Towards a Multi-fold Assessment Approach to Enrich the Virtualization of Collaborative Learning

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Abstract

Collaborative and social learning assessment requires a broad perspective about learning and the involved processes. Assessment processes have a significant effect on CSCL because they engage learners through accountability and constructive feedback. However, in order to design a coherent and efficient assessment system for collaborative and social learning it is necessary to design an enriched learning experience that predisposes the feedback and awareness in the group. A complex set of simultaneously applied assessment approaches, each reinforcing and/or complementing the other is the main tool to enhance collaborative learning and social interaction amongst group members. In this paper, collaborative learning will be developed into a special environment: a Storyboard Learning Object. Collaborative learning using a storyboard may develop partners’ collaborative and social abilities and competences through a sequential of integrated process where the interaction moves are continuously evaluated to determine the storyboard sequence and the use of the resources. To this end, two levels of assessment are proposed: deferred and immediate. Both are combined with contextual information about the user in order to produce an efficient and personalized assessment feedback to ultimately enhance and improve the collaborative learning experience. The research reported in this paper is currently undertaken within a FP7 European project called ALICE.

1. Introduction and motivation

Assessment is a systematic process for making inferences about the learning and development of students. More specifically, assessment is a process of defining, selecting, analyzing, interpreting, and using information to increase students’ learning through motivation, engaging, awareness and real experiences [1], [2] In collaborative learning, assessment requires an even broader perspective about learning and the involved processes. It is necessary to encompass the asynchronous and synchronous interactions produced between group members as well as a formative evaluation of the group activity [3], [4], [5], [6]. These assessment methods have a significant effect on computer-supported collaborative learning (CSCL) processes because it engages learners through accountability and constructive feedback [7], [8]. From this perspective, the grounds for designing enriched collaborative learning experiences are self-regulation of formative activities, evaluation of contributions and encouraging of participation behaviour, knowledge building and performance through selected assessment feedback [6], [9].

In addition, CSCL has an important social foundation [10]. Collaborative and social assessment has the mission of detecting problems in the interaction attributes produced during the collaborative work sessions, such as content, collaboration, conversation, interpersonal interaction, and performance support. All these attributes are interesting to evaluate the group social performance [7]. Within the context of social and instructional interaction, each of these interaction attributes embeds possible strategies and tactics that can be used to facilitate instructional and social interactivity (interaction with content, collaboration, conversation, intrapersonal interaction, and performance support). Tools which fulfil these functions increase the CSCL environment's interactivity and thus the level of interaction [11]. As a result, collaborative and social aspects of CSCL are developed in a sequential process that can be evaluated step by step to give a useful feedback to partners. This assessment feedback meets the purpose of producing an enriched collaborative learning experience [8].

This paper presents an innovative assessment system for CSCL that combines interactive (i.e., deferred) and formative (i.e., immediate) evaluation through discourse activities in order to produce effective feedback that ultimately enhances learners’ engagement through participation behaviour, knowledge building and performance while improving the overall collaborative learning experience.
The research reported in this paper is currently undertaken within a FP7 European project called ALICE [12], which has the general objective of building an innovative adaptive environment for e-learning combining personalization, collaboration and simulation aspects within an affective/emotional based approach able to contribute to the overcoming of the quoted limitations of interactivity, challenging and context aware of current e-learning systems and content while enabling learners’ demand of empowerment, social identity, and authentic learning experience.

The paper is structured as follows: Section 2 presents the main concepts and system requirements. Section 3 specifies the system architecture and logics. Section 4 addresses how the system has been implemented. Finally, Section 5 concludes the paper summarizing the main ideas.

2. Main concepts and requirements

This section deals with the concepts and requirements that have to be considered when developing an innovative assessment system to support collaborative learning activities, such as, in-class discussion assignments.

The context of our work is the ALICE project [12] and specifically a new type of Collaborative Complex Learning Object called Storyboard Learning Object (SLO) embedded into a Virtualized Collaborative Sessions (VCS) system [13], [14], [15]. A VCS allows for the virtualization and registration of live collaborative sessions (i.e., SLOs), which are augmented by alternative flows, additional content, etc., during an authoring phase (subsequent to the registration phase). The VCS can be interactive and animated (by movies or comic strips) and learners can observe in the SLOs how knowledge is constructed, refined and consolidated. SLOs include also assessment, collaboration and communication features to enrich the learning experience provided by the VCS. The registered SLOs are eventually packed and stored as learning objects for further reuse so that individual learners can leverage the benefits from live sessions of collaborative learning enriched with high quotes of interaction, challenge and empowerment. Learners use the SLO to develop their collaborative abilities and competences through a sequential and the integrated process where interaction moves determinate the storyboard sequence according to assessment indicators and rules, and the use of resources are continuously evaluated. New forms of assessment are hence essential in this context in order to empower the learning experience and improve the student awareness and engagement.

The focus of our work is on the assessment procedures that are embedded in discussion activities with the aim to provide an enriched collaborative learning experience. To this end, we base these new forms of assessment on the Bloom’s taxonomy [16] of educational objectives (knowledge, comprehension, application, analysis, synthesis, and evaluation) and the effective kinds of learning such as reflective learning, experiential learning, and socio-cognitive learning.

Based on the above, two assessment models or approaches are proposed to develop the assessment component of the VCS system, namely deferred and immediate assessment:

- **Deferred assessment** is embedded into SLOs generated from the live collaboration (i.e., original collaboration) and show how the collaboration evolved from the interactive assessment perspective. Students watch the SLO generated during their collaborative work and learn by observing (i.e., social learning [10]) how the collaborative process was developed and how it was evaluated. As a result, the learner achieves a better understanding of the collaborative learning process while improving the overall social experience. For instance, by constantly showing assessment information about the live collaboration the learner can develop reflective and experiential learning skills by analysis and application [16].

- **Immediate assessment** is focused on real time collaboration, understood as interaction moves among the implicated actors and with the formative activities involved during the current collaborative learning process (students, tutors, learning materials, etc). Immediate assessment allows the actors to increase their social awareness and engagement during the collaboration and know how any cause produces evaluation effects (e.g., self-evaluation tests provide immediate feedback of the progress of the current formative activity). For instance, immediate assessment evaluates the cognitive state of the student in real time and takes the appropriate corrective action by redirecting the learners to a specific control point in the storyboard of the SLO where to reinforce socio-cognitive learning by evaluation and comprehension [16].

Both types of assessment can be combined and realized jointly, each evaluating special aspects of the learning produced by collaborative interactions. Deferred assessment can be realized in the SLO as individual or group activity and be generated in many
formats, such as storyboards, forum dialogs and collaborative material creation. On the other hand, immediate assessment evaluates the questionnaires’ questions and responses, interaction with the storyboard and time elapsed in every action or response. This information is processed and enriched with contextual information about the users’ profile and cognitive state as well as environmental data.

In immediate assessment, the data generated is to be collected and processed efficiently in real time in order to obtain reliable results. To this end, we propose the development of a set of assessment rubrics that take diagnose inputs and return a diagnosis response. The diagnose inputs are the interaction moves data and some information related with a personal user, group, a resource or the environment. It is possible to detect problems with interaction human-human, human-resource or human-environment. These responses can be processed as human feedback or as changes in the interaction response of resources and environment. Learners, on the other hand, must be able to understand and manage the feedback supplied by the assessment system in order to have an enriched learning experience and a feeling of deeply controlling their learning process.

Deferred assessment allows for understanding how the original collaborative interactions developed over time by showing a variety of elements that contribute to the understanding of the nature of the collaborative interactions, such as the learners’ passivity, proactivity, reactivity as well as the effectiveness and impact of their contributions to the overall goal of the collaborative learning activity [9]. Large amounts of information data are expected from asynchronous interaction, which includes complex issues of the collaborative work and learning process (e.g., group well-being as well as self-, peer- and group activity evaluation [13]). To this end, in the SLO every avatar is assigned to representative icons (e.g., coloured hats, medals, etc.) that show selected performance indicators of the collaboration and make the deferred social interactions easier to understand.

The assessment system must join both assessment models through a rubric module specially designed to diagnose and propose changes in the interaction behaviour in case of that the interaction produces negative effects in social empathy or the collaborative learning process. Furthermore, it should be possible to adjust the interaction behaviour in line with the resources or environment.

All the interactions with the learning environment, resources, task, and among students are essential part of the learning process, thus collecting and processing data about interaction with the aim of creating an effective assessment feedback response. The first step is to set a storyboard scenes sequence where the collaboration can be developed and the learning tasks and assessment can be performed. The storyboard information is then to be managed and enriched with author information by incorporating learning materials, resources, and evaluation mechanisms. Finally, we consider Web forums of any kind to support the virtualization process from the live collaborative learning producing the storyboard as a result [17].

Following the research methodology of the ALICE project the enriched learning experience is addressed through four main components: didactical objectives, complex learning resources, assessment activities (including feedback), and indicators for its evaluation and validation. Results from the validation and evaluation processes can again influence the first three components. Hence the development of effective learning environments is seen as a cyclic process, which is open to improvements.

The enriched learning experience is also influenced by several components like educational and psychological aspects, technical issues and existing standards and best practices, respectively. Furthermore, quality criteria have to be defined to ensure a high quality standard of all activities in this complex learning environment. Quality assurance is also relevant with respect to the indicators that measure educational efficiency and effectiveness. To create a quality framework is needed the educator experience and a planned process of validation. As scene learning process is recorded and stored in a scene repository, it is possible review and study the learning process to tune the rubric module in an easy process.

Finally, in order to ensure that the learning experience can be adapted and personalized, the model also interacts with and collects contextual information from specific data models found in most of e-learning tools [18], such as the learner model, the knowledge model, and the didactic model, respectively. In the next sections all these approaches are discussed from a computational perspective.

3. Architecture of the application

This section presents the main architectural blocks for developing the assessment system. The general architecture of the VCS system is formed by several components as depicted in Fig. 1 (also see [12] for further details). The first level in the VCS architecture is the conversion layer, which converts collaborative session data from different sources into a common specification called CS2 in a XML-based language called CSML [17] used to represent collaborative sessions passed to the VCS system in order to convert
them into SLOs (see [17] for details). The CS2toSLO component inside the VCS system (see Fig. 1), processes data in common format and creates a SLO containing information about scenes, characters, and other artifacts used during the later visualization of this learning object (see Fig. 2).

![Figure 1. VCS architecture](image)

This SLO is then stored into the SLO Repository to be available for its further reuse. SLOs are editable by the use of an editor tool (SLO Editor) which allows for changing scenes order, adding or removing content, adding special scenes, defining workflow, etc. Finally, the player tool (SLO Player) enables students and moderators to see virtualized collaborative sessions in an interactive but read-only way.

The architecture blocks described in Fig. 1 are also related with the assessment environment. The SLO player is linked to the immediate assessment interactions (see Section 2) and data collection. While the SLO scene is played, the partners produce the interaction moves to be assessed. The SLO Editor is also an essential component for assessment purposes, mainly deferred assessment (see Section 2). To this end, the original contribution and interactions are managed by a specific service of the SLO Editor which enables to categorize the original contributions according to its intentions (inform, request of information, support, etc) and start the process to turn this information into knowledge in terms of activity, passivity, impact, effectiveness and assessment) of the discussants (see Section 2 and [9]). This knowledge is embedded in the SLO dialog scene (see Fig. 2) by the Editor and presented to the SLO consumers by certain symbols on the scene characters (hats, medals, etc.) showing what character performs best and also selected indicators of the group functioning and task performance.

![Figure 2. SLO modules](image)

Furthermore, there are other SLO modules relevant to assessment in the context of the scene dialog (see Fig. 2), such as speech, character, emotional state, category, key words, special marks and eAssessment. All these modules are interaction ambits where to collect data to produce diagnosis feedback. For instance, the emotional state manages the emotional interactions among students (e.g., by smileys) and are relevant as assessment feedback in the dialog scene. Also, original contributions can be assessed using keywords to provide a meta-information for searching purposes and also summarize the contribution. Finally, the eAssessment module produces immediate assessment by incorporating evaluation tests in the dialog scenes. All these SLO modules are to be eventually managed by the SLO Editor which is in charge of providing the main assessment capabilities to the SLO.

Upper the SLO architecture lays the assessment architecture (see Fig. 3), which shows the assessment flows and processes of the VCS in the context of a generic learning activity. Both architectures are linked by the SLO scene. In the assessment architecture, the learning flow creates the SLO scene, which is the product of partners’ interaction during a learning activity (e.g., discussion) and takes place in the e-learning tool (e.g., a discussion forum such as the IWT forum [18]).
The CC-LO/SLO scene recorder module acquires all data necessary to reproduce the discussion forum interactions and saves the scene data in a repository to be used later on. The SLO scene generated is edited and can be enriched with more information. Later, in a deferred learning session the enriched scene can be used to develop an immediate assessment session.

The immediate assessment module is in charge of managing the current learning process of the student. The learners' interactions are evaluated in real time to provide effective feedback information. The rubrics, as evaluation rules, process the data inputs and create feedback outcomes.

Finally, by combining the assessment produced with information about the learners' profile, resources, materials as well as about the environment (IWT's assessment wizard module), the assessment feedback becomes more effective and personalized.

4. Implementation Issues and Prototyping

The SLO Player and SLO Editor [15] are designed as web clients applications developed with Silverlight technology and communicate to the corresponding components. These two clients can be accessed directly from the main client of the prototype, called VCS Creator, which is in charge of the SLO creation. The VCS Creator is also a Silverlight application. On the other hand, the VCS components are installed on a server and the communication between the VCS clients and the server components are implemented through web services.

The assessment module in the VCS was designed to respond to the requirements of each assessment mode (see Section 2), namely immediate and deferred.

The immediate assessment model takes as data sources the personal user and the environmental information combined with data from interaction. Interaction information can be collected from a great variety of sources, such as questionnaires (open and close test questions), storyboard’s control buttons and links to contextual information, in various formats, textual and graphical. For example, an evaluation test on a SLO scene requires some user response that leads to the next scene in the sequence. Figure 4 shows an example of immediate learning assessment where the SLO scene sequence is driven through a test. The assessment module processes the test response together with user personal information in order to decide the next scene to play.

In deferred assessment the users observe a sequence of SLO scenes with relevant information about how the collaborative learning activity was developed by showing assessment information of each scene and character as feedback indicators about performance. Figure 5 depicts an example of qualitative (I1) and quantitative (I2) indicators about the user contributions and how they are modified in the course of the sequence of the scenes. The deferred assessment module creates also global feedback indicators about the whole storyboard, which can be parametrized on specific dimensions of the collaborative learning process, such as the reactive behavior and effectiveness of the group as well as quality. Eventually, an evaluation mark of each character in the storyboard is provided for each dimension of the discussion.
5. Conclusions and Ongoing Work

Assessment is an essential part in virtualized CSCL as it provides the required feedback to engage learners in the collaborative learning process. It is even more important in virtualized collaborative environments because of the lack of real interactivity and the feeling of social isolation of the learners. These problems can be minimized considering both current interactions with the virtualized collaboration (immediate assessment) and past interactions with the live collaboration (deferred assessment). Interactions and user information on profile and cognitive state are combined to provide effective feedback assessment.

Extensions of the architecture presented are considered to make it possible to play recorded sessions and compare it with a social pattern scene with the purpose to promote the acquisition of social skills necessary to develop the collaborative virtual activities optimally.

Ongoing work is centered in the implementation stage of the assessment component and the integration in the VCS. Next, we plan to experiment with this component in a real context of e-learning as part of the evaluation activities of the ALICE project.

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6. REFERENCES


