An Introduction of GQM Approach for Measuring Educational Activities for Accreditation

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Abstract

One of the key preparations for engineering accreditation is measurements and evaluation of various activities in educational environment and its documentation to record evidences which can be used to prove those activities are operational and effective to meet the accreditation criteria. It is not easy to obtain the measures about the activities such as the student observation and achievement of educational objectives because many of them have qualitative characteristics. Then we need systematic ways to measure it while considering the measurement purpose and how to measure and why do it. In this paper, GQM(Goal-Question-Metric) method as a measurement framework is introduced to measure the educational activities for accreditation and case study is provided to represent this method was effective.

Introduction

Measurement is necessary to characterize the current status of an educational activities and its objective can be used to evaluate and improve of all aspects of those activities. Once the current status of those activities have been identified and described quantitatively, an evaluation through measurement can be performed to make changes for improvement.

The measures for easy quantification can be the test score of subjects or Grade Point Average, however the activities for accreditation such as the achievement assessment of educational objectives and observation of students are difficult to collect and quantify those ones. In case of measuring activities which have qualitative characteristics[9], we need to think of the measurement purpose and the reasons why we perform this measurement. This consideration may contribute to avoid putting overload to the faculty to acquire the redundant and excessive measurement data. Then, it is necessary to establish measurement framework to decide what and how data can be collected and why do it for engineering accreditation.

The Accreditation Board for Engineering Education of Korea (ABEEK) accreditation criteria[1] demand strict terms what is required for a program to be accredited. The rigid nature of this system was a source of frustrations to engineering faculty and administrators and the issues of "bean counting". ABEEK engineering criteria not only requires a systematic and effective management of operational data including evaluation in an engineering program, but also to develop measures and evidence that indicate the degree to which each of engineering criterion is met.

In order to cope with the issues described above, we need a systematic approach adequate for evaluation and improvement based on effective measurement. In this paper, GQM(Goal-Question-Metric) approach as a measurement framework is introduced to measure educational activities for accreditation.

An overview of GQM approach

The GQM approach[2,3,4,5,6,7] was developed in response to the need for a goal-oriented approach that would support the measurement of processes and products in the software engineering domain. The GQM supports a top-down approach to defining the goals behind measuring software processes and products, and using these goals to decide precisely what to measure, namely choosing metrics. GQM emphasizes the need to (1) establish an explicit

measurement goal that is specific to the process activity or product characteristics that is to be assessed, (2) define a set of questions that must be answered in order to achieve the goal, and (3) identify well-formulated metrics that help to answer the questions[8]. This GQM structure is represented in Figure 1.

Fig. 1 Goal-Question-Metric structure

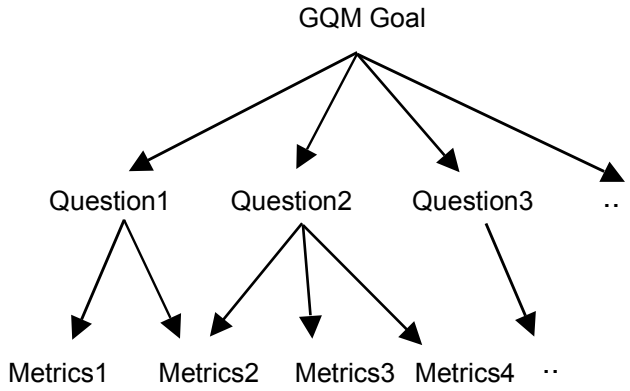

Fig. 1 Goal-Question-Metric structure

The process of setting goals and refining them into quantifiable questions is complex and requires experience. The template for a GQM goal has been developed to indicate the required contents of the GQM goal and to support the goal-setting activity.

The template identifies five major aspects, namely the object, purpose, quality focus, viewpoint and environment. First, the object aspect expresses the primary target of the study which is process or product that will be analyzed. Second, the purpose aspect expresses how object will be analyzed. Will it be analyzed for the purpose of understanding and characterization? Will it be compared with some other objects? Third, the quality focus aspect expresses the particular property of the object that will be analyzed in the course of study, such as cost, reliability, etc.
Fourth, the viewpoint aspect expresses information about the group of people that will see and interpret the data. By stating clearly the group to which the analyzed data will be released, issues of confidentiality can addressed before any data are collected. Finally, the environment aspect expresses the context in which study will be performed and is used to make influencing factors explicit. An example of the goal constructed using this template might be:
Analyze the **testing process** (object) for the purpose **of improvement** (purpose) with respect to **reliability** (quality focus) from the viewpoint of the **developer** (viewpoint) in the context of **Project Y** (environment).

Application of GQM approach

To apply GQM approach to measure educational activities for accreditation, the following steps are needed.

Step 1) Develop data user goals and associated measurement goals. This approach starts by capturing the goals of the user group and using the goal template. Using this template, each goal is described. The example of goal template for increasing the efficiency of student consultation in the accreditation program is represented as follows. Analyze the **student consultation process** (object) for the purpose **of improvement** (purpose) with respect to **consultation efficiency and satisfaction** (quality focus) from the viewpoint of the **program committee** (viewpoint) in the context of **an engineering program** (environment).

Step 2) Generate meaningful questions that define those goals as completely as possible in a quantifiable way. The example of derived questions is represented as follows.
- Q1: Do students think the accreditation is necessary?
- Q2: How many students are consulted on a regular basis?

- Q3: How much time is spent for a single student consultation?
- Q4: Does the consultation cover all the aspects of educational activities?
- Q5: Is the teachers well educated in consultation techniques?

Step 3) Once the questions have been developed, Specify the metrics needed to be collected to answer those questions. The example of the metrics is represented as follows.
- M1: Subjective assessment by teachers.
- M2: Average number of consulted students in one semester
- M3: Average consultation time per a student
- M4: Questionnaire answered by students.
- M5: Number of teacher participation in consultation seminars or workshops.

Step 4) Develop mechanisms for data collection.
As methods used for collecting data, questionnaires, surveys, checklists, interviews, documentation review, focus groups etc. can be used.

Step 5) Collect and analyze the data to provide feedback to accreditation activities for corrective action and make recommendations for future improvements. In this step, the indicators which are measure or combination of measures that provides insight accreditation activities is derived.

We applied GQM approach to measure educational activities for accreditation and the results are represented in Table 1 and Table 2.

Table 1: GQM for measuring the extent of student participation in the accreditation program

Goal	**Questions**	**Questions**
To improve the extent of student participation in the accreditation program	What is the current level of understanding for the engineering accreditation?	Questionnaire answered by students.
	What is the extent of student participation in the seminar or workshops for the engineering accreditation?	Number of participation in seminars or workshops.
	Is communications carried out between teachers and students about the engineering accreditation?	Subjective assessment by teachers.
	Do students think the accreditation is necessary for finding jobs or going up to a school of higher grade?	% of students identified during interview.

Table 2: GQM for measuring the efficiency of student consultation

Goal	**Questions**	**Questions**
To improve in the efficiency of student consultation	Do students think the accreditation is necessary?	Subjective assessment by teachers.
	How many students are consulted on a regular basis?	Average number of consulted students in one semester.
	How much time is spent for a single student consultation?	Average consultation time per a student.
	Does the consultation cover all the aspects of educational activities?	Questionnaire answered by students.
	Is the teachers well educated in consultation techniques?	Number of participation in consultation seminars or workshops

Conclusions

The ABEEK accreditation criteria request strict terms what is required for a program to be accredited. The rigidity of this system was a source of frustrations to engineering faculty and administrators. This also bring forth the issues of “bean counting” which means the collection of excessive data not necessary for demonstrating the educational activities for accreditation are well performed. ABEEK engineering criteria not only requires a systematic and effective management of operational data including evaluation in an engineering program, but also to develop measures and evidence that indicate the degree to which each of engineering criterion is met.

In order to cope with the issues described above, we introduced GQM approach as a measurement framework and applied this systematic approach to know the measurement purpose and how to measure and why do it. This approach was effective for focusing on the essence of measurement and for avoiding extra workload of faculty doing the measurement of redundant and excessive data.

References

01. ABEEK, KEC2005 engineering criteria documentation, ABEEK-2006-AB-021, 2006.
02. Basili,V.R., and D.M.Weiss,” A methodology for collecting valid software engineering Data”,IEEE TOSE,vol. SE-10,pp.728-738, 1984.
03. Basili,V.R, et al, Goal Question Metric Approach, John Wiley&Sons,1994.
04. Wolfhart Goethert, Deriving Enterprise-Based Measures using the balanced Scorecard and Goal-driven measurement Techniques, Technical Note CMU/SEI-2003 -TN-024, 2003.
05. Mendonca et al,An approach to improving existing measurement frameworks, IBM systems Journal vol.37,No.4,1998.
06. Markus Nick et al,Facilitating the practical Evaluation of Organizational Memories using the Goal-Question-Metric Technique, KAW’99,1999.
07. Dieter Rombach,Technology Package for the Goal Question Metric Paradigm, Kaiserslautern,1996.
08. Roger S. Pressman, Software engineering-A Practitioner’s approach, MdGraw-Hill, pp.614-618,2010.
09. Joni E. Spurlin, Assessment method used in undergraduate program assessment , Designing better engineering education through assessment- A practical resources for faculty and department chairs on using assessment and ABET criteria to improve student learning, edited by joni E. Spurlin, Sarah A. Rajala, and Jerome P.Lavelle, p.117-148, 2008