

Learning with Moodle and Google Drive: Instrumental Conflicts in Question

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Abstract: Learning management systems (LMSs) are still supporting artefacts by allowing higher education students to conduct learning activities using teaching resources. These artefacts are based on graphical interfaces that display modules and contents. The mediated contents force students to manage instrumental conflicts resulting of a poor integration between didactic, pedagogical and technical artefacts, during the learning activity (Marquet, 2005). This paper investigates the impact of using the LMS Moodle on the realisation of an activity carried out in this same environment, during a business intelligence (BI) course, according to the type of integration of the teaching resources used: resources integrated into the environment and resources external to the environment. After conducting a literature review on the information search task and on learning BI with LMSs, this empirical work (N = 69) examines the effects of the type of integration of said resources on the results obtained in the quiz. The results suggest that the implementation of external resources around an LMS and therefore not integrated into the environment paradoxically enables students to obtain better results on a score in a shorter time, thus improving their ability to act.

Keywords: LMS, Business Intelligence, Interface, Instrumental Conflict, Moodle

1. Introduction

According to Rabardel (1995), an artefact becomes an instrument through transformations that involve itself and the user's patterns of use (Overdijk et al., 2012). The introduction of digital technologies in the learning activity adds an additional level of appropriation to the didactic and pedagogical artefacts: the technical artefact. In a computerised pedagogical situation, the graphical interface of the LMS aims to represent, adapt and make accessible didactic objects. An instrumental conflict designates the failure of the instrumental genesis of at least one of the three artefacts at stake in a teaching-learning situation involving an ILE (Marquet, 2005, 2010, 2019).

This paper focusses on the effect of implementing pedagogical resources in an LMS for carrying out the learning activity. The analytics for each student is collected from Moodle to measure the effect of the integration of content, both inside or outside Moodle, on the scores obtained in a quiz. This is followed by the analysis of the impact of the type of implementation on the time taken to complete the quiz.

2. Literature Review

2.1 The Information Search Task

The task of finding information is central to many areas of human activity. In relevant literature, authors such as Bernstein (1993) distinguish three types of information search: (1) mining, (2) manufacturing and (3) farming. Mining, now known as data mining, is a research activity involving the extraction of information from large containers of data, known as big data. In this type of activity, the relevant information is a set of data that can become a valuable resource once it has been extracted and curated. Manufacturing information retrieval is a second-level search activity aimed at designing or creating a document, often based on the results of previous mining tasks. This type of activity sees the acquisition, refinement, assembly and maintenance of information as part of a continuous, iterative cycle. Farming information-seeking activity is a cycle and a family of continuous and collaborative information-seeking activities that may include the aforementioned activities and that are collectively carried out by groups of people within an organisation in pursuit of common, individual and changing goals depending on the situation. The study on the implementation of an information retrieval task in an LMS by Tricot and Golanski (2002) has enabled the differentiation of four variables, independent of the user or the topic addressed: (1) the repetitiveness of the task, (2) the degree of explicitness of the targets, (3) the location of the targets and (4) the quantity of the targets (Tricot, 1993). This makes it possible to characterise its implementation in an information retrieval system. Once the research results have been obtained and before being able to utilise first-level information, known as data in strategic intelligence, understanding the data is the first challenge that students face. This data is contained in texts of varying degrees of difficulty. These texts are generally expository and rarely narrative. Research into the difficulty of texts and questions shows that obstacles can arise from the organisation of the information and the familiarity with the subject matter (Rawson & Kintsch, 2002), bearing in mind that the subjects used for learning to monitor are based on all disciplines, from medicine

to nuclear energy, not to forget acoustics, the arts or even aeronautics, for example. Authors have shown that the frequency of and familiarity with the words used, as well as their level of abstraction, make texts, more or less, accessible (Beck et al., 1982; Mesnager, 2002). Similarly, the structure of the text (Caccamise et al., 2013) is another dimension to consider when assessing its difficulty.

2.2 Learning Business Intelligence (BI)

Business intelligence can be defined as all coordinated actions of the research, processing, distribution and protection of legally obtained information, useful to economic players in implementing individual and collective strategies (Martre et al., 1994). This activity requires the implementation of information search tasks. This can prove complex in the absence of a precise definition of what business intelligence covers. Marcon and Moinet (2011) underline the complexity and importance of a clear definition, in which data, as a basic material, is at the heart of a dynamic wherein the transition from strategic information to knowledge, from 'knowledge to act' to 'knowing is to act', is played out. In fact, during the learning process of business intelligence, students often confuse key concepts such as data, information, knowledge and intelligence. However, in this specific field, these concepts refer to the different stages in the processing of basic material for creating value (Degoul, 2001). This discipline relies heavily on online data collection and the use of digital technologies for data analysis, hence the importance of using an LMS.

2.3 Learning BI with Moodle

A recent study on the effect of LMSs on student performance in learning educational assessment (Oguguo et al., 2021) recommends learning and using LMSs such as Moodle. According to Gamage et al. (2022), who analysed 155 articles on LMSs from 2015 to 2020, the studies show that 'Moodle is a powerful tool used to support learning in a variety of ways'. The authors suggest that 'there is strong evidence that Moodle increases student engagement, performance and satisfaction, while improving the flexibility of their learning environments'. Research investigating students' views indicates that students agree that Moodle is easy to use and complements teaching. However, one study did not find a direct relationship between student preferences and academic performance (Cakiroglu et al., 2017). Using an LMS such as Moodle can assist students in learning business intelligence. Pedagogical resources may be integrated into this LMS or external to the environment. In the latter case, the environment simply contains hyperlinks to access them (e.g. links to videos hosted on YouTube). However, these external resources may be in very different formats and based on different graphical interfaces to that of the LMS used. In this case, the reduction of degrees of freedom, aimed at lowering the complexity of the solving process, or the maintenance of orientation to prevent the learner from losing sight of the initially set objective and to continue conducting the main task may be severely hampered despite the use of a central system, which is supposed to support these functions, because of the affordances returned by these environments, perceived or not by the learners, affordances initially returned by signs displayed on their graphical interfaces. Bruillard and Paindorge (2022) suggest that 'questions of sign are central. Difficulty in understanding them can be a major obstacle to learning'.

This study therefore aims to examine the impact of the type of implementation chosen for a documentary resource in an LMS on the performance of the instrumented activity by the learner. Therefore, the study seeks to answer the following research question: to what extent does the type of integration of a pedagogical resource inside or outside Moodle impact the results obtained in a quiz on the same environment at the end of the activity?

3. Methodology

Recent studies focusing on teaching with LMSs suggest that these platforms and the tools they contain increase engagement, motivation, collaboration (Campbell et al., 2020; Hwang, 2020; Jones et al., 2021), student performance, retention and critical thinking (Alkholly et al., 2015; Ardianti et al., 2020; Bernacki et al., 2020; Cadaret & Yates, 2018; Hempel et al., 2020; Oguguo et al., 2021). Some LMSs such as Moodle contain a learning analytics module that allows conducting research to measure student engagement (Mwalumbwe & Mtebe, 2017).

The present study analyses the traces left by the user of a GUI on Moodle, which includes several modules, from which we chose a PDF player. Moodle automatically collects learning analytics in a dedicated module. Students were asked to take a quiz on Moodle after having studied resources, hosted inside Moodle for the control group and outside Moodle on Google Drive for the experimental group. Answering the questions required studying the

pedagogical resources that contained the answers. Resources could be used by the students during the quiz realisation.

3.1 The Survey

3.1.1 Implementation of resources and performance on the quiz

Regarding the control group, we hypothesise that the integration of resources hosted on Moodle will ease the appropriation of the interface displaying the content and of the content itself, unlike for the experimental group that will have to switch back and forth between the module, the PDF, and Google Drive, resulting in the need to adopt two graphical interfaces producing instrumental conflicts between each other regarding the didactic, pedagogical and technical artefacts present in the learning situation (Marquet, 2005). This study makes the general assumption that, depending on the type of resource implementation, whether external or internal to Moodle, the additional navigation and window management activities in the graphical interface will, for the experimental group having to deal with two environments simultaneously, make it more complex to carry out their instrumented actions, resulting in lower results than those of the control group. We also hypothesise longer activity completion times will be observed for this group.

3.1.2 Sample and procedure

This research was carried out on students enrolled in a course in business intelligence and strategic intelligence at the University of Strasbourg. The activity involved dividing the total 69 participants into either the control or experimental group and required them to study pedagogical resources related to business intelligence. To this end, students had to read PDF documents hosted either inside or outside Moodle. They were asked to go through the resources, taking notes if necessary, and then take a quiz at the end of the activity related to the content studied. The students participated in two sessions, enabling the collection of pre-test and post-test measurements. Attention was drawn to the following variables: V1-SCORE – score obtained in the quiz and V2-TIME – time taken to complete the quiz.

4. Results

4.1 Performances on the Quiz

We initially performed a Levene’s homoscedasticity test, which indicated significant homogeneity between the variances of the quiz scores in the pre-test [$F(1, 67) = 0, 91; p = 0.34$] and in the post-test [$F(1, 67) = 0, 43; p = 0.51$]. A repeated measures ANOVA was performed, with the following conditions: type of resource implementation as a between-subjects factor, pre-test and post-test as within-subjects factors and total scores (V1-SCORE) as the dependent variable. An overall main effect of conditions – type of implementation of the PDF resource was found – $F(1, 67) = 201, 05; p = 0.02$ – due to the greater improvement in scores between pre-test and post-test for the experimental group using resources hosted on Google Drive compared with the control group that used resources hosted on Moodle (Tables 1 and 2).

Table 1: Repeated Measures ANOVA – Between Subjects Effects – V1-SCORE

	Sum of Squares	df	Mean Square	F	p
Group	201	1	201.1	5.64	0.020
Residual	2387	67	35.6		

Table 2: Descriptives – V1-SCORE

	Group	N	Mean	Median	SD	Minimum	Maximum
Pre-test V1-SCORE	Control group	33	6.86	5.09	4.44	1.360	18.0
	Exp. group	36	9.76	9.20	4.79	0.700	19.6
Post-test V1-SCORE	Control group	33	12.19	11.44	4.55	4.430	19.6
	Exp. group	36	14.12	15.43	4.40	2.830	20.0

4.2 Quiz Completion Time

The time (in minutes) taken to complete the quiz was subsequently studied. A repeated measures ANOVA was performed, with the following conditions: type of resource implementation as a between-subjects factor, pre-test and post-test as within-subjects factors and quiz completion time (V2-TIME) as the dependent variable. An overall main effect of conditions – type of implementation of the PDF resource – between-subjects was found – $F(1, 67) = 14, 10; p < 0.01$ – due to the greater decrease in quiz completion time between pre-test and post-test for the experimental group using resources hosted on Google Drive than that of the control group that used resources hosted on Moodle (Tables 3 and 4).

Table 3: Repeated Measures ANOVA – Between Subjects Effects – V2-TIME

	Sum of Squares	df	Mean Square	F	p
Group	1589	1	1599	14.10	<.001
Residual	7589	67	113		

Table 4: Descriptives – V2-TIME

	Group	N	Mean	Median	SD	Minimum	Maximum
Pre-test V2_TIME	Control group	33	29.3	28.8	9.79	12.92	44.9
	Exp. group	36	23.0	19.9	9.22	9.07	43.0
Post-test V2_TIME	Control group	33	28.7	29.9	7.30	10.65	45.0
	Exp. group	36	21.4	23.6	8.13	7.97	42.5

5. Discussion

The results show that the difference in score is significant between the experimental group and the control group; the experimental group obtained a better score. The difference is also significant between the two groups regarding the time taken to complete the quiz, with the experimental group completing the quiz in a shorter time. This finding contradicts our hypothesis that interface will, for the experimental group having to deal with two environments simultaneously, make it more complex to carry out their instrumented actions, resulting in lower results and longer activity completion times compared with the control group. We suggest that those results can be apprehended as one of the effects of instrumental conflicts found in LMS, which should be apprehended both as a complexifying and a facilitating factor for learning.

Studies on theories of cognitive information processing indicate that our cognitive systems have a limited capacity and that learners must therefore select those that best match their objectives (Clark & Mayer, 2011). Furthermore, the process of finding information with multimedia is complex by relying on the cognitive processes of representation (Mayer, 2005) as well as the process of regulation, analysis and synthesis and which mobilises numerous skills around the identification of a problem, the search for information and the scanning and processing of information (Wopereis et al., 2008). To carry out the instrumented action, we therefore suggest that learners differentiate the tasks of studying resources, from the task of completing the quiz, as these tasks require the use of specific instruments, differentiated by the nature of the task to be completed. The use of a hosting platform such as Google Drive, whose primary purpose is not to assess learners but to make documentary resources available, along with the LMS Moodle, dedicated to carrying out the quiz, encouraged better differentiation of the tasks among the learners in the experimental group, thus enabling them to obtain better results.

In other words, the learners in the experimental group were able to produce actions that met the diversity of criteria they had explicitly expected their actions to meet (Rabardel, 2005). We understand these uses in response to a Moodle misaffordance (Beatty & Nunan, 2004) comprising a feature or property of the object, which diverts the object from its intended use: how can Moodle as an LMS help students achieve better results and succeed by providing documentary resources and simultaneously be responsible for assessing their knowledge in a quiz, in complete impartiality?

The answer to this question invites us to reconsider the issue of integrating a resource in an LMS; integration would not only be apprehended from a technical standpoint, between the search for the best possible

articulation between several educational technologies, but also from an instrumental standpoint, in order to find the best possible articulation between the prescribed task, its requirements, the underlying actions to complete it, and the proposed instruments for carrying it out (Rabardel, 2005).

6. Conclusion

This study evaluates the impact of the implementation of pedagogical resources in the LMS Moodle on the realisation of a learning activity, depending on whether the resources are implemented within the LMS or outside it, on Google Drive. The results reveal that the effects of instrumental conflicts resulting from a problem of integration between didactic, pedagogical and technical artefacts modify the results of action instrumented with an LMS and the means of obtaining them. A greater improvement can be observed in scores between the pre-test and the post-test for the experimental group using resources hosted on Google Drive that were not integrated into the environment, compared with the control group that used integrated resources hosted on Moodle. Those instrumental conflicts are so pervasive that the time taken to complete the quiz between the pre-test and the post-test was shorter for the experimental group, who paradoxically had to use two different environments with graphic interfaces that bore little resemblance in terms of iconography. The limitation of this study is that it only used desktop computers and only one LMS, Moodle, and one cloud storage solution, Google Drive. Further research could be based on mobile terminals using others LMSs and cloud storage systems.

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