Bridge the Gap of Codification and Personalization Strategies: Gain and Lost of Knowledge Management of Postgraduate Student Project Meetings

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Abstract: It is acknowledged that knowledge management (KM) brings several benefits for an organization, and two types of knowledge management strategies exist: codification and personalization, and a gap exisits between both strategies. In this paper, the context of KM is placed on the campus of higher education. A knowledge capturing tool, in the form of a tablet based APP, is introduced to capture problem solving knowledge during a student project meeting. This tool intends to propose a new way of technology support to codify knowledge during socialization. A series of comparative experiments were undertaken to investigate the APP's influence on users' meeting experiences. This paper will present results based on interviews with the participants, which showed both positive and negative effects of the APP usage on their meeting experience.

1 INTRODUCTION

The concept of knowledge management has existed for almost 40 years, originated from the consultancy business in the late 1980s (Koenig and Neveroski, 2008), theorized by Nonaka and Takeuchi in the 1990s (Nonaka and Takeuchi, 1995). It is no doubt that a good knowledge management strategy can foster innovation (López-Nicolás and Meroño-Cerdán, 2011), increase an organization's competitiveness (Carneiro, 2000), and promote organizational learning (Vera and Crossan, 2003). In the last two decades, with the fast development and vast implementation of computer systems, IT begins and continues to shape the knowledge management strategies. A knowledge management strategy should to be tailored to an organization's specific context to achieve its goals (Bierly and Daly, 2002). In general, two knowledge management strategies can be identified based on the use of IT: codification and personalization (Hansen et al., 1999). In the codification strategy, knowledge is extracted, codified and stored, as a resource independent of its creator. This process is usually done with the help of a knowledge engineer, rather than the knowledge creator him or herself. In the personalization strategy, knowledge stays in the memory of people, and it can be shared through socialization among individuals. However, these two strategies are not mutually exclusive (McMahon et al., 2004), both strategies are necessary for an organization, codification can nurture personalization, and vice versa.

Several efforts have been made to bridge the personalization and codification strategy together. The ubiquitous use of computer systems in our everyday life and work environment has drastically changed the way we share knowledge. Many collaborative work platforms and groupware have been developed to support project management, task realization and online communication, while knowledge can be extracted from the voluminous data generated through these platforms (Ackerman et al., 2013) (Eseryel et al., 2002). However, face to face meetings still play a crucial role in project decision making (Kirkman et al., 2004), computer mediated communication still can't replace physical conversation between individuals. Recently, social computing has gained more and more attention, it is an area of computer science that focuses on the intersection of social behaviour

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and computational systems (Wang et al., 2007). New ICT technologies result in new technology augmented human interactions, which brings new opportunities for knowledge codification during the process of personalization.

In this paper, the organizational context of knowledge management is placed into a university campus, the target group being graduate students in higher education. J. Duderstadt envisioned in the late 90s that higher education would evolve into a global knowledge industry, and future universities should offer new opportunities of learning through the use of information technology in the "age of knowledge" (Duderstadt, 1997). Nearly two decades have passed since then, and the form of higher education nowadays is hugely shaped by IT. Academic knowledge is being captured, structured, represented, codified, and shared through all kinds of computer systems: e-learning platforms, campus wikis, academic online forums and social networks just to name a few. However, numerous research universities are still unable to grasp the importance of KM (Tan, 2016). On one hand, collaboration is regarded as the breeding base for new knowledge in research universities, and a strategic knowledge management approach is needed to encourage knowledge sharing. On the other hand, the educational domain is often engaged in a massive and senseless duplication of effort due to the lack of educational material sharing (Robson et al., 2003). The few attempts that we found on university campus knowledge management fall exclusively into the division of codification strategy, by implementing IT based infrastructure within certain academic activities to facilitate computer mediated knowledge sharing (Bender and Longmuss, 2003) (Cain et al., 2008), or personalization strategy, by proposing a management policy to foster socialization among individuals (Petrides and Nodine, 2003) (Rasmussen et al., 2006) (Raymond et al., 2010) (Marques et al., 2006).

This research is focused on a specific academic activity: graduate student projects. With the trend of project-based learning in higher education, especially in engineering science and management science, post graduate students are usually required to realize several group projects with real industrial partners. These student projects not only train student's working skills, but also contribute "real world" value to their industrial partners (Hertel, 2002) (Gorman, 2010). Some of the student projects may even lead to a real business. During student projects, group members are involved in complex problem solving, in which knowledge is shared, used and learned. Therefore, these graduate students should be considered as knowledge workers (Nonaka et al., 1998), and their project experience harbours valuable knowledge capital. Student projects are usually documented in their final project reports, which are usually a combination of each group member's task. Although collaborative tools are generally used in student projects for the main purpose of communication and coordination, e.g. google groups, FB messengers and what'sapp, face to face meetings still play an important role in collaborative decision-making (Joo and Mark, 2008), and undocumented face to face project meetings remain a black box of knowledge.

In this paper we are going to introduce a tablet-based APP to capture the problem-solving knowledge produced during project meetings, in order to codify knowledge produced through personalization. However, this APP will change the naturalistic communication among users, and it may bring negative effects to the meeting experience. A series of comparative experiments were undertaken to study the influence of this APP usage on participants' perception of their meeting experience, and this paper will present the results based on the interviews with the users.

The paper is structured in five sections. First, the concept argumentation-based design rationale is introduced, and the APP interface will be demonstrated. Second, methodology of the experiment is explained. Third, results of this experiment are shown. Next, the gain and cost of this APP use for the purpose of knowledge management are discussed. Finally, conclusions, limitations and future research are presented.

2 ARGUMENTATION-BASED DESIGN RATIONALE

One way to extract problem-solving knowledge from a meeting is by analysing the meeting transcription. The raw meeting transcription data is a chaotic pool of dialogue among people, it is extremely difficult for other people to make sense of it. In order to transform the meeting data into comprehensible knowledge, the data should be further classified into concepts, and relationships among these concepts need to be drawn. By doing this, the dispersed meeting data will be structured into knowledge networks (DAI et al., 2014).

Design rationale is originally defined as the reason behind design decisions. From this perspective, it can be used as a knowledge capturing structure for the decision making process.

According to the source and goal, design rationale can come in various forms. The ISAL model aims to extract design rationales from design documents (Liu et al., 2010), which consist of three layers, namely issue, solution and artefact. The decision rationale language (DRL) model is a descriptive language that represents the elements related to design decisions (Moran and Carroll, 1996). The argumentation-based design rationale model adapts argumentation as the knowledge representation of the design reasoning, and argumentation is considered as the most common form of reasoning (Toulmin, 2003), hence closest to natural communication.

Several knowledge representation models were developed to capture the design rationale, most of these models are extensions of two fundamental models, namely IBIS (Conklin and Yakemovic, 1991) and QOC (MacLean et al., 1991). These models generally involve three major concepts: issue, position, and argument. They are represented in graphs, consisting of nodes as concepts and links as relationships. The QOC model has proved to be useful for each individual designer to clarify their design intentions, but is unable to represent the collaborative decision making (Lewkowicz and Zacklad, 2000). Therefore, we choose to use the issue based structure IBIS, since it is a flexible structure that describes communication of the design deliberation (Regli et al., 2000). In order to better represent the dynamic negotiation process, the IBIS model is further elaborated into a semantic network as illustrated in Figure 1.

The semantic network of decision making includes the classic IBIS model concepts: issue, proposition (position), and argument. In order to represent the evolving nature of issue, the relationship “reform” is introduced between argument and issue to indicate that issue may be modified according to the arguments, and a new issue may be established if the group decides to accept the modification. Compared to the IBIS model, the concept “decision” is added to indicate the outcome of problem-solving. This semantic network will be used as the knowledge structure for meeting data.

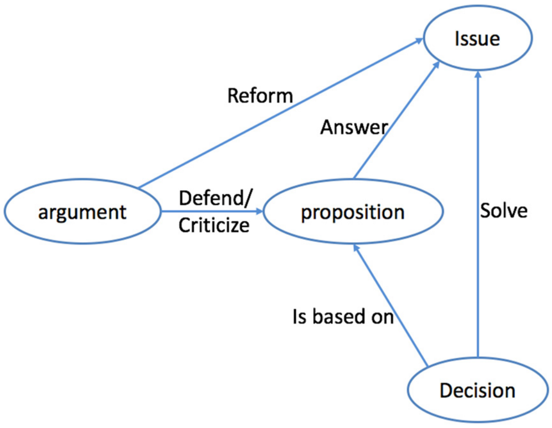

Figure 1: The semantic network of decision making process.

The IBIS model has been adapted by many computer systems to capture the decision rationale, but most of which support only computer mediated communication. Since we want to codify directly face to face meeting, a tablet-based APP called MMrecord/MMreport is used in this research. It was developed by the University of Technology of Troyes, and can be downloaded from the APP store on IOS devices, detailed instruction manual can be found in the APP. They are originally designed to record a multi-party meeting, with the function to specify a meeting’s issue, participants, and decisions. In this research, the interface of this APP was arranged according to the decision-making structure showed in Figure 1. The interface of this APP is shown in Figure 2, as follows:

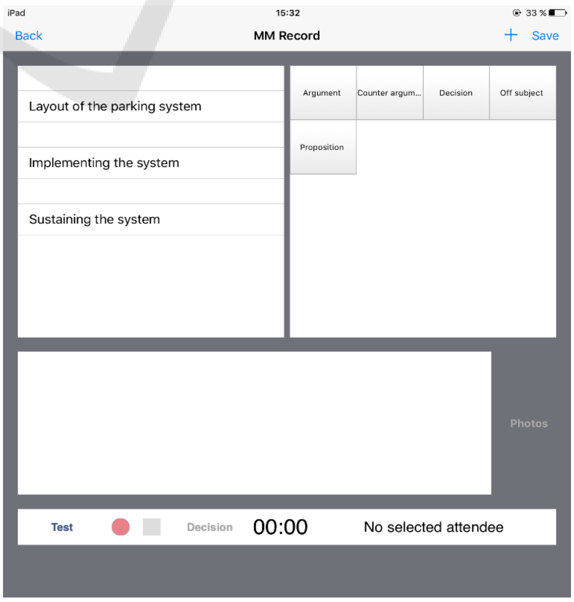

Figure 2: The user interface of MMrecord.

On the left side of the screen, a customizable list of meeting issues is presented, on the right side are 5 interactive tags: argument, counter argument, decision, off subject and proposition. The APP enables the user to give one's speech intention by tapping on one of the 5 buttons while recording the user's speech. In MMreport, a meeting recording can be generated, as well as a log file containing all the tap events given by the users. Therefore, by using this APP, the user is given the possibility to explain intuitively their rationale in the form of argumentation with a simple gesture of tapping on the screen, and meeting data will be segmented, and classified by these tapping events, resulting in a more comprehensible form of meeting report that can be shared with other users.

3 EXPERIMENT DESIGN

In order to study the influence of this technical support on user's meeting experience, a series of comparative experiments were undertaken. 20 students, with an average age of 20 years (sd =1,01), majoring in psychology from the university of Twente were recruited for this study. They were randomly divided into 5 groups of 4 people. Each group was asked to go through two sessions of 30 minutes' project meeting. In one session the participants are required to use the APP during their discussion, they were required to tap on the screen button to indicate the intention of their speech in the form of argumentation as showed above in the figure 2, in the other session the participants went through their meeting without the APP. In order to rule out the learning factor on the discussion topic, two different meeting topics were assigned to the two sessions. The first one is "design a university student online forum for the university of Twente", the second one is "design a bike parking system for the university of Twente". Four different experiment conditions can be identified: "with APP" and "without APP" in terms of APP usage, "online forum" and "bike parking" in terms of meeting topic. In order to include all the four possible conditions, the experiment was arranged as shown in table 1.

3.1 Meeting Data Collection

The two meeting sessions of each group were hold at two consecutive days, and took approximately 90 minutes each, including interviews and questionnaires after each meeting. Each participant signed an informed consent form before the experiment, allowing their meeting to be registered and used for research purposes. Then the participants were given 5 minutes to read the project specification, as for the APP session, a short demonstration of the APP usage was given. The maximum meeting time is limited to 30 minutes. Each participant is required to wear a lavalier microphone connected to an iPad to record his or her speech, and two video cameras were set up in two diagonal corners in the meeting room to record the meeting's audio and video in a holistic manner. After the meeting, the participants were asked to fill in a questionnaire, then being interviewed individually in a random order, the interviews were recorded with an ambient voice recorder.

Table 1: Experiment design of group meetings.

Group	*Participant*	*Session 1*	*Session 2*
1	1,2,3,4	No APP Bike	APP Website
2	5,6,7,8	APP Bike	No APP Website
3	9,10,11,12	No APP Bike	APP Website
4	13,14,15,16	APP Website	No APP Bike
5	17,18,19,20	No APP Website	APP Bike

3.2 Interview Design

The goal of the APP is to capture the collaborative problem solving process without hindering it. Although literature has shown that argumentation-based design rationale is aligned with the conceptual collaborative problem solving process, the problem solver may still experience difficulties in explaining it within this process, due to the fact that interaction with the APP may increase user's cognitive load, resulting in poor conversation flow. The interviews aim to investigate the influence of the APP usage on participant's meeting experience. The interview examines generally three aspects: structure of the discussion, group communication and individual task focus. The detailed interview question list can be found in appendix 1.

Table 2: interview results on user's meeting experience (concept "discussion").

			Communication	Content	Depth	Flow	Focus	General	Structure
Group 2	*With app*	*Positive*	3	0	1	0	3	0	4
		Negative	2	0	3	6	9	1	11
	Without app	*Positive*	4	2	1	6	7	3	1
		Negative	0	0	1	0	3	1	7
Group 3	*With app*	*Positive*	4	1	1	3	12	4	12
		Negative	1	0	0	1	1	1	0
	Without app	*Positive*	0	0	0	0	3	5	1
		Negative	1	0	0	0	5	0	3
Group 4	*With app*	*Positive*	6	0	0	2	8	5	10
		Negative	1	1	0	5	2	0	5
	Without app	*Positive*	1	0	0	3	2	3	3
		Negative	1	3	1	1	3	0	8
Group 5	*With app*	*Positive*	2	1	2	2	3	2	9
		Negative	0	0	1	1	3	0	2
	Without app	*Positive*	0	1	0	0	3	3	4
		Negative	0	0	1	0	1	0	4

4 RESULTS

Due to the absence of one participant in the first group, the two sessions of group 1 was used as a pilot study. First, the interview recording was transcribed into text through a speech recognizer. In this secion, results are based on the analysis of the interview transcription. The analysis of the interview transcription is done according to (Baarda et al., 2005). The analysis is based on the concept of "grounded theory", which means that the data is analysed in an iterative process, to extract new theories. First, the interview transritpion was labelled under the main topics of this study, namely "discussion", "communication", "decision" and "cognitive load". These concepts were used as the first-round classification by annotators. After they finished labelling the transcription for the first round, the labelled transcription was refined and modified in a second-round classification, with more specific sub-concepts identified under each first-round concepts. In the third round, a variation code, ranging from negative, neutral to positive, is attached to the labelled data. The variation code indicates the interviewee's opition on a specific concept. Each time a similar opinion is found about a specific concept, score of the related variation code will increase by 1. Finally, a total score was calculated for each concept by adding up the score of variation code. Two annotators were involved in analysing the interview data, in order to validate the rating reliability. The Cohen's Kappa is between 0.84 and 0.96, which represents an almost perfect agreement between annotators (Landis and Koch, 1977).

Table 2 shows the result on the concept "discussion", which is further specified into 7 sub-concepts: group communication, content of discussion, depth of discussion, conversation flow, user's focus on the primary task, general impression and structure of the discussion. Table 3 shows the average score of each concept of the two sessions. Both sessions of discussions are perceived as positive in general. The general impression of discussion without APP (positive average = 3.50) is rated slightly higher than that with APP (positive

Table 3: comparison of the two sessions.

			Communication	Content	Depth	Flow	Focus	General	Structure
Condition	*With app*	*Positive*	3.75	0.5	1	1.75	6.5	2.75	8.75
		Negative	1	0.25	1	3.25	3.75	1	4.5
	Without app	*Positive*	1.25	0.75	0.25	2.25	3.75	3.5	2.25
		Negative	0.5	0.75	0.75	1	3	1	5.5

average = 2.75), whereas the discussion structure, the task focus and group communication are perceived better in the discussion with the APP.

The structure of the discussion was perceived positive for the discussion with APP with an average of 8.75 positive ratings (median = 9.5, range = 8, sd = 3.403) and 4.5 negative ratings (median = 3.5, range = 11, sd = 4.796) per group, whereas the structure of the discussion without APP was rated negative with an average of only 2.25 positive ratings (median = 2, range = 3, sd = 1.5) and an average of 5.5 negative ratings (median = 5.5, range = 5, sd = 2.380) per group. The focus on the discussion and the communication were rated positive for both sessions, with and without APP. However, the sessions with APP were rated more positive for both factors. The focus on the discussion with APP was rated with an average of 6.5 positive ratings (median = 5.5, range = 9, sd = 4.359) and an average of 3.75 negative ratings (median = 2.5, range = 8; sd = 3.594) per group, whereas the focus on the discussion without APP was rated with an average of 3.75 positive ratings (median = 3, range = 5, sd = 2.217) and an average of 3 negative ratings (median = 3, range = 4, sd = 1.633) per group.

The communication was rated positive for the discussion with APP with an average of 3.75 positive ratings (median = 3.5, range = 4, sd = 1.708) and an average of 1 negative rating (median = 1, range = 2, sd = 0.816) per group. Compared to that the communication in the discussion without APP was rated less positive with an average of only 1.25 positive ratings (median = 0.5, range = 4, sd = 1.893) and an average of 0.5 negative ratings (median = 0.5, range = 1, sd = 0.577) per group.

In contrast to that, the conversation flow was rated positive for the discussion without APP with an average of 2.25 positive ratings (median = 1.5, range = 6, sd = 2.872) per group and only one negative statement (average = 0.25, median = 0, range = 1, sd = 0.5). The flow on the discussion with APP on the other hand was rated negative with an average of 3.25 negative ratings (median: 3; range: 5; sd = 2.630) and only 1.75 positive ratings (median: 2; range: 3; sd = 1.258) per group.

5 GAIN AND LOST

The results above have shown that the APP usage in a group discussion has both positive and negative influences on participants' meeting experience. The problem-solving structure, group communication and task focus were reported to be improved by the APP, while conversation flow was reported to be hindered by the APP.

One of the challenges of small group decision making lies in the fact that they don't know where to start. The APP guides the collaborative problem-solving process by allowing the participants to follow a systematic discussion structure through a intuitive tactile interface, which improves the efficiency of decision making (Antunes et al., 2014). The visualization of topics and issues increases the awareness of participants, which leads to better task focus. The participants' perception of communication is also improved by the APP. Communication in a project meeting is very decision oriented, the function of communication is to share information, coordinate conflicts towards consensus, and argumentation offers the participants a common framework of communication, which makes them aware of their speech intention, leading to a more explicit communication. One participant said in his interview that his discussion in the second session without the APP was improved by his experience from the first session with the APP, he felt that he was better at structuring the group discussion, and more mindful of the topics that he needed to discuss.

The major negative effect of this APP is to over burden user's cognitive load, making them distracted from their primary task, resulting in poor conversation flow. According to (Watson et al., 1988), a 20 minutes training is needed for the users to get used to a new computer system, which is missing in this study. Therefore, the negative effect on conversation flow can be potentially mitigated with training.

6 CONCLUSION

Knowledge management is a research topic that encompasses several disciplines, from management science to computer science, from economy to anthropology. Although the conceptual framework of KM has been developed extensively in the last two decades, relatively few empirical implementations of KM were discussed. In this paper, KM is placed in the context of higher education. It is argued that graduate students should be regarded as knowledge workers, and their student project experience harbours valuable knowledge, for both pedagogic and entrepreneurial purposes. A knowledge capturing tool is introduced to capture project meeting knowledge during the meeting process, and a series of comparative studies were undertaken to investigate its influence on user's meeting experience. Results based on interviews with the participants showed that the tool usage improved the structure of problem solving, group communication and task focus, but hindered conversation flow. Participants also reported that the tool usage trained them at better structuring their problem solving.

This study is limited by its small number of subjects, and subjects' prior knowledge on the discussion topic may also influence their meeting experience. In the following research, more meeting data will be collected. More subjects are needed to mitigate the influence of their prior knowledge, and a long term experiment is needed to examine the learning effect of the tool usage.

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APPENDIX 1

Interview 1 (meeting with APP)

What do you think about your discussion?

- What do you think about the structure of your discussion?
- What do you think about the structure of your communication?
- How would you describe the focus on the defined issue in the group?
- What do you think about your decision(s)?

What do you think about the communication?

- Do you think the app influenced the communication? How?
- How did the app influence your focus on the discussion?
- How did the app influence your focus on the communicational aspects that are pointed out by the app (buttons)?

Do you have any other comments or questions?

Interview 2 (meeting without APP)

What do you think about your discussion?

- What do you think about the structure of your discussion?
- What do you think about the structure of your communication?
- How would you describe the focus on the defined issue in the group?
- What do you think about your decision (s)?

Do you have any other comments or questions?

Interview 3 *(comparing the two sessions)*

What are the differences you perceived, comparing the decision making without the app to the decision making with the app, regarding to the discussion/structure/workflow/decision?

Do you have any other comments or questions?