DEVELOPMENT AND EVALUATION OF THE 'FEEDBACK AND REFLECTION IN ONLINE COLLABORATIVE LEARNING' (FROCOLE) APP

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Abstract

Computer-supported collaborative learning (CSCL) in online distance education brings many advantages such as a decrease in feelings of loneliness and isolation and an increase of social interaction and peer support which is found to positively affect motivation and academic achievement. However, social interaction in CSCL settings cannot be taken for granted. Especially in the case of online CSCL settings where all communication and collaboration take place through mostly text-based electronic learning environments, often in an a-synchronous mode. The use of peer feedback and reflection would be a solution as it reinforces productive social interaction. To stimulate this, the Feedback and Reflection in Online Collaborative Learning (FROCOLE) app was developed. The design-aim was to develop an accessible, easy-to-use app, with minimal invasion of privacy and independent of any virtual learning environment. After an iterative development process, during which the app was presented to several educators as well as tested by a group of users to collect feedback for further improvement, the FROCOLE app version 1.0 was piloted in two higher education courses at two different higher education institutes and evaluated on its perceived usefulness and usability. Generally, the usability was considered good. The usefulness of the app however, was not clear to students of pilot 2. In addition, students experienced installation problems. Based on the pilots, features for further development are determined as well as possible solutions for solving experienced problems are suggested. Pilots of the FROCOLE app version 2.0 will, besides experienced usefulness and usability, specifically focus on the ability of the app to enhance and support interaction in groups, which is the main aim of the app.

Keywords: CSCL, group learning, Peer feedback, Reflection, FROCOLE app.

1 THEORETICAL BACKGROUND

The deployment of computer-supported collaborative learning (CSCL) in online distance education is seen as beneficial as it might not only decrease transactional distance [1], feelings of loneliness and isolation [2] but also increase learning and social performances [3], [4], [5]. Furthermore, collaborative learning also has societal benefits: students become prepared for the global economy and knowledge society where collaboration skills are necessary to survive as collaboration skills are part of the 21st century skills [6]. In addition, through collaborative learning, social interaction and peer support are enabled which may positively affect motivation and academic achievement [7], [8], [9].

However, although collaborative learning is premised on social interaction, social interaction cannot be taken for granted. This is especially true in an online CSCL setting where all the communication and collaboration have to take place through mostly text-based electronic learning environments, often in an a-synchronous mode [10]. Generally, it is a major challenge to stimulate social interaction in online CSCL-groups which is productive in a way that it will lead to achieving the learning goals [11], [12]. The use of peer feedback and reflection would be a solution as it reinforces productive social interaction [13], [14]. Peer feedback is a measured approach by which students carefully assess the quality of their peers' work [15]. According to Huisman [16] it also encompasses reflection as the peer feedback "can be used to modify his or her thinking or behaviour for the purpose of learning" (p. 10). Previous research on peer-feedback and reflection has shown the benefits for both receivers and providers of the feedback. For receivers, the feedback improves reflection and self- regulatory skills [17]. For providers it improves critical thinking skills [18] and also supports generating new ideas and comparing and connecting them to old ones that are currently evaluated and questioned [19].

Peer feedback and reflection requires a sound social space [20]. Social space can be defined as "the network of interpersonal relationships embedded in group structures of norms and values, rules and roles, and beliefs and ideals" [21]. When a social space is sound, it is characterized by attributes like a sense of community, positive group climate, mutual trust, social identity, and group cohesion [21].

According to Filius et al. [20], a sound social space or climate allows for critical feedback to be given without the receiver feeling attacked. The emergence of a sound social space depends on how the group dynamics unfolds in time but as Filius et al. [20] noted, it is difficult to achieve. Added to that, group dynamic related problems may arise during the group learning, thereby endangering the stability or preventing a healthy social space from emerging. Among them are free-riding (i.e., profiting from others) and social loafing (i.e., lack of motivation to contribute) [22]. These problems are specifically reported in regard to long-running (about 6-12 weeks) online CSCL groups. Therefore, peer-feedback should not only deal with the subject matter but should also inform students in a long- running CSCL-group how the group learning progresses and how the group dynamics develop. Peer feedback and the reflection helps students to regulate their group learning, referred to as metacognition or metacognitive regulation [23]. It also helps students to regulate the group dynamics, which involves the regulation of the socio-emotional processes, referred as the regulation of emotion and motivation [24], [25].

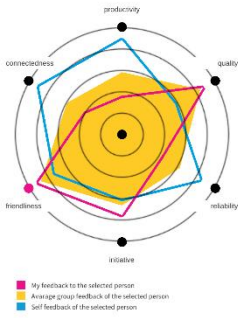
To stimulate and support interaction as well as reflection in CSCL groups, a mobile application was developed. The *F*eedback and *R*eflection in *O*nline *CO*llaborative *LE*arning (*FROCOLE*) app aims to support the formation of a sound social space and therefore group climate which in turn facilitates social interaction and reflection ultimately leading to decreased transactional distance and feelings of loneliness and isolation and increased motivation and academic achievement.

2 DESIGN OF THE FROCOLE APP

The FROCOLE app was developed for use on mobile phones and tablets based on Android and iOS operating systems. (Fig. 1).

Figure 1. Start screen

The design-aim was to develop an accessible, easy-to-use app, in the Dutch language, with minimal invasion of privacy and independent of any virtual learning environment (VLE) for maximum flexibility of deployment. The feedback part of the FROCOLE app utilizes a graphical interface to facilitate the rating and interpretation of scores on different performance indicators, which are placed in such a way that they form a radar diagram (Fig. 2A). The reflection part will use a pedagogical agent format to guide the reflection process. The graphical interface is based on the principle of direct manipulation interfaces [26]. A direct manipulation interface means that students can enter their judgments directly by dragging slides or lines using their fingers thereby avoiding to enter their ratings textual via lists or in other ways (Fig. 2B).



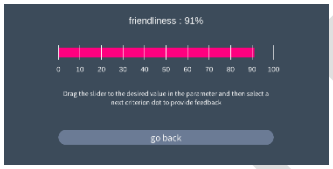
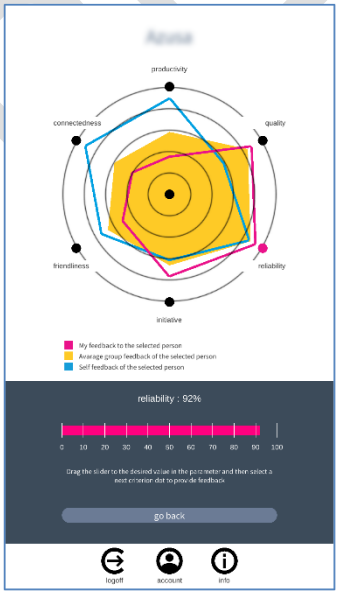


Figure 2A. radar diagram *Figure 2B. feedback slider*

The FROCOLE app assumes three roles: 1) administrator, 2) teacher and 3) student. An administrator can parameterize the FROCOLE app such as installing performance indicators and their labels to fit the requirements of the user (teacher) via an administrator area of the accompanying website. Via the FROCOLE app, the teacher then can create groups, assign students to groups and inspect the feedback given by the individual students and the average of the groups. Students can rate their fellow group members, themselves and the group as a whole on the respective performance indicators. The FROCOLE app includes two diagrams: 1) The Individual Performance Feedback Radar Diagram (IPF-RD) (Fig. 3A) and 2) Group Performance Feedback-Radar Diagram (GPF-RD) (Fig. 3B) in which the rating take place. The diagrams are explained in more detail below.



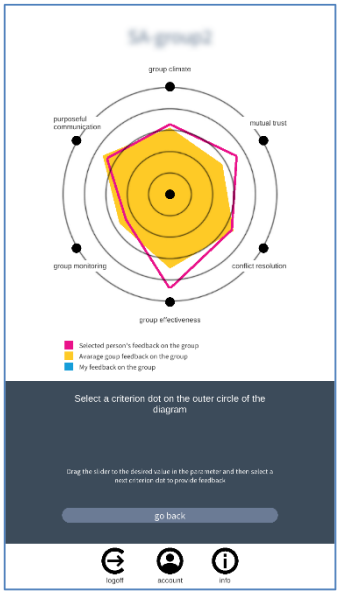


Figure 3A. IPF-RD *Figure 3B. GPF-RD*

The basic idea of the visualization of the feedback data was inspired by the work of Phielix (see [27]). As mentioned above, the FROCOLE app currently facilitates two diagrams, IPF-RD and GPF-RD, which can contain up to 9 performance indicators each. The IPF-RD is aimed at giving feedback to each individual group members by rating them on each individual performance indicator (e.g., reliability, productivity; see Fig. 3A). The rating is done by giving them a score between 0 and 100. To do so, students have to drag a slide using a finger. In a similar way, students can rate themselves. The IPF-RD then visualizes how a student perceived him/herself in the group versus how the group perceived that student (a mean is calculated using the scores of the other students about that student). The different ratings are represented by two coloured lines and one coloured area; 1) a magenta solid line represents the feedback given to the respective group member, 2) a cyan solid line represents the feedback given to oneself and 3) a yellow opaque area represents the average score of the group members on the performance of oneself. The calculation of this average score does not take into account the self-feedback. The GPF-RD is aimed at giving feedback on the level of the group as a whole by rating group performance indicators (e.g., purposeful communication, group climate; see Fig. 3B). The scoring procedure is similar to rating the IPF-RD. The GPF-RD then visualizes how the student perceived the group versus how the other students perceived the group (a mean is calculated using the ratings of the other students about the group). The different ratings are represented by one coloured line and one coloured area; 1) a magenta solid line represents the feedback given to the group, 2) a yellow opaque area represents the average score of the group members on the performance of group.

Each student in the group, thus, can compare his/her own judgement versus the group average which may give a reason for reflection (this is where the reflection part comes in). Both IPF- and GPF-RD support self-, co- and socially shared regulation in the group, which are considered as very important in the CSCL-community as it contributes to an increase of social interaction and group functioning [28], [29]. The reflection part will consist of a pedagogical agent (PA) that guides the reflection process, for example, the PA will alert the group that they should have a group meeting because the performance rating of the group has fallen below a certain threshold. Currently, the pedagogical agent is under development.

3 PEDAGOGICAL BACKGROUND

The FROCOLE app can be used in different scenarios: 1) unstructured – students can give each other feedback at any time and have a group meeting whenever they feel the need for it to reflect on the feedback, 2) structured and supervised - a number of "fixed" moments of feedback and group meetings are built into a course and a teacher guides the group meetings, or 3) structured and unsupervised - a number of "fixed" moments of feedback and reflection are built into a course, yet it is it is up to the students themselves whether they feel the need for a group meeting to reflect on the feedback. Regardless of which scenario is used, the meaning of the performance indicators determined by the teacher must be clear to all group members to be able to assess the performance criteria and then interpret the scores in a meaningful way.

It is advisable to include feedback and reflection as a fixed topic on the agenda of scheduled group meetings taking the IPF-RD and GPF-RD as a starting point. Different approaches to discussing the diagrams are possible. One likely approach is to have each member of the group reflect briefly on the feedback scores. They can indicate what stands out to them and if they wish further explanation for individual reflection, but also for reflection in the group. It is, therefore, important for group members to make clear agreements with each other about how to discuss the feedback. Ultimately, discussing feedback should always be done in good mutual consultation, with both sides being heard. This way, points that arise from the feedback and reflection discussions can be resolved in a constructive and respectful manner. In case of unsupervised scenarios, if there are problems that cannot be solved within the group, the group can decide to involve the teacher of the course.

4 USE CASES

FROCOLE app version 1.0 was piloted in two higher education courses at two different higher education institutes after an iterative development process, during which the app was presented to several educators as well as tested by a group of users to collect feedback for further improvement. At the start of the pilots, the feedback part of the app was fully functioning; the reflection part was not yet implemented. The first pilot took place in a first-year course about Entrepreneurship & Sustainability at a university for applied science using a blended learning education format. Two groups of five students participated. The course ran for 9 weeks from the start of September until the end of October 2021 and

the FROCOLE app was used following a structured and supervised scenario. In the second week of the course, the teacher introduced the FROCOLE app, explained the performance indicators and set a deadline for its installation. In addition, a quick-starter installation- and user manual were provided to the students. Two fixed feedback and reflection moments were built in the course; week three and week seven. After the course finished (in week 10) evaluation regarding the perceived usefulness and usability of the FROCOLE app took place in the form of an online survey. The survey for evaluating the perceived usefulness of the FROCOLE app consisted of 13 questions (11 closed questions; 2 open ended questions). This survey was adapted from the Educate-it student survey for evaluating ICT tools and applications [30, p11]. For evaluating the usability of the FROCOLE app the System Usability Scale (SUS) as developed by Brooke [31] was used as it is considered a robust and versatile tool for quickly and easily collecting information about the user experience [32].

The second pilot took place in an international course about CSCL, in which four universities participated. As the participants of the course did not speak Dutch, the app was translated in English and made available to the students as an installable file (i.e., an apk file). Eight groups of four to five students participated. The course ran for 11 weeks, from the end of September until the 17th of December, and consisted of an individual part and a collaboration part. The collaboration part started in November and lasted 6 weeks until the end of the course. At the start of the collaboration part, the app was briefly introduced by the tutors of the groups and an extensive installation- and user manual was provided in the learning environment. After the course finished, evaluation of the course, including the FROCOLE app took place in the form of an online survey. The results of this evaluation are not yet complete, therefore feedback comments by the students about the app, listed by the teachers during the weeks the app was used, are included.

5 EVALUATION RESULTS

5.1 Pilot 1

Table 1 gives an overview of the evaluation questions and average score (*M*) and standard deviation (*SD*) per question are given. As can be seen, all mean scores are 4.5 or higher, which indicates that the student generally perceived the app as useful. Specifically, they perceived using the app as valuable (item 3, *M* = 5.4) and easy to use for giving feedback (item 6, *M* = 5.2). Regarding reflection, using the app has made this easier (item 9, *M* = 5.1) and made them more aware of their performance (ie., functioning) in the group (item 11, *M* = 5.2).

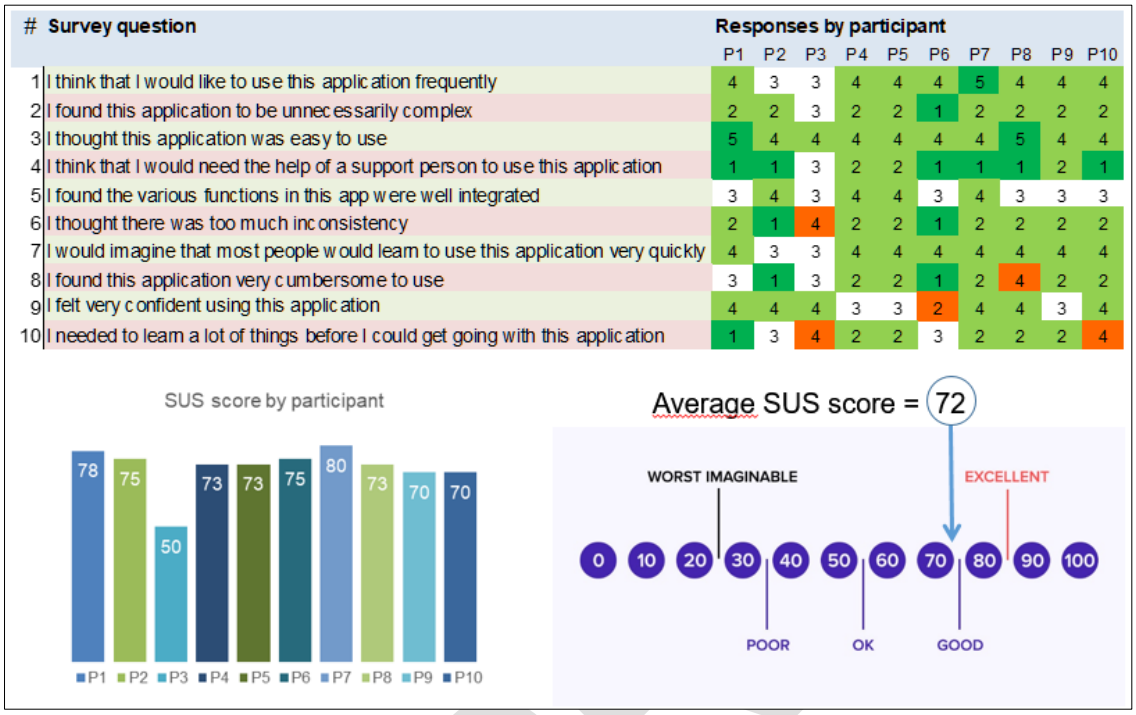
Table 1. Survey questions and scores regarding perceived usefulness of the FROCOLE app (N=10)

#	Questions	Mean	SD
1	Using the app was motivating	4.5	0,81
2	Using the app was fun	4.6	0,80
3	Using the app was valuable	5.4	0,49
4	Using the app has enabled me to collaborate better	4.5	0,50
5	By using the app I have received (constructive) feedback	4.9	0,83
6	By using the app, I was able to give feedback in an uncomplicated way	5.2	0,60
7	By using the app, I have gained insight into my learning points regarding the criteria in the tool	4.8	0,75
8	The use of the app stimulated reflection in the group	4.8	0,60
9	The use of the app has made reflection in the group easier	5.1	0,70
10	The use of the app has resulted in more attention for reflection in the group	4.7	0,78
11	The use of the app has made me more aware of my functioning in the group	5.2	0,60

Note: The questions were answered on a 6-point Likert scale (1=completely disagree, 2=disagree,3=somewhat disagree, 4=somewhat agree, 5=agree, 6 = completely agree)

In the open-ended questions students were asked to indicate what they considered most positive about the FROCOLE app and what they would like to see different. According to them the ease of use, the transparency of the figures and the way the figures provide instant insight into the group versus oneself were considered most positive. Regarding what the students would like to see different in the FROCOLE app, the students were fairly unanimous; an option to retrieve the password, a possibility to add comments to feedback scores via a text field and a built-in history overview of the scores for each performance indicator.

In addition to questions about the perceived usefulness of the app, students also filled in the SUS-questionnaire. Fig. 4 gives an overview of the question ratings per student in the form of a heat map matrix, the usability score per student and the average usability score.



#	Survey question	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
1	I think that I would like to use this application frequently	4	3	3	4	4	4	5	4	4	4
2	I found this application to be unnecessarily complex	2	2	3	2	2	1	2	2	2	2
3	I thought this application was easy to use	5	4	4	4	4	4	4	5	4	4
4	I think that I would need the help of a support person to use this application	1	1	3	2	2	1	1	1	2	1
5	I found the various functions in this app were well integrated	3	4	3	4	4	3	4	3	3	3
6	I thought there was too much inconsistency	2	1	4	2	2	1	2	2	2	2
7	I would imagine that most people would learn to use this application very quickly	4	3	3	4	4	4	4	4	4	4
8	I found this application very cumbersome to use	3	1	3	2	2	1	2	4	2	2
9	I felt very confident using this application	4	4	4	3	3	2	4	4	3	4
10	I needed to learn a lot of things before I could get going with this application	1	3	4	2	2	3	2	2	2	4

Figure 4. SUS score heat map matrix, SUS score per participant and Average SUS score (N=10)
Note: the questions were answered on a 5-point Likert scale (1=completely disagree, 2=disagree, 3=neutral, 4=agree, 5=completely agree)

The scores and colors in the heat map matrix show that the majority of the students is generally positive and particularly positive about the ease of use of the app (item 3) and about using the app frequently (item 1). However, two students felt that they had to learn a lot before they could use the app (item 10). The SUS score per student shows that all but one student perceived the usability as good (SUS score >=70). One student scored considerably lower and perceived the usability of the app as ok (see Fig. 2 SUS score by participant: P3, 50). The average SUS score is 72, which indicates that this group of students perceived the usability as good.

5.2 Pilot 2

During the pilot of the international CSCL course feedback comments by students were listed by the teachers. One of the main issues raised by the students was the installation of the app. Some of the students experienced difficulties during the installation of the app. The installable file, which was provided caused for various problems which, in some cases, were not solvable. These problems occurred when trying installation on a mobile phone as well as during installation via an emulator. This resulted in a number of students not being able to use the app in time at the beginning of the collaboration phase. Students also indicated that the installation manual was very long and, therefore, not clear. However, most students did not read that installation manual. Generally, they felt the app was fairly easy to use but they were not sure yet if the app enhanced group discussion or supported collaboration. Overall, the general feeling of the students was that the FROCOLE app was a research instrument to collect data about their performance rather than an instrument that could be helpful for regulating their group processes by means of feedback and reflection.

6 CONCLUSIONS AND FURTHER DEVELOPMENT

Even though the reflection part of the app was still under development, two pilots took place with the aim to get insight into the perceived usefulness and the usability of the FROCOLE app 1.0 in educational

settings. Pilot 1, although small, can be regarded as successful. Students used the app at two fixed moments during the course and discussed the feedback results, visualized in the radar diagram, under the supervision of a teacher during a group meeting. They indicated that using the app was easy, which is supported by the mean usability score of 72, and that it made feedback and reflection easier. They were very positive about the radar diagrams and the way these diagrams gave insight into the group versus themselves. Generally, this gave them a better idea of their functioning in the group. Suggested improvements by them were the possibility to retrieve the password when forgotten, the option to add comments to the feedback scores and an option to check previous feedback scores. Pilot 2, of which the evaluation results are not complete yet, does not seem such a success. The participating students experienced quite some difficulties installing the FROCOLE app, hardly any student read the provided installation manual because they thought it was too long and complicated and the intended purpose of the FROCOLE app was not clear to most of the students. On the positive side, they generally felt that the app was easy to use.

The results of these pilots indicate that although the experienced ease of use of the FROCOLE app was overall good, for students to also understand its usefulness and reap the benefits of the app, it is important to allocate time to explain and show the app before it will be used, as was done in pilot 1. Also, it seems that installing the app directly from the app stores is substantially less troublesome than installing it via an installable file (i.e., apk file). Thus, it may be beneficiary to have the installation of the app to take place in a plenary session so that installation issues can be discussed and solved immediately. The FROCOLE app 2.0 version will be bilingual (NL and UK) to increase the accessibility of the app via the app stores and subsequently decrease installation issues. The installation- and user manual will be converted to a “quick starter’ format. In addition to this, short video’s about installing and using the FROCOLE app are created. Another feature that will be included in the 2.0 version is a history functionality of the feedback, as was suggested by the students of pilot 1. The option to retrieve the password will not be possible to implement because of privacy issues. An account can now be created without giving any retraceable personal information and we wish to maintain this design decision. Another suggestion made by the students in pilot 1, facilitating the possibility to add comments to the feedback scores, will also not be implemented in the 2.0 version. One of the main purposes of the app (next to group functioning) is to facilitate social interaction to decrease transactional distance and feelings of loneliness. Adding a text comment option is likely to reduce the need for real-time social interaction and will thus defeat the purpose.

FROCOLE app 2.0 pilots will, besides evaluating perceived usefulness and usability, specifically focus on the ability of the app to enhance and support interaction in groups, which is the main aim of the app.

ACKNOWLEDGEMENTS

The study was part of the FROCOLE project subsidized by SURF (the Netherlands).

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