An educational information system to follow up on the perceived IT skills of pre-service teachers

MONCEF BARI
Department of Didactics
University of Quebec at Montreal
405 Sainte-Catherine Est, Montréal, QC H2L 2C4
CANADA

Abstract: - We describe an educational information system for following up the perceived IT skills of pre-service teachers. Such an information system will help to undertake the necessary actions to better prepare them for mastering, and eventually for using computer applications during their service teaching.
The article introduces the IT skills of pre-service teachers intended to be tracked then it describes the approach used to collect the data related to those skills (questionnaire and survey). The approach used to store and compute the collected data is based on various computer applications and fields, namely Google forms, Google spreadsheets, Structured Query Language (SQL), and Weka for the data mining part

Key-Words: - Educational information system, IT skills, perceived IT skills, pre-service teachers, following up, information system architecture

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1 Introduction

As societies become more and more digitally oriented, it is essential to prepare people to master the use of computers in most human activities. This objective must be undertaken from primary school or even from early childhood. Therefore, teachers are among the first to have the responsibility of developing the computer skills of their pupils. Teachers, on the other hand, need to acquire their own computer skills during their schooling. Having a tool following up the evolution of their skills during their college studies will help undertake the necessary actions to better prepare them for such a task.
Information and communication technologies (ICT) skills of teachers, consequently those of pre-service teachers (hereinafter the "participants" or "students"), have been a subject of interest for a long time since computer use started spreading in most human activities. One of the main challenges remains to find the best way to teach ICT to pre-service teachers.
In order to have a better understanding of the perceived IT skills of pre-service teachers, it is interesting to (1) have a digital tool to collect the data about these skills and (2) use different means allowing various kinds of analysis including several types of comparisons according to different criteria and variables. These means will allow us to undergo quantitative analysis, different kinds of queries, and, eventually, data mining in order to better understand current situations (i.e. snapshots at a particular point of time) and the evolution over an interval of time of several years.
This article is organized as follows: after the introduction, section 2 explores the IT skills of pre-service teachers, section 3 presents the survey used to collect their perceived IT skills, section 4 describes the educational information system used to store and process the collected data and, finally, section 5 concludes this article.

2 IT skills of pre-service teachers

Research suggested that "computer skills instruction increased students' technology integration self-efficacy only when instructors modeled teaching-related examples and provided students with multiple mastery experiences of technology integration practices" [1]. As stated by Charles Buabeng-Andoh [2], "it is recommended that courses such as computer-supported learning, ICTs and designing instructional materials should be introduced in initial teacher training programs to improve teachers' level of confidence and perceptions towards the use of ICT". Many various strategies have been used. For instance, a research project using intelligent tutoring found that

approach to be "effective in improving the learning effectiveness of students with low-level prior knowledge" [3]. Knowing that "use of technology takes time and requires a paradigm change for teachers to adopt it" [4] showed that "computer ownership, the internet access and amount of daily computer use do not correlate with the attitude towards computer-assisted education", what is more important is the perceived usefulness and the enjoyment since they have a positive effect on the attitude of teachers towards the use of ICT for teaching.

In our case, we have established a set covering a wide range of computer applications and technologies among which pre-service teachers usually have variable levels of mastery. This range of computer applications and technologies are the following:

- Use of most current applications: texts, spreadsheets, forms, presentations
- Creating, editing, and managing digital objects (i.e. image, audio, video)
- Use of interactive boards
- Use of advanced internet search
- Creating and managing websites
- Creating online interactive activities
- Use of visual programming platforms
- Use of digital communication with teachers and fellows
- Use of cloud technology to store data and/or to use online applications
- Use of various computer applications for learning

The next section presents the approach used to collect the perceived ICT skills of the pre-service teachers.

3 The approach used to collect the data

The approach adopted consists of a survey based on a questionnaire which will be sent to all of the students of the teacher training programs of the Faculty of Pedagogy of Dalat University.

The questionnaire comprises 30 questions, created using Google Forms. The questions are written in Vietnamese, followed by their English translation, and are mainly related to the computer applications and technologies listed in the previous section. Other questions relate to the participants' program, their progress in the program, their gender, the use of a computer at home, and whether they have already had an IT course at the university or/and at the high school.

For most of the questions, the answers are based on a multiple-choice approach. For instance, the choices related to the questions about the perceived IT skills are as follows: *Very high, High, Average, Poor, Very poor, I don't know what it is*.

Prior to sending the questionnaire to the participants, it was sent to 12 randomly selected participants, from different programs, in order to validate their understanding of the questions. Following this validation step, adjustments were made to 6 questions in accordance with the feedback obtained.

The survey will be conducted for four years starting 2021. The link to the questionnaire form is sent to the participants by email with an explanation about the purpose of the research project and an invitation to complete it. For the first survey conducted in late 2021, 381 answers have been received.

Once the responses are received, the answers based on multiple-choice are transformed to numeric values according to the correspondence shown in Table 1:

Table 1. Correspondence between multiple choices values and numeric values (weights)

Multiple choices values	Weight
Very high	6
High	5
Average	4
Poor	3
Very poor	2
I don't know what it is	1
No answer	0

This transformation step is named "Weighting" (see Figure 1, section 4). Thus, it becomes possible to grant a weight based on numerical values allowing for multiple kinds of comparisons: between individuals, between programs, between years in the programs, etc. Showing the changing over time is also becoming easier to do.

The next section describes the educational information system used to store and process the collected data resulting from the survey.

4 Description of the following up educational information system

The approach to creating the educational information system to follow up on the perceived IT skills of pre-service teachers is described in Figure 1. This approach uses various computer applications and fields, namely Google forms, Google spreadsheets, Structured Query Language (SQL), and Weka for the data mining part.

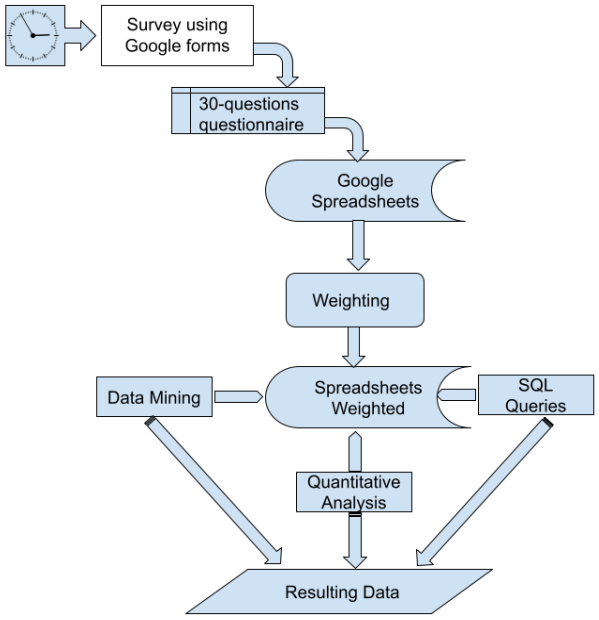

Figure 1. The architecture of the following up educational information system

As mentioned in the previous section, the Google form comprises 30 questions. This form allows, by itself, to extract basic information in order to make comparisons between the different programs, between the years according to the progress in the program of the students, between their gender or whether they own a personal computer or not. These initial analyses are based on the data such as the absolute values, the means, and the standard deviations related to the different answered questions.
This kind of data suits the analysis of the answers gathered for a given year: they allow us to have a snapshot of the situation at a particular point in time. It is also suited for making comparisons between several years, i.e., comparing the snapshots taken at different points of time several consecutive years.

For more complex analysis, especially if we handle data related to several years, we need more sophisticated tools. We have decided to use SQL queries and data mining tools. Let's present them in turn.

SQL is used to communicate with databases, independently of their internal representation. According to the American National Standards Institute (ANSI), it is the standard language for relational database management systems. Is it possible to use this powerful language on spreadsheets because they are more and more being used to create and manage information systems that rely on data repositories that can grow significantly. Thus, spreadsheets may be seen as databases and [5] proposed “an expressive and composable technique where intuitive queries can be defined ... builds on a model-driven spreadsheet development environment, and queries … expressed referencing entities in the model of a spreadsheet instead of in its actual data”. Their proposal has been implemented relying on Google's query function for spreadsheets.

Since spreadsheets have become very popular databases in use nowadays it is possible to “extend the usage of spreadsheets in any direction as it provides great flexibility in terms of data storage and dependency of stored data” [6]. The same authors “surveyed some of research which took great attention over spreadsheets and its applicability in different functional cases, such as Data Visualization, SQL Engines and many more”.

Dealing with a great number of attributes and sheets may result in difficulties to implement efficient databases relying on spreadsheets only. Thus, [7] suggested another approach based on “importing the spreadsheet data into a database manager, joining tables, and performing the analysis using database querying”.
A similar approach may be found in [8] since they built an exploration tool, namely DataSpread, “that holistically unifies databases and spreadsheets”.

In our case, since we don't have too many sheets, we use, for now, a more conventional solution based on Google's query function for spreadsheets. This function allows us to write simple as well as complex queries based on SQL.

When there will be thousands of questionnaires, their data can serve as a basis for more sophisticated processing. At this point, it will be possible to use data mining tools for performing different data mining tasks such as data preprocessing, classification, clustering, association rule mining,

visualization, … These tasks are mainly based on machine learning algorithms.

Simply stated, data mining is a part of artificial intelligence techniques used to extract useful knowledge from raw data. This extracted knowledge may then be used to help make decisions or better understand various phenomena. Data mining techniques are used in many different domains, including education. A new research area is emerging and many authors, for instance [9] and [10], are talking of educational data mining.

We have already chosen the Weka platform, a Java-based software suite that implements a large number of machine learning algorithms [11]. This choice was easy to do not only because we have already used Weka in previous data mining projects [12] and also because it is an open-source platform widely used in the scientific community. Moreover, it is easy to convert spreadsheets files to Weka-supported file formats.

5 Conclusion

We have presented an educational information system to follow up on the perceived IT skills of pre-service teachers. This information system allows us to (1) have a digital tool to collect data about these perceived skills and (2) use different means allowing different kinds of analysis including several types of comparisons according to different criteria and variables. With these means, it will be possible to undergo quantitative analysis, different kinds of queries, and, eventually, data mining in order to better understand current situations (i.e. snapshots at a particular point of time) and the evolution over an interval of time.
The analysis of the data resulting from the use of this educational information system will give rise to subsequent publications.

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