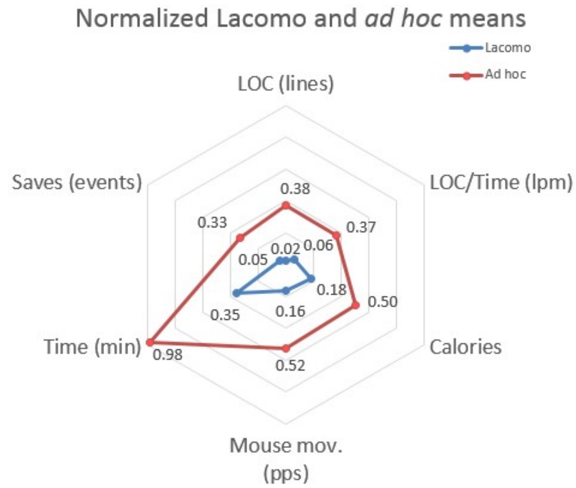

Figure 2. Normalized values of the effort metric.

The effort required to change a mobile app to support collaborative requirements is, on average, 27.7 minutes, 11.3 lines of code, 0.51 lines per minute, 97.1 calories, 224,841.1 pixels traveled by the mouse, and 6.7 save events. The effort to use an event notification approach compared to *ad hoc* implementation required, on average, 64% less time, 95% less lines of code, 78% less lines per minute, 64% less calories, 69% less pixels traveled by the mouse, and 85% less save events.

In general, participants commented that the Lacomo approach was interesting. P8: "*It was interesting to see a new way of development*". P16: "*I liked, and it [Lacomo] was very interesting. It would open other [development] possibilities*". When asked about the difficulty they faced, participants of the ad hoc group reported problems to understand the application code and to capture events. P17: "*[I could not] make the client event appear on the next tablet*". P13: "*It was hard for me to understand the large [existing] code and find the elements [needed]*"

References

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