Extending Pre-Service Teacher Education through an Interdisciplinary Mathematics, Health, and Technology Approach.

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Abstract
For the past two years faculty members in mathematics education and health education in Nipissing University's teacher education program have engaged preservice students in an interdisciplinary project that provided them with an opportunity to create learning resources that combined relevant international health data, the school mathematics of data management, and the use of technology to access, analyze, and display the data. This paper will present the 2005-06 and follow-up 2006-07 interdisciplinary experiences, including some of the research results based on this teacher education activity, and the resource website for Canadian teachers being developed as a result of this work. Educators from other countries may see potential in this model.

Introduction

For the past two years faculty members in mathematics education and health education in Nipissing University's one year after degree teacher education program have engaged pre-service students in an interdisciplinary project that provided them with an opportunity to create learning resources that combined relevant international health data, the school mathematics of data management, and the use of technology to access, analyze, and display the data. Teacher candidates, especially those at the elementary and intermediate levels, are usually eager to make mathematics relevant for their students, but they often do not know how. On the other hand, they may not see health education at these levels as involving statistical data. Furthermore, in an intense one year teacher education program, professors must make the most of opportunities to model possibilities for interdisciplinary teaching. This project and the associated research provided both students and faculty the chance to experience all these elements.

This paper will present the 2005-06 and follow-up 2006-07 interdisciplinary experiences, including some of the research results based on this teacher education activity, and the resource website being developed as a result of this work. The resources created provide Canadian teachers with an excellent way to connect with a national database, and an opportunity that those in other countries may also see as appropriate to their respective contexts.

The Health-Mathematics Project

Developing the assignment and the research Rationale

In 2005 all 290 students enrolled in the Junior/Intermediate (J/I) division of the teacher education program (grades 4 – 10) took part in a joint assignment for both health and mathematics education courses as part of a research project on Statistics Canada resources ("Canada's national statistical agency"—www.statcan.ca). The authors were the instructors for these one semester courses, which were given concurrently September to December. The assignment was developed jointly by the three of us during the summer, following consultation with Statistics Canada's education liaison officer. All preservice candidates admitted to the Nipissing University Faculty of Education are required to lease a personal laptop computer for use in the

program, and providing opportunities for them to experience meaningful and practical teaching uses for the computer in a range of subject areas was important. Furthermore, both elementary (grades 1-8) provincial mathematics and health curriculum documents (Ontario Ministry of Education, 2005; Ontario Ministry of Education and Training, 1998) call for the use of technology, including the Internet, to be incorporated into classroom instruction. Our focus was very much in line with Russell, Bebell, O'Dwyer and O'Connor's (2003) statement that integrating technology "such as Web pages or PowerPoint presentations" into instruction in preservice teacher education is likely to strengthen beliefs in teacher candidates about the value of technology for teaching and learning (p. 308).

The intention of this project was two-fold: (1) Develop an interdisciplinary project that asked pre-service teachers working together to create a presentation lesson for their students that would at once, through the use of computer technology, explore student-relevant health issues and incorporate data management mathematical skills. (2) Research the response of preservice teachers to this assignment for their perceptions of its implementation, meaningfulness in terms of interdisciplinary potential and electronic resources, and practicality, such as the feasibility of actually using such a technologically-based instructional approach in the practicum classroom.

National—and international—data source

The data set used in the project was from the survey conducted by the federal agency Health Canada in 2001/2002 (e.g., Boyce, 2004) as part of the international "World Health Organization Cross-National Collaborative Study" on the Health Behaviour of School-Aged Children (HBSC) aged 11, 13, and 15. During the same period 34 other European and North American countries also conducted their own surveys of similarly-aged children. The data from approximately 4300 Canadian children contributed to the 2001/2002 international study, while the tabulated results from the more than 7200 Canadian children who actually took part in the survey were made available on Statistics Canada's E-STAT website (Statistics Canada, n.d.) in 2005.

The E-STAT website was designed particularly for use by educators at all levels. The HBSC data seemed ideal for J/I graduates teaching grades 4 to 10. It included well over one hundred tables of data on the following twenty broad health-related topics:

Physical Activity levels	Prescription drugs versus over-the-counter drugs	Asthma/second-hand smoke	Fighting/conflict resolution
Media use	Sexual intercourse	Alcohol use	Bullying
Eating habits	Contraceptive use	Marijuana use	Peer pressure
Personal injuries	Personal relationships	Other drug use	Body image
Family structure	Personal safety practices	Tobacco smoking	Dieting/eating disorders

Implementing the Assignment

Overview

Preservice teachers were introduced to the assignment in both courses in the first week of classes. They worked in pairs to generate an interesting class Microsoft PowerPoint presentation regarding one of the health topics for a selected grade. Through this classroom presentation they were to raise awareness in the students of issues and attitudes related to the health topic, and to prepare them for their own exploration of the subject. As part of that presentation they were to:

Establish the topic and rationale in an introduction.

Include information from the E-STAT HBSC data, in the form of graphs.

Create a number of higher order questions for their school students regarding the health topic based on their presentation, including the graphs.

Reflect on the experience of doing the assignment, and how they thought it might inform their teaching.

Some class time was granted in both courses for the pairs to work on the assignment and ask clarifying questions, but most work was done out of class. It was completed by the end of September, just before they went out to their first practicum in October.

Health focus

The preservice student pairs were responsible for picking their own health topic—no duplicates--and identifying relevant health expectations or objectives from the curriculum for an appropriate grade. They were required to maintain focus on this grade throughout for all aspects of the presentation. While students had to make the presentation appealing and informative, they were limited to a maximum of ten PowerPoint slides.

Students used the Internet to access the HBSC topics and work with the tables of data identified with their health topic. They had to consider how best to make meaningfully connections for their chosen topic. For most topics students were required to choose the table that provided 'best fit' for their chosen topic. Each table offered several variables from which to choose. There was also potential to utilize data from other countries, adding to the decision making process. Finally some tables, although connected to a particular topic, could also effectively be used with another topic, thus encouraging students to look beyond their initial list of tables. A small sample of the HBSC questions asked of the children for several health topics is given in Table 1.

Table 1:
A Sample of HBSC Questions

How many times a week do you usually eat or drink these items [a list]?
At present are you on a diet or doing something else to lose weight?
How often have you been bullied at school in the last couple of months in the ways listed below?
Have you ever used or taken cannabis?
How often do you smoke tobacco at present?
Have you ever had so much alcohol that you were really drunk?
Have you ever had sexual intercourse?
How do you and your friends decide what to do together?
How often do you go to school or to bed hungry because there is not enough food at home?

Mathematics and technology

Although health was the focus of the assignment, mathematics figured prominently in the teacher candidates' selection of data--usually given in percentages--and their ability to display it accurately and effectively, and to analyze it in depth in order to create mathematics and health questions of a higher order for the children. The preservice teachers had to examine the mathematics curriculum for the chosen grade level and identify appropriate expectations. Most often those came from the Data Management strand, which in Ontario beginning in grade 4 calls for using spreadsheets, and by grade 6, recommends the specific use of E-STAT. The graphs the preservice students were required to develop had to be of at least of two different types from

among such types as line, bar, circle, etc. Ideally, the graphs were to tell a strong story very much supporting the chosen health focus.

Technology was the medium of development and display throughout the student project. Students had to access the HBSC tables through the Internet, and navigate the sequence of E-STAT pages to retrieve the specific data they wanted. E-STAT has extensive graphing capabilities for use with the data tables—bar graphs, pie charts, line graphs, etc.—but we also required students to import their chosen data tables into Microsoft Excel. The use of Excel required students to gain familiarity with importing data into a spreadsheet, and create appropriate graphs that were accurately and effectively done and meaningful for the children or adolescents in their classrooms. Mumford (2006) stated that "graphs are a hugely undervalued tool in our understanding of the world" (p. 25), and further concluded that "tools, such as Excel, when used properly, make mathematics fun, tangible, and visual" (p. 27). And finally we required the product to be in the form of a PowerPoint presentation, thus again needing information importation and some skill in creating an engaging presentation.

Evaluation

A rubric was used to evaluate the final product, which students submitted in both paper and electronic forms. The rubric addressed the four main categories of Communication, Knowledge and Understanding, Application, and Thinking and Inquiry.

In the first year we asked the preservice students to create their electronic presentation as if they were telling their preservice peers what they planned to do in their selected classroom. The Communication element, a strong focus of assessment in Ontario in all subject areas, therefore addressed both the pair's ability to communicate to their peers (the PowerPoint presentation itself), and the intention of the presentation—the content to be communicated to the children. This proved to be challenging and confusing, so in the second year we asked that the presentation be created directly for presentation to the children. Rather than being about the classroom lesson, the presentation was the classroom lesson. This proved much more satisfactory for the students and for evaluators.

Into the Second Year, 2006-07

Over 300 J/I Teacher candidates completed the assignment and related research in the second year. Based on the results of 2005-06, we changed the focus of the presentation, as noted above, and Statistics Canada made a substantial change to the E-STAT interface with the HBSC tables to make access much more direct, icon-based, and "user friendly." We also developed a website devoted to interdisciplinary health and mathematics, on which we have begun to place the students' PowerPoint presentations with their permission, available to all educators with an interest in teaching mathematics or health (http://nipissingu.ca/iteachhealth/ -- "the website integrating mathematics and technology with health")

Looking at Some Results of the Project

Preservice Teachers' Responses

Methodology

After the assignment was completed at the end of September, students went on a short two week practicum. The assignments were returned and discussed during their period back on campus. They were also encouraged to use Internet resources such as those from Statistics Canada during their next three week practicum, which occurred in November, if circumstances permitted.

In 2005, a questionnaire was administered on a voluntary basis to all J/I students in December following their return once again from practicum. This questionnaire consisted of a demographics section, a fifty-item, five-point Likert scale section on the assignment itself, and a third section seeking information on their possible use of these resources during their November practicum. In late January 2006 focus group interviews were held with those volunteering to participate. In 2006 we modified the questionnaire slightly and split its administration, with the assignment and demographic section in October, and the practicum response in December. We again conducted focus group interviews in January. We will just comment briefly here on the results as space is limited. The experiences from both years have been submitted for publication. A final report to Statistics Canada on year one is also available on request from the authors (Olmsted, McCabe, & Franks, 2006).

A positive response

The response from the J/I preservice candidates in both years who completed the questionnaire was generally quite positive (item responses often over 80%). Students in particular liked the fact that the health data appeared relevant to their world of the classroom, and they felt that the assignment demonstrated a meaningful interdisciplinary approach to the HBSC data on E-STAT. They were pleased to be presented with ideas that demonstrated how well both mathematics and technology might be used to support learning in other subjects. In general, results from the second year were even more positive than the first.

Students expressed some frustration with accessing the health data in E-STAT, especially finding tables for their particular health topic. As noted above, this led to Statistics Canada significantly changing their interface to the HBSC tables. The question of access to the HBSC data was much more positive in the second year (75% compared to 57%), suggesting that data bases attempting to attract educators need to pay close attention to the needs of teachers, who are busy people without a great deal of time to sort through even somewhat unorganized information.

In both years only a few actually attempted the use of Statistics Canada resources such as E-STAT during the practica. There were many reasons for this, and among them was a concern that they were not quite ready with their own use of E-STAT. There was also a feeling that E-STAT was challenging enough that grade level was a definite consideration—it was easier to use in grades 7 and 8 than in grades 4 to 6, and even easier in grades 9 and 10. The technological status of their practicum schools was also a major factor.

Mathematics and Technology and the Interdisciplinary Approach

During the time students were actually working on the assignment, they were given instruction in importing data into Excel, and some review in graphing generally and with a spreadsheet. However, the effective use Excel and PowerPoint and the application of the ‘fundamentals’ of accurate graph building was largely left to them, to assist one another and seek outside help where necessary. In general students responded that they were successful in this process, but not everyone was comfortable being placed in that situation. The final products were commonly well done, but as expected some students were more successful in this experience than others.

This task was complex because of all the components involved. The focus was health, but in order to do justice to presenting children with an engaging, connected, and substantial health lesson, preservice candidates had to navigate a substantial amount of technology, and

demonstrate an understanding of selecting and transforming data from numbers in a table to appropriate and meaningful visual displays. This was no small feat, especially for people for whom mathematics was often not positive. To become fully comfortable with all these elements for many students required more time than was available. However, we have been very pleased with the results. We see databases such as HBSC providing a great deal of potential for classroom teachers who are looking for effective and interesting ways to bring relevance to their mathematics classes, and have students see subjects such as health in a potentially whole new light. The most recent HBSC survey was conducted in 2006/2007 with 41 countries taking part (HBSC News, n.d.). If even some of these data can be accessed, they have the potential, then, to provide an extraordinarily interesting opportunity for educators seeking relevant and meaningful data to bring to classrooms in a variety of subject areas.

Note:
[1]The authors wish to acknowledge the grants from Statistics Canada which supported the research for this project.

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