Teaching Creativity Skills Using Process-based Creativity Theories within a Social Network

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Abstract - This paper describes the design of a system that has been developed to improve the creativity skills and knowledge of tertiary-level students. The system was built using an open source social network engine as its core. This engine was then integrated with process-based creativity theories which is used to guide students to hone their creativity skills while completing assignments for a particular course. This paper outlines the architecture of the system and how it was evaluated. It also gives a brief scenario of the use of the system. The system provides an effective tool for teaching and supporting creativity in tertiary students without adding additional components to current course curricula.

Keywords: Creativity, Social Network, Process-based Creativity Theory, Creativity Assessment, Creativity Support Tool (CST).

1 Introduction

Governments and leaders around the world are placing emphasis on creativity in education. Our research focuses on a system for teaching creativity skills at the tertiary level. The system is meant to be used by students while they are completing assignments for particular courses. In using the system, students are guided through a particular process-based creative pedagogy, consisting of activities and tools, to create a solution for their assignment or project. The objective is that through interaction with the pedagogy, activities and tools, students will gain constructive, practical experience in creative thinking and in producing creative work.

The paper is organized into several sections. The next section gives an overview of the background literature on creativity and the elements of creativity on which the system is based. Following this, the design and architecture of the system are described. Two types of evaluations follow; the first explains how the creativity of students is assessed in the system, and the second describes the students’ evaluation of the system after usage. Next, a discussion of the usage of the system is given. Finally, the paper ends with the conclusion and contributions.

2 Background

The main components of the system include Creativity Pedagogies, Creativity Support Tools (CSTs), Creativity Assessment and the social network at its core. Creativity Pedagogies that are grounded in education literature are integrated into the software as pedagogical guidelines to students. These theories are used to guide the students through various processes which aim to develop the students’ creativity skills, whilst they are completing a task. Various software tools called CSTs have been designed, developed and integrated into the software, which support the students in exploration and development of creativity skills. Students are required to use the software to undertake course assignments; hence, the social network is automatically populated and immediately usable. When students use the software, data are recorded that represent their digital creative processes. The output of the process is also saved as an artefact or as a creative product. Thus, Creativity Assessment is performed by the instructor on the students’ creative processes and products.

Research has shown that creativity can be improved in anyone given the right combination of components [1]. The components of creativity can be described in terms of Runco’s [2] 4P’s. These are Process – the mental mechanisms used in creative thinking, Product – the thing judged to be creative, Person – the personality traits indicative of creative potential, and Place – environments in which creativity is expected to flourish. In our system, we focus on the Process, which involves the use of several creativity pedagogies, and Place, which is the environment our system provides, as well as the CSTs developed.

<table>
<thead>
<tr>
<th>Tool</th>
<th>Example Usage</th>
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<tbody>
<tr>
<td>Collaborative Input tool</td>
<td>Provides specific questions that students must answer, such as, “List the strengths of your current solution”.</td>
</tr>
<tr>
<td>Choice tool</td>
<td>Provides students with a context-sensitive listing of their ideas or alternative solutions and gives a visual interface for comparing and choosing among the alternatives.</td>
</tr>
<tr>
<td>Round Robin</td>
<td>Used to poll students for an opinion.</td>
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Table 1. CSTs and Examples of Their Use

Table 1 shows several CSTs which we have built that support specific activities within the process-based creativity pedagogies. CSTs support creativity through specific requirements and principles. For example, the literature says
that CSTs should facilitate sharing and play amongst participants, thus our tools support collaboration and prompt in various ways to ‘play’ or ‘explore’ ideas. Another design requirement of CSTs is the design must consider the effects of repurposing and augmentation of the system’s tools by the users, thus, the actual creative process can be modified by the student by adding activities and external tools. Another requirement states that CSTs should provide high socio-emotional content since this is critical in forming relationships and building the trust that is required for successful, collaborative work [3]; from this requirement, we embed a social network at the core of the system. Additional principles for CSTs include support for exploratory search which is related to the concept of play and flow, collaboration support which is also related to play, and rich history keeping which is provided via persistence of data in a database [4]. Also, the design principle of ‘low thresholds, high ceilings and wide walls’ [4], or a system that is accessible and flexible to the user, is provided via the familiarity and flexibility of the core social network. Finally, another principle is the active engagement of the individual [4], which is accomplished through tools in the prescribed activities in the creative pedagogy. Furthermore, the system can be viewed as a CST.

The research community recognizes that there are different levels of creativity — Mini-C, Little-C, Pro-C and Big-C — that is, personal, classroom, professional and genius levels of creativity. Our system focuses on the Little-C and Mini-C levels of Creativity, which relate to students solving everyday problems and being able to adapt and provide novel and relevant solutions and ideas. There is also emphasis on supporting social creativity [5], that is, collaborative task completion in a collaborative environment; however, individual creativity is also supported as it is a key part of social creativity.

Fig. 1. Architecture Diagram

3 Design

3.1 Features and Functionality

To improve creativity skills in students the system provides a computational approach towards integrating creativity theories using a social network for collaborative task completion. The main features of the social network being used are profile creation, activity stream (similar to Facebook’s wall), messaging, blogs, bookmarks, pages, file storage and group creation. These features are important for support in building trust, providing essential communication tools and providing basic file sharing and group creation functionality.

This research integrates several process-based theories into the social network including Resnick’s Spiral, Wallas’ Stage theory/Mihaly Csikszentmihalyi’s 5 steps [6], Roger von Oech’s Creativity Strategies and De Bono’s Thinking Steps. These theories are incorporated into the social network via a sequence of activities which the students collaboratively undertake. For each assignment given, a specific creative process pedagogy is chosen by the instructor. Each process theory has several stages and there are activities that can be completed for each stage. These activities are flexible in that they can be repeated by the student groups, they include many alternative activities and they do not have to be followed in order. The overall idea is to guide the groups without constraining their own intuitive creativity processes.

There are specific tools for each activity within each creative pedagogy. These tools assist the students in carrying out the various activities. For this research, the software supports the students up to the final stage of a creative process, but does not include the final stage in which the product is created, unless the product is a written assignment. Future plugins can be developed to provide, for instance, collaborative code environments for Computer Science students or virtual labs for Chemistry students. However, students can leave the system and return as they create their solution iteratively, with the system guiding them through each
The system is intended to support the essential brainstorming, design, iterative, and collaborative parts of the creative process.

### 3.2 System Architecture

As shown in Figure 1, the system is designed for primarily two users, the instructor and the student. The instructor interacts with the system via an interface for setting assignments which allows him/her to select the appropriate creative pedagogy for the assignment, that is, the Creative Pedagogy Engine. The students interact with an interface, that is, the Creative Pedagogy Player, in which they form groups and the groups are given an instantiated Creative Pedagogy (CP), which contains stages, activities and tools with instructions to follow. If a student must work individually, he/she would still form a ‘group’ of 1.

The social network platform is the core of the system and an open source platform called ELGG was used. Integrated into this platform is a Creative Pedagogy Engine and a Creative Pedagogy Player; both interact to produce an instantiated CP for groups to use. This CP uses a module containing CSTs that provide various support features to student’s groups. As the groups work through the CP, all their actions are recorded and form their creative digital process. This digital process is recorded per student, and thus provides an individual representation of the student’s individual creative process. Additionally, the group submits a solution, which is the creative product at the end of the process.

The instructor then interacts with the assessment module and selects the assessment technique for grading the student’s creative process and the group’s creative product. The sum of the individual grade for the creative process and the group’s grade for the creative product is assigned to each student and represents their creative assessment.

### 4 Student Assessment

Creative Processes are measured in the literature using interviews, study of working habits, anecdotal reports, autobiographical statements, and other methods. However, these assessments are all related to big-C creativity and were done in hindsight of the validated creative output. As specified in [7] the Creative Solution Diagnosis Scale (CSDS) was used to assess the creative Product or output produced by the group, and the Consensual Assessment Technique (CAT) to assess the creative Process of producing that product/output.

The CSDS provides 24 criteria that measure the creative characteristics of a creative product. The instructor of the course chooses from the set of criteria for assessment of the creative product at the time the assignment is set, thus students can be informed of these criteria beforehand. Qualitative analysis of creative processes are done on the data that the system stores on student’s groups’ activities and CST usage. Additionally, questionnaires are completed by students to self-assess their knowledge of creativity and creativity techniques prior to and after using the system. Peer-assessment is also part of some of the creative pedagogies in the stages and activities where groups share their solution and both receive and provide constructive feedback on the shared solutions. This feedback forms part of the creative process of the student.

### 5 System Evaluation

Two experiments were successfully run using the system. A short course on Scratch programming [8] was taught over a period of 6 weeks, 6 hours each week. Participants comprised of undergraduate students who had no previous knowledge of programming. At the end of 3 weeks, students were given a project for which they formed groups of 3. Students had to design their own project ideas and had them vetted by the instructor. Groups used the system to guide them in idea definition, design, and development. The system was used iteratively along with the Scratch software to produce Scratch games, which were the output of the projects. At the end of both experiments the instructor graded the creative process stored by the system per student and the creative output, that is, the completed project per group. In the first experiment, there were 24 students and 9 groups. In the second, there were 44 students and 17 groups.

Evaluation of the software as a CST along the guidelines of the requirements of CSTs was undertaken via student questionnaires. Students had to assess the system based on the Creativity Support Index [3] which is a metric of the system’s effectiveness in supporting the student personally in being creative. The results of the pre- and post- questionnaires show that the majority of students evaluated the system as effectively supporting them in their personal creative processes.

Furthermore, the system ran correctly in terms of formation of groups, individual support for creative pedagogical guidance, support for individuals and groups via CSTs and support of the social network. All data was correctly collected, and the instructor was supported effectively via the assessment module.

### 6 Discussion

A sample scenario is discussed in this section. Given a course in which students complete a 3-credit project in groups with periodic meetings with an instructor, the system can be used to teach and support the students’ creativity and knowledge of creativity. If the instructor chose a creative pedagogy, which is based on De Bono’s Thinking Technique, there would be 5 stages, each containing activities and CSTs. The students would begin at the first stage, which guides them through discussion on the purpose, goals, and criteria for their project. In completing this stage, the students are required to use the Collaborative Input Tool and the pages feature of the social network, while following the guided instructions.

In the second stage, students are prompted to gather data using the Collaborative Input tool and several communication features of the social network, including its feature to store
and share files and bookmarks. In the third stage, students choose among several activities for idea generation. At first, the goal of idea generation would be to choose an appropriate project, based on the understanding of the previous two stages. In subsequent iterations of (or jumps to) the 5 stages, the objective of idea generation would be to brainstorm solution ideas for the project.

Next the students use several CSTs, such as Choice, to guide them through careful development of their various solution ideas and finally, to choose one for development. The final stage provides several motivational activities and guidelines for the actual creation of the solution, for which students may leave the system environment. Students are allowed to move freely through the stages, activities and tools. They are also allowed to create a new activity and include an online or offline tool that may not be provided by the system and is a part of the students’ creative process. All usage and movement through the guided pedagogy are stored automatically by the system and constitutes a student’s digital creative process.

This is one example of a creative pedagogy and its functionality as available to the student. At the end of the project, the instructor can view both the process and product of the students and use the creativity assessment module to assign creativity grades.

7 Conclusion

The computational representation of process-based creativity theories, the tools developed for each creativity theory and the assessment tools developed for assessing creative product and process are the major contributions of this research. Additionally, the design principles of the software, the implementation of CST requirements and the actual CST software provide value to the research community. It is expected that the system developed will improve creativity knowledge and skills in tertiary-level students and can be extended as an effective training and educational tool for improving creativity in students.

8 References


