Developing an Interactive Approach in Teaching Medical Informatics

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Abstract. A new masters program in medical informatics is proposed for development at the University of Medicine and Pharmacy in Timisoara. Given the rapidly changing technology itself and its deployment in biomedical science, the master’s program curriculum has to be multidisciplinary, comprehensive and coherent in conveying the concepts, as well as the interdisciplinary character, of medical informatics (MI). We describe the rationale and methods for a pilot study to develop a new, interactive approach in teaching MI. The study is being conducted within the existing MI course offered for the medical students in order to evaluate its impact on instruction and determine if a larger scale design is feasible. Two teaching teams of four instructors have been assigned to one of two tracks in our pilot study: traditional instruction or interactive instruction. After one term we have gained important information about how the structural and instructional aspects of the pilot design may influence confidence and attitudes.

Keywords: Medical Informatics, Education, Teaching Methods

1. Introduction

A two-year masters program in medical informatics (MI) is proposed for development at the University of Medicine and Pharmacy in Timisoara. This decision came in response to the current explosion in complexity in, and attention to, issues in health care quality, cost-effectiveness, access to health information, and medical research, especially in the context of our aging society. There is a need for professionals educated at the intersection of computer science, medicine, statistics, cognitive science, health economics, and medical ethics — the MI professionals. In order to meet these interdisciplinary demands in the educational approach we intend to partner with the Faculty of Computer Science from the Polytechnic University in Timisoara in the establishment of the new program.

The curriculum has to be inter- and multi-disciplinary, comprehensive, and coherent at the same time. It has to employ the best ways of effectively conveying the concepts and the interdisciplinary character of medical informatics. The field is dynamic, so the overall objectives of the educational process will be to: (1) provide an understanding of how computer technology can contribute to improving the quality in...
healthcare; (2) support the development of critical thinking skills; and (3) enable these professionals to continue to learn and to assume responsibility for their further development in the future. Such a curriculum cannot be developed in a single step. In fact, both the content and the delivery must be carefully considered. The content will be based on other MI programs [1-3], classical books of MI [4, 5], the Recommendations of the International Medical Informatics Association [6], and international experience [7]. Moreover, in 1997-1998 the Department of MI at the University of Medicine and Pharmacy in Timisoara coordinated a European Tempus Programme which focused on identifying the needs of different specialists in the Romanian health informatics market and the ways the universities curricula should be adjusted to meet these needs [8]. This is a large amount of content, and the traditional instructional stance would be to cover it all within the two years of the program. Instead, with appropriate attention to the structure of the curriculum, we may be able to accommodate it in ways that, rather than presenting a huge pile of material for students to simply consume, can be integrated across courses and other instructional opportunities to promote deeper learning and engagement with the materials. We wish to promote learning, not coverage.

The teaching in our universities is generally one-way, based mainly on traditional lectures with examinations typically at the end of the term. We believe a new approach should be employed for this interdisciplinary program with interactivity being a characteristic of the whole program, rather than of one or some particular course(s).

Taking all these into consideration, we started a pilot program in the context of the existing one-semester course in MI for medical students, with two main aims: (1) to test a new approach in teaching MI, mainly based on a high degree of teacher-student interaction in the teaching process itself and on a formative evaluation procedure for students’ learning; (2) to evaluate changes in student (subjective) ratings of self-confidence with MI and attitudes towards the discipline and the course as indicators of the effectiveness of our changes to the instructional character of the course.

2. Material and Methods

2.1. Developing a New Approach in Teaching

Figure 1 presents the pilot program in the context of the masters MI program, emphasizing its aims and outputs for the long-term objective of the masters program. The aim of the pilot program is to test an instructional approach based on a high degree of interaction and on a formative evaluation procedure. The expected outcomes consist of: a higher level of self-confidence in using computers; a better attitude towards MI in general and the course in particular; and a better understanding of the course material.

Three important issues were addressed for designing the new approach in teaching MI: (a) restructured course material, but following the same main chapters as before; (b) more interactive teaching methods; (c) students’ evaluation procedure aimed at assessing the deep learning and conducted during the entire semester, so providing both formative and summative assessment.

The long-term objective is to transfer the experience gained during the pilot study to the larger task of designing a successful MI masters program with a holistic, modern teaching approach, rather than a collection of heterogeneous courses.
Figure 1. The pilot study in the context of the MI Masters Program’s global structure. The output of the pilot study consists of both a new teaching approach for the masters MI program and a preliminary study for evaluation and analysis of the curriculum during the first generation of masters’ program students.

For good quality teaching, there should be a good compatibility and aligning between: the curriculum (what we want), the teaching methods (how we teach), the assessment procedures and methods of reporting (how we assess), and the climate we create. A problem largely discussed in the literature is the teaching approach we should employ for making the transition between surface learning to deep learning [9-11].

At our university the courses are based on large-class teaching – especially the lectures have a high student-staff ratio (about 60-80 students). As it is difficult to really engage in dialogue in these conditions, we propose to take advantage of the setting to provide the necessary information in a “classical” fashion (basic concepts, general ideas, theory, etc.), while encouraging discussions at the seminar & computer room work in groups of 10-12 students. Shortliffe, too, suggests the lecture format for the basic MI concepts [5].

Table 1 presents the proposal for a more interactive course of MI in contrast to the present approach. In the pilot course, the instructors will not gauge the progress of the class in terms of the amount of material that is ‘covered’ [12]; instead they will allot time for discussing major topics in a more detailed manner, using the minor topics as opportunities to extend thinking patterns that are a part of the presentation of the major topical material. Additionally, the instructors in the pilot course will focus more on the depth of approach (based on the feedback from seminar), so that the faculty should increasingly be perceived “less as disseminators of knowledge and more as facilitators of learning” [13]. Another important aspect we propose to change is the assessment of student work: in the pilot course the assessments are aimed at deep learning: weekly home-work will be assigned, and then problem-solving strategies and difficulties will be discussed at seminars. Further, instead of a single end-of-term exam the pilot course will involve three examinations during the semester, with the last one assessing their capacity of literature research and synthesizing (T1, T2, T3 respectively in Table 1 and Figure 2). One final attribute of the pilot course that is very different from the traditional version is the level and type of communication that is encouraged between students and between students and the instructors throughout the term. We use Moodle, an open-source educational application [15], as a standard communication tool for
encouraging/pursuing questions beyond the classroom and throughout the whole semester. Moreover, incorporating this application into the course compels the students to use IT in their daily work. In Romania, most medical students do not have personal computers or Internet access at home and have to come to the University for computer work. Thus, incorporating Moodle into the instructional environment promotes familiarity with this technology.

In Romania medical students are selected based on their results in admittance and baccalaureate examinations and then quasi-randomly assigned to parallel “study series” of about 60-80 students. One of the two existing courses remained in traditional instruction environment and assessment and the other became the pilot course; thus the grouping was naturalistic, and not specifically randomized.

2.2. Designing and Testing a Mechanism for Assessing Teaching Effectiveness

The general scheme for teaching effectiveness’ assessment is presented in Figure 2. Our mechanisms for assessing effectiveness combine quantitative measures (grades) and qualitative ones (attitude, change in attitude, comfort level) [16]. We also explore the possible inclusion of students’ background (technical/non-technical) and gender as covariates in future models.

Table 1. The present traditional vs. the pilot approach in teaching MI – 14 weeks/semester. In order to keep the programs independent, the two teaching teams are completely separated, while keeping them multi-disciplinary.

<table>
<thead>
<tr>
<th>Current traditional approach</th>
<th>Pilot approach</th>
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<tr>
<td>Group 1 — 84 students enrolled</td>
<td>Group 2 — 84 students enrolled</td>
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<tr>
<td>Background of the teaching team: 1-mathematics/physics, 2-informatics, 1-medicine</td>
<td>Background of the teaching team: 2-computer science, 1-mathematics, 1-medicine</td>
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**Large classes — lectures**

Classical one-way directed lectures – 2 hours/week, 1 chapter (main topic) / lecture, trying to cover as much as possible

**Pilot approach**

Large classes — combined lectures & discussions

1 hour detailed presentation + discussion of 1 or 2 topics of interest, addressing any practical concerns that came up at the seminars

1 hour “moving forward” lecture – handouts, outline of a chapter, suggested readings, topic-related homework assignment

**Practical work**

Practical computer room work under supervision — groups of 10-12 students, 2 hours/week (no required homework)

**Seminar & computer work**

Seminar & computer room work – encourage discussions to put forward questions, suggestions for topics to be detailed, weekly homework — groups of 10-12 students, 2 hours/week

**Examination** is mainly summative, at the end of the semester:

(a) practical skills - ECDL-based [14]

(b) in-class 90 min written examination: a 10-question quiz; 3-4 simple problems; short essays on 2 important MI topics

**Formative & summative evaluation**

Students’ evaluation is conducted during the semester – formative feedback — open for discussions after every assignment + give the graded papers back.

T1 – computer-based examination (15 min) – to assess basic knowledge of IT concepts

T2 – in-class open-books problem solving – 45 min – to assess the capacity of applying theory to practical situations

T3 – take-home paper – the subject posted 1 week before the due date – to assess capacity to synthesize – a learning experience in itself
Figure 2. The design we use for data collection and analysis. T1, T2, and T3 are the examinations mentioned in Table 1. Attitude towards MI and IT was investigated at beginning of the semester, before any material had been presented. Other anonymous questionnaires are given after T2 (for the pilot program) and T3 (for both programs).

For assessing the program effectiveness we developed questionnaires that reflect: a) the level of self-confidence with respect to MI technology; b) students’ attitudes towards MI and the course; we also use the final grades. The final questionnaires (comprising 40 questions) include questions like: Your knowledge about the use of information technology and computers in medicine have improved (Not at all – Very little – Partly – Much – Very much); Your practical skills in using computers and data synthesizing or looking for information on Internet have improved (Not at all – Very little – Partly – Much – Very much); Practical applications/homework helped course understanding (Not at all – Very little – Little – Quite a lot – Completely); The pace for lectures was adequate (No – No opinion – Yes); The pace for seminars/practical activities was adequate (No – No opinion – Yes).

3. Results and Conclusions

This paper is mainly focused on the rationale and methods of the pilot study, but after one term we have already gained important information. Attitudes and confidence were assessed in both courses at the start of the term, and there was no significant difference between the two groups of students: they all were a little confused (e.g. not sure why such a course had been included in their curriculum) but generally positive towards using information technology tools.

More than halfway through the term, the instructors’ informal and subjective perceptions of the two courses reflected a sense that the students in the pilot group seem to have a greater level of self-confidence towards the student-teacher relationship. At the T2 assessments in the pilot course (evaluations as well as examination) students expressed some displeasure about their work-load (weekly homework, examinations during the semester, etc.) because their other courses were not so demanding during the semester and moreover, many students reported they knew that other students (in other study series or in previous years) do/did not have to work so much every week. When comparing the attitude of pilot course students towards the course at T2 and T3 (Mann-Whitney U test), we found statistically significant improvement at T3 for almost every
item: e.g. volume of course material and work (p=0.031), structure of the course (p<0.001), usefulness of homework (p=0.001), course attractiveness (p=0.014), audience-appropriate level of the course (p=0.001). At T2, responses to open-ended questions suggested that students perceived the course to involve too much work, requiring too much time. However, when approaching the subject of their personal development they seem pleased and, sometimes, surprised at their own achievements.

When comparing attitudes at T3 across the two programs (Mann-Whitney U test), we found the pilot was perceived as being more structured (p=0.016) and leading to a better progress in practical skills (p=0.025); however, the students in pilot program perceived their seminar pace and clarity as being worse than students in the traditional program (p<0.01 for both items). The instructors’ subjective perception was that both programs’ students were working harder and with dedication, but self-reported attendance was significantly better for the pilot group (Mann-Whitney U, p=0.001) and final grades for the pilot group were a little higher (mean=7.24 compared to 6.55; ind-samples t-test, p=0.037) on a scale from 0 to 10 (10 = best).

We conclude that this “reshaping” of the teaching process is difficult, implying a completely different teaching philosophy; however there are indications that students will benefit from this shift. The dynamic nature of the MI curriculum surely warrants greater consideration of a more dynamic instructional orientation.

References