Music Learning with Massive Open Online Courses (MOOCs) L. Steels (Ed.) © 2015 The authors and IOS Press. This article is published online with Open Access by IOS Press and distributed under the terms of the Creative Commons Attribution License. doi:10.3233/978-1-61499-593-7-145

# Chapter 10. Collaborative Peer Assessment using PeerLearn

Ismel Brito <sup>a</sup> Patricia Gutierrez <sup>a</sup> Katina Hazelden <sup>a</sup> Dave de Jonge <sup>a</sup> Lisette Lemus <sup>a</sup> Nardine Osman <sup>a</sup> Bruno Rosell <sup>a</sup> Carles Sierra <sup>a</sup> and Carme Roig <sup>b</sup>

> <sup>a</sup>IIIA-CSIC, Bellaterra, Catalonia, Spain <sup>b</sup>IES Torras i Bages, L'Hospitalet, Catalonia, Spain

AbstractIn this chapter we introduce the PeerLearn methodology and its associated tools. We base the design of pedagogical workflows for students on the definition of rubrics (using PeerAssess) as the starting element that drives the creation of lesson plans (using LessonEditor). These plans run over our web platform (Peer-Flow). Students can evaluate one another following given rubrics and teachers can accept (or not) marks produced by a collaborative assessment tool (COMAS). Experimental results show that PeerLearn provide students with a highly satisfying new pedagogical experience and increased learning outcomes.

## 1. Introduction

There are a number of available tools that support teachers in the management of lesson plans on the web. However, none of them is task-centered and support any form of lesson plan's 'execution' over the web. PlanBoard<sup>1</sup> and PlanbookEdu<sup>2</sup> deal with issues such as lesson planning, standards setting, assessment management, etc. that help teachers in their scheduling and management of resources. CorePlanner<sup>3</sup> on top of that allows teachers to set the objectives of classes following national standards like the Core Standards.<sup>4</sup> There is a large number of repositories of lesson plans that can be consulted freely.

All mentioned tools understand a lesson plan as a document that can be shared among teachers. They do not provide any IT environment where these lesson plans become 'executable'. Against this background, our goal in this paper is to introduce Peer-Learn, a set of tools for the design and, most importantly, the *execution* of lesson plans.

Thus, In this paper we propose a methodology and associated tools suite that covers the educational process that goes from the preparation of evaluation rubrics to the actual assessment of students (see Figure 1).

The methodology consists of the following steps:

• **Define a rubric.** In modern pedagogy [9] the definition of a rubric is the first step in the preparation of teaching materials. How students will be evaluated has to

<sup>&</sup>lt;sup>1</sup>https://www.planboardapp.com/

<sup>&</sup>lt;sup>2</sup>http://planbookedu.com/

<sup>&</sup>lt;sup>3</sup>http://coreplanner.com/

<sup>&</sup>lt;sup>4</sup>http://www.corestandards.org/



Figure 1. Methodology and PeerLearn tools for lesson plan management.

drive the relevance of the learning materials and activities to be defined by teachers. The tool PeerAssess, explained in detail in Section 2.6, helps pedagogues in the management of a database of rubric criteria. Pedagogues, or teachers, may create new evaluation criteria, adapt generic criteria or group criteria as a rubric.

- **Define a lesson plan**. In order to achieve the pedagogical objectives associated with a rubric teachers must lay down a sequence, or flow, of activities. These activities can be individual or in groups. The performance of an activity may need the consumption of digital resources, e.g. files containing explanations, exercises, etc., and may require that students produce outcomes like presentations, audio or video recordings or documents. We have developed a tool called FlowEditor that allows for the definition of sophisticated lesson plans. The tool is explained in detail in Section 3.3.
- Do the lesson. Once a lesson plan is defined, students have to follow the activities of the lesson plan in order to achieve the desired competencies and produce the outcomes that would allow for their evaluation. The tool PeerFlow allows for the assignment of lesson plans to groups of students, imposes restrictions on the activity flow of students so that they perform them in the right order, grants access to the digital resources established in the lesson, and keeps a database of the files produced by the students. PeerFlow facilitates the structured interactions that the lesson plan includes, like group communication, teacher check points, and so on. The tool is explained in detail in Section 4.5.
- Assess students. Finally, we have developed an assessment tool called COMAS that allows the mutual assessment of students and uses a measure of the teacher's trust on the evaluation skills of students to assign marks to students according to the rubric, minimising the number of assessments that teachers have to make. This is specially relevant when the number of students is very large as in the recent MOOCs movement. Section 5.3 provides the details of this tool.

## 2. PeerAssess

In this Section we describe the tool PeerAssess. PeeAssess is an online database platform that helps teachers in the management of groups, lesson plans and evaluation criteria

(rubrics), and makes defining subsequent lesson plans easy. In the following we enumerate the functionalities embedded in PeerAssess and provide examples of the pedagogical materials that can be managed through this platform.

## 2.1. Log in

Teachers log in to PeerAssess through the Welcome page (Figure 2). Once logged in, they have access to their personalized information and can manage their groups, their lesson plans and assessment materials (rubrics).

## 2.2. Manage Groups

As teachers can teach in one or more groups, Group management (add, edit, remove, list groups) can be performed choosing the "Groups" menu option (Figure 3).

## 2.3. Manage Evaluation Criteria

Formative assessment plays a very important role during the learning process and students should be frequently assessed. Assessment is usually performed upon different skills based on different assessment criteria. For instance, in an English course, oral skills may be evaluated considering one or more of the following criteria: fluency, pronunciation, clarity, speed, etc. The definition of the assessment criteria is important because it provides a clear view of the desired outcome and of how an assignment will be graded (something which the student often considers to be subjective). The setting of clear assessment criteria simplifies the marking process and helps ensure that marking is a thoughtful exercise mapped to specific desired learning outcomes. In addition, the definition of the assessment criteria plays an important role in the preparation of the learning materials and activities that will be used in the lessons.

In PeerAssess teachers are able to create personalized assessment criteria that may be later on used in different assignments. Assessment criteria consist of a name and a

## Peer Assessments

A platform for online learning support

Username	teacher
Password	
	Login
	Username Password

Home	<b>me Groups</b> Tasks Assignments		Assignments	Model Criteria Printable Evalu		ion Form
Group	)S					
Group N	lame					
3r D				Edit		Delete
2n C				Edit		Delete
2n B				Edit		Delete
Add Grou	n					

#### Figure 3. Group Management

Home d	Groups	Tasks	Assignments	Model Criteria	Printable Evaluation Form		Log ou
Model C	Criteria						
Criteria Nar	me	Des	cription				
Fluecy in Or Presentatior	ral n	1-S 2-S 3-S 4-S	peaking with man peaking too slowh peaking generally epeaking fluently	y pauses y at normal speed		Edit	Delete
Pronunciatic Presentatior	on in Oral n	1- \$ 2- \$ 3- \$ 4- \$	Speaking words in Speaking with inco Speaking with seve Speaking with inco	comprehensibly prect pronnunciatic eral incorrect pronr prect pronnunciatic	ວກ but still understandable າunciation າກ	Edit	Delete
Accuracy in Presentatior	Oral n	1-T 2-T 3- T 4- T	he serious errors he errors present 'he speech is still 'he errors present	presented in speed ed in speech would understood althoug t in speech are so r	ch makes the message difficult to understand d frequently create confusion gh it consists of many errors minor that the message would be easily comprehended	Edit	Delete

Figure 4. Evaluation Criteria Management

graded description that specifies the requirements to be met by students' performance, from completely met to "not satisfactorily met" (usually 4 descriptors, see examples in Figure 4). Teachers can manage the evaluation criteria (add, edit, remove, list) choosing the "Model Criteria" option from the menu.

## 2.4. Manage Tasks

Teachers are able to create different lesson plans. Lesson plans consist of a number of tasks conducent to a learning outcome. A lesson is defined by its name and a description of the outcomes that students will have to deliver (see examples in Figure 5). Teachers can manage their lessons (add, edit, remove, list tasks) choosing the "Tasks" menu option.

## 2.5. Manage Assignments

Once the teacher has decided the final outcome, the assessment criteria and the different tasks — that is, once the teacher has a lesson plan — specific lesson plans can be cus-

Home o	Groups <b>Tasks</b> Ass							
Tasks								
Task Name	Description							
Composition	omposition							
WH-words song	Upload a video with a song onto our Edmodo page. This song must have at least 3 wh-words, and it must show its lyrics. Then write 3 wh-words that appear in the song in Edmodo. Last date to upload: 26/10/14							
Scary Prepositions	Students have to prepare a Prezy with 5 slidesthat include: 5 Halloween pictures 5 sentences about the pictures that include 5 different prepositions s The prezi must have at least 2 special effects: -animation -rotation any other effect will add marks up. students have to upload their prezi onto Edmodo.							
My ideal Home U2	dy ideal       Write a composition about your ideal home following the instructions from pag 25.         forme U2       You have to design a prezi showing your ten New Year's resolutions. Some of them must be very original. Each resolution is in the future tense.         esolutions       Each resolution has a picture showing your resolutions. There must be some animations.							
New Year's resolutions								

Add Task

Figure 5. Task Management

tomized for different groups. An assignment is defined by a name, a submission date, an outcome (which describes the activity), the group that will be assigned to, and a set of assessment criteria (a rubric) that measures the student's performance. The set of assessment criteria defines a *rubric*. Rubrics are of great importance to ensure the consistency of assessments along different dates of marking and among different markers. Rubrics guide students in the understanding of the assignment, making explicit what is required, what qualities and skills are looked for, the weight of these skills in the marking process and the essential elements that shouldn't be missed.

Teachers can manage their assignments (add, edit, remove, list) choosing the "Assignments" menu option. To make the rubric creation more user friendly and avoid the need to repeat the same evaluation criteria from one assignment to the next, we provide the functionality of selecting an already created evaluation criteria (see functionality **Manage Evaluation Criteria**) and loading the stored information from that criteria into the form. Teachers can then add the selected criteria directly into the rubric, or modify it and add it into the rubric. In Figure 6 an example of assignment creation and criteria selection for the rubric using a pre-defined evaluation criteria is shown.

#### 2.6. Print or Download Evaluation Form

Once an assignment has been defined, teachers can generate an evaluation form for its assessment choosing the "Printable Evaluation Form" menu option (Figure 7) and filling the group and assignment filters. The way in which assignments will be delivered during the course and the way in which evaluations will be conducted (in-person or online assignments, group submissions or individual, peer-to-peer or teacher evaluations, etc) will depend on the lesson plan designed by the teacher. In any case, this tool helps the tutor providing an evaluation template for assignments, whether in a printable format, using the "Show Evaluation Form" option, or for online evaluations, using the "Download rubric to xml" option. In the latter case, the xml file generated will be used in the Peerflow tool (see next Sections) when defining the rubric in the lesson plan.

	New Years resolutions
Submission Date	20/03/2015
Min Marking Value	1
Max Marking Value	
Group	
Task	
Add Evaluation	Criteria
Row Criteria Name	Description
Criteria Name	2-Speaking too slowly     3-Speaking generally at normal speed     4-Sepeaking fluently     Use this model     Filed     Filed
Criteria Description	Clarity in Oral Presentation Performance in Oral Presentation
Criteria Description (use \n for return)	Clarity in Order Presentation Performance in Order Presentation Procus and Coherence in Written Composition Organization in Written Composition Development of Meas in Written Composition Voice in Written Composition Focus Maduresa (composition) 2n ES Grammar (composition) 2n ES Grammar (composition) 2n ES Precisió Quantitat - Prezi
Criteria Description (use \n for return) Delete Criteria Row	Clarify in Order Resentation Performance in Oral Presentation Performance in Oral Presentation Organization I Written Composition Organization I Written Composition Conventions in Written Composition Conventions in Written Composition Focus Maduresa (composition) 2n ESO Temportzació (composition) RESO Temportzació (composition) Precisió Ouantifat Quantifat - Prezi Temportzació - Prezi Temportzació - Prezi

#### Assignments

Assignment Name	Submission Date	Min Marking Value	Max Marking Value	Group	Task			
composition Unit 1	0014-10-25	1	4	2n B	Composition	Details	Edit	Delete
composition unit 1	2014-10-20	1	4	2n C	Composition	Details	Edit	Delete
Wh-words song	2014-10-26	1	4	2n B	WH-words song	Details	Edit	Delete
Wh-words song	2014-10-26	1	4	2n C	WH-words song	Details	Edit	Delete
Scary Prezi	2014-11-07	1	4	2n C	Scary Prepositions	Details	Edit	Delete
Scary Prezy	2014-11-06	1	4	2n B	Scary Prepositions	Details	Edit	Delete
My ideal House	2014-11-24	1	4	2n B	My ideal Home U2	Details	Edit	Delete
New Year's resolutions	2015-01-30	1	4	2n C	New Year's resolutions	Details	Edit	Delete
New Year's resolutions	2015-01-30	1	4	2n B	New Year's resolutions	Details	Edit	Delete

Add Assignment

#### (b) List Assignments

#### Figure 6. Assignment Management

Home Groups Tas	ks Assignments Model Criteria Printable Evaluation Form	Log out								
Evaluation Form										
Select a Group Select an Assignment	2n B     •       New Year's resolutions     •       Show Evaluation Form     Download Rubric to XML									
Your name: Student being evaluated:										
Criteria Name	Description	Assessment								
Originalitat	<ol> <li>4- Totes les New Year's resolutions són molt originals.</li> <li>3- Gairebé totes les New Year's resolutions són molt originals.</li> <li>2- Poques de les New Year's resolutions són molt originals.</li> <li>1- Cap de les New Year's resolutions sés molt originals.</li> </ol>									
Quantity: prezi	Hi ha entre 9 i 10 diapositives, a totes les diapositives hi ha una New Yea's resolution i una imatge.     Hi ha entre 8 i 6 diapositives, a galrebé totes les diapositives hi ha una New Yea's resolution i una imatge.     Hi ha entre 5 i 3 diapositives, a galrebé totes les diapositives hi ha una New Yea's resolution i una imatge.     Hi ha entre 5 d'apositives, a galrebé totes les diapositives hi ha una New Yea's resolution i una imatge.									
Grammar	<ul> <li>4- Totes les frases utilitzen bé el future tense.</li> <li>3- Força frases utilitzen bé el future tense.</li> <li>2- Poques de les frases utilitzen bé el future tense.</li> <li>1- En cap de les frases s'utilitza bé el future tense.</li> </ul>									

Figure 7. Evaluation Form

#### 3. Lesson Plan Editor

This section is intended to give assistance to people creating workflows using the webbased PeerFlow Editor. We envision a workflow in PeerFlow as a recipe with six key ingredients: activities, roles, resources, applications, timeouts and files. Broadly speaking, we define a workflow as an ordered set of activities that should be carried out by its participants, playing a certain role. Resources, applications, timeouts, and files allow us to further enrich the definition of the actions that participants can perform within activities. In a user-friendly manner, the editor enables people to drag-and-drop and link different graphical elements to create workflows.

In the following subsections we introduce the six key elements aforementioned through an example. Furthermore, we provide guidance for the design of a workflow using the PeerFlow Editor. We use the example of a class room environment where a teacher and a number of students engage in a set of educational activities to clarify the concepts. Finally, we introduce the New Year's resolution workflow, which have been designed and tested in the PeerFlow platform.

Throughout this section we will refer to the person designing a workflow as 'the workflow designer' or simply 'the designer'.

#### 3.1. Ingredients of a PeerFlow Workflow

A workflow is an interaction model that determines the way its participants perform a set of activities in a predefined order. Designing a workflow can be a very challenging task without the appropriate supporting tools. Obviously, a workflow designer would be frustrated if a supporting tool requires him or her to know many technical details. This is in fact the main issue we face in the context of the PRAISE project, where we want music teachers with average computer skills to be able to design lesson plans. The PeerFlow Editor helps people to create workflows in an easy-to-use and user-friendly environment.

Evaluation		Assessment	Role Properties	[X]
Teacher Student		Teacher	<ul> <li>Name</li> <li>Teacher</li> <li>Termination Power</li> <li>Minimum</li> <li>Maximum</li> <li>Maximum</li> </ul>	

Figure 8. Evaluation and Assessment Activities

In the following subsections we introduce and provide examples of the six basic elements of PeerFlow workflows: activities, roles, resources, applications, timeouts and files. We also provide an example of the use of group activities. A group activity is an activity in which the participants are split into groups of a desired size.

## 3.1.1. Activities and Roles

One of the central concepts in PeerFlow is the concept of a *role*. Every participant in a workflow is required to adopt one of the roles that have been defined by the designer of the workflow. The role of a participant determines what he or she is allowed to do. Two obvious examples of roles in a teaching environment would be the roles 'teacher' and 'student'.

Another central concept in PeerFlow is the concept of an *activity*. A workflow is in fact a sequence of activities, and each activity defines what actions can be performed by the participants involved in it and what resources are available to them.

For instance, let us consider a simple class room scenario. For this example we can create a workflow with two activities, named Evaluation and Assessment. In the former activity the teacher assigns students an assignment and each student returns his or her answers to the assignment. In the latter activity the teacher assesses each student's assignment. Both activities involve the teacher as well as the students, so we need to specify for both activities that the teacher as well as the students can enter. Figure 8 displays the aforementioned activities and the data the designer needs to fill in for each role in the activity. Besides the role name, the designer should define whether this role is permitted to terminate the activity and the minimum and maximum number of participants that can adopt this role.

## 3.1.2. Resources, Applications and Timeouts

Activities may also include resources, applications and a timeout. A *resource* is a document that participants in the workflow may consult within the activity. In the example above, the designer could decide to give the students access to an online dictionary during the Assessment activity. This can be achieved by adding a resource to the Evaluation activity that links that dictionary. As can be seen in Figure 9, each included resource is determined by a name, a description and an the Internet address where the resource is located.



Figure 9. Adding a dictionary as resource to the Evaluation activity.

To improve the attractiveness and readability of workflows, the editor permits the designer to choose among 5 different icons to represent the type of resource: book, video, image, audio and document. Changing the icon does not change the functionality of the resource. However, choosing the appropriate icon helps the designer to see what kind of resource it represents. By default, each new resource added to a workflow is represented by the book icon, which can then be changed as desired.

An *application* in PeerFlow is an external service running online that, when consulted, allows users to perform specific tasks. One can see an application as an online software tool that provides extra functionality that is not part of the PeerFlow framework. Unlike resources, which are passive objects, the participants may need to interact with an application in the activity according to some protocol defined by the application itself. In the music learning domain (and hence in the context of the PRAISE project) the use of applications is of paramount importance. For instance, there are software tools for automatically assessing the performance of musical recordings. It is here where the use of applications is vital to connect external tools with the workflows defined in PeerFlow. In this way, the workflow designer enriches its workflows by means of applications, which provide extra functionalities to workflows. In the example considered, one can imagine an application that supports teachers in automatically assessing students' exams. For the sake of simplification, however, we decided not to include any application in this example. We will return to applications when we introduce the new year resolution example in subsection 3.3.

Before continuing, let us review the approach we proposed in the example above. We mentioned the need of having two activities: Evaluation and Assessment. The Evaluation activity covers two main actions: the teacher handing out the assignment to the students and the students returning their finished assignments. As is common in teaching, the teacher may want his students to have a deadline for returning the assignment. In order to address this challenge and give clarity to our example we now propose to split the first activity into two new ones: Assignment and Examination. A *timeout*, one of the other ingredients of the PeerFlow recipe, is what we need to face the teacher's new requirement. We have redrawn the activities of our example in Figure 10. Notice that the



Figure 10. Adding a timeout to the Examination activity.

workflow designer should define a timeout as the number of days, hours and minutes the activity lasts. In this case, we state the students have 2 hours to submit the assignment.

#### 3.1.3. File sharing

A *file* is a concept similar to a resource. Just like a resource, it represents an online document that is available to the participants. The difference however is that a resource is an immutable document, while a file can be created or adapted at runtime by the participants. There are two kinds of files: intra-files and inter-files. An intra-file is generated and consulted by users inside a single activity, while inter-files can be shared across multiple activities. Each inter-file must be linked to two roles belonging to two different activities. Those links are established by arrows in the editor. In Figure 11, we show how two inter-files can be used to define the process of a teacher handing out an exam to its students, followed by the students handing their answers back in to the teacher. The arrow from the teacher to the exam file indicates that the teacher must upload this file in the Assignment activity. The arrow from the exam file to the students, on the other hand, indicates that the students in the Examination activity can download the exam file. Once the students finish their exams, they should be able to send back their answers to the teacher. In order to make this possible we have added an arrow from the students to the answers file.

It might seem that our workflow is complete, but if we go back to the definition of the workflow we gave in the first paragraph of this section, we should note that something is lacking. We have not yet defined the order in which the activities take place. Of course, in this example the order of the activities could be inferred from the directions of the arrows between the inter-files and the roles. However, not every workflow may contain inter-files. For this reason we also need to explicitly indicate how the users can move from activity to activity.



Figure 11. Adding Exam and Answers as files that are exchanged between teacher and students.

The order between activities can be established by drawing arrows between roles in different activities. In this way, the designer can determine the order in which the users of a specific role can enter the different activities. In Figure 12 we have added such arrows to our example. The new workflow indicates that the process starts in the Assignment activity in which only a teacher is involved. Once this activity is finished, the teacher is then permitted to move to the Examination activity and eventually to the Assessment activity. The students on the other hand, start in the Examination activity and when they have finished their exams, they can move to the Assessment activity.

## 3.1.4. Group activities

Another common requirement in teaching environments is to split the class into smaller groups of students and have the students working together, as a group, on a certain assignment. In Figure 13 we have changed the previous example to set the Examination activity as a group activity where the 'groups' are of size 1. After all, taking an exam is indeed an individual activity.

## 3.2. The PeerFlow Editor

In this section we introduce the PeerFlow Editor, as illustrated by Figure 14. The editor window is split into five working areas: the menu bar, the toolbars that appear at the top and left side of the window, the main screen or edition area, and the properties panel. The menu bar contains a set of actions for creating, saving, importing and publishing workflows into the PeerFlow site, whereas the toolbar at the top of the main screen includes the shortcuts to some of the actions appearing in the menu bar, as highlighted by Figure 15. Of special interest is the fourth shortcut in this toolbar that allows users to draw arrows among the basic elements. We will discuss workflow arrows below.



Figure 12. Setting the order in which the participants playing a certain role may enter the activities.



Figure 13. Changing Examination as an activity in which each student takes the exam alone.

The six necessary elements for creating a workflow are shown in the left-side toolbar of 14, and highlighted by Figure 16. Those are: activities, roles, resources, applications, files and timeouts. The main screen (14) is the area where the designer can drop the elements and link them to each other in order to create a workflow. The panel on the right (14) shows the properties of the currently selected element.



Figure 14. A screenshot of the simplified institution specification editor.



Figure 15. Toolbar that appears at the top of the main screen



Figure 16. Basic elements involved in the design of a workflow: activities, roles, resources, applications, files and timeouts

An activity can be created by dragging and dropping an icon representing an activity (first icon, from left to right, in Figure 16) from the toolbar to the central screen. In the same manner the designer can create group activities by dropping the group activity icon into the edition area (second icon, from left to right, in Figure 16). As mentioned in the previous sections, each role, application, resource or timeout in a workflow must be part of an activity or a group activity. Each of these elements can be added to an already existent activity by dragging and dropping the corresponding icon inside the activity or group activity. The icons that correspond to a role, an application, a resource and a timeout are the third, fourth, fifth and seventh icon in Figure 16, respectively.

The sixth icon shown in Figure 16 represents a file. A file can either be part of an activity (intra-files) or of the workflow (inter-files). Like the rest of elements before mentioned, the user can drop files into the main screen area, either inside or outside any of the already existing activities.

Activity order and roles in file sharing Arrows play an important roles in PeerFlow because they define the relationships between the basic elements of a workflow. The



Figure 17. Glue points as guidance for drawing arrows between basic elements.

designer draws arrows between the roles in different activities to determine how the users playing those roles can move from one activity to another. Those movements determine the order in which activities are performed by each role. In a similar fashion, the designer needs to draw arrows between inter-files and the roles that produce or consume them. The PeerFlow Editor provides useful tips on how to draw arrows. The icon for connecting basic elements is the fourth icon in the toolbar that appears at the top of the main screen, which is highlighted in red in Figure 15. When the user clicks on this icon, each linkable element shows five yellow glue points, as illustrated in Figure 17.

All the designer then needs to do is to draw an arrow between glue points of the desired elements. In order to provide more expressiveness to workflows, the PeerFlow editor lets designers add labels to arrows. The designer can also modify default texts of labels by changing the label text input that is shown in the property panel when the arrow is selected. The editor establishes the default text of each label in line with the elements the arrow links and its direction. For instance, the label of an incoming arrow to an interfile contains the text 'generate', which means that the role on the tail side of that arrow is in charge of generating the file.

#### 3.3. The New Year's Resolution Workflow

After we have explained how to create workflows using the PeerFlow Editor, we are ready to design a more ambitious workflow. In this subsection we present the New Year's resolution workflow, which is aimed at improving students' skills in using verb tenses when speaking about New Year's Resolution. Figure 18 illustrates the New Year's resolu-



Figure 18. The New Year's Resolution workflow.

tion workflow. The new example consists of 9 educational activities, which are described next:

**Watch this Video**: This is the first activity in which students participate. In this activity, the designer requests students watch a video where people talk about their New Year's resolutions. We represent the video as a resource within the activity as can be seen in Figure 18.

**Grammar Practice**: This is the second activity in which students are involved. This activity should be performed individually by each student. The goal of this activity is for students to use the future tense. Students first should read the grammar text, and then do the exercises. When a student finishes, she needs to upload pictures of the finished exercises showing her marks. These exercises will be evaluated by the teacher only. The practice and the pictures will only improve students' marks, they are not mandatory. In the workflow the grammar text and the exercises' to capture the fact that students' results need to be exchanged between the activities 'Grammar Practice' and 'Watch Prezi and Write'.

**New Year Resolutions Prezi**: In this activity students learn how to create presentations using Prezi, a cloud-based presentation tool. As a result of this learning, each student creates a Prezi presentation about her New Year's resolutions. The presentations are accessible for the teacher and the other students in the next activity. In the workflow we include a resource called 'Example Prezi' in which students find the necessary materials to learn how to create presentations with Prezi. The file 'New YearResolutionsPrezi' allows us to exchange students' presentations from this activity to the proceeding one.

Watch Prezi And Write: In this activity students watch their colleagues' Prezis and list the more frequent resolutions in a word file. We use the file 'Coincidences' to model the exchange of those word files between this activity and 'Create A Prezi' activity. This is the first activity for the teacher. The teacher receives the results the students obtained in the 'Grammar Practice' activity as well the New Year's presentations generated in 'New Year Resolutions Prezi' activity.

**Create A Prezi**: In this activity students individually create a new Prezi with the top 10 resolutions of the group. The new presentations are going to be evaluated in a collaborative way in the proceeding activities so we need to exchange those files among the activities. To do that we use the file 'Top 10 Resolutions' which is generated by every student and consulted by two applications in the 'Teacher Assessment' and 'Student Assessment' activities.

Teacher Assessment and Student Assessment: It is now time for assessing students. A Prezi generated by a student in 'Create a Prezi' activity is then evaluated by the teacher and other students in the 'Teacher Assessment' and 'Student Assessment' activities. The applications 'Teacher Assessment Manager' and 'Student Assessment Manager' manage the assessment process within these two activities. The 'Teacher Assessment Manager' sends students' presentations to the teacher. When receiving a student's presentation, the teacher can choose to assess the presentation. In that way, the teacher does not need to mark all students. The rest of the work is done by the 'Teacher Assessment Manager', which, as well as providing students' Prezi to the teacher, learns to assess students as the teacher does. On the other hand, the Student Assessment manager' in'Student Assessment' activity asks students to assess the presentations of other students. In turn, a student may decide to assess, or not, a received presentation. The 'Teacher Assessment Manager' is also fed with the assessment that each student makes about other students' Prezi. Finally, the'Teacher Assessment Manager' proposes marks for students that are later validated by the teacher. The 'Teacher Assessment Manager' and the 'Student Assessment Manager' work together as a Collaborative Assessment tool as described in Section 5.

It should be noted the workflow designer also needs to define on which criteria the assessment of a presentation is based. Among the properties of the 'Teacher Assessment Manager' application, the designer specifies the rubric used to assess students as seen in Figure 19. This rubric file includes the assessment criteria for the workflow.

Get Your Marks: In this activity students are notified about their marks.

**Your Experience**: Finally, as a complementary task, students are requested to respond to a questionnaire aimed at collecting their experience using the PeerFlow framework.

Look for Applications								
🥕 Name								
Teacher assessment manager								
Description								
This application helps teachers to assess its students.								
nubric								
http://10.10.200.92:8080/api/resource/5ebb7328-926								
Upload file								
Reset Ok								

Figure 19. Defining assessment criteria as parameter of the Teacher Assessment Manager.

#### 4. PeerFlow

In this section we explain how to activate a lesson and how students and teachers can participate in such lessons. For more information about the technical background we refer for example to [2,3,1].

#### 4.1. Entering PeerFlow

To enter PeerFlow, you need to go to http://peerflow.iiia.csic.es and log in (or create an account if you don't have one).

Once logged in, you will see the screen displayed in Figure 20. This is the 'search' screen. On the top of this screen (as highlighted by Figure 21 you see a menu with five menu items:

- search
- running
- publish
- edit
- quit

The 'search' button takes you to the search screen. The search screen enables you to search for lesson plans that have been published, so that you can launch them (see Section 4.3).

The 'running' button takes you to a screen that looks almost identical to the 'search' screen. It also allows you to search, but this time the search will display lessons that are already currently running, rather than lesson plans that can be launched (see Section 4.4).

The 'publish' button allows you to publish a lesson plan that was created with the PeerFlow editor and that you saved on your hard drive. Alternatively, you may also publish a file directly from inside the PeerFlow editor (see Section 4.2).

The 'edit' button takes you to the PeerFlow editor where you can design a new lesson plan and save it to your hard drive or publish it, as described in Section 3.

Finally, the 'quit' button allows you to safely log out of PeerFlow.

## 4.2. Publishing a Lesson Plan

Let us now assume that you have already created a lesson plan with the PeerFlow editor and stored it on your hard drive (recall that to create the lesson plan, one needs to click the 'edit' button, as described in Section 3, and save the file).

When you have logged in to PeerFlow, click the 'publish' button. This will bring you to the screen displayed in Figure 22.

#### 4.3. Launching a Lesson

Once you have published a new lesson plan you can launch it immediately. Alternatively, you can launch a lesson plan that has been designed and published by someone else.

In order to launch a new lesson, you first need to find the lesson plan among all lesson plans that have been published. In order to do so, click on the 'search' menu item. You will now see the screen displayed in Figure 20.

guestUser		Search Running P		
🔍 Search				
Role: Name:		() ()		
Description:	•			
Koywords:			Search	Clear

Figure 20. The search screen. This screen allows you to search for lesson plans that have been published.



Figure 21. The menu in the top of the PeerFlow screen, enlarged.



Figure 22. The Publish Screen. This allows you to publish a lesson plan that is stored on your hard disk.

In order to search through all published lesson plans you simply click the square 'Search' button in the bottom right of the screen. You may also apply a detailed search by filling out the fields provided by this screen.

For example, if you have given the name 'EnglishCourse1' to your lesson plan, then you can fill out that name in the 'Name' field such that the search will only return the lesson plan with that name.

Similarly, you can search for all lesson plans that fulfill a specific role, for example, you could limit your search to those lesson plans containing the role 'student'. Similarly you can search for lesson plans with a certain description, or lesson plans that specify certain keywords. To clear the search fields again, click the 'Clear' button in the bottom right.

After clicking the square 'Search' button in the bottom right a new screen will appear that displays the search results; see the example displayed in Figure 23. The search results are listed in the left part of the screen. When you click on one of them, more details about that specific lesson plan will appear in the right part of the screen.

If the lesson plan you desire to launch is listed in the search results, you can select it, and launch it by clicking on the 'Launch' button on the bottom right. Another screen will then appear showing the name and description of the lesson plan you have selected to launch. You can now choose between 'Launch' and 'Launch & Join'. The difference between the two is that in the case of 'Launch' you are just launching the lesson so that other users can participate in it, while if you click 'Launch & Join' you yourself will also enter the lesson. Of course, if you accidentally click 'Launch' while you wanted to Join it as well, you can still join it later (see Section 4.4). If you click 'Launch & Join' you wish to adopt in the lesson. Next, after clicking the 'Join' button a new window will open that will allow you to participate in the lesson, as explained in Section 4.5.

guestUser		(Q) Descri	Reverse Passes Ed Cat		
₩Q Search Results					
Specifications:		Specification Description		i	
Name Name Name Speed_And_Expressivity_Lesson Student,Teacher lesson,music	۲.	Identifier: Name: Description:			
NewYearResolutions2cv1 Student,Teacher	٤	Roles			
Workflow Role1	٤	Keywords:			
				Clear Launch	

Figure 23. Search results. This screen displays the lesson plans that have been published and that match your search criteria.

#### 4.4. Entering a Running Lesson

In this section we will assume that you want to participate in a lesson that has been started by someone else. For example, a teacher has started a lesson and you are a student and you want to take part in it. The teacher may have told you (e.g. by e-mail or in a physical class room) the name of the lesson, so that you can find it. In order to join the class you go to the PeerFlow website and click on the 'running' menu item. This will open a screen identical to the one displayed in Figure 20. You can apply exactly the same search criteria as when searching for lesson plans. When clicking the square 'Search' button in the bottom right, a screen such as the one in Figure 25 will appear. Note that it is almost identical to the one in Figure 23. The difference however, is that this time the search results will consist of running instances of lessons rather than lesson plans. For that reason, there is a 'Join' button instead of a 'Launch' button in the bottom right. After clicking the 'Join' button a screen appears where you can select the role you wish to adopt in the lesson, as displayed in Figure 24. After clicking the 'Join' button again, a new window will open that will allow you to participate in the lesson, as explained in Section 4.5.

#### 4.5. Participation

Once you have entered a lesson (either after launching a new lesson and joining it as explained in Section 4.3, or after searching for a lesson that was already running as explained in Section 4.4), a new window with the participation screen, displayed in Figure 26, will appear.

This screen contains two main sections: the interaction screen on the left, and the action history on the right. Furthermore, there is a menu bar above the two main sections,

guestUser		Search Revenue Cater	<b>O</b>	
👬 Join				
Specification name	Test26			
Running Name	guestUser			
Description				
		h		
Rele	Student	1.		
KOIE				
			Join	

Figure 24. The Join screen. Here you can select the role you wish to adopt in the lesson (e.g. 'teacher' or 'student'. The roles you can choose between differ per lesson.

and in the top left you will find your personal avatar, your user name and the role you have adopted. The menu bar contains the name of the current activity in the left, and a list of menu items that you can use to move from one activity to the next. Some of these menu items may be disabled (or all of them). This happens when you are not yet allowed to move to those activities.

In the right of the menu there is a 'Map' button. When clicking it a map will appear that gives an overview of the lesson plan (see Figure 28), i.e. it displays all activities the lesson consists of, shows the paths you can follow to move from one activity to another and displays the actions that can be performed in the current activity.

The interaction screen displays a number of different icons: A circular icon for each participant in the current activity displays the avatar of the participants. As you can see in Figure 26, a number is displayed in the upper left side of the avatar. This number indicates the number of actions undertaken by this participant in the current activity. In the bottom right of each avatar two letters are displayed that represent the role of that participant.

Another circular icon represents a resource or a file (see Section 3 for an explanation of these concepts). In Figure 26 the icon is displayed as a book. Clicking on such an icon will open a new browser tab with the corresponding resource or file.

A cog-wheel icon represents an action you can perform. For example there could be an action named 'upload homework'. As a participant you can perform an action by clicking on its corresponding icon. When clicked, a pop-up screen will appear, as displayed in Figure 29, where the parameters of the action can be filled out.

Some actions may have *receivers*. This means that if you perform an action, some of the other participants in the activity will be notified that you did so, and will be able to see the parameters that you have filled out for the action. An example of such an action

و Search	guestUser Run Results		Image: Second	4
Specificatio	ns Results	i	Specification Description	i
Name	Roles Playing	Action	Identifier: http://158.109.36.141:52552/c763ab74-ac93-49eb-b419-b46c3a7c10a1.xml Name: Test25	
Test25	Student,teacher (guestuser:student)	20	Roles Student, teacher	
			Playing:	
			O	A Din

Figure 25. The results of a search for running lessons. This screen displays the lesson plans that are currently running and match your search criteria.

Nardine Student					
Watch this video	Grammar practice				Мар
		s message 3	st	Say: Hello everybody!         Say: Good morning!         Say: Say: hi!	

Figure 26. The participation screen.



Figure 27. The messages appear in the right column.

Watch this video	Grammar practice				
Teacher assessment					Messages
Watch this video Grammar practice	New year res	solutions prezi Watch	h prezi and write	Create a prezzi	
Hall					

Figure 28. The map that shows the structure between the several activities of the lesson plan.

could be the action 'assess'; when the teacher performs this action he or she would need to select a student in the activity as the receiver of the action and write the item from the assessment rubric that will assess that student's outcome. The student will then receive a message with his or her assessment. Another type of action is simply a text message sent from one user into the activity of another user. The action history (Figure 27) displays a list of actions that have been either performed or received by you.

If you want to stop participating in the lesson there are two ways to realize this. One is by simply closing the browser window. This does not cause you to leave the lesson. You will still be in the lesson so the next time you log in to PeerFlow you can continue with the lesson. All you have to do is to search for running lessons to locate the specific lesson in which you were participating. Once you join, you will be back in the activity where you were when you left the lesson.



Figure 29. After clicking on an action a pop-up window appears to fill out the details of the action. In this example the student needs to select a file to upload.

The second way to leave a lesson is to click the 'Exit' button in the top right of the participation screen. Note however, that this will cause you to leave it definitively. If you change your mind afterwards and come back to the lesson this means that you will have to start all over again from the first activity. Moreover, it is not guaranteed that this is even possible, because some lesson plans may not allow students to join after the lesson has already started.

Although closing the browser window clearly has the advantage that you may come back, it is advised to use the other option if you really do not plan to come back. This is because if you do not exit the lesson but merely close the browser window, other participants in the lesson plan might expect you to still be with them, and hence they may wait for you for performing certain actions. By clicking the exit button you let everybody clearly know that you are no longer in the lesson and that others can continue the lesson without you.

## 5. Collaborative Assessment

In this section we provide details of the Collaborative Assessment (COMAS, short for Community Assessment) tool, which is integrated in PeerFlow and can be used as part of a lesson plan. This is an automated assessment service which (1) allows the tutor to evaluate students, (2) allows students to evaluate each other and (3) after analyzing students and tutor's assessments, generates automatic marks for students who have not been assessed by the tutor. The service is intended for intelligent online learning applications

that encourage peer assessment, aiming to profit from these interactions to deduce new, meaningful information and reduce the work load for tutors.

#### 5.1. Pedagogical Advantages of Peer Assessment

Self and peer assessment have clear pedagogical advantages [6,8,7,4,5]. Students increase their responsibility and autonomy, get a deeper understanding of the subject, become more active in the learning process, reflect on their role in group learning, and improve their judgement skills. Online learning communities encourage different types of peer-to-peer interactions along the learning process. These interactions permit students to get more feedback, to be more motivated to improve, and to compare their own work with other students' accomplishments. Tutors, on the other hand, benefit from these interactions as they get a clearer perception of the student engagement and learning process.

The method proposed here goes beyond current tutor-student online learning tools by making students participate in the learning process of the whole group, providing mutual assessment and making the overall learning process much more collaborative. Furthermore, peer assessment also has the positive, and much needed, effect of reducing the marking load for tutors. This is specially critical when tutors face the challenge of marking large quantities of students, as required by the increasingly popular Massive Open Online Courses (MOOC).

#### 5.2. Method Description

Consider a lesson plan where students have submitted assignments that need to be assessed. Due to the large amount of assignments, the tutor is just unable to mark them all, although he or she can mark a subset of them. As part of the lesson plan, students are asked to mark each others' assignments and submit their feedback. The teacher will then be expected to mark a small set of assignments, and students will be expected to mark an even smaller number of their peers' assignments. Then, for all assignments not assessed by the teacher, COMAS will suggest marks based on aggregating students' marks. This aggregation takes into consideration the degree of trust the tutor has in each student's assessment (or mark). We define this trust measure based on the following two intuitions. Our first intuition states that if the tutor and the student have both assessed the same assignment, then the similarity of their marks can give a hint of how close the judgments of the student and the tutor are. Similarly, we can define the similarity of judgments of any two students by looking into the common assignments evaluated by both of them. We refer to these similarity measures as the *direct trust* between two people.

However, cases may arise where there are simply no assignments evaluated by both the tutor or selected students. In such a case, one may think of simply neglecting (or not taking into account) that student's mark, as the tutor would not know how much to trust that student's mark. Our second intuition, however, proposes an alternative approach for such cases, where we approximate that unknown trust between the tutor and the student by looking into the chains of trust between the tutor and the student through other students. For instance, we can say "if the tutor trusts student 1, and student 1 trusts student 2, then the tutor can likely trust student 2". We refer to this similarity measure as the *indirect trust*. And it is calculated using this approach in such a way that the longer

the chain between the tutor and the student, the lower their indirect trust will be. To find such chains of peers, we build a trust graph from the history of assessments made, where nodes are the members of the community and edges join peers with direct or indirect trust relations between them.

The main task of the COMAS algorithm is to build a trust graph from the list of marks. Every time a new mark is added, the trust graph is updated with the new direct and indirect trust values. Once trust values are calculated/updated, final marks to be suggested are computed as follows. If the tutor marks an assignment, then the tutor's mark is considered as the final mark. Otherwise, a weighted average of the marks of students is calculated for this assignment, where the weight of each student is the trust of the tutor on that student.

## 5.3. Example

Figure 30 shows a simple example of a lesson plan with a tutor and two students where peer assessments are performed as part of the lesson plan. Assessments are made following 2 criteria: speed and expressivity, with an evaluation range from 1 to 10.



(a) Lesson plan in Peerflow

(b) Assessment in Peerflow

Figure 30. Example of a lesson plan and peer assessment

Figure 31 shows the evolution of a trust graph from the history of assessments made. We write every assessment using the notation:  $(exercise, assessor) = \langle speed mark, expressivity mark \rangle$ . In Figure 31 (a), there is one node representing the tutor who has made the first assessment over the assignment  $ex_1$ ,  $(ex_1, tutor) = \langle 5, 5 \rangle$ , and there are no links to other nodes as no one else has assessed anything yet. In Figure 31 (b), the student Dave assesses the same exercise as the tutor,  $(ex_1, dave) = \langle 6, 6 \rangle$ , and thus a link is created between them. The trust value between Dave and the tutor is high since their marks were similar. In Figure 31 (c), a new assessment by Dave is added for assignment  $ex_2$ ,  $(ex_2, dave) = \langle 2, 2 \rangle$ . This has no consequences on the graph construction, since no one else has marked  $ex_2$  yet. In Figure 31 (d), the student Patricia adds an assessment on  $ex_2$ ,  $(ex_2, patricia) = \langle 8, 8 \rangle$ , that allows to build a direct trust between Dave and Patricia. The trust between them is low since their marks were not very similar. Also, an indirect trust between the tutor and Patricia is added, through Dave. This indirect trust is also low because, even though the tutor has a high trust on Dave, Dave does not has a high trust on Patricia.

The automated assessments generated when we reach stage (d) are:



Figure 31. Trust graph example.

- $\langle 5, 5 \rangle$  for exercise 1, which preserves the tutor's assessment
- (3.7,3.7) for exercise 2, which uses a weighted aggregation of the students' assessments according to their trust relation with the tutor

#### 6. Experiment results

#### 6.1. Experimental setting

We evaluated the tools by running an experiment with real students. The experiment was carried out at a High School called Torras i Bages and located in L'Hospitalet de Llobregat, Barcelona, where Carme Roig works. Her students are familiar with the use of computers for learning, as she encourages them to use technology as much as possible. Students were informed that researchers from the IIIA research centre wanted to test a learning program. Out of a group of 25, 10 students were selected according to the following traits: familiarity with the use of computers, good behaviour in class, interest in the subject (English language), average knowledge of English (although this was not the most important point), all in all: "good students". The rest of the students were asked to wait for the next experiment. We were given a time slot of 2 hours to perform the experiment. The experience began with students logging in into the system and familiarising themselves with the PeerFlow environment. For a few minutes they were encouraged to click everywhere and to test what they could and could not do. None of them had problems with the log in process. Then they were asked to follow the lesson plan as it has been designed: they learned about the tasks they had to do, and they started performing them. That included watching a sample video of New Years resolutions, practicing their grammar by doing an online exercise, and doing their own presentation of their New Year's resolutions. At the same time they were able to talk to their friends online through the system, or they could ask the teacher online. At the end of the experiment they answered a survey, which we analyse next.

#### 6.2. Survey results

The survey questions were simple and targeted to specific answers (mostly yes/no answers).

The first group of questions were related to the level of acceptance of the students with respect to the type of online activity performed *in the classroom*. Answers showed (Figure 32) a high level of acceptance towards the activity performed (Would you participate in this kind of online activities more times?: 100% acceptance, Would you like your classmates to participate?: 100% acceptance, Do you think evaluating you classmates can help you learning: 95% acceptance, Would you like to use always your PC in class and make the class activities with a computer online?: 95% acceptance).



Figure 32. Level of acceptance of the type of online activity performed.

The second group of questions (Figure 33) were related to the level of acceptance of the students with respect to engaging in an online learning community where they could perform learning activities and about their habits of using online tools to study/learn. Students were more reluctant to engage in a learning community (Would you participate in an online learning community with other students: 63 % acceptance). Further questions showed that most students use online tools to communicate with each other for activities such as "make homework", "ask doubts" or simply "talk about any subject". When asked if they used any online tool to study/learn with their classmates a significant number (59 % of the classroom) answered yes and mentioned tools such as "edmodo", "prezi", "skype", "google" or "traductor".



Figure 33. Level of acceptance in engaging in online learning communities and other online tools used to study/learn.

The third group of questions were targeted to the specific online application used in class, namely the PeerFlow tool. Answers showed (Figure 34) that most of the students liked the tool and were willing to use it again although many of them found it difficult to use (consider this is the first time they see and interact with the tool) and they considered the activity performed in class moderately difficult.



Figure 34. Level of acceptance of the PeerFlow tool. Difficulty in using the tool and difficulty of the activity performed in class.

In the last group of questions we asked students about their preferences about different features of the PeerFlow tool to improve its usability and to make it more friendly for potential users (questions included features such as the clarity/utility of the lesson map navigation tool, preference of navigation through the lesson plan map or through the menu, preference of choosing actions from the main window or from the lateral menu, preference of seeing the teacher's activities or not, login preferences, etc).



Figure 35. Student's preferences about different features of PeerFlow.

Overall, the survey showed an enthusiastic response from the classroom to the online learning activity performed and to the possibility of using again the Peerflow tool to perform more online activities with other classmates (more than 80-100 % acceptance). The response to the complexity of the tool and of the lesson plan performed was moderated, as it was the perspective of engaging in an online learning community with other students (about 50-60 % acceptance). Last but not least, we obtained a precious feedback from the students about specific usability questions that will help us improve our interface and functionality for potential final users.

#### 7. Conclusions

This chapter has introduced the PeerLearn methodology and its associated tools. We design pedagogical workflows for students on the definition of rubrics (using PeerAssess) as the starting element that drives the creation of lesson plans (using LessonEditor). PeerAssess, an online database platform, helps teachers manage their groups of students, their lesson plans, and the scoring rubrics (or evaluation criteria). The web-based LessonEditor provides assistance to users to create workflows for their lesson plans. The six basic ingredients in creating workflows are: activities, roles, resources, applications, timeouts and files. Lesson plans created with the LessonEditor run over our web platform, PeerFlow.

We have also presented COMAS, the collaborative assessment tool, which is integrated in PeerFlow and can be used as part of a lesson plan. COMAS is an automated assessment service which allows each of the tutor and students to evaluate a small subset of assignemtns, and then, after analyzing students and tutor's assessments, generates automatic marks for students who have not been assessed by the tutor. This is specially critical when tutors face the challenge of marking large quantities of students, as required by the increasingly popular Massive Open Online Courses (MOOC).

Finally, we have evaluated the PeerLearn tools by running an experiment with real students. The experiment was carried out at a High School, Torras i Bages in L'Hospitalet de Llobregat, Barcelona, where 10 students from the English Language classroom were involved. By the end of the experiment, where students were interacting in a real lesson plan running over PeerFlow, the students had to answer a survey. The results of the survey illustrate an enthusiastic response towards using PeerFlow, and provide important feedback on usability that will help us improve our interface and functionality for potential final users.

#### References

- Dave de Jonge, Nardine Osman, Bruno Rosell i Gui, and Carles Sierra. D3.1 electronic institutions for community building (v1). Public deliverable, The PRAISE Project (THEME 3: FP7-ICT-2011-8 no 318770), 2013.
- [2] Dave de Jonge, Bruno Rosell, and Carles Sierra. Human interactions in electronic institutions. volume 8068, pages 75–89, Beijing, China, 01/08/2013 2013. Springer, Springer.
- [3] Mark d'Inverno, Michael Luck, Pablo Noriega, Juan A. Rodríguez-Aguilar, and Carles Sierra. Communicating open systems. *Artif. Intell.*, 186:38–94, 2012.
- [4] Valerie Hannon. 'Only connect!' : a new paradigm for learning innovation in the 21st century. Centre for Strategic Education occasional paper ; no. 112, September 2009. Centre for Strategic Education, East Melbourne, Vic, 2009.
- [5] Henry Jenkins. Confronting the challenges of participatory culture: Media education for the 21st century. 06 2009.
- [6] Jingyan Lu and Zhidong Zhang. Understanding the effectiveness of online peer assessment: A path model. *Journal of Educational Computing Research*, 46(3):313–333, 2012.
- [7] Karen Stepanyan, Richard Mather, Hamilton Jones, and Carlo Lusuardi. Student engagement with peer assessment: A review of pedagogical design and technologies. In Marc Spaniol, Qing Li, Ralf Klamma, and RynsonW.H. Lau, editors, Advances in Web Based Learning, ICWL 2009, volume 5686 of Lecture Notes in Computer Science, pages 367–375. Springer Berlin Heidelberg, 2009.
- [8] Keith Topping. Peer assessment between students in colleges and universities. *Review of Educational Research*, 68(3):249–276, 1998.
- [9] Grant P. Wiggins and Jay. McTighe. Understanding by design. Hawker Brownlow Education Moorabbin, Vic, 2nd expanded ed. edition, 2005.