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A Framework to Identify Students at Risk in Blended Business Informatics Courses: A Case Study on Moodle

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Vassilis Zakopoulos[1]

Abstract:

Purpose: *Students at risk is a cardinal problem. Students' failure has a negative impact on many areas. Students are more liable to fail in courses that call for specific skills' development. A typical paradigm is the Business Informatics courses which combine digital and business skills. The research objective is to address the problem of students' failure in blended Business Informatics courses by identifying students who are liable to fall through.*
Design/methodology/approach: *Students' data in regard to enterprise and informatics skills were analyzed in terms of a binary logistics regression with a view to developing a model to identify students at risk. A binary variable was modeled to describe students at risk and students not at risk. The students' data constituted the independent variables in our regression analysis whereas the variable describing students at risk was the dependent variable. The students' data was collected by well- designed students' learning activities on Moodle. The data was collected after the first course-run. The regression analysis outcome was a classification table indicating students at risk.*
Findings: *The number of laboratory exercises completed along with the self-test's assessment completed were the main risk factors for this Business Informatics course. Given that the laboratory exercises were implemented through Moodle and were explained during conventional laboratory lectures, it appears that both the e-learning part and the conventional part plays a significant role in students' critical achievement in terms of this specific Business Informatics course. In parallel, factors related to practical skills' development (laboratory exercises completed)[1] have appeared to assume a cardinal role in students' final learning outcome.*
Originality/value: *The originality of this research lies in the fact that the issue of identifying students at risk is not addressed in a fragmentary way by just carrying out a specific analysis and coming up with results, like many similar studies in the literature. Thereby, a concrete methodology was developed on the basis of an established generic risk management framework. Therefore, the identification of students at risk is included in the phases of a potent framework. The added value of this research is centered on the fact that this model could potentially be applied to any Business Informatics blended course in order to come up with the respective risk factors. In parallel, this model could be verified by being applied to a plethora of Business Informatics blended courses with a view to generating a prediction model for students at risk for Business Informatics blended courses that share the same learning design.*

Keywords: *Business Informatics, blended courses, risk model, risk factors, students at risk.*
Paper Type: *A research study.*

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[1]*Corresponding Author, Laboratory Teaching Staff, Department of Accounting and Finance, University of West Attica, Greece, v.zakopoulos@uniwa.gr;*

1. Introduction

Business Informatics is an inter-disciplinary science which is built upon the principles of many scientific fields (Markov *et al.,* 2008). According to Helfert and Duncan (2006) 'Business informatics centers on information systems architectures and takes an active role in aligning business strategy, business processes, and information technology' (p. 231). Business Informatics aids managers, executives and general staff to come up with a solution to a variety of enterprise problems by developing digital and enterprise skills. The digital skills refer to the efficient use of technology to answer the previously-cited purpose. The enterprise skills refer to the efficient use of Business principles for the purpose of addressing the enterprise problems (Zabukovšek *et al.,* 2020).

However, the development of both digital and enterprise skills assumes a rudimentary knowledge take in. Thereby, the principal goals (learning objectives) of a typical Business Informatics course are (Baser *et al.,* 2017):

1. to provide the fundamental theoretical background in relation to the entire field in which the dimensions of Business Informatics lie;
2. to familiarize learners with digital and enterprise skills;
3. to help learners to apply the theory in order to come up with a solution to real enterprise problems;

In that spirit, Business Informatics courses could be either deemed as fully online courses or as blended ones. In Higher Education in a wide range of academic disciplines, new teaching methods and pedagogical approaches and models have been adopted and applied thanks to the innovative technological tools and applications that swiftly became available. Blended or hybrid learning, which combines traditional face to face classroom methods (with technology mediated) and on-line educational material (Garrison and Kanuka 2004; Vaughan 2007; Garrison and Vaughan 2008) became soon very common to many academic institutes. In the case of blended Business Informatics courses, the e-learning part is implemented through the use of a competent Learning Management System (LMS) like Moodle.

An LMS provides valuable data which enables instructors and educators to monitor the entire learning process. As a consequence, educators get an overall picture of their electronic class (Krupcala, 2021). Given that Business Informatics courses combine digital and enterprise skills, the assessment of students' competence in the development of the requisite skills is not an easy task in terms of the conventional course delivery mode. Though, by taking advantage of an LMS potential, the underlying assessment could be easier in terms of an e-learning course delivery mode. In parallel, the task of identifying students who are liable to fall through a Business Informatics course could be easily implemented in terms of e-learning courses or in terms of blended courses. On this ground, a lot of Business Schools have included blended Business Informatics courses in their curriculum.

In this paper, we propose a potent framework to identify students at risk in blended Business Informatics courses. Our framework is applied to a specific Business Informatics course, the e-learning part of which is implemented on Moodle LMS. Our framework is based on the development of a competent risk model that is built in the context of students' interaction with the learning activities which are designed to reflect the extent of students' competence in the development of Business Informatics skills.

2. Literature Review

A study conducted by Wu and Liu (2013) concerning students' attitude towards blended courses, has indicated that in general, students show positive attitude towards blended courses and that factors affiliated with learning climate, perceived enjoyment, perceived usefulness, system functionality, social interaction, content feature and performance expectation are also significantly related to students' satisfaction in blended courses. Also, Wang (2018) in another study, has proved that a lot of students who attend blended courses not only show positive attitude towards these courses but they also achieve better results in the context of their performance in comparison to students enrolled in conventional courses.

Some other studies have addressed the issue of students at risk in e-learning courses by analyzing students' data in regard to their interaction with Moodle LMS (Macfayden and Dawson, 2010; Georgakopoulos *et al.,* 2018; Anagnostopoulos *et al.,* 2020). In parallel, a couple of studies deal with the issue of students at risk in blended courses by developing proper risk models that identify the risk factors of students' failure in the respective courses. These studies have proved that students' interaction with Moodle or with Ms-Teams is a critical factor that affects their final learning outcome (Georgakopoulos *et al.,* 2020; Zakopoulos *et al.,* 2021).

Though, the studies mentioned above have also indicated that the risk factors are course oriented. Therefore, it is difficult to find a risk model that is suitable for all blended courses. However, these studies have pointed out that there is great probability that a same set of factors affects students' critical achievement in blended courses with the same learning design, denoting that it is possible to come up with a risk model for students at risk in blended courses with the same structure.

Nevertheless, there is no substantial reference to studies relating to students at risk in Business Informatics courses. Given that the successful culmination of Business Informatics courses calls for specific skills' development, students' evaluation should be based on the assessment of their competence regarding the requisite enterprise and informatics skills (Baser *et al.,* 2017). Thereby, there is much space for scientific output in that field, focusing on the development of a concrete framework to deal with the issue of students at risk in Business Informatics courses.

3. The Research Objective

Our research interest is centered on identifying students at risk in blended Business Informatics courses. Our endeavor is directed into developing a risk model which will decide on students at risk after the first course-run. Students at risk are considered to be those on which the risk factors have effect. The risk model is based on a proper analysis of the data related to students' involvement in the learning activities. In our study, the e-learning part is accomplished by well-orchestrated activities on Moodle.

4. Research Methodology

Our research methodology consists of the following stages (Vose, 2008; Georgakopoulos *et al.*, 2018):

1. Data Collection;
2. Risk Model Development;
3. Prediction Model Generation;

4.1 Data Collection

The data collection process is centered on gathering all students' behavioral engagement data in regard to the conventional and e-learning part in the course delivery process. Regarding the e-learning part, a lot of statistically meaningful data are stored into Moodle log files such as:

- Students' total Logins into the System;
- Resources viewed by Students;
- Students' grades on activities;
- Activities completed;

However, there is not so much meaningful data which are interrelated to the conventional part which could be easily measured except data related to students' attendance.

4.2 Risk Model Development

The collected data is being analyzed in terms of appropriate machine learning or statistical techniques with a view to building a model which will decide on students at risk (Macfayden and Dawson, 2010; Georgakopoulos *et al.*, 2018; 2020; Anagnostopoulos *et al.*, 2020; Zakopoulos *et al.*, 2021). In our case we employed a binary logistics regression analysis to answer this purpose.

Being more elaborate, through the use of the previously cited techniques, students could be classified into appropriate groups. In our case, students were classified into

students at risk and into students not at risk (Macfayden and Dawson, 2010; Georgakopoulos *et al.,* 2018; 2020; Anagnostopoulos *et al.,* 2020; Zakopoulos *et al.,* 2021). In parallel, it is important to stress the fact that the classification is being implemented in the context of a specific numeric threshold which is called 'cut value'. In our case, the cut value was reflected by the number 5.

4.3 Prediction Model Generation

Afterwards, the risk model is applied to a plethora of courses sharing the same learning design. In the case that the risk model achieves a high classification percentage the risk model will lead to a prediction model. In any other case, the whole process is reviewed, and new data is collected in order to come up with another risk model. This paper focuses on the risk model development. The prediction model generation is in the pipeline.

5. Applying the Research Methodology

Our methodology was applied to a specific Business Informatics course delivered at the faculty of 'Accounting, Finance and Social Sciences' at the University of West Attica. The respective Business Informatics course is divided into two parts, the e-learning part and the conventional one. The e-learning part also breaks down into two main parts. The first part (theory) is related to the theoretical background that includes multimedia material in the format of slides which aims at familiarizing students with the fundamentals of Business Informatics, being aware of the Business Informatics principles (Zabukovšek *et al.,* 2020).

Students can also evaluate themselves by performing appropriate self-assessment tests. The practical part is implemented by a set of practical exercises in the format of enterprise scenarios with a view to aiding students to develop practical Business Informatics skills. The cardinal exercise is implemented as a project in the context of which students have the opportunity to test themselves in a real case. These learning activities are implemented on Moodle in order to enable educators to monitor the entire learning process.

The conventional part includes a series of well-planned laboratory lectures through which students can get feedback on questions bearing on the theoretical background. In parallel, these lectures equip students to deal with real enterprise problems. A meaningful set of data is elicited by the students' involvement in the previously cited activities. This data set includes:

- Total Number of Students' logins into Moodle;
- Total Number of slides completed;
- Total Number of self-assessment tests completed;
- Total Number of laboratory exercises completed;
- Total Number of absences (measured in terms of the lectures);

- Average grade on self-assessment tests;
- Average grade on laboratory exercises;
- Average grade on project;

Students at risk were considered those who achieved a final grade less than five (5). The final grade was calculated as the average grade of all graded activities (self-assessment tests, laboratory exercises and project). Three hundred (300) students participated in the course.

We modeled the binomial variable student risk to describe students who were about to fail the course as it is suggested in several studies (MacFayden and Dawson, 2010; Georgakopoulos *et al.*, 2018; 2020; Anagnostopoulos *et al.*, 2020). The state zero (0) was modeled to indicate students not at risk whereas the state one (1) was modeled to indicate students at risk. The student risk variable along with the variables modeled to reflect the data elicited were employed in terms of a binary logistics regression analysis in order to come up with the risk model. It is also important to denote that the engagements' data described by the respective variables were measured two weeks before the end of the course.

6. Results

The risk model for the course (Table 1) accounts for 87.8% (Nagelkerke R Square) of the risk factors denoting that only 12.2% of the liable risk factors is not identified. Thereby, there are a small number of factors that could potentially lead to the students' failure which is not identified through the use of our model. This argument is also enhanced by the fact that the Nagelkerke R square value was close to 1 (0.878), denoting a good ft to the results (Allison, 2014; Menard, 2000; Smith and McKenna, 2013).

Table 1. *The Regression Model Fitness' Metrics*

Metric	**Value**
Nagelkerke R Square	0.878

Source: *Own study.*

The classification potential of our model is indicated into Table 2.

Table 2. *Classification Percentage*

Overall Classification Percentage	88.8

Source: *Own study.*

The model achieved an 88.8% correct classification percentage (Table 2) indicating that only 11.2% of the cases are not correctly classified, meaning that a small portion of students who were not at risk were classified into students at risk.

Table 3. points out the real risk factors according to the Sig. Value. The column B. on Table 3 shows the coefficients that are entered into the regression model.

Table 3. *Coefficients*

Coefficients	**B (Coefficient Value)**	**Sig**
Number of self-assessment tests completed	-1.27	0.02
Number of laboratory exercises completed	-2.974	0.002

Source: *Own study.*

The column B on Table 3 indicates that the risk factors for the respective Business Informatics Course are the number of laboratory exercises completed and the number of self-assessment tests completed. According to the contribution of the risk factors to the risk occurrence, the major risk factor is considered to be the number of the laboratory exercises completed. Thereby, students at risk in the context of the underlying course could be identified among those who have not completed a sufficient number of laboratory exercises along with a sufficient number of self-assessment tests.

7. Discussion

The risk factors for the underlying course clarify that the number of laboratory exercises completed critically affects the students' final learning outcome. Therefore, a factor that is related to the practical skills development has proved to be critical in the specific Business Informatics course. In parallel, a factor that is related to the theoretical knowledge gain (self-assessment tests) is considered to be significant in this respective Business Informatics course.

However, it is essential to stress the fact that the grade on project hasn't proved to affect students' final negative learning outcome, indicating that students who managed to complete the laboratory exercises could potentially manage to deal with the real enterprise problem. Consequently, the laboratory exercises (skills development) equipped students to level up their competence extent by culminating the entire project.

Another important finding is that the e-learning part assumes a cardinal role in the respective Business Informatics course given that self-assessment exercises which are mounted on Moodle LMS has proved to be a decisive factor that is related to students' performance. Though, the laboratory exercises which have proved to be the major decisive factor are implemented in terms of the e-learning part. It is important to direct attention into studies that have also proved the contribution of the e-learning part in students' performance in blended courses (Georgakopoulos and Tsakirtzis, 2021; Tsakirtzis and Georgakopoulos, 2020).

Nevertheless, the completeness of the laboratory exercises is aided by the laboratory lectures which are delivered in terms of the conventional part. As a consequence, it is vital to point out that both the conventional and the e-learning part play a cardinal role in students' final learning outcome for that respective course, implying that both parts (conventional and e-learning) could be considered to be significant in blended Business Informatics courses.

8. Conclusion

The paper demonstrated a potent framework to identify students at risk in Business Informatics courses. Additionally, the paper proved that the skills developed by the implementation of the laboratory exercises is a principal factor that affects students' critical achievement in the respective blended Business Informatics course. Though, more courses are needed to argue that the underlying risk factor holds for any blended Business Informatics course.

Our team is currently working on applying our model to a plethora of courses in order to verify the model with a view to generating a prediction model for students at risk in Business Informatics courses.

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