Quality Improvement in Education, based on Student Feedback

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Abstract: This work deals with the improvement of higher education processes and the identification of solution guidelines, for problem areas analyzed from student feedback. The purpose of this article is to analyze and evaluate student opinions and suggestions. To this end, on the one hand, we conducted an online survey, with the aim of collecting educational improvement proposals, from the student's perspective. On the other hand, we investigated the applicability of this method, which is well known and effectively used in the field of social science. Using the method, we examined what student expectations can be formulated, in order to improve and develop the quality of education. In the course of factor analysis, we planned to define those expectations and attitudes that will be of effective help, in the successful improvement and development of the teaching work, which can ultimately mean long-term success for the student.

Keywords: Quality improvement; Student feedback; Q-method; Factor analysis

1 Introduction and Purpose

Determining quality is basically a difficult task, especially in the field of education or training. According to the requirements of Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG), quality can be formulated as a result of the interaction of the instructor, the student and the institutional learning environment. Quality assurance in higher education means among other things, providing a learning environment in which the content of the trainings, learning opportunities and infrastructure are fit for purpose. To do this it is essential to take into account the needs and expectations of students and other stakeholders as well as society (stakeholders). [1] There are several types of opinion surveys in our institution. Students are given the opportunity to express their opinions both during training (Opinion request sheet) and directly upon graduation (final examination student opinion survey). Due to the character of the service, it is also important to know how graduate students can benefit from their acquired knowledge in the longer term. Therefore, the 1st, 3rd and 5th years of the

student's follow-up (Graduate Career Tracking System), is important feedback for the higher education institution. To improve the quality of education we can receive important information from student and teacher feedbacks but at the same time we need to know the expected needs. There are no needs assessments of this kind and it is hard to imagine that those entering higher education could describe this. There are methods, tools which can help to determine these expectations (student attitudes). In our research we chose the Q-method which is becoming increasingly popular in social science research and has already been applied in several ways in educational and pedagogical fields.

2 Literature Review

The Q-method is suitable for researching the range and diversity of subjective experiences, points of view and opinions. However, it facilitates the identification of similarities, the construction of broader categories of the phenomenon under study as well as the exploration of patterns and relationships within and between these categories. The method has been used in various fields and its application is increasing from time to time. [2] Therefore, the main goal of the Q-method is to form types and attitudes from subjective points of view towards a thing, e.g., towards political attitudes, advertisements, environment. The creation of the Q-method is associated with the name of the English psychologist-physicist William Stephenson. The development of the method was based on the desire to provide a scientific framework for determining subjectivity. [3] The Q-method assists in the systematic examination of human subjective opinion-forming and decision-making. [4] A qualitative analysis evaluating subjective opinions that uses a quantitative approach to factor analysis based on statements ranked by respondents. [5]

The Q-method is not a tool designed to reach agreement but a means of examining the diversity of opinions on topics about which there has been a more or less mature debate. [6] This is due to forcing respondents to choose or rank between opinions and statements. [7] The Q-method is also an effective tool for managing conflicts and identifying expectations for future directions. [8]

It can be considered a reverse factor analysis, according to which it analyzes the people themselves not their characteristics. The method does not focus on differences between individuals but on differences within individuals. The mathematical basis of the method is the same as the mathematical basis of factor analysis. With the Q-method a relatively large number of statements can be evaluated with the involvement of a very small number of individuals. The correlation coefficients calculated by this method show what the correlation is between people. [9]

The mathematical background of the procedure is provided by calculation of the correlation and modified (inverse) factor analysis with the help of which we can create common groups and factors from similar opinions [10]. Relatively few, usually from 10 to 50 individuals are involved in the study, who are selected on the basis of specific criteria. Due to its distinctive features, the Q-methodology combines qualitative and quantitative research procedures, combining the advantages of both research methods. [11] [12] The method is a scientifically based philosophical and statistical framework and approach with the help of which various individual subjectivities can be quantitatively analyzed and evaluated using objective scientific means. [13] In a sense the Q-methodology combines the power of qualitative and quantitative research traditions. [14]

The Q-method uses a set of statements (Q sample) describing a certain topic, formulating statements. [15] Within this framework study participants (P-set) should be selected and invited to participate in a group from among these statements. They are asked to evaluate a heterogeneous set of claims in terms of agreement and disagreement. [16]

The application areas of the Q-method are wide-ranging but it is typically used in areas where customer expectations can be analyzed qualitatively and quantitatively:

- In opinion polls, e.g., the definition of political leanings
- For behavioral studies of health patients in clinical psychology, for analysis of social work [17] [18]
- In education, pedagogical analyses, qualitative examination of opinions, expectations [19]
- In media research, marketing research, examining customer attitudes

3 Methodology and Approach

Our studies are based on the results of surveys conducted among students who passed the final exam in the 2021 and 2022 academic years. During this period, there were typically attendance and online final exams, so the surveys were conducted by students both online and personal. In the case of our institution the surveys were carried out with a completion result of 14-63%. The questionnaire used is structured as follows:

1. Evaluation of educational activities of specialization (satisfaction [1-6] and importance [1-6]); 8 questions
2. Evaluation of general educational infrastructure (satisfaction [1-6] and importance [1-6]); 7 questions

3. Evaluation of the means to support the teaching of basic and vocational subjects (satisfaction [1-6] and importance [1-6]); 5 questions
4. Evaluation of activities related to the organization of education (satisfaction [1-6] and importance [1-6]); 11 questions
5. Overall, I got what I expected from the training [1-6]
6. If I were to start my studies again in this field, I would choose the same University again [1-6]
7. Strengths-Weaknesses

The results evaluation sheets are prepared in a separate way for Institutes, which does not allow for the separate evaluation of individual courses (BSc, MSc, special postgraduate training scheme) or specializations. The formulation of quality improvement options that can be formulated on the basis of the results of the surveys can be done at different levels. In the questionnaire compiled for student review, the individual questions and the evaluations given to them can be linked to different levels of intervention (responsibility), these are: instructor, lecturer of the subject (L), Institute (I), head of the training (H), Faculty (F), University (U).

In our research, we treated the results of the surveys carried out during the period under review as a whole and in general and based them on our further studies. Of the listed intervention levels, only the subject areas at teaching (L) and Institute (I) level were analyzed. In general, the following areas were identified by students as problems:

- Professional and pedagogical preparedness of teachers
- The relationship between faculty and students of the training/specialization
- Organization of classes (lectures, seminars, labs)
- Effective filling of training time with subjects
- Interdependence of subjects
- Organization of exams
- The matching of the final exam with what they have learned

We conducted an online survey among our students about what educational development opportunities and solutions they find useful to improve the listed problems. During the filling out, they could choose more than one of the development options defined, and they could also formulate their own proposal, A total of 88 students participated in the survey. Of those surveyed, 53.4% are BSc in mechanical engineering, 35.2% are BSc in mechatronics engineering and 11.4% are BSc in safety engineering. 70.5% are full-time students and 29.5% are correspondence students. The results of the questions and answers in the

questionnaire on the development of teaching activities, evaluation and collection of suggestions were as follows:

1. In your opinion, what are some ways the instructors could improve communication with students?
2. In your opinion, what are some ways the instructors could improve their professional and pedagogical skills?
3. In your opinion, how can the instructors improve the educational support tools (notes, aids, presentations, etc.) of their subjects?
4. In your opinion, what are some ways the instructors can improve the educational tools and techniques that help to get to know the profession and transfer knowledge during the training?
5. In your opinion, what are some ways the instructors can improve the organization of classes (lecture, practice, lab)?
6. In your opinion, what are some ways to improve the accountability of subjects and the organization of exams?
7. In your opinion, what are some ways to improve the structure of subjects?
8. In your opinion, what are some ways to improve the interdependence of subjects?
9. In your opinion, what are some ways to improve student involvement in research?
10. In your opinion, what are some ways to improve the educational infrastructure in each training program/specialization?
11. In your opinion, what are some ways to improve the infrastructure related to services at the Faculty?
12. In your opinion, what are some ways to improve student counseling and administration at the Faculty?

Based on the student responses, in the rest of our research we would like to examine the expectations and attitudes of the students using the Q-method. The steps in this method are shown in Figure 1.

Figure 1
Steps of the practical application of the Q-method

In the first step the purpose of our research was determined. In the course of our studies, we are looking at what groups of student expectations can be defined using the Q-method along the lines of educational development. To do this in the next step we have identified 34 statements, these are:

1. It is useful to create and operate a complaint interface where students can make their comments.
2. For all subjects, it is expected that the assessment method is in accordance with the requirements.
3. There should be exam topics for the subjects and they should fit the learning materials.
4. Involving external lecturers in education effectively improves knowledge of the profession.
5. Organizing and holding small group sessions and exercises is an effective way to improve communication.
6. As a student I am satisfied to participate in company visits, where you can get acquainted with industrial practices.
7. In a well-functioning educational infrastructure, there are open labs available to students at any time.
8. In a well-functioning educational infrastructure, it is essential to have software that is also used in industry.
9. In a well-functioning educational infrastructure, it is necessary that the technical equipment of the lecturers and classrooms is at a high level.
10. In a well-functioning educational infrastructure, a room provided for project tasks is essential for students.

11. In an effective educational infrastructure, it is necessary to have modern machines, tools, instruments in laboratories.
12. In an effective educational infrastructure, it is necessary to have labs suitable for practical sessions.
13. The basis of the organized lessons (lectures, practices) is that the instructor knows and properly manages the technical devices.
14. Online tests effectively help to complete the tests for the purpose of practice and self-checking.
15. Instructors should provide with an adequate number of consultation opportunities for students.
16. Instructors should regularly participate in educational methodology training.
17. The professionalism of instructors can be effectively developed if they strengthen their industrial relations.
18. The theoretical curriculum should be supported by appropriate textbooks and recommended literature.
19. Notes, aids and examples should be prepared for each subject, which are also available in digital form.
20. Transparent, outlined, illustrative presentations help to understand the curriculum, therefore it is an effective educational support tool.
21. The curriculum of the given subject should be adapted to the training goals of the given specialty/training/specialization.
22. Study administration is facilitated by the mobile application developed for this purpose.
23. For academic administration, it is important to have up-to-date information on the websites, which is easily accessible.
24. The schedule of the subject must include the learning materials covered during the semester.
25. The interdependence of subjects is facilitated by increasing the number of practical lessons.
26. Learning materials will help you learn the profession much better if they contain real, industrial examples.
27. The theoretical and practical parts of the curriculum should be balanced.
28. The learning materials to be uploaded to Moodle should be uploaded on time, and their availability should be ensured by the instructor.
29. Learning materials often contain outdated, old examples or worse, no examples. Their topicality contributes to the development of educational support tools.

30. Students would prefer to participate in research if there was a thesis topic they could develop.
31. One of the best ways to motivate students is if they can earn extra points during lessons.
32. Students could be more involved in research if there were suitable labs for this.
33. When teaching the practical curriculum, it should be a truly practical (lab) lesson.
34. Create a learning material of examples for practical tasks with real, industrial examples.

Then we defined the Q-table in which the 34 statements can be placed (Figure 2).

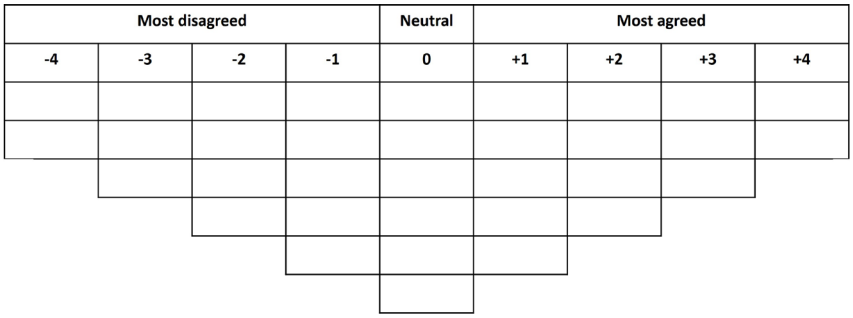

Figure 2
The structure of the Q-table

We asked 15 participants to settle the statements. Respondents were selected to reflect the opinions of those interested in a particular topic, but they did not represent the entire student community. The respondent students were full-time undergraduate students. Their task was to place the statements in the Q-table. First it was necessary to divide the statements into three groups: agree, disagree, indifferent (neutral). Each score then had to be sorted according to how much you agree or disagree with that statement. After sorting, we used PQMethod - 2.35 (Mar 2014) by Peter Schmolck to perform factor analysis. [20] Our program settings were:

- Title of Study: My first analysis of the development of education
- Column Range: -4 TO 4
- Depth of Columns: 2 3 4 5 6 5 4 3 2
- Sorts Entered: 15

To perform a factor analysis, the program guide was used. Based on this the main component analysis was carried out, the factors were determined and analyzed with the factor analysis. [21] In the following we present our results for both the online survey and the Q-method.

4 Results

The 15 completed Q-sorts (individual evaluation table) were then processed using the already referenced Schmolz's PQMethod computer program. The program trained typical Q-classes (factors), based on their similarity or difference in individual preference sequences (Q-classes). Using the Q-method, we originally created eight factors from individual rankings, which were reduced by rotations to 4 factors. The Q factor analysis identified the following types of students:

- Students who require practice-oriented instruction typically consider it important to have real-world hands-on (labs) sessions that include learning materials that contain real industry examples. In this expectation, there is a need for external (industrial partner) involvement in education, supporting the theory, with applications presented in industrial practice.
- Students who require an appropriate learning environment and who consider it important to have computer labs with the appropriate software and to use open labs during their studies. They expect labs equipped with machines and devices that also perform tasks for teaching and research purposes.
- Students who require well qualified teachers formulate as expectations the organization of classes, the timely availability of learning materials, the alignment of requirements with the subject and the teacher's educational methodological preparation. They require a combination of traditional and modern forms of education, in which they can feel more motivated. They consider it important that the exam requirements are aligned with the curriculum.
- Students who need up-to-date, informational (communication) background. They place great emphasis on the quick, easy access to real-world information that is important to them. They require up-to-date information on the websites operated by the institutions, easy, fast search possibilities and descriptions to help with certain administrative procedures. Not only academic administration, but also communication with instructors is considered important, and in the event of a problem, they should receive appropriate help and quick and efficient operation of complaint handling.

In the following we analyzed student opinions based on responses to the educational development questionnaire:

1. In your opinion, what are some ways instructors could improve communication with students?

The largest number of votes was 58% for small, group lessons and practices, followed by 51.1% by the functioning, fast complaint interface, where students can indicate their problems, 29% for more face-to-face consultations with students, 26.1% for educational-methodological training for instructors, and also 26.1% for class visits in which the instructor's ability as a lecturer is assessed.

2. In your opinion, what are some ways instructors could improve their professional and pedagogical skills?

In this issue 64.8% of the votes were given to strengthening industrial relations, followed by 44.3% participation in educational-methodological training for trainers, 42% participation in professional conferences, 38.6% participation in pedagogical training for trainers, and 33% in the processing of professional journals and textbooks.

3. In your opinion, how can instructors improve the educational support tools (notes, aids, presentations, etc.) of the subjects?

In this topic 75% of the votes were given to the learning materials available on Moodle, followed by 70.5% if possible, a book of problems, 65.9% learning materials available in electronic and printed form, 56.8% notes to be updated with current events, including follow-up questions and 52.3% to provide transparent, outline and illustrative presentations.

4. In your opinion, what are some ways instructors can improve the educational tools and techniques that help to get to know the profession and transfer knowledge during the training?

The most votes 80.7% was given by real-world industrial examples and practices in the teaching materials, followed by 69.73% for the involvement of an external lecturer and 65.9% for the organization of study trips to industrial partners.

5. In your opinion, what are some ways instructors can improve the organization of classes (lecture, practice, lab)?

In this topic 65.9% of the votes were given to the proper use of technical means, followed by 64.8% for student motivation, 38.6% for group work and consultation opportunities and 33% for accurate start and end of classes.

6. In your opinion, what are some ways to improve the accountability of subjects and the organization of exams?

70.5% of the votes were given to the accountability for the requirements of the subject or in the case of exams for the exam topics to fit the curriculum, followed by 63.6% for the use of online tests in Moodle and 45.5% for the correction of midterm tests within a fixed deadline.

7. In your opinion, what are some ways to improve the structure of subjects?

In this case the advices were in order: the teaching materials should be aligned with the training goals of the given training program/specialization (69.3%), the topics should include the teaching materials involved during the semester (65.9%), the industrial and professional expectations should be taken into account in the structure of the curriculum (65.9%), the teaching of the practical curriculum should be a truly practical (lab) occupation (63.6%), the theoretical and practical parts of the curriculum should be balanced (51.1%).

8. In your opinion, what are some ways to improve the interdependence of subjects?

Student opinions for the development of the teaching were in order: increasing the number of practical lessons (55.7%), reducing the pre-requirements for subjects (37.5%), increasing the number of exam courses (35.2%), taking subjects without pre-requirements (34.1%).

9. In your opinion, what are some ways to improve student involvement in research?

In this issue the suggestions were in order: providing thesis topics related to research tasks (71.6%), providing laboratories for students for research tasks (59.1%), providing several Scientific Student Circle topics related to research topics (33%).

10. In your opinion, what are some ways to improve the educational infrastructure in each training program/specialization?

The most votes (84.1%) were given to the provision and education of modern software also used in industry, followed by the development and modernization of laboratory equipment and instruments by 73.9%, the development of laboratories suitable for practical sessions and the provision of open laboratories for students (65.9%).

11. In your opinion, what are some ways to improve the infrastructure related to services at the Faculty?

In this case the most evaluated things were in order: improving the technical equipment of lecturers and classrooms (67%), providing a room suitable for project tasks (62.5%), providing a computer room outside the classroom (50%).

12. In your opinion, what are some ways to improve student counselling and administration at the Faculty?

In this question the order was between the devices: development of the Faculty website, easier access of information (60.2%), provision of a room suitable for project tasks (62.5%), provision of a computer room outside the classroom (50%).

Conclusions

In this work, we presented the educational development opportunities, based on the assessment of student opinions. With our studies we focused on examining the most problematic areas identified by students. On the one hand, we have completed a series of questions in which we collected suggestions for quality improvement by interviewing students. The questionnaire was compiled by nearly a hundred students and reflects the opinions and insights of all three undergraduate, full-time and correspondence students in our institution. After that we examined the applicability of the method, which is popular in the fields of

social science, made the necessary statements for quality improvement and asked students currently studying to prepare Q tables. We evaluated and analyzed the vessels and then compared them with each other.

Overall, we can say that the applied Q-method is well suited for exploratory and analytical examination of qualitative opinion types, expectations, evaluations. The method usually works with a small sample (10-50 test subjects) and representativeness is not required. In our study there were 15 students who are currently pursuing their studies in all three undergraduate courses. The Q-procedure is usually used in cases where there are not yet conscious standard opinions and points of view. The Q-method can be used in this context as an exploratory tool as a preliminary or complementary procedure for various quantitative and qualitative research. In contrast to the usual review methods that reveal problems and satisfactions, the Q-method is also suitable for identifying trends and expectations that can be detected based on reviews. For this reason, it can be used to complement traditional methods and be a step forward in defining trends for quality improvement. It can prevent large-sample, statistically determined quantitative research but it is by no means an alternative to survey research, where representativeness is an important requirement. The results of the Q-method cannot be generalized to the population in the same way as the results of qualitative studies in general, i.e., it is not possible to determine from the types explored how much of the sample is included, nor what percentage of the basic population may be characterized by that type of behavior. Further studies would be needed to establish this, which could be formulated as the next step in our research. Based on its results, it can be said that it is worth using this method either to analyze the temporality of expectations or to analyze a community of opinions in more detail. Finally, we can state that our research has also shown, that opinion assessment and the Q-method, are suitable and complementary procedures, for determining subjective value judgments and expectations.

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