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INSIGHTS INTO INNOVATION OF INITIAL SCIENCE TEACHER TRAINING

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Abstract

The quality of science education is a very contemporary didactic topic at present. Improving the quality of this education is unthinkable without a quality science teacher training at universities and other educational institutions. Some innovation of contents and organization of the study programme for future science teachers was realized within the ESF project "Professional science teacher training for careers in a competitive environment" at Faculty of Science of Palacký University in Olomouc, Czech Republic. The project focuses on improving the training of teachers of all science branches in connection with the growing needs of the current competitive labour market. One of the main aims of the project leading to this improvement was the creation of new and innovated subjects oriented to teaching practice. A research focused on finding benefits of the new subjects for students was realized within the project. The objective of the research was to investigate the difference between students' expectations and real benefits of the subjects. The research results were very useful as a feedback for a subsequent modification of the study programs. Some particular examples of the process and results of the research are described in the paper.
Key words: *initial teacher training, science subjects, innovation, evaluation*.

Introduction

Various researches in many countries show that students' interest in science both in Lower and Upper secondary schools has a tendency to decrease (Gedrovics & Mozeika & Cedere, 2010; Schmidt, 2000; Bilek & Radkova & Gedrovics, 2006). Improvement of this situation is unthinkable without well-prepared science teachers. The problem of quality science teacher training is being solved within the ESF project "Professional science teacher training for careers in a competitive environment" at Faculty of Science of Palacký University in Olomouc, Czech Republic. One of the main aims of the project is the creation of new and innovated curricula and special textbooks for the science teachers' programmes. A research focused on finding benefits of the new subjects for students was carried out to strengthen the feedback from pilot teaching of new and innovated subjects. The aim of the research was to determine the difference between students' expectations and real benefits of the subjects. The research results were very useful for a subsequent modification of the study programmes. The research was a part of an overall project evaluation. An evaluation as a process or as a result of an objective assessment of the value, quality and efficiency of target programs, results, resources, conditions, contexts

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(Švec, 2002) should serve as a feedback for the realization of a project. The purpose of a project evaluation is to evaluate whether and to what extent the project objectives are fulfilled. The project evaluation is also a means of checking the correct and successful implementation of the project. According to Westat (2002), the current view of evaluation stresses the inherent interrelationships between evaluation and programme implementation. Evaluation is not separate from, or added to, a project, but is rather part of it from the beginning. Planning, evaluation, and implementation are all parts of a whole, and they work best when they work together. Lamanauskas (2011) presents another interesting features of the evaluation process. For an evaluation of process of science teaching and learning there are different strategy and ways. The main questions are: What is to be evaluated? When and why to evaluate? How to evaluate? It is clear that for science teaching success one of the most important resources is feedback from students (Lamanauskas & Vilkonienė, 2008).

Characterization of the Project

The project aims to improve the training of teachers of science subjects in line with the growing needs of the current competitive labour market. One of the main aims of the project leading to this improvement is the creation of innovated curricula for teacher training in mathematics, physics, chemistry, biology and geography at the Faculty of Science at Palacký University in Olomouc, including a common base and teaching practice. Within this key activity new syllabi of some selected subjects were created and study textbooks were specifically treated for teaching these subjects. Pilot teaching of the innovated subjects is aimed at testing the innovated items on the target group of science teacher training students. A feedback based on the evaluation of the pilot teaching is used to modify the content of the final innovated subjects before their inclusion in regular study programme. Another objective of the project is the creation and development of university schools system in the region of Palacký University, in particular for the purpose of the implementation of the newly conceived student teaching practice. University schools will also be used to realize education research of students and university teachers and systematic work with potential applicants to study at the Faculty of Science at Palacký University. The project target group consists primarily of students studying teacher training programme of natural sciences at the Faculty of Science, as well as secondary school students (potential applicants for the study at the Faculty of Science) and university teachers involved in training of the future teachers. The support for secondary school students is implemented within the project mainly by popularizing events, competitions, educational seminars, etc. Educational events thematically focused on the needs of teaching practice are organized for the target group of university teachers and students.

Evaluation of Innovated Teaching and Teaching Practice

In the first evaluation, teaching of the following new subjects was evaluated: Introduction to Study of Mathematics, Current Issues of Teaching Mathematics, Fundamentals of Educational Research, Local Region in Teaching Geography, Current Issues of Teaching Geography and Current Issues of Teaching Physics. The starting point for the evaluation was whether the teaching of new subjects which were integrated into study programmes would be helpful for students. Another question was whether the newly conceived concept of teaching practice would be more beneficial for students and also for their experienced supervising teachers than the old concept. The form of a questionnaire was chosen as a method of evaluation. Four research tools – questionnaires - were developed. Two were designed for evaluation of teaching and two for the evaluation of the teaching practice. The evaluation of the whole project is divided into the evaluation of the teaching of new subjects included in the study programme and the evaluation

of the teaching practice in a new concept. The first part of evaluation runs twice each semester, always at the beginning of the semester and at the end of the semester when those subjects are taught. The evaluation of the teaching practice is different. The teaching practice is also assessed twice; the first time from the perspective of a practicing student who gains teaching experience at school and the second time from the perspective of an experienced teacher with whom the student held the practice. These two forms of evaluation are always carried out at the end of the practice. Using the questionnaires during the evaluation of teaching of new subjects there were compared the expectations of students at the beginning of the course with the fulfilment of the expectations at the end, i.e. with their evaluation of teaching the subject throughout the semester. For this reason, the evaluation took place immediately at the beginning of teaching, i.e. in the first lesson of the subject.

Questionnaire Method

The questionnaires were designed to investigate whether students' expectations of the course were to acquire new knowledge, skills in practical or theoretical platform, whether they expected well-prepared teachers, and whether a motivation for choosing the subject was their interest. The evaluation questionnaire that students filled out at the end of teaching the subject, again carried the questions relating to the acquisition of new knowledge, and practical and theoretical skills. Other questions related to the quality of the professional preparedness of the teachers, the subject content - whether the students were interested in the subject, whether the form of implementation suited them, whether the issue was new and rewarding for them, whether they had enough quality literature and whether they would chose the subject again. Finally, the students rated the subject with a mark from 1 to 5, where 1 meant the best rating and 5 was the worst one. All questions except the last one were multiple-choice questions, the possible answers being: yes, partly, no, no answer (noncomparative scaling). The questions were deliberately formulated with closed response options because of easier statistical processing. There were two questionnaires to assess the teaching practice. The first one investigated the perspective of a student who had just finished his/her teaching practice at school. Here the student was asked how he or she was prepared from university in terms of knowledge and skills in the subjects of his or her qualification. Further interest was to find out whether a student was informed about educational programmes used at school. Whether he or she was able to formulate the goals of teaching, to structure a lesson, whether he or she managed to motivate pupils properly, to have contact with them, to answer their questions, to evaluate their performance, to manage educational problems. Whether he or she managed to make appropriate use of information technology, whether he or she could prepare a written examination and conduct an oral examination, whether his or her speech was comprehensible for the students. In one of the items the student was asked whether the practice was used to collect data for educational research. The last item of the questionnaire provided the students with space to comment all activities which exceeded their duties. In the second questionnaire, filled out by an experienced teacher with whom the student held the practice, were items of similar content. The teacher used them to evaluate the student practitioner. All items except the last one offered options from 1 to 4, where 1 meant excellent and 4 unsatisfactory evaluation ratings. The research group for evaluation of the teaching was formed by all students who chose the subjects newly integrated into the study programme in the semester. Almost all the questionnaires in all new subjects were returned. It was because the teacher distributed the evaluation questionnaires at the beginning and at the end of the teaching practice personally and the students returned them to the teacher personally as well. The research group for the evaluation of teaching practice in the new concept was formed by all students who realized their teaching practice in a given semester. Before starting the practice they received the evaluation

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questionnaires in both versions (for themselves and their teachers) from their methodologist of qualification subjects which returned to their methodologist after the practice. This ensured an almost total return.

Research Focus

The research focused on finding benefits of new and innovated subjects for students was realized within the project as a part of an overall project evaluation. The objective of the research was to investigate the difference between students' expectations and real benefits of the subjects. The research results were very useful as a feedback for a subsequent modification of the study programs.

Research Question

The following research question was formulated for each new and innovated subject:

- Is the teaching of the subject a benefit for students?

Methodology of Research

Research Hypotheses

Two research hypotheses were formulated for each new and innovated subject:
H_1: The subject contributes to the acquisition of new student's knowledge.
H_2: The subject contributes to the acquisition of new student's skills.

The questionnaire method described above was chosen as research instrument for verification of the hypotheses. Note that only responses of questions connected with students' knowledge and skills were used for the purpose of the research.

Data Processing

To observe anonymity it was necessary to use the two-sample (unpaired) method, and a nonparametric method according to the type of answers. Using the Mann-Whitney test for the significance level of 0.05, statistically significant differences were investigated. The data processing was done using the system SPSS, version 12.0.

Results of Research

Verification of Hypothesis H_1

The question 1 of pre-course questionnaire was: "Do you expect that you acquire new knowledge by completion of this course?" The question 1 of post-course questionnaire was: "Do you think that you have acquired new knowledge by completion of this course?" The following table shows the frequencies of student's responses to question 1 in pre-course questionnaire (expectation) and post-course questionnaire (evaluation) within the subject "Current Issues of Teaching Mathematics". Total number of students taking part in the course was 21. The results from the Table 1 were used to verify the hypothesis H_1.

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Table 1. Subject „Current Issues of Teaching Mathematics" – answers to question 1.

Question 1	Expectation		Evaluation	
Answer	n	%	n	%
Yes	16	76.2	17	81.0
Partially	4	19.0	4	19.0
No	1	4.8		
No answer				
Total	21	100	21	100

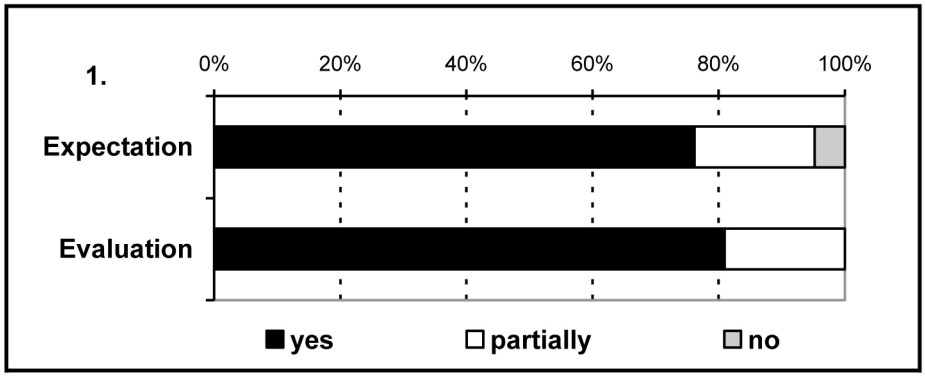

Figure 1: Subject „Current Issues of Teaching Mathematics"– answers to question 1.

The following null hypothesis H_{01} and alternative hypothesis H_{A1} were formulated to verify the hypothesis H_1:

H_{01}: There is no statistically significant difference between the frequencies of the student's responses to question 1 in pre-course questionnaire and post-course questionnaire within the subject.

H_{A1}: There is statistically significant difference between the frequencies of the student's responses to question 1 in pre-course questionnaire and post-course questionnaire within the subject.

Using the Mann-Whitney test for the significance level of 0.05 and the system SPSS, version 12.0, no statistically significant difference was found. The hypothesis H_1 was verified for the other subjects in a similar manner. It means that the hypothesis H_1 can be accepted for all subjects newly implemented in the study programme.

Verification of Hypothesis H_2

The question 2 of pre-course questionnaire was: "Do you expect that you acquire new skills by completion of this course?" The question 2 of post-course questionnaire was: "Do you think that you have acquired new skills by completion of this course?" The following table shows the frequencies of the student's responses to question 2 in pre-course questionnaire (expectation) and post-course questionnaire (evaluation) within the subject "Current Issues of Teaching Mathematics". Total number of students taking part in the course was 21. The data from the Table 2 were used to verify the hypothesis H_2.

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Table 2. Subject „Current Issues of Teaching Mathematics" – answers to question 2.

Question 2	Expectation		Evaluation	
Answer	n	%	n	%
Yes	8	38.1	11	52.4
Partially	12	57.1	9	42.9
No	1	4.8	1	4.8
No answer				
Total	21	100	21	100

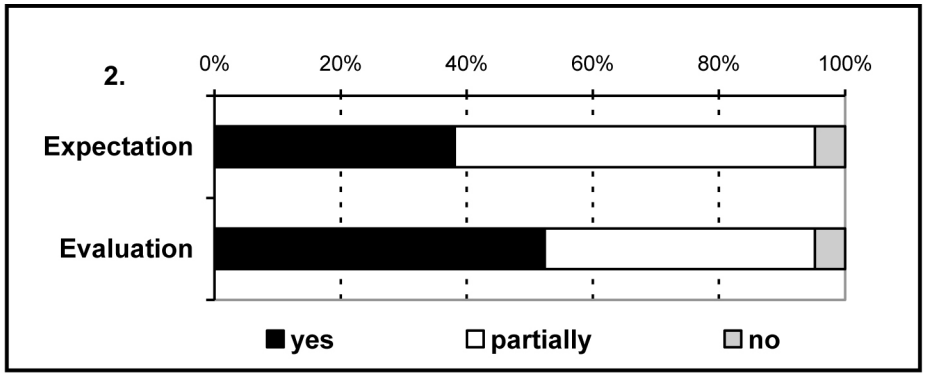

Figure 2: Subject „Current Issues of Teaching Mathematics"– answers to question 2.

The following null hypothesis H_{02} and alternative hypothesis H_{A2} were formulated to verify the hypothesis H_2:

H_{02}: There is no statistically significant difference between the frequencies of the student's responses to question 2 in pre-course questionnaire and post-course questionnaire within the subject.

H_{A2}: There is statistically significant difference between the frequencies of the student's responses to question 2 in pre-course questionnaire and post-course questionnaire within the subject.

Using the Mann-Whitney test for the significance level of 0.05 and the system SPSS, version 12.0, no statistically significant difference was found. The hypothesis H_2 was verified for the other subjects in a similar way. It means that the hypothesis H_2 can be accepted for all new subjects.

Discussion

It can be stated that the project is after one year initial pilot phase. The subjects adjusted in accordance with the evaluation should reappear in the teaching next year. The natural aim of researchers is to compare the level of pilot and modified form of the subjects. Teachers will be able to modify the content of the course, i.e. included topics, the proportion between obtained theoretical knowledge and practical skills, etc. The similar questionnaire on professional competence given to teachers at the beginning and the end of the study, verifies an improvement in their professional skills was described by Díaz & Poblete (2005).

From further analysis of data obtained via questionnaires can result other facts on

which the teachers will have to respond. It is mainly about personality of the teacher, his or her qualifications, the attractiveness of the chosen subject, etc. Such more comprehensive study was done by Sameena (2006). The study has brought forth the expectations that students have in six distinct areas – course curriculum, teaching staff, student life, classmates, facilities and support services. It is important that the universities understand these expectations in light of the knowledge that this study provides on why these expectations were formed. It is also important to understand recognize the possibility that, at times, students may have unrealistic expectations. However, if these (unrealistic expectations) are not addressed directly by the universities, it may lead to dissatisfaction or disengagement on the part of the students.

The study of students' expectations of various aspects of quality teaching has become prominent in the last two decades (Addison, Best, & Warrington, 2006; Ferreira & Santoso, 2008). As education is a dynamic human activity it is obvious that students, being the end users of the academic community, would be able to provide important insights derived from their experiences in the classroom (Cunningham, 2008). Such feedback can be interpreted at various levels of the scholarship of learning and teaching. These include generic expectations that might feed pedagogies across disciplines, as well as those regarding specific fields of study or particular educational settings.

Handal & Wood & Muchatuta, (2011) explore these expectations in the business and economics disciplines. It also seeks to identify those expectations that differ from the current literature on effective instructional practice. This study reflects on literature about students' expectations and perceptions of what constitutes effective pedagogies in the last two decades in higher education. The findings are aimed towards informing course delivery and enhancing professional development programs, with the ultimate purpose of influencing the retention and success rates also in economics faculties.

Conclusions

A general conclusion can be achieved from the research: the implementation of new subjects was successful and met the expectations of the students. The new approach to the teaching has resulted in a stronger feedback and the subsequent creation of conditions for improvement of the teaching. A scientific conference on the issue of education of science branches teachers will be organized at the end of the project. Further experience with innovated teaching and the results of its evaluation should be presented. As it is usual for ESF projects, the outputs of the project should be sustainable for several years. Therefore, as well as because of the positive results of the research, it is the intention of the realization team to implement new subjects as a permanent part of the study programme.

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