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Teaching and educational notes

Power to business professors: Automatic grading of problem-solving tasks in a spreadsheet

Bernt Arne Bertheussen *

Tromsø University Business School, UiT The Arctic University of Norway, N-9019 Tromsø, Norway

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ABSTRACT

This paper presents an innovative approach, based on Excel files and a detailed implementation guide, that allows a professor with proficient spreadsheet skills to develop individualized problem-solving tasks for assignments and examinations that test students on cognitive thinking processes beyond memorizing and drilling. The professor accomplishes this goal by requiring the students to model a business problem-solving task in a worksheet environment. Each student's work is marked automatically by a generic "plug and play" Visual Basic for Application (VBA) algorithm. The scores and feedback provided are tailored to each individual student and address not only the problem-solving outcome but also the problem-solving process. The learning objective discussed in this work is implemented at a Norwegian university business school.

1. Introduction

Typical class sizes in introductory accounting and business economics subjects are quite large in higher education, and in these courses manual marking of assignments and examinations capture a significant portion of the professor's work capacity. However, traditional paper-based marking can be replaced by innovative use of information and communication technology (Evans, 2013; Marriott

* Tel.: +47 77 62 31 54, mobile: +47 90 09 78 54; fax: +47 77 64 49 00.
E-mail address: bernt.bertheussen@uit.no

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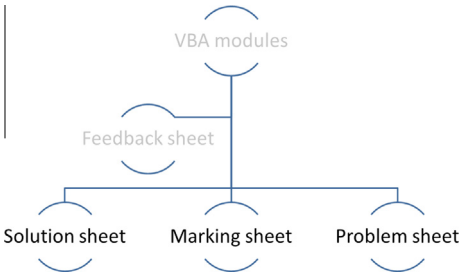

Fig. 1. The architecture of an interactive financial problem-solving application.

& Lau, 2008), and computer-aided assessment can significantly ease the professor's assessment load (Gikandi, Morrow, & Davis, 2011).

Spreadsheets (e.g., Excel) have become a *de facto* standard calculation engine in businesses worldwide, and instructors have used this digital tool to deliver drill-and-practice questions that are marked automatically (Drier, 2001; Lehman & Herring, 2003). However, such questions primarily test a student's ability to remember facts and understand concepts. Remembering and understanding represent lower-order cognitive processes (Anderson & Krathwohl, 2001).

Blayney and Freeman (2008) described an approach that instructors can use to create drill-and-practice rules-based questions in Excel that require students to enter cell-referenced formulas, thus promoting greater understanding of underlying concepts. The questions are marked automatically and provide individual feedback to the students. Nevertheless, drill-and-practice rules-based questions are designed to apply procedural knowledge, which is also a lower-order cognitive process (Anderson & Krathwohl, 2001).

If students are able to achieve high marks strictly by memorization and drilling, the assignments and examinations will promote a surface-learning approach (Knight, 2002a). In higher education, however, we aim to encourage deep learning (Gibbs, 1992; Marton & Saljo, 1984; Ramsden, 1992). Students can obtain deep learning if they are also challenged with higher-order cognitive thinking, which involves analysis, evaluation, and synthesis (Anderson & Krathwohl, 2001; QAA, 2006).

The final examination is an important tool used to foster deep learning (Gibbs, 2006; Knight, 2002b). Consequently, we should design examination questions and problem solving-tasks that are difficult for students who have only a surface knowledge of the subject.

The objective of this paper is to present an innovative approach that a professor with proficient spreadsheet skills can use to develop individualized problem-solving tasks for assignments and examinations that test students on cognitive thinking processes beyond memorizing and drilling. The professor can accomplish this goal by requiring students to model a business problem-solving task in a worksheet environment.

In the following sections the architecture and functionality of a financial problem-solving task that is marked automatically by a generic (''plug and play'') Visual Basic for Application (VBA) algorithm are described. The key discussion focuses on how professors without programming skills can tailor automatically marked problem-solving tasks to their unique accounting and business economics courses. Accordingly, this article is written with the professor and the student in mind.

2. The architecture

The financial problem-solving application described in this article is an Excel workbook composed of four worksheets and two VBA code modules. Fig. 1 illustrates the general structure of such an application.[1]

[1] Interested readers can obtain file copy of the Excel workbook and a detailed implementation guide by sending an email to bernt.bertheussen@uit.no.