

# Interactive Assignment: a Moodle Component to Enrich the Learning Process

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**Abstract** – Nowadays, people are proactive concerning Web-related issues and reasons for that could be explained by the availability of Web systems and the immediate response they provide. The same is also true whenever considering web-based courses. In this context, interactivity and automatic assessment may be responsible for keeping the learners' motivation. Also, these characteristics may promote active learning. Currently, Moodle is one of the most popular Learning Management System (LMS) to support courses through the Web. However, since it is a general system, if the subject to be taught or learnt is related to Mathematics there is a lack of interactive modules to be integrated with LMS in general, Moodle in particular. In this paper we present Interactive Assignment (i-Assign), a package to be integrated into Moodle in order to improve interactivity and promote automatic assessment of interactive activities developed using e-Learning Modules (e-LM). e-LM are interactive Java applets that supports the teaching and learning process of specific subjects and may offer resources for automatic assessment of solved activities, providing instantaneous feedback for learners concerning their performance.

*Index Terms* – Interactivity, Moodle, Distance Learning, Mathematics, e-Learning Modules.

## INTRODUCTION

Nowadays, people are used to navigate through the Web, to use Web-based communication applications and to participate in social networks. Also, they are more and more motivated to assume the Web as the media for solving several day-life issues as well. In fact, people are proactive concerning Web-related issues. Two important reasons for that are the availability of Web systems and the immediate response provided for them. This is also true whenever considering computer supported courses. In this context, interactivity and automatic assessment are keywords to keep the learners' motivation [5][6]. Interactivity is also important to promote active learning [10], a common method used to enhance the learning process. Currently, Moodle is one of the most popular Learning Management Systems (LMS) to support courses. However, if the subject to be taught or learnt is related to Mathematics, there is a lack of interactive modules to be integrated into LMS in general, Moodle in particular [14].

In this paper we address the problem of interactive assignment in Moodle. Our contribution is a free software component, the Interactive Assignment (i-Assign) package, which allows an easy way to integrate e-Learning Modules (e-LM) to Moodle. e-LM are interactive Java applets that supports the teaching and learning process of specific subjects and may offer resources for automatic assessment of solved activities, providing instantaneous feedback for learners concerning their performance [11]. In order to evaluate this package, the paper also presents some results of its usage through the description and analysis of several case studies conducted with learners and K-12 equivalent math teachers during the first semester of 2009 and the summer of 2010 (South Hemisphere). The results indicate how students value the immediate feedback of their activities' assessment and the advantage of using integrated interactive modules to enhance their learning process.

In the next sections we discuss about interactivity in Moodle then we briefly describe e-LMs and some related work. After that, we present the Interactive Assignment Package through the explanation of its functionalities and describe some experiments that were conducted from 2009 and this summer (South Hemisphere). Finally, we close the paper with some conclusions.

## INTERACTIVITY IN MOODLE

Moodle<sup>1</sup> is a well known Learning Management System which development began with Martin Dougiamas during the decade of 1990 and its first release dated from 2002. Moodle is an Open Source software and it has been collaboratively developed since its very beginning. From that on, several releases adding new features, better scalability and improved performance were launched. Moreover, it has been used for thousands of people all over the world.

Currently, interactivity in Moodle is mostly represented by filling and submitting forms. This could be defined as *discrete interactivity*, since the user/learner waits for the server's answer, characterizing the occurrence of discrete events: (i) the user/learner fills and (ii) submits a form related to an educational activity; (iii) the server receives the form, (iv) processes it and (v) sends the answer to the user/learner. We argue that the possibility of integrating components with Moodle to provide *continuous interactivity* may benefit both, teachers and learners, specially the ones

<sup>1</sup> Modular Object Oriented Dynamic Learning Environment:  
<http://moodle.org>

interested in teaching and learning specific contents such as Mathematics and Programming. By continuous interactivity we mean the possibility of manipulating educational content in real time, in order to evaluate their properties and do experiments before submitting the activity results to the server.

Although the variety of resources that are available for Moodle's users in order to fulfill their needs, there are some limitations whenever we consider its use for supporting the teaching and learning process of specific contents, such as Mathematics. In fact, Moodle's resources for supporting teaching and learning Mathematics and related contents are limited to the possibility of incorporating math formulae along the body of text, by using filters [14]. However, none of these filters provide continuous interactivity with the educational environment offered by Moodle.

Interactivity and automatic assessment are keywords to keep the learners' motivation and promote active learning [5][6][10]. Therefore, improving interactivity in a LMS such as Moodle could benefit a large amount of users all over the world. A possible solution for that is the incorporation of e-LMs [11] into Moodle. In the next section we will discuss about e-LMs and related issues.

**E-LEARNING MODULES AND RELATED ISSUES**

e-Learning Modules (e-LMs) are content specific software components, typically Java applets, which provide communication resources through reading HTML tags as applets' parameters and sending data through the POST method [15]. These communication resources are responsible for the interaction between the e-LM and the LMS. Such a scheme brings flexibility concerning interactivity and may provide as many e-LMs for specific topics as existent Java applets under free software basis. Moreover, having such Java applet at hand, the e-LM developer just has to implement three additional methods: one to read the content from the server, one to send the student solution and one for sending the solution assessment. Currently, the only LMS that allows the incorporation of e-LMs on it is SAW [11], which has limited use and access, since its code is not available yet.

An e-LM must be developed to provide support for the teaching and learning process of specific contents. They may provide resources for authoring and automatic assessment of activities that will be included in the system as exercises or examples. iGeom [2], iComb [3], iVProg [9] and iGraf [13] are examples of available e-LMs. iGeom is an e-LM which implements interactive (or dynamic) geometry [1] for teaching/learning geometry. It possesses functionalities for authoring geometric problems, as well as resources for automatic assessment to their solutions [7]. iComb is an e-LM conceived as a widget [16] to support the teaching and learning process of combinatorics. iVProg is an e-LM for introductory programming and iGraf is an e-LM for teaching and learning functions. Except for iVProg, all the e-LMs provide automatic assessment resources. The automatic assessment resource for iVProg is currently under

development. Figure 1 shows the iGeom authoring interface which is related to its automatic assessment functionality [8].

There are some works [4][12] that offer resources for improve interactivity while teaching or learning math content via some LMS. Collaborative Tabulae [4] provides some resources for collaborative learning of interactive geometry by sharing geometrical constructions through the web. Although it allows several didactic strategies for distance learning courses, it doesn't provide automatic assessment resources. The LMS ROODA<sup>2</sup> possesses the tool ROODA Exata [12] that provides resources for incorporating math formulae along the body of text in order to improve the communication among math students within their educational environment, but it is already possible into Moodle using appropriated filters and didn't bring interactivity as well.

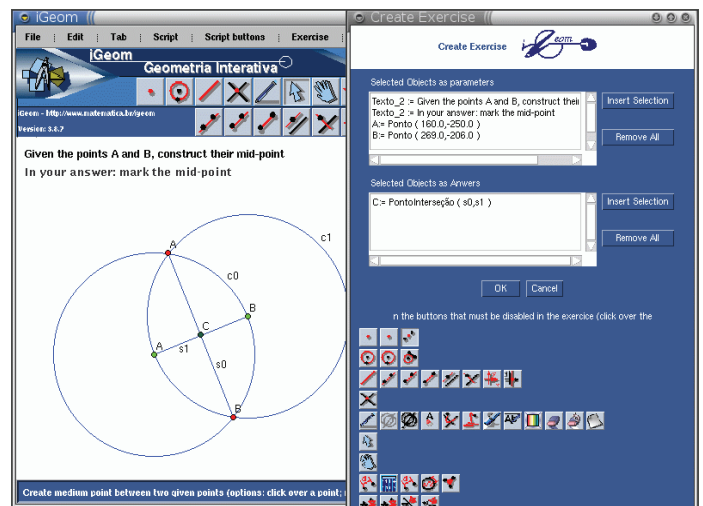


FIGURE 1  
THE IGEOM AUTHORIZING INTERFACE

**THE INTERACTIVE ASSIGNMENT PACKAGE**

The Interactive Assignment (i-Assign) is a Moodle package that contains resources for improving its interactivity with the incorporation of e-LMs into several educational contexts offered by the system. The main functionalities that i-Assign provides are: interactive activity, detailed report and e-LM filter.

Figure 2 shows the i-Assign interface. It looks like any Moodle's interface for supporting courses. In the left side there is a frame containing information related to the available resources. We introduced the link for i-Assign within the box that contains the available activities (zoom out inside Figure 2). The main frame of the page contains general information about the course and a list of interactive activities proposed using the e-LM iGeom (dashed rectangle at the bottom of Figure 2).

<sup>2</sup> <https://www.ead.ufrgs.br/rooda/>

I. Interactive Activity

The *Interactive Activity* is an i-Assign resource that offers to its user (mostly teachers and tutors) the possibility of authoring interactive activities (exercises, examples) using e-LMs. If the e-LM has resources for automatic assessment, the *Interactive Activity* is also responsible for it. Therefore, whenever one consider automatic assessment of learning activities while preparing specific content (e.g. math) for web-based courses, *Interactive Activity* improves the interactivity of the LMS as a whole since it offers resources diverse from multiple choices activities.



FIGURE 2 THE I-ASSIGN INTERFACE

This functionality provides resources for incorporating into Moodle some interactive activities prepared using e-LMs. Figure 3 consolidates the i-Assign interface for choosing among the available e-LMs with the display of each of them (iGeom, iComb, iVProg and iGraf). Such e-LMs are used to create interactive activities to be incorporated as didactic content into a web-based course delivered through Moodle.

II. Detailed Report

The *Detailed Report* is an i-Assign resource that offers to its user (mostly teachers and tutors) the possibility of having several information related to the activities his/her students had done. Such information can be presented by activity or by student, through a detailed report. This report contains information related to all activities executed by all students. For instance, the teacher/tutor can visualize the number of attempts the student tried to solve an activity until it was assessed as correct. Such information allows teachers/tutors

to find difficulties on solving some activity in general or particularly, for a student.

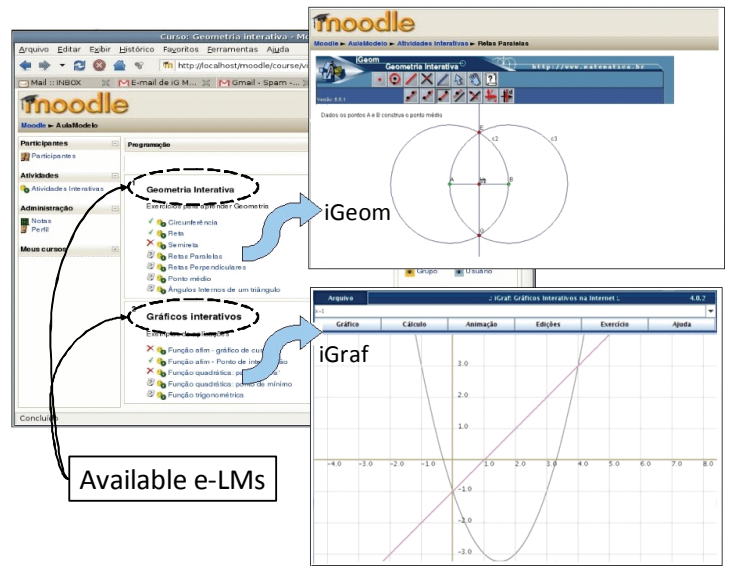


FIGURE 3 THE I-ASSIGN INTERFACE – INTERACTIVE ACTIVITY

The report generates a table that presents an icon representing the state of the activity (*correct*, *incorrect*, *uploaded* and *not uploaded*) in each cell followed by the number of attempts the students had uploaded it. If the teacher wants to see the activity, he/she just clicks on its icon to open it, visualizes it in the correspondent e-LM and, maybe, inserts some comment to be read further by the student. Figure 4 shows an example of report.

Construindo atividades interativas com o MA iGeom

Legenda: ✓ (certo) ✗ (errado) ? (não fez)

O número de tentativas encontra-se abaixo do ícone do número da atividade

Estudantes	Activity state	1	2	3	4	5
Aluno	Student name	(1) ✓	(1) ✓	(3) ✗	(1) ✓	(1) ✗
Aluno	Attempts #	(1) ✓	(2) ✓	(1) ✓	(2) ✓	(1) ✓
Aluno	Attempts #	(0) ?	(1) ✓	(1) ✓	(1) ✓	(1) ✓

FIGURE 4 DETAILED REPORT

III. e-LM Filter

An *e-LM Filter* is an i-Assign functionality that allows the incorporation of activities prepared using e-LMs along the body of text within any Moodle’s asynchronous context, such as forum, glossary and wiki. This improves interactivity in all such contexts.

The incorporation consists of inserting the e-LM file name between specific tags delimiters (`<ia>__</ia>`) wherever it must be displayed within the text. The only constrain is that the e-LM file must be uploaded into the system before its insertion in a text. Figure 5 shows an example of including interactive content into the glossary of Moodle, for the term *Barycenter*. The editor interface shows the insertion of `baricentro.geo` (dashed rectangle on top) and the content of it could be continuously manipulated by moving one of the points A, B and C (dashed rectangle in the bottom). Such manipulation allows learners to analyze the property of a point being a barycenter.

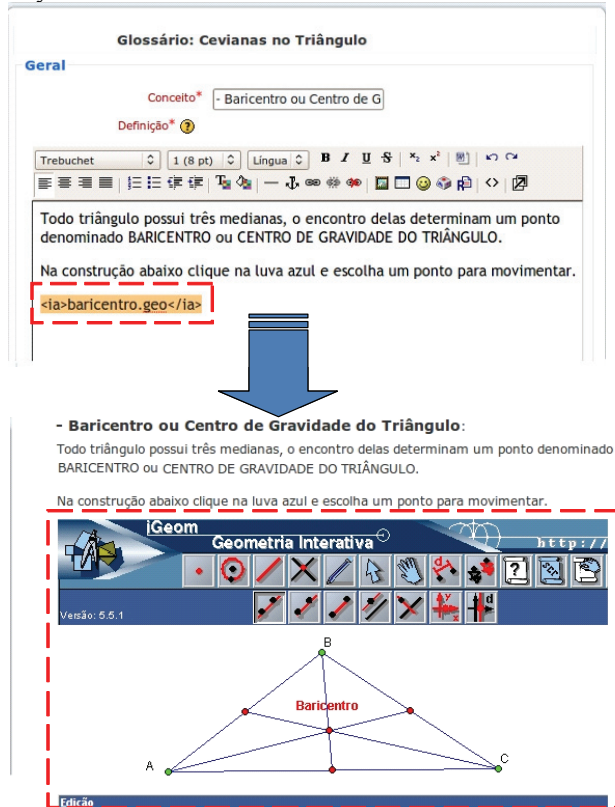


FIGURE 5  
INCLUDING E-LM CONTENT INTO A TEXT

**EVALUATING THE INTERACTIVE ASSIGNMENT PACKAGE**

*I. Experiencing i-Assign with students*

An experiment was conducted with students from three K-12-equivalent classes in a course of basic Euclidean Geometry during the first semester of 2009. A total of 35 students took part on it.

The course plan was: (i) the course would last three weeks and, except for the first and the last activities, all of them would be remote; (ii) each class would have three teacher assistants to provide online support through chats and forums; (iii) a questionnaire would be applied at the end, in order to evaluate the course.

Several activities were proposed during these three weeks and students were really compromised with the course. Most

of them usually entered in the system once a day and solved (or even tried to solve) the proposed activities. Also, most of them took part in several discussions using the resources of forum e chat. At the end of the course they had answered several questions and one of the questions was: *How motivated you are during the course?* Possible answers for this were: *bad, regular, good, very good* and *excellent*. The results confirmed our expectations, since 100% answered good (28%), very good (47%) and excellent.(25%).

*II. Experiencing i-Assign with teachers*

A series of three experiments (experiment 2a, 2b and 2c) were conducted with Math teachers during January, 2010. The first two experiments consider teachers playing the role of students enrolled in computer mediated course supported by Moodle with i-Assign. The last experiment consider teachers playing the role of teachers in the system: it was a meta-course in a sense that it was a course about preparing web-based courses using Moodle with i-Assign. All experiments were conducted in a lab.

During the experiment 2a teachers had used Moodle and i-Assign as students. Several teachers hadn't had any prior use of LMSs and most of them had never used any software to teach geometry or functions. Classes had 15 participants, occurred in a lab, 8 hours a day during one week, one teacher per computer. During class, a series of online activities were proposed giving them ability on using the system resources. Questionnaires were applied at the very beginning and at the end of the course in order to evaluate their proficiency on using computers and the course results, respectively. Most of them had used the computer for diverse purpose than teaching although the availability of the school lab. At the end of the course all of them were well motivated to study geometry through the system using the interactive resources provided by i-Assign. One of the questions they answered was: *How motivated you are to study geometry using i-Assign?* Possible answers for this were: *bad, regular, good, very good* and *excellent*. Figure 6 shows the results, very similar to the ones from experiencing i-Assign with students.

During the experiment 2b, teachers also had used Moodle with i-Assign, but it differed from experiment 2a since its focus was working on *Notable Points* in a triangle (e.g. barycenter, circumcenter, incenter, orthocenter, among others). Classes had 18 participants, occurred in a lab, 2 hours a day during a week, one teacher per computer. Questionnaires were applied at the very beginning and at the end of the course in order to evaluate their proficiency on using computers and the course results, respectively. Again, most of them had used the computer for diverse purpose than teaching although the availability of the school lab, just one had used Moodle before but 8 had searched for educational content through the Web. At the end of the course all of them were well motivated to study geometry through the system using the interactive resources provided by i-Assign with iGeom. Also, the degree of satisfaction with the course was very high. The answers' results for

question 1 (satisfaction): *How satisfied you are with the course?*. Possible answers for them were: *bad, regular, good, very good and excellent*. The answers were 100% among good (10%), very good (40%) and excellent (50%). In addition, Figure 6 shows the answers' results for question 2 (motivation): *How motivated you are to study geometry using i-Assign and iGeom?*. Same answers of the first question were possible for this one.

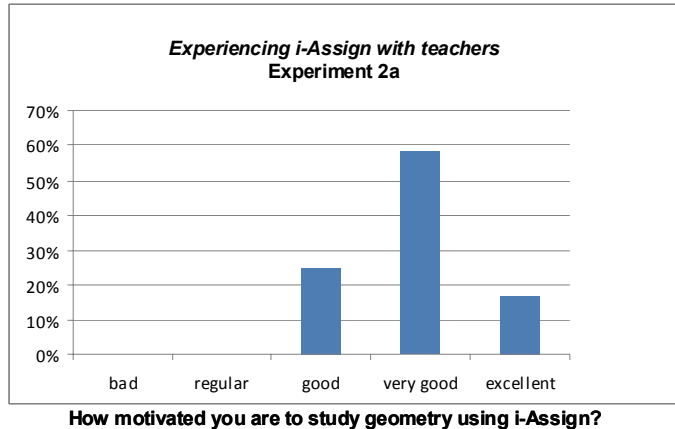


FIGURE 6  
TEACHERS' MOTIVATION – EXPERIMENT 2A

During the experiment 2b, teachers also had used Moodle with i-Assign, but it differed from experiment 2a since its focus was working on *Notable Points* in a triangle (e.g. barycenter, circumcenter, incenter, orthocenter, among others). Classes had 18 participants, occurred in a lab, 2 hours a day during a week, one teacher per computer. Questionnaires were applied at the very beginning and at the end of the course in order to evaluate their proficiency on using computers and the course results, respectively. Again, most of them had used the computer for diverse purpose than teaching although the availability of the school lab, just one had used Moodle before but 8 had searched for educational content through de Web.

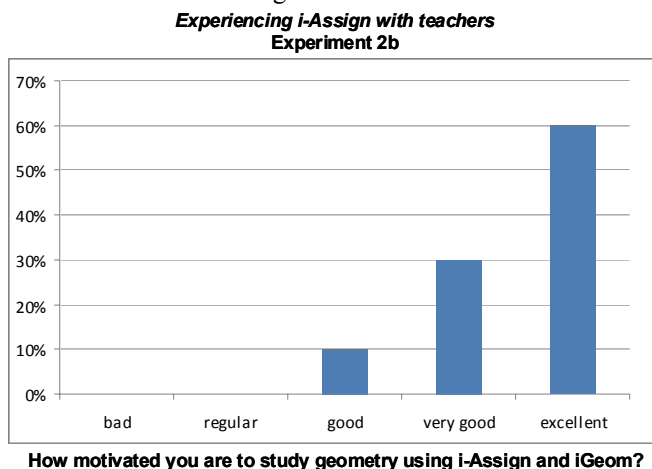


FIGURE 7  
TEACHERS' MOTIVATION – EXPERIMENT 2B

At the end of the course all of them were well motivated to study geometry through the system using the

interactive resources provided by i-Assign with iGeom. Also, the degree of satisfaction with the course was very high. The answers' results for question 1 (satisfaction): *How satisfied you are with the course?*. Possible answers for them were: *bad, regular, good, very good and excellent* were 100% among good (10%), very good (40%) and excellent (50%). In addition, Figure 10 shows the answers' results for question 2 (motivation): *How motivated you are to study geometry using i-Assign and iGeom?*. Same answers of the first question were possible for this one.

The experiment 2c consisted of a course about creating web-based courses using Moodle and i-Assign. Classes had 19 participants, occurred in a lab, 2 hours a day during 2 weeks, one teacher per computer. During the first 8 hours the course was dedicated to present the resources of Moodle and i-Assign to teachers through the use of online activities and examples. Therefore, the class was divided into small groups (3 or 4 people per group) and each group was responsible for developing a mini-course about some geometry topic using the resources from i-Assign with the e-LM iGeom. These activities last 6 hours (in the lab) and, at the end of them, each group applied its mini-course to another group in order to evaluate both: the mini-course and the way resources from i-Assign were used on it. Questionnaires were applied at the very beginning and at the end of the course in order to evaluate their proficiency on using computers and the course results, respectively.

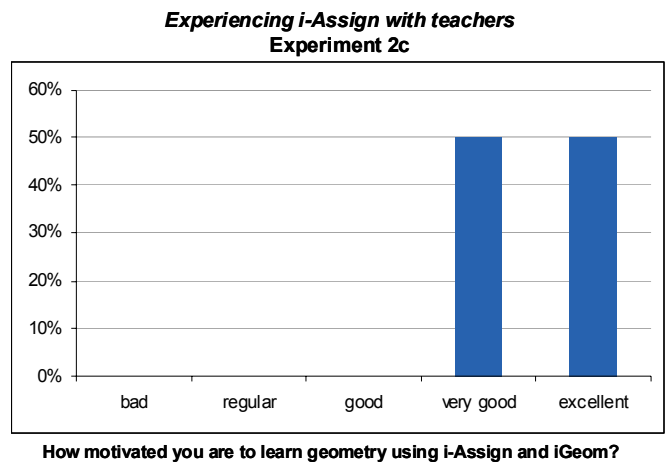


FIGURE 8  
TEACHERS' MOTIVATION – EXPERIMENT 2C

Considering the group that was participating of experiment 2c, 60% of it had already enrolled in a web-based course and 66.7% had searched for educational material into the Web to apply during classroom. At the end of the course, 100% believed that Moodle with i-Assign could help teachers by promote and improve learning. In fact, the following questions were part of the questionnaire and their answers were presented on Figure 11, Figure 12 and Figure 13, respectively: Question 1 (motivation). *How motivated you are to learn geometry using Moodle with i-Assign?* Question 2 (experience). *What do you think of experiencing to learn geometry using Moodle with i-Assign?*

Question 3 (evaluation). *How do you evaluate the possibility of incorporating e-LMs into Moodle in order to build interactive activities?* Possible answers for them were: *bad, regular, good, very good and excellent.*

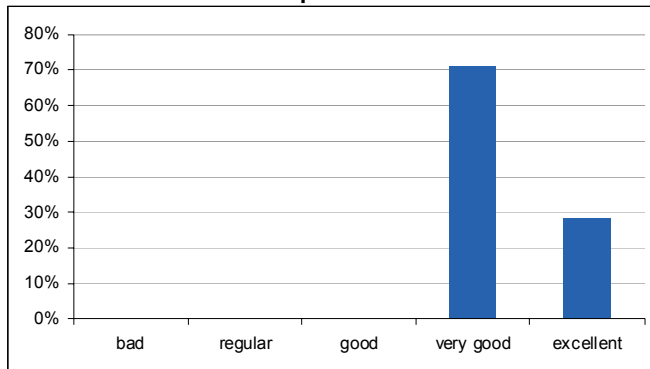
**Experiencing i-Assign with teachers  
Experiment 2c**



What do you think of experiencing to learn geometry using Moodle with i-Assign?

FIGURE 9  
TEACHERS' EXPERIENCE – EXPERIMENT 2C

**Experiencing i-Assign with teachers  
Experiment 2c**



How do you evaluate the possibility of incorporating e-LMs into Moodle in order to build interactive activities?

FIGURE 10  
TEACHERS' EVALUATION – EXPERIMENT 2C

### CONCLUSIONS

In this paper we presented i-Assign, an interactive package that brought interactivity to Moodle in a sense that it allows Moodle users to create interactive activities within any Moodle context (forum, chat, etc). Interactivity provided by i-Assign is due to the simplicity of incorporating interactive content created through e-LMs.

A series of experiments were conducted to evaluate the impact of introducing interactivity in Math classes via the use of Moodle with i-Assign. Such experiments consider both: the student view and the teacher view while using the system. Experiments consider topics related to geometry, mainly. The results show that all of them were motivated to learn geometry using Moodle with i-Assign and all teachers that participated on the experiment agreed that using Moodle with i-Assign could help them to promote and improve learning.

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