A FRAMEWORK TO TEACH ERP SYSTEMS IN AN UNDERGRADUATE BUSINESS SCHOOL

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Abstract

Since the 1990’s higher education institutions (HEIs) have been making attempts to incorporate Enterprise Resource Planning (ERP) systems in their business undergraduate curricula. Additionally, all major global ERP vendors have invested in establishing academic alliances to assist higher education institutions in their efforts to provide students with necessary industry skills. However, simply using an ERP system (as presentation means) in a taught component is not enough to meet the predefined course learning outcomes, unless the latter are coupled with hands-on experience and both integrated into a teaching framework. This paper draws from the extant literature and follows a documented methodology for identifying relevant sources. The sources of the works consulted and cited were benchmarked with respect to impact factor or peer review, and include academic journals, books, and conference proceedings in higher education. As a next step, sources were analyzed by matching their methods and results against the principle of constructive alignment in higher education. The analysis results identified key areas where the existing literature is incomplete and needs further enrichment. Moreover, results showed lack of a comprehensive method for “teaching ERP systems”, including teaching methodologies, assessment practices and learning theories relevant to the Information Systems discipline. This paper is introducing a framework for guiding faculty into effectively teaching an ERP Systems course to undergraduate business students. The guidelines for synthesizing the framework rely on three axes, namely, learning theories, the results from the analysis of current literature and the empirical observations drawn from teaching an ERP Systems course in a business school for the past 4 years. This paper concludes with recommendations for further research, mostly relevant to quantitative studies on the performance of teaching and learning strategies relevant to ERP systems in higher education.

Keywords: ERP systems, teaching and learning, literature review, framework, constructive alignment.

1 INTRODUCTION

Enterprise systems have evolved to mission critical information systems in today’s business world. Higher Education institutions around the world, responding to the demand for new skills in business courses, have tried to integrate in their curriculum courses relevant to the study and implementation of enterprise systems in various fields. While the study of enterprise systems is primarily relevant to the information systems discipline, other disciplines have tried to integrate enterprise systems in their modules. In order to get synchronized with this trend, major software providers such as SAP, Oracle, Microsoft have created academic alliances and academic programs to provide training material relevant to the study of enterprise systems for university courses. In this context, universities have acquired access to enterprise systems in order to provide their students with a hands-on experience. However, by simply providing hands-on practice to such solutions does not necessarily lead to an improved learning experience (as cited in Laosethakul, Tarasovich, & Boyer, 2016). Introducing a course in Enterprise Systems in an undergraduate Business School, we faced similar challenges as others did, while the use of an Enterprise System by itself could not guarantee meeting the learning outcomes of the course. The literature on teaching ERP ranges as early as 1999 [2] where the sources used were relevant to teaching information systems using actual systems enabling students to have a hands-on experience. Since then, these systems have evolved not only in terms of user interface but also in terms of functionality and areas of application [3]. The need to introduce a hands-on approach was identified as early as 2003 [4], for the purpose of satisfying the demand from the industry. However, meeting this demand would not be satisfied simply by asking students to follow instructions and complete certain steps using the software (as cited in [5]). This paper seeks to conduct an analysis of the accessible literature, in order to identify trends and patterns in terms of responding to the question “How to effectively teach ERP in an Undergraduate Business School”. The rationale behind this research is to
identify gaps within the literature in terms of theory, methodologies, areas of application, types of analysis (qualitative or quantitative) and successful and unsuccessful ways of introducing ERP systems in such a context. As these systems continue to evolve, we need to continue investigating about forms of learning, that best support student learning. The paper follows a structure that includes the methodology used for data collection and analysis, the results, a discussion on the course we teach on Enterprise systems, the use of constructive alignment and the outcomes from its use.

2 METHODOLOGY

The methodology used in order to identify trends, patterns and gaps, involves a dual approach. In order to identify relevant pieces of work, we conducted a literature review, on the topic “teaching ERP in Higher Education”. Then, we performed an integrative review on the works identified by our bibliographic search. The objective of the integrative review was to identify Methods of teaching, Theories applied and Disciplines where ERP is taught, as well as any relationship between these elements. Apart from conducting statistical analysis and data mining on the data recorded, we also used a text analytics approach in order to provide a quantifiable way into findings. The methodology of the bibliographic search is described for both approaches in the following sections.

2.1 Data search and data collection

The team used Google Scholar, and EBSCOHost to identify works relevant to the research area. Those works were identified by using keywords such as Query 1: “Teach ERP”, and Query 2: “ERP Higher Education”. Those search terms were selected since they represent the essence and focus of our research. We also used online journals dedicated to research with respect to higher education. Most of this data was automatically transferred to an excel spreadsheet using the “publish or perish” tool. We identified 214 entries from Query 2, 156 entries from Query 1, 52 entries from EBSCOHOST and Journals on Education. A total of 422 entries were identified and were stored with data relevant to those works such as authors, title, year of publication, source, publisher, number of citations, and URL articles in a Microsoft Excel® spreadsheet.

2.2 Data Cleansing

Having collected the relevant articles and works, the second step was conducted in order to identify which of those works are relevant or not to our field of study. This step, consisted of (a) recording all entries in an MS-Excel spreadsheet, and (b) identifying double entries in the two search sources. Then, we rejected sources based on the fact that they were (a) not relevant to the research area, i.e. teaching ERP in Higher Education context, (b) relevant but had “Work in Progress” designation, and (c) Language barrier (not in English).

2.3 Data Pre-processing

At this stage, the entries that passed the criteria defined, were 94, and the relevant documents were loaded to Mendeley Desktop©. Subsequently, we performed corrections with respect to the metadata of the documents, such as incomplete author’s list, wrong type of source (journal, conference, book, etc.) missing abstract, or keywords. For purposes of quantitative analysis, text mining, we performed further processing on the 94 documents by removing headers, footers, figures, tables, abstracts, keywords, references and any text relevant to the publishing entity of the document. We then transformed the documents from a pdf to a simple text document which was then processed by means of text analytics. Out of the 94 documents, 4 were not appropriately transformed into text and were therefore excluded from the text analytics processing.

3 LITERATURE REVIEW ANALYSIS

3.1 Text mining

Using the text files from all 90 sources, we processed them through the text mining software Voyant Server® and produced the following visualizations. Preceding the visualizations, we removed stop words and produced the following word cloud. The word cloud is a visual representation of the terms that occur most frequently in the corpus. While its significance is not that important, since the absolute occurrence of terms might not be revealing any trends or patterns; it does, however, give an indication of focus
areas, where the researcher might want to further investigate. The color and position of the terms is not representative of its value. In Fig. 1, the most revealing terms are ERP, Business, Students, Learning, Systems, SAP, Process, Knowledge, Course, Game. These terms are significant and relevant to our research. These terms are validated in the course of our study by other methods such as data mining. Moreover, these terms are relevant to Higher Education, the concept of ERP and business processes, the fact that SAP is the world leader in ERP systems, and gaming as a method of teaching and learning. Moreover, the word cloud can be used as a first step validation in terms of the representativeness of the corpus.

A second visualization, collocates graph, represents the major terms identified in the corpus and the links with other terms closely identified in the corpus. This visualization is like a force directed network graph. The collocation graph while is not new, it has been recently recognized as an important corpus analytical technique [6].
The collocates graph represents in blue color the terms which most frequently appear. The larger the frame the highest the frequency. Each one of those terms is linked with a number from the other items. The size and the color of those terms are indicative. According to Fig. 2, “Processes” is closely related with “understanding”, “business”, “erp”, “learning” and “systems”. Actually, these terms are describing the reason behind this research, i.e. teaching ERP systems in such a way so as to enable students to learn how business processes are run [7]. Moreover, the terms “game” and “play” are displayed linked to each other as a proof of their relevance since a number of sources in the corpus have focused on simulation games.

3.2 Data Mining

To identify the patterns of the bibliography available, we recorded two types of data, namely categorical and numerical, for each of the available and selected sources:

- **Categorical data**: Individual authors (maximum 6), Title, Abstract, Theoretical Support (the name of the theory, framework, model used to support their research), the type of source, i.e. Journal, Report, Conference, Thesis, or Book Chapter, the discipline served i.e. Information Systems, Business, Accounting, etc., the year of publication, whether there was statistical analysis conducted or not (1/0) or (Yes/No), the objective of the work reviewed and the teaching method used.

- **Numerical data**: number of authors per item, number of citations, and number of distinct theories/models/frameworks used in each item.

These data were recorded into a .csv file and were loaded into Orange Data Mining Software® to gain insights from the analysis of the metadata of the corpus.

The scatter plot on Fig.3, reveals the fact that most sources with a high number of citations were published in a Journal. Moreover, to a large extent, the sources with a high number of citations after 2011 conducted statistical analysis either to guide their research or to evaluate the method used. Furthermore, those sources objective was to evaluate a teaching method. In order to provide a better visualization, we used the Jitter function to single out sources which otherwise would be on top of each other. That is why some of the observations appear below the “0 number of citations” axis line.

Figure 3: Citations per Year of Publication, colored region by Source Type, shaped by Research Objective, labelled by Statistical Analysis performed (Yes/No).
The scatter plot on Fig. 4, reveals three main colored areas according to the teaching method. The ones that prevail are “simulation game”, “specific” (meaning a specific methodology was described, and the “not specific”, meaning there was no specific methodology described in the source. In order to provide a better visualization, we used the Jitter function to single out sources which otherwise would be on top of each other. That is why some of the observations appear below the “0 number of citations” axis line. Fig.2, demonstrates that sources with no specific teaching method were mostly published, prior to 2008, while after 2008 and we can identify sources with specific teaching methods, one of which prevails and is the use of simulation games. One disconcerting finding is that a lot of sources have not employed any theoretical support to their work. This fact is best identified in the following table.

<table>
<thead>
<tr>
<th>Theoretical Support by Teaching Method</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>2.22%</td>
<td></td>
<td></td>
<td></td>
<td>2.22%</td>
</tr>
<tr>
<td>Not specific</td>
<td>22.22%</td>
<td>3.33%</td>
<td></td>
<td></td>
<td>25.56%</td>
</tr>
<tr>
<td>Simulation</td>
<td>1.11%</td>
<td></td>
<td></td>
<td></td>
<td>1.11%</td>
</tr>
<tr>
<td>Simulation game</td>
<td>17.78%</td>
<td>7.78%</td>
<td>1.11%</td>
<td>1.11%</td>
<td>27.78%</td>
</tr>
<tr>
<td>Specific</td>
<td>32.22%</td>
<td>10.00%</td>
<td>1.11%</td>
<td></td>
<td>43.33%</td>
</tr>
<tr>
<td>Grand Total</td>
<td>75.56%</td>
<td>21.11%</td>
<td>2.22%</td>
<td>1.11%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

According to Table 1, 75.56% of the sources have no theoretical support, i.e. they have employed no theory, framework or model to guide their research. This is a major concern, in terms of the validity of the research produced. The theoretical framework choice guides the researcher in terms of the design of the research as well as the way in the way of data analysis [8]. Furthermore, it enables other researchers to better relate to the study and decide on its relevance to other areas of study(as cited in [8]). This demonstrates the need to guide our research and practice, based on a theoretical perspective, in order to be able to explain the outcomes of the teaching and learning efforts in higher education.
Moreover, research effort of around 30%, has gone into simulations. Unfortunately, only a third of those works has used some theoretical background, leading to a sound explanation of the outcomes as well as, the thinking behind the design of the teaching methods.

### 3.3 Literature Review Conclusion

Concluding, the literature review demonstrates a gap in the use of theoretical tools. Moreover, the sources describing assessment methods, did so with the objective assess the learning. This fact indicates the lack of intention to use the assessment as a tool which enables the student to learn through the feedback loop. Moreover, while several sources (13%) in the corpus have based their research on Experiential Learning, they have missed the point of employing reflective writing as a means for students to contemplate on their hands-on experience [9], whether simulated or not towards enhancing their learning. In addition, there is a lack of a comprehensive framework in the corpus, which will enable the instructor to design the course content in such a way that all activities point to the learning outcomes. The latter is supported by the principle of Constructive Alignment. The principle of Constructive Alignment is to ensure that all Teaching and Learning Activities (TLA), which also include assessments, guide students towards achieving the intended learning outcomes of the course.

### 4 THE TEACHING FRAMEWORK

The Management Information Systems (MIS) bachelors' program accepted its first student cohort in autumn 2014. By design, this program included a required course (module) on Enterprise Systems. Since the first time this course was offered, we integrated the SAP ERP system, capitalizing on our membership in the SAP University Alliance, together with supporting teaching material and a case of a virtual company named Global Bikes. A principal ingredient in the course delivery was the alignment of the course Learning Outcomes (LOs) with the assessments and the TLAs. While having access to a real system was a breakthrough for the academic department and the business school, it was evident that the complexity of an ERP system had to be dealt with in the most effective and efficient way. The literature suggests that just by providing a hands-on experience does not really contribute to the learning of the students in terms of the respective learning outcomes [10]. The two generic learning outcomes were the following (drawn from the course syllabus):

1. Explain the role of Enterprise Systems within an organization and of the various challenges and impacts related to their implementation.
2. Apply ERP systems that will facilitate the management of business processes, in given context.

Additionally, the MIS bachelor’s program was validated by the Open University UK Validation Services (OUVS), meaning that the course syllabus (module description) was constructively scrutinized by expert colleagues of the OUVS before it was approved. Based on the above LOs, we designed two summative assessments: a written midterm examination comprising of essay questions and a research project. Through the midterm examination, we assess the first learning outcome, while through the project we assess both LOs. The delivery of the course was designed under the principle of constructive alignment, where all course activities are designed in such a way that they assist students in meeting the intended learning outcomes [11], [12].

#### 4.1 Teaching and learning activities (TLAs)

The course is delivered using the typical instructional delivery method enhanced by in-class group and individual case study analyses, role-playing games, presentations and discussions on various topics, ranging from Integration, Business Processes, Implementation Methods, to Success and Failure of ERP implementation. Moreover, covering key theory points during lectures, the instructor uses gamification techniques such as the use of Socrative© web-based and mobile student-response system. In this way, students and instructor reflect on whether these key points are assimilated and as a result, students are actively engaged in discussing the appropriateness of their answers provided in real time. In addition, students undertake formative assignments using the concept of Flipped Classroom, where a topic is assigned to them before it is discussed in class or online. All formative assignments are delivered through a web-based Course Management Systems (CMS) platform, Blackboard©, and the instructor provides online feedback on the student’s submission. Prior to the midterm examination, a formative examination is delivered. Following this examination, apart from the feedback, the instructor provides a collation of appropriate and inappropriate answers, anonymously, and the students engage in discussions on the topics examined. The feedback provided by the instructor is of paramount
importance, since students can always go back and check their submission and the instructor’s notes and therefore promotes their learning in view of the activities left to complete. The feedback is an integral part of the assessment cycle and a cornerstone in the Assessment for Learning (AfL) [13].

After the summative midterm examination, students need to prepare a proposal for their research project. At this point, for the completion of the course, students are required to follow two parallel paths which meet to become one in the end: one is the project management path towards the submission of the research project, and the second one, is the hands-on experience with the ERP system in the computer laboratory.

4.2 ERP System teaching and learning method

It is important to state that the ERP system is not considered as a separate module, rather it is an integral part of the teaching and learning framework. The material provided by SAP is divided in four (4) different categories; (a) Introduction to the GBI company, its structure and operations, (b) terminology of the data and the relevant processes in SAP ERP, (c) a set of exercises for various processes such as Sales and Distribution, Material Management, etc., and (d) a set of case studies which require from the student to complete a process through its various tasks, simulating a real process taking on different roles from different functions. Students are asked to write a research paper on the “Implementation of ERP systems” in a given industry/functional area, focusing on issues such as “Impact of ERP, Business Processes, and Middleware and ERP”. They are also asked to complete a process chosen from Sales and Distribution, Material Management or other processes, which is relevant to the topic they have chosen. The case studies are designed in such a way, that it is moderately easy for a business student to complete since they include screenshots of the various tasks, as well as a narrative on the different tasks and roles the student will undertake. The importance, however, lays on the fact that students should “discuss the way information flows between the different tasks and different business functions and differentiate on how things would have been, without the use of such a system”. This requirement challenges students to move away from clicking-through and direct their focus on the business process aspect and the importance of functional integration. Moreover, this requirement enables students to shift their understanding from the specific case, Global Bikes, to their own area of study. This activity is compliant to the fifth level of understanding, “Extended Abstract”, according to SOLO[11]. SOLO describes the different stages of a student's learning progression in various tasks. The stages include “Prestructural”, where the student has not understood the intended outcome, the “Unistructural”, where the student has demonstrated some understanding, the “Multistructural”, where the student has demonstrated a deeper understanding but is lacking in understanding the whole idea of the task. The fourth level of SOLO is the “Relational” where the student not only has comprehended and completed the task but has also demonstrated an understanding of the “big picture” as well as on how the different items contribute to the whole meaning. The last stage, titled as “Extended abstract”, where students can generalize and provide a mental link to the use in a different context. Finally, the students are asked to discuss their experience “with respect to the use of the ERP system to support a business process”. The latter is feeding into the reflective aspect of the assessment, a significant component of constructive alignment principle. With respect to process, the class meets twice a week to gain understanding on the Company and two different business processes. Moreover, the instructor uses Socrative ©, to assess the level of understanding and engage them in discussions leading to higher level of learning. The role of the instructor is supportive, and students slowly become more independent in their learning. A Q&A section is created on the learning platform and students post their questions, and the instructor provides guidance, enabling the whole class to have access to the clarifications provided. Moreover, SAP provides a monitoring tool which enables the instructor to check the progress of each student. This tool is also used to identify to the students the kind of errors they have done, and how this impacts their process. The use of this tool has proven to be quite significant since it enables the instructor to stress the importance and the impact of functional integration in a business context. Students then understand how these mistakes can impact a company. One important finding is that, when they compile their learning into their research project they can then relate their experience to the reality of the business world, an outcome of Experiential Learning [14][7].
Figure 5 displays the proposed framework, with its various activities as they escalate over a semester. Each activity is linked to its supportive theoretical construct. There is a progression from lower levels of understanding to higher ones according to the Structure of the Observed Learning Outcome (SOLO) taxonomy [11].

### 4.3 Evaluation of the teaching methods

The metrics in regard to the evaluation of the instructor’s teaching methods from students taking the course, are available in the following table.

#### Table 2: Course Evaluation results.

<table>
<thead>
<tr>
<th>Survey Year</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>Q5</th>
<th>Q6</th>
<th>Q7</th>
<th>Q8</th>
<th>Q9</th>
<th>Q10</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>7</td>
<td>11</td>
<td>44</td>
<td>43</td>
<td>7</td>
<td>4.4</td>
<td>4.3</td>
<td>4.57</td>
<td>7</td>
<td>-</td>
<td>4.20</td>
</tr>
<tr>
<td>2016</td>
<td>0</td>
<td>13</td>
<td>43</td>
<td>42</td>
<td>8</td>
<td>4.25</td>
<td>4.18</td>
<td>4.38</td>
<td>8</td>
<td>4.35</td>
<td>4.25</td>
</tr>
<tr>
<td>2017</td>
<td>12</td>
<td>17</td>
<td>41</td>
<td>40</td>
<td>12</td>
<td>4.26</td>
<td>4.26</td>
<td>4.20</td>
<td>12</td>
<td>4.30</td>
<td>4.20</td>
</tr>
<tr>
<td>2018</td>
<td>18</td>
<td>16</td>
<td>47</td>
<td>45</td>
<td>11</td>
<td>4.30</td>
<td>4.30</td>
<td>4.30</td>
<td>11</td>
<td>4.30</td>
<td>4.30</td>
</tr>
<tr>
<td>Total</td>
<td>56</td>
<td>50</td>
<td>62</td>
<td>60</td>
<td>36</td>
<td>4.37</td>
<td>4.37</td>
<td>4.37</td>
<td>36</td>
<td>4.37</td>
<td>4.37</td>
</tr>
</tbody>
</table>

It is interesting to note that on a 5-point scale, the scores are quite high, considering that this is a relatively new course, offered few times, and students who register in this course are not only in the MIS program but in business programs like Logistics and Management. Special attention should be given to the score in questions:

- “The course materials helped me understand the subject” – 4.18,
- “The instructor’s teaching methods helped me acquire knowledge on the subject” – 4.23, and
- “The instructor provided adequate preparation for exams and/or assignments”. These scores demonstrate students’ recognition of the value in this course and verify to an extent the effectiveness of the teaching and learning framework.

### 5 CONCLUSIONS

This paper suggests a holistic approach of teaching ERP Systems in the context of a Business School. The analysis on the corpus created, demonstrated that a lot of research efforts has been directed towards simulations and evaluation of teaching methods. However, the literature revealed a weakness
in the lack of theoretical support in the vast majority of the accessible sources. The innovation we are introducing has its basis on the idea to use data and text mining techniques to gain insights into a large number of documents which were processed not only algorithmically but also manually. Moreover, we contributed to the teaching and research community by constructing a framework based on the principle of Constructive Alignment, which is comprehensive and Holistic by design. The teaching and learning method was discussed to a certain level of detail enabling the reader to link the TLAs to theories, and frameworks, ensuring that the students will meet the learning outcomes irrespective of what those learning outcomes maybe.

6 LIMITATIONS AND FUTURE RESEARCH

The findings, especially the ones resulting from text and data mining, are subject to critique since they are limited to the number of works that we had access to. However, the results demonstrate that the topics identified are relevant to the area of study. Moreover, we suggest that further research should be directed towards a more statistically-sound approach on the evaluation of the teaching method. Moreover, a more comprehensive data and text mining approach could be undertaken with a larger corpus.

ACKNOWLEDGEMENTS

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REFERENCES


1 The detailed list of documents reviewed through text and data mining are available upon demand, by sending an email to K. Leftheriotis, kolef@acg.edu
