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Applied Epidemiology - A full-subject self-directed computer-based problem-solving learning experience

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Abstract

A major difficulty of teaching public health to students in a Masters Program is conveying the need for taking a strategic approach to situations. Tackling real-life public health issues is rather complex. There will generally be a number of avenues of investigation and it is necessary to be wary of the short and long-term consequences of actions. Also time and money need to be managed effectively. As one approach to the education of students about these issues, a computer-based package has been developed which simulates the investigation of a real public health problem. This simulation enables students to encounter such issues in a risk-free environment, and to carry out their own investigations and propose their own solutions to the problems presented. Specifically, students have to clarify the impact of pollution on the health of residents in an affected area. They will collect and analyse data (from in-built real-life data sets), design and analyse their own epidemiological study and present their findings as reports, press-releases and presentations. The task takes students an entire subject (14-weeks) to complete and is largely self-directed. The package contains both quantitative data, such as mortality and morbidity statistics, and qualitative data, such as the outcome of interviews with key stakeholders. The package also exploits the multimedia capabilities of a PC by incorporating maps and photographs of the polluted area. This enables students to undertake a virtual trip, and thus pick up vital clues about potential sources of contamination. The package provides links to standard statistical software, thereby giving students an opportunity to become more familiar with programs they are likely to use in real-life. The data provide sufficient breadth and detail for students to use various strategies. But, to simulate real-life, students have to conduct their investigations within virtual time and budgetary constraints, continuously monitored by the computer program. In particular, monitoring of constraints, the real-life data and the linked use of standard software allow for the realistic development of essential skills. In the subject setting, role-play during the presentations, and reporting in real-life formats, add to the simulation. Practical exercises have not been part of most Public Health Masters programs world wide, and yet the complexity of real-life situations means that such experience is invaluable. When fully complete, this package will offer a novel, innovative and important approach to the teaching of this aspect of public health.

Keywords

epidemiology, education, case-study, team-work, communication, environment

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APPLIED EPIDEMIOLOGY, A FULL-SUBJECT SELF-DIRECTED COMPUTER-BASED PROBLEM-SOLVING LEARNING EXPERIENCE

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ABSTRACT

A major difficulty of teaching public health to students in a Masters Program is conveying the need for taking a strategic approach to situations. Tackling real-life public health issues is rather complex. There will generally be a number of avenues of investigation and it is necessary to be wary of the short and long-term consequences of actions. Also time and money need to be managed effectively.

As one approach to the education of students about these issues, a computer-based package has been developed which simulates the investigation of a real public health problem. This simulation enables students to encounter such issues in a risk-free environment, and to carry out their own investigations and propose their own solutions to the problems presented.

Specifically, students have to clarify the impact of pollution on the health of residents in an affected area. They will collect and analyse data (from in-built real-life data sets), design and analyse their own epidemiological study and present their findings as reports, press-releases and presentations. The task takes students an entire subject (14-weeks) to complete and is largely self-directed.

The package contains both quantitative data, such as mortality and morbidity statistics, and qualitative data, such as the outcome of interviews with key stakeholders. The package also exploits the multimedia capabilities of a PC by incorporating maps and photographs of the polluted area. This enables students to undertake a virtual trip, and thus pick up vital clues about potential sources of contamination. The package provides links to standard statistical software, thereby giving students an opportunity to become more familiar with programs they are likely to use in real-life.

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Practical exercises have not been part of most Public Health Masters programs world wide, and yet the complexity of real-life situations means that such experience is invaluable. When fully complete, this package will offer a novel, innovative and important approach to the teaching of this aspect of public health.

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1. INTRODUCTION

While public health students can be taught epidemiological methods, communication and project management skills using standard teaching methods, it is difficult to give them a feel for the richness of undertaking a real epidemiological study. The need for some experience in dealing with a total study is enforced by the observation that public health practitioners often have to deal with complicated situations such as cancer clusters, contaminated drinking water, hepatitis epidemics or unplanned emissions from factories. In these situations, they have to assess the situation quickly and systematically, gather and evaluate the available information, and present their opinion about health risks. Public health postgraduate students are taught the concepts needed to deal with these issues in subjects such as epidemiology, bio-statistics and research methods. The breadth of knowledge that needs to be covered and the complexity of the causes of diseases rarely allows for an active involvement of students. Only such an involvement would allow the students to experience the concepts and methods and internalise the thought process involved. There are some pen and paper exercises available that do attempt to cover this gap but they fall far short of the complexity and magnitude public health problems actually can reach (*WHO materials*).

It was thought that a real-life public health problem, that was extensively investigated, could be turned into a useful teaching tool (*Kreis PhD*). A simulation of the situation the students are likely to encounter when employed including the likely constraints on time and money would potentially give the students a feel of what it will be like. This paper describes the tool developed for this purpose. It also describes the teaching advantages that are possible when using such a tool as well as some of the potential shortcomings.

2. AIMS

The aims of the subject for which the teaching tool has been and is continuing to be developed are that at the end of the subject (whole class of 14 weeks and a total of 1/12th of a Masters degree) the student will be able to:

- actively engage in small team problem solving;
- strategically plan their actions and manage time and financial constraints;
- utilise available data-sets on health, environmental contamination levels and exposure;
- use and apply knowledge on statistical computer software and word processing;
- analyse the collected data and integrate the results with literature information into a view as to whether there is a health risk to a population; and
- present and defend conclusions to a critical audience and in a written format according to established professional standards.

3. MATERIALS AND STRUCTURE

The problem is derived from a case study of cadmium contaminated soil in The Netherlands. The contamination resulted from long term air emissions and the deposition of waste materials by a number of metallurgic factories. The investigation of the possible health effects covered all stages that can be recognised in such investigations. Expert opinion, routine data-sets, ad-hoc data-sets and data from a large scale study were available or possible to simulate. Information on both health status and environment relevant to the case study were extensively available (if predominantly in government reports and often in Dutch). Copyright issues are limited as the data were collected with public money and the case itself dates back to the early 1980's.

The case-study had been worked into a simple computer-based teaching tool in the Netherlands itself by the University of Nijmegen. This material was designed to function on the most basic PC (XT's) and only used text and some numerical information. There was some limitation of choice in the use of data-sets and students had to work within the constraints of a financial budget. The structure and some of the materials of this Dutch version were used after translation. The new CD-ROM based program uses specific multi-media authoring (developed in MacroMedia Authorware) and allows for greater consistency in the application of the time or financial restraints. It is also different in that it aims to incorporate standard software that is often used in public health practice such as Epi-Info. The teaching tool can be used on Windows 3.1 or Windows 95 operating systems with only limited need to install other software. The minimum requirement for the computers is that they need to have a CD-ROM as well as a floppy drive. The floppy is needed because the progress of the student is monitored on a personal floppy so that students can change between computers, and so that students can save 'notebook' information which they can later incorporate into their reports. (Figure 1)

Figure 1: Notebook with reference text

The case-study is structured in four stages and some additional information is available at all times (tutorials and maps). The stages represent a pre-structured approach to public health problems that is widely accepted as reasonable. The tutorials cover materials that one could assume the student would know but that might do with some repetition (presentation techniques and the use of Epi-Info), or provide information that might be too hard to collect otherwise (dietary intake). Also some additional information on the organisation of public health around the world and dietary intake around the world is available. This enables the student to assess the equivalent situation in their own country.

The first stage of the actual case-study covers an orientation to the problem including qualitative as well as some quantitative material. The material covers interviews with experts such as University professors (Figure 2), and stakeholders such as politicians, factory owner and residents. Other qualitative data result from simulated literature searches, a tour of the regions with visual clues (Figure 3) and the inspection of maps. Quantitative data include some limited environmental sampling and some limited routine data sets. During this stage, the budget is time related and the students are limited to an equivalent of 3 working weeks. The students will have to plan their actions as some information takes time to arrive after requesting it. Another aspect in this stage is that the students can make some clearly wrong choices and they will get fired from their jobs if they do. The students will then have to start all over. The multimedia version of this stage has been in use for the past two years (at the time of writing).

Figure 2: Some of the interview subjects

Figure 3: Part of the guided tour

The second stage of the case-study requires the students to divide their attention between the environmental component of the case and the health effects component. They are asked to buy information (Figure 4), but stay within a budget, and they are required to analyse the information. They also need to make a choice between some analytic tools eg. various forms of standardisation of the data. To simulate the real-life situation the data-sets need to be ordered separately but need to be complete when analysing them. This again stimulates strategic planning by the students. In analysing the health data, some money can be saved by the ingenious combination of data-sets and being focussed on realistic questions to ask of the data. The multimedia version of this stage has been in use for the past year (at the time of writing).

Figure 4: Ordering demographic data for East Kempen

The third stage requires the students to design an analytic epidemiological study of health effects from the environmental contamination. The type of questions the study can address can vary widely. The students are first and foremost restricted by financial constraints. They will have to take account of the financial cost of each measurement and also the logistics of the study they propose. Ultimately they are also restricted by limitations of the database supporting this and the next stage. However, the currently available database is very extensive and so this is not a major issue. In addition, it may be possible later to extend the options by including databases from similar research projects. Once the students have decided how they are going to collect their information, a database will be created according to their specifications.

In stage four the students are required to analyse the database created at the end of stage three. The subject assumes that the analysis will take place in the public domain software of Epi-Info. However, the data can also be exported to software the local teaching facility prefers eg SAS or SPSS. At this stage, the students will be limited in time only.

In teaching the subject, the students are organised into teams of two to three people. At the end of each stage, the students present the results in standard professional formats such as reports, press releases and a proposal. To simulate presenting their results to the public, the students are asked to present their findings orally as well. The other students are asked to play the roles of stake-holders in the community which thus creates the atmosphere of a public meeting.

4. STATUS AND PLANS

The subject has so far been run employing the multimedia materials over the past two years. Modifications were made after the first year based on the experiences of the teacher and the students, and the updated version was used the second time. The current model was used with a class of 6 students. The evaluation of this teaching process is reflected in a remark form a student: “I never worked so hard and I never learned so much”. Stage one is complete except for the simulation of the literature searches that would be expected at this time. Stage two has had a limited number of databases for health available but these are the most relevant ones. The environmental component of this stage is complete except for the translation of one rather hefty report on environmental investigations. The interfaces for the information in this stage have all been redesigned from the earlier version and are considerably improved. They require a lot of attention to detail by the student but that has been a conscious decision in the design process. Stages three and four are not yet included in the multimedia program and have been run using the material in a non-computerised form. Stage three has been simulated with proposal writing without linking it to the actual data to be analysed. Stage four has been simulated by giving the students access to the original database but with a limited number of variables. Most of the essential tutorial material is now available, which was not the case during the teaching of the subject in 1998.

The plan is to extend the number of databases available in stage two as they are readily available in the original case-study. It is also intended to implement stages three and four. Some extension of the materials available in the tutorials is also being prepared. From a teaching perspective it is envisaged that further trials with the fully completed multimedia program need to be run under various conditions. One of the possible options is a trial of a workshop format where the students go through the whole program in a much more condensed time frame. Another aspect of the evaluation will be the assessment of its effectiveness to a teacher who is less familiar with the original case study.

5. DISCUSSION

A number of aspects about this teaching tool can be addressed. It can be questioned why one would use a case study in a country like the Netherlands and why one would not translate the situation to an imaginary place where the names and such would be more easy pronounced. If one were to do that, a host of information about the local situation would have to be invented. Visual clues would be much harder to incorporate and the total case study would become much less interesting in the view of these authors. Also, within the public health profession, it is entirely usual to use information from other countries. Using the Netherlands thus becomes an additional bonus rather than a handicap. The addition of information about other countries in the tutorial allows teachers and students using the tool, to address the comparability of the situation.

Another question one can ask is whether cadmium contamination is sufficiently important to spend this much time on during the limited time of a Masters program. However, the aim of the subject is not to teach students all the aspects of cadmium contamination, although cadmium contamination is enough of a problem worldwide to deserve some attention, and cadmium is one of the heavy metal pollutants such as lead which all share environmental similarities. Instead the aim is to confront students with the structured approach to complex problems which extend beyond the case-study. This is possible because the case study is similar enough in structure to other public health problems such as the earlier mentioned cancer clusters or water contamination incidents, that it can function as a teaching model where the content is less important.

It could be argued that in presenting the case-study in the four prescribed stages we have pre-structured the approach such that the student can no longer make major mistakes in structuring the handling of the problem. It is clear that some structuring has taken place and that the amount of information is presented in a lot more systematic manner than it would in real life. However, to allow the student to understand the model of investigation, the possibility of getting fired in the first stage has been consciously incorporated. It does emphasise to the student that something that turns out to be perfectly OK much later in the investigation can be entirely out of order in the earlier stages. The clarification of this observation is clearly the task of the teacher in charge of the subject.

In the subject as we have conducted it at this University, we have insisted on the students working in teams of two, occasionally three as the class size requires. In the earlier classes as taught at the University of Nijmegen they had made the same choice. The first reason for doing this is that the amount of work involved is rather substantial. Another reason is that the University has stated, in its aims for the attitudes of its graduates, that they should be able to work in teams. The third but most important reason is that most, if not all public health practice, is conducted in teams. Developing skills in collaboration and in delegating are essential for a public health practitioner.

The presentation formats required of the students have been chosen to be as similar as possible to those often used in public health practice. A teacher using the tool could decide to change the requirements placed on the students. However, it was found that using reports and press releases rather than an essay format uncovered a lack of recognition by the students of the differences between the various formats. Using the professional formats also enhanced the feeling of being part of a real investigation and increased the commitment of the students to the subject. Assigning students specific roles during the presentations stimulated the discussion. It also provided additional clues to the students for the context of the case-study.

It can be questioned whether one really needs a computer-based package to do the teaching as conducted in the subject. It would be possible to give the students some of the information in more traditional paper formats including the visual clues. However, monitoring their progress and restricting some options would become incredibly labour intensive to the lecturer. Also, some aspects of the practice of public health inherently involves computer databases in most countries in the world.

It is possible that once developed, the teaching tool becomes stale as a number of students have gone through the process. Either the students collective memory will get to know all the ins and outs of the case study or the teacher could get bored with the amount of marking that is inherent in the exercise. The boredom of the teacher can be prevented by having different staff teaching the subject once all the material has been developed. As the subject is likely to be one of the last subjects undertaken by the students they are less likely to be in frequent contact with students yet to undertake the subject. However, the possibility of the tool aging will have to be evaluated over time. The experience at the University of Nijmegen which has been using the earlier version for about 8 years, seems to indicate that if one keeps the teachers fresh, the students keep enjoying the case study.

6. CONCLUSION

The development of a problem-solving computer-based teaching tool seems to indicate that it is possible to simulate a complex public health problem in a student friendly way. It is also clear that the development of such a tool requires extensive resources in the availability of data, time and know-how.

7. ACKNOWLEDGMENT

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