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Abstract

The purpose of the present study was to examine if the provision of illusionary adaptive support, in the form of control that resides at the collaborators, could be perceived as such and cause intrinsic motivation towards better collaboration in Computer Supported Collaborative Learning (CSCL) settings. A pilot study on a case of collaborative concept mapping from four dyads was conducted. The preliminary results showed that the two experimental dyads, who received this type of support, produced richer concept maps and better collaborative performance, as compared to the two control ones who did not receive it. The proposed approach extends previous relative work from individual to collaborative settings and reveals new possibilities in the design of adaptive CSCL support.

Keywords: illusionary adaptive support, illusion in CSCL, illusion of control, perception of control

Introduction

Many definitions have been proposed for intrinsic motivation, including, "the interest in or enjoyment of an activity for its own sake" (Ryan, 1993) or "what people will do without external inducement" (Malone & Lepper, 1987). The importance of intrinsic motivation in learning and achievement has been reported in reviews of motivation in education, either in individual or in Computer Supported Collaborative Learning (CSCL) settings (Ryan & Deci, 2000; Shroff & Vogel, 2009). Existing research on intrinsic motivation has focused on various factors that may increase or decrease it, i.e., challenge, curiosity, control, fantasy, competition, cooperation and recognition (Malone & Lepper, 1987). In particular, the factor of control refers to the tendency of people to want to control what happens to them, e.g., of a learner to direct his/her own learning process (Milheim & Azbell, 1988). Support on this need for self-determination may refer to helping people to feel that they have choices when they are involved in an educational experience (Reeve et al., 2003). An educational setting that incorporates such support, provides options, minimizes specific engagements and gives the learner the ability to control issues like content, pace of learning, interfaces, timing; thus, it helps the individual to feel capable of engaging in those activities (Cordova & Lepper, 1996; Shroff & Vogel, 2009). This design aims at challenging awareness of the learner's desires and an integrated sense of self that underlies the autonomy orientation (Ryan & Deci, 2004). Under this perspective the notion of adaptation can be perceived as a notion of control. Furthermore, research showed that even the mere illusion of control (i.e., illusion of adaptation) can improve the learning outcomes. In such a situation the illusion refers to giving the learners a feeling that they control the learning when in fact they do not (Dror, 2008). Research works in this area that focus on individual learning (Berger & Schnerring,

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1982; Vandewaetere, 2009; Vandewaetere et al., 2009), report that the illusion of control (i.e., adaptivity) can be perceived by the learner and trigger better performance, even when the choices provided are irrelevant to learning (Corbalan et al., 2009).

In this work, the aforementioned notion of the illusion of control is extended to CSCL settings, where specific design considerations must be made to produce it. Research in such settings focuses on structuring collaboration, since productive collaboration does not occur when the learners are left to their own devices (Salomon & Globerson, 1989). Examples of operationalization of this approach include structuring the problem itself, process scaffolds, scripts, provision of tools, expert help and adaptive feedback (Stahl, 2007). Here, the process of structuring collaboration is considered under the broad perspective of the Boulding's typology of system complexity (Boulding, 1956). A pilot study was set to test the impacts of an illusionary adaptive support (stimuli) towards the intrinsic motivation for the enhancement of collaborative work, revealing new possibilities of adaptation in CSCL.

A case in concept mapping

In this section, details about the pilot study are presented.

Methodology

Boulding's typology

The process of structuring any device within CSCL may be considered under the approach of the Boulding's typology regarding the system complexity (Boulding, 1956). This typology aims at uncovering the "hard" facts (e.g., laws in the "hard" natural sciences) of "soft" social systems (e.g., collaborative settings). According to this typology, the systems of the world are ranked from simple to complex in nine levels as follows: 1) *Frameworks* (systems with static structures), 2) *Clockworks* (simple dynamic systems with predetermined motions), 3) *Thermostats* (cybernetic systems, i.e., self-regulated on the basis of an external prescribed criterion, 4) *Open systems* (systems that are self-maintained on the basis of resources from the environment, e.g., the cell), 5) *Blue-printed growth systems* (systems that contain pre-programmed instructions for development, e.g., the plant), 6) *Internal-image systems* (systems capable of a detailed awareness of the environment through sense organs, e.g. the animal), 7) *Symbol-processing systems* (systems that use language and other symbols, are self-conscious, and can contemplate the past, present, and future e.g., humans), 8) *Social systems* (comprising actors from level 7 who share a common social order and culture, e.g., social organizations), and 9) *Transcendental systems* (systems composed of the "absolutes and the inescapable unknowables"). The levels in this taxonomy, are in parallel characterized as a) *designable*, i.e., externally regulating to externally prescribed criteria, (levels 1 and 2) and self-regulating to externally prescribed or designable criteria (level 3) and b) as *undesignable*, i.e., self-regulating to internally prescribed criteria (levels 4 -7) and intangible (levels 8-9). This distinction clarifies which levels (subsystems) are predictable and controllable and which are not, and classifies the relevant types of external (inputs) or internal (attractors) stimuli for their function. Within this context, the assistance dilemma arises (Kapur & Rummel, 2009), that introduces issues concerning the visibility and timing of the provision of the stimuli along collaboration, as well as its adaptivity. The first two vary between the position of it initial provision, yet with a degrading presence, and a delayed provision. On the other hand, the adaptive character may inherit the system the choice of the time of the stimuli provision according to the needs of the learners. Moreover, the adaptation issues concerning the assistance dilemma in CSCL, may be extended to issues regarding also the level of the stimuli provision and its type. When this effort is put up at level 7, adaptation may concern the development of inputs-attractors that may maximize the opportunities to produce intrinsic motivation towards better collaboration. However, since each level in this hierarchy incorporates all below (Boulding, 1956), it is easily realized that when inputs are designed at levels 1-3, they are predictable and designable and are expected first to be perceived at level 6 and then reformed to attractors of intrinsic motivation at level 7, towards fulfilling both individual and social goals from level 8 and up.

Collaborative concept maps

Collaborative concept mapping was chosen as the task within the framework of the pilot study. Concept maps were developed by Novak upon Ausubel's idea that learning takes place by the assimilation of new concepts and propositions into existing concept and propositional frameworks held by the learner (Ausubel et al., 1978). Thus, they entail perception of the regularities and constructs of the learner's own concepts. In particular, Novak & Gowin (1984) defined concept map as a "schematic device for representing a set of concept meanings embedded in a framework of propositions". Each proposition is a statement that contains two or more concepts connected through linking words or phrases to form a meaningful statement. The depiction of a concept map comprises a graphical network of nodes (points-vertices) and non-, uni- or bi-directional links (arcs-edges), the first representing the concepts and the latter carrying the relations between the former. Concepts and links may be categorised; they can be simply associative, specified or divided in categories such as causal or temporal relations. Apart from integration of new knowledge to old one, the concept mapping has been used for many purposes such as, stimulus for the generation of ideas, depiction and communication of complex structures, detection of misconceptions, assessment tool. The construction of a concept map can be realised either individually or in a collaborative setting. In the latter case, the explicitness of the structure and content of the concept map, facilitates the exchange of ideas or the collaborative construction of new knowledge. Under such collaboration, significantly greater learning occurs (Preszler, 2004). Digital concept maps can be easily modified (Laanpere et al., 2006).

The IHMC CmapTool

In the present study the IHMC CmapTools, version 5.3 (Cañas et al., 2004) (available at http://cmap.ihmc.us) was chosen. Among other possibilities, it supports collaborative work on the WWW. The concept maps that are produced are stored in servers and can be accessible and modifiable by the collaborators, either synchronously or asynchronously. Moreover, the recorder feature of the tool, allows recording and playback of the history of the steps (individual interactions with the commonly sighted workspace) that were made for the map construction, including identification of each contributor. Additionally, the export feature of the tool, allows the logging and extraction of each participant's activity in the form of raw data, that can facilitate further research work in CSCL.

The illusion of control

The choice of the collaborative tool was followed by the definition of the issue of the illusionary adaptive support while collaborating with it, which was in fact the perception of the illusion of control that would serve as external input to the collaborators. As Dror (2008) states "the learners' control can take many forms and can be viewed as a continuum. At one extreme, control is totally surrendered to the learners, giving them full freedom to do (or not do) as they please. At the other extreme of the continuum, the learners have no control at all". The benefits of the provision of as much as possible control to the learner have already been discussed. Yet, if learners do not perceive the choices or if they are too many, this may cause excessive cognitive load and become detrimental to learning (Dror, 2008). Based on the above, a need of a choice of how much control to be provided had to be made. The collaborators within the IHMC CmapTools are free to control all the tools that are provided in order to construct the concept map; this control was kept as such. Two other areas of freedom that could be controlled by the collaborators were the choice of the content of the concept map and their participation in the evaluation of their effort. In the first area, a continuum between the free choice and a defined one were examined. The free choice would lead to extra load, be cognitive and time consuming, whereas the defined one would lead to no adaptation, so a shared control between the system and the collaborators was chosen. On the basis of the collaborators' profiles, an input (levels 1-3) of specific choices was decided to be provided to them to choose upon the construction of the concept map. The first hypothesis (H1) to be tested here, was the perception of adaptivity through this design in a collaborative setting. The second area of freedom to be controlled was the participation of the learners in their evaluation. It was also examined within the continuum of a fully adaptive situation, of an evaluation exclusively based on self-evaluation, to the non adaptive situation of an expert-system evaluation. In this case, an illusionary adaptive support was decided to increase the perception of control concerning the participation of the collaborators in their evaluation. An input (designed at levels 1-3), was decided to aim at the intrinsic motivation through the perception of the illusion of the above control (levels 7 and upwards). The second hypothesis (H2) to be tested here was that the perception of the illusionary adaptation could impact the collaboration.

The pilot study

In order to examine the above hypotheses, two collaborative uses of the IHMC CmapTools were designed, i.e., the control and the experimental case, respectively. The participants in both the experiments were two dyads, namely d1 and d2, of mixed sex, of pre-service teachers, aged between 24-30 years old, with similar scientific background within each dyad. Both d1 and d2 were completely acquainted with the collaborative concept mapping using the IHMC CmapTools before the experiments. In the control case, d1 and d2 were asked to collaborate and construct a concept map within 20 minutes. This duration was considered as adequate to keep the procedure intensive and illusion sustaining, and was defined on the basis of the acquaintance period of all the dyads with the IHMC CmapTools about a month before the control case. Concerning the H1, they were provided with the free choice to select the content of the concept map within their scientific area (full learner control). The choice should be made before the collaboration, in order to save the relevant time. Moreover, concerning the H2, they were told that their collaboration was to be evaluated by the system, without any information concerning the evaluation criteria (no learner control). The experimental case, was conducted after two weeks between the same dyads and had the same duration with the previous one. As far as the H1 is concerned, the participants were provided with the choice to select among the content they had chosen at the control case or any other within their scientific area (shared contextual control). This decision was also taken before the experimental case. The illusion they received at the beginning of the collaboration, for the purpose of the H2, referred to their participation in the evaluation of their collaboration. They were told that by enhancing their collaborative performance in any way they could, they could influence its evaluation (shared control). Again neither specific evaluation criteria nor any information about the enhancement of the collaboration were provided. Within the collaboration space the researcher, under the name 'system' was also registered and made her presence obvious, through the addition of a concept, around the 10th minute of the collaboration. The text in the concept aimed at reinforcing the illusion of adaptivity and was irrelevant to the content of the concept map. Obviously, the IHMC CmapTools does not provide ready tools for the aforementioned evaluations. The interactions in both experiments were recorded and log files were exported in .txt format, including, for each interaction, stamps of the date, the time, the user identity (id), the ids of the action (e.g., add, delete, move, modify) and the entity type (e.g., concept, linking phrase, connection) and the step number. However, there were cases where a single interaction of a collaborator resulted in logging of a set of interactions under the same step number (e.g., the adding of a concept by the collaborator, logged automatically the interactions add concept, add connection, add linking phrase and add connection, all under the same step number). In such cases, a weighting approach for the interactions was established, and the number of the step was attributed to the main interaction, e.g., in the above example to the 'add connection', and the rest interactions were omitted. The addition of a concept, irrespectively from the collaborator, was regarded as the initiation of a collaborative episode.

Preliminary results

Regarding the H1, the contextual choice of the concept map in the control case was totally free, it was performed outside the experimental setting and thus it is not commented. This choice under the shared control in the experimental case resulted not only in the selection of the same theme in d1, but in the construction of entirely the same concept map. On the other hand, the d2 choose another theme, yet relative to their scientific background that resulted in an entirely different concept map. Details about the structure of the concept maps, along with the comparison of the concept maps between control (ctr) and experimental (exp) cases of d1 and d2, are provided in Table 1, on the basis of the 'Cmap List View' and 'Compare to another Cmap' tools, of the IHMC CmapTools, respectively. In Table 2 the history of the activity that took place for the construction of the concept maps in both cases is presented.

Table 1. Structure and comparisons of the final Cmaps of d1 and d2

Cmap structure	d1			d2		
	Cmap_ctr Freq.	Cmap_exp Freq.	Matched Cmap_ctr to Cmap_exp	Cmap_ctr Freq.	Cmap_exp Freq.	Matched Cmap_ctr to Cmap_exp
Propositions	13	13	13/13	8	16	0/8
Connections	17	17	17/17	12	23	0/12
Linking phrases	4	4	4/4	4	8	0/4
Concepts	14	14	14/14	9	18	0/9

Table 2. The history of the activity towards the construction the final Cmaps of d1 and d2

	d1		d2	
	Cmap_ctr	Cmap_exp	Cmap_ctr	Cmap_exp
Total interactions/ Peer's A and B contribution	126/ A(14%)-B(86%)	172/ A(30%)-B(70%)	379/ A(59%)-B(41%)	797/ A(53%)-B(47%)
Total interactions/min				
Mean(std/ range)	7,00(±4,93)/ 14	6,88(±6,78) 33	25,27(±40,44) 161	44,28(±43,86) 120
Total interactions/episode				
Mean(std/ range)	5,25(±4,40)/ 18	7,82(±10,45) 50	19,95(±47,32) 197	39,85(±95,63) 432

Discussion

According to an extended review upon the contextual control provided to individual learners within computer supported settings (Corbalan et al., 2009) attention needs to be taken as for the similarity of the choices that are presented. They must differ in a way that at a higher level of abstraction the learner can realize that they present opportunities for new learning and in parallel provide the control to him/her to choose the most relevant to his/her interests. If this difference is too big, the learners tend to choose similar tasks to their prior activities, near to their abilities. In this case, along with the case when the difference of the choices is too small, there is no transfer of the knowledge in new tasks. The hypothesis H1 of the pilot study, referred to the perception and use of the adaptivity of the provided support, in the form of choices available concerning the contextual part of the collaboration. The d1 opted to select exactly the same content for both the experiments despite the adaptive support they received (Table 1). It is obvious that in the experimental case either they did not perceived this kind of adaptability or they selected the most familiar context to them, i.e., the same with the control case. It is evident that in the second case the d1 found the two choices (the same or any other task within their scientific area) too divergent to decide and they finally preferred the most familiar and thus easiest. The d2, on the other hand, perceived the adaptability despite the divergence and selected another task to extend the collaborative activity (Table 1). From the above it is evident that the preliminary results of the pilot study, confirm the collective perception of adaptivity in terms of the provided control to the group. Moreover the findings concerning the limitations of this perception as they were reported in individual settings, are also detected in collaborative settings. Regarding the hypothesis H2, i.e., that the perception if the illusionary adaptation could impact the collaboration, the history of the collaboration as it is depicted in Table 2, provides clear indications for its acceptance. Initially, from this Table it can be noticed that in both d1 and d2, the total effort in terms of the number of interactions performed at the experimental were bigger than those in the control case. Moreover, this effort was better distributed among the collaborators, A and B in each dyad, as the percentage of their contributions converges to balance. A more detailed examination of the characteristics of the collaboration concerning the distribution of total interactions per min, reveals that in the d1, this rate was almost kept the same, whereas in d2 it was increased, indicating a greater effort in time. The distribution of the interactions per episode is also presented in Table 2. It can be easily realized that in both dyads the mean value was increased. From the combination of the results that are presented in both Tables 1 and 2 it can be noticed that both the task and the collaborative part of the collaboration were enhanced on the basis of the illusionary adaptive support. Furthermore, in order to examine the change in the frequency of peers' interactions across the session, the turn-taking (transition between peers) was estimated as a function of the session duration (normalized to the total duration). The results of this analysis when applied to data from both d1 (control (left-top) and experimental (left-bottom)) and d2 (control (right-top) and experimental (right-bottom)) groups are depicted in Figure 1. In particular, the d1 group exhibited an asymmetry in the peers' contribution (also justified by the results in Table 2), with B-peer almost dominating over A-peer. Clearly, the turn-taking for the control case is only symptomatically fired around 37%-50% and sporadically around 80% and 90% (Figure 1: left-top); thus, the collaboration balance is reduced. Nevertheless, this effect is reduced in the experimental case (Figure 1: left-bottom), where a more uniform distribution of the peers' contributions is noticed. The system intervention (at the 50% of the session duration) reminding the illusionary monitoring causes a positive effect in sustaining and even increasing further (at ~70:90%) the turn-taking; hence, contributing to a higher balance in peers' collaboration. This effect is also evident in the second group (d2, Figure 1: right), where the collaboration is more balanced (both in control and experimental cases, see Table 2). The illusionary monitoring, as expressed through the system intervention (at the 50% of the session duration), shifts the local domination of A-peer (Figure 1: right-bottom) to an almost periodic rhythm of interaction for the rest of the collaboration, converging to a more balanced nature. These results are indicative of the possibility to design support at the low levels of the Boulding's typology in order to enhance the collaborative work at the social level, through triggering intrinsic motivation. The findings of this work cannot however be generalized due to the obvious limitations of their preliminary character. Yet, they are indicative of the work that can be continued in the area of the CSCL.

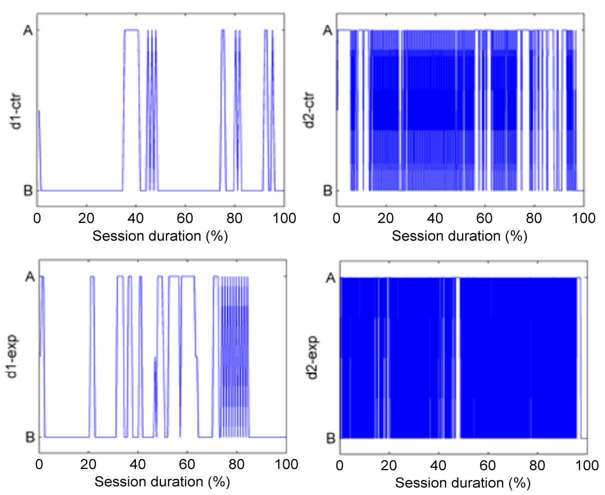

Figure 1. Turn-taking between A and B members of experimental and control dyads along the duration of each collaborative session

Conclusions

In this work, a typology is initially established in order to provide an overview of the possibilities to design support in the area of CSCL. Within this hierarchy, the focus was put at the higher levels where the intrinsic motivation, and especially the perception of adaptivity in the form of control, can be triggered, in order to increase the possibilities to sustain the even higher level of social collaborative work. Through a pilot study, this research initially verified that the illusion of the adaptivity in the form of provided choices to the collaborators, may enhance the collaboration. Future work is expected to verify the possibilities of lowering the ratio between investment and result in CSCL through the minimal design of supporting mechanisms.

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