Fishbone Diagram Approach for Improving the Passing rate for Basic Engineering Subjects

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Abstract: Maintaining quality graduates at higher education become one of the strategies in order to cope with the unprecedented competitions among higher institutions. Passing rate is an important indication to what extent the students achieved the learning outcomes for specific subjects and the programme outcomes in general. There are several factors which attributes for achieving lower passing rate at higher education. Even though there are numerous factors which contribute for low passing rate, the degree of impact on the overall passing rate varies greatly depending on the nature and type of factors. In order to get a comprehensive solution for low passing rate, the method of problem solving should have to cover all possible causes of the problem. This paper addresses the implication of applying Fishbone Diagram methodology over higher education to identify factors which affects passing rate at basic engineering units. The paper also reviews the implication of applying the proposed methodology to evaluate the various causes in order to rectify the ‘vital few’ factors which have significant effect on the passing rate. Identifying these factors is essential in order to design a method for improving the passing rate.

Keywords: fishbone diagram; passing rate; Pareto analysis; higher education; quality improvement

Introduction

Currently, higher education faces a new challenge as a result of changes in the way people view colleges and universities. Furthermore, the expectations from parents, industries and other related stakeholders for better performance in terms of teaching and producing competent college graduates are increasing. It is reported in Hogg and Hogg (Hogg & Hogg, 1995) that the implementation of Total Quality Management (TQM) at higher institution is an important tool in improving the teaching and learning. Maintaining quality education through the application of the principles of quality management is becoming one of the competitive advantages for higher education institution. It is reported in Sohail et. al (Sohail, Rajadurai, & Rahman, 2003) that implementing the principles of quality at higher education institution...
improved the student enrolment, overall pass rate, interdepartmental working relation, and staff and supplier satisfaction.

This paper focuses on improving passing rate by applying Fishbone Diagram methodology over higher education to identify factors which affects passing rate at basic engineering units. Focusing on passing rate has lots important benefits as passing rate has significant implication on various stakeholders in higher education institution.

One of the implications of passing rate is on the students. It is clear that students come to higher education institutions to build and improve their careers. If students fail the courses, there is significant effect on the student such us being marginalized from their ‘successful’ friends and even tempted to commit suicide. As a result, it is vital to improve the passing rate to avoid one of the significant effects on the students. The other implication of passing rate is on increasing attrition rate at the higher institutions. It is reported in (Amaral, 1997) that the overall student attrition for engineering students has been increasing in higher education institutions. It also reported in Hyden (Hayden, Penelope, Eva, & Barry, 2010) that student attrition from higher education is universally regarded as a serious educational concern. It results costs which might be shared among individual students, higher education institution and the public. Student attrition provides an early warning sign of possible problems in higher education institution.

Attrition is generally regarded as an indicator whether higher education institutions are providing their students the kind of education they want. It is a measure of the level of student satisfaction, performance and development. As reported in (Latif, Sungsri, & Bahroom, 2009), attrition has series impact on the individual students, the higher education institution and the nation. For the individual students, attrition means a lost opportunity to enhance his level of personal and career development. For the higher education institutions, it represents a loss of revenue as well as a blemish on its image and reputation. For the nation, it is a reduction in its manpower capability. Generally, researchers acknowledge that the reasons for attrition are many and complex and that there are no simple solutions (Tyler-Smith, 2006). Hence, various researches has been conducted on improving the passing rate under different strategies (Davidowitz & Rollnick, 2005; Latif, et al., 2009).

Passing rate has also significant effect on the quality of the higher education institute. Therefore, every member of the higher education has contributions in improving the passing rate to maintain the quality of the higher education institute. As reported in Kuashik and khanduja (Kaushik & Khanduja, 2010), higher education institute is highly dependent on passing rate of the students. Figure 1 shows the relationships between passing rate of students and the contribution from members of the higher institute to achieve the overall reputation for the higher institutions.

Generally, maintaining high student success rate became one of the primary factors in discussions of higher education quality. Although student success has been defined in a variety of ways, most definitions include the idea of persistence to the completion of the student’s program. Thus, increased retention becomes the goal of many of an institution’s quality assessment and improvement efforts (Berge & Huang, 2004).
The use of Fishbone Diagram in higher education institutions

Refereed papers, In order to get a comprehensive solution for a problem, the method of problem solving should have to cover all possible causes of the problem. The uses of problem analysis and management tools are becoming one of the strategies in order to get competitive advantages to achieve great success for an organization. Quality tools can be used for problem identification, problem definition and problem solving or improvement. Fish bone diagram has been applied widely in various sectors in order to indentify the possible causes for problems.

The Fishbone diagram (FBD) is also known as the cause and effect diagram, the root cause analysis, and the Ishikawa diagram, named after its originator Kaoru Ishikawa, the Japanese quality pioneer (Dhandapani, 2004). Since the diagram is similar to the fishbone, it is called the Fishbone diagram. The Fishbone diagram is essential tool in order to arrive at the root cause of a problem through brainstorming.

Fishbone diagram was used in various sectors in order to structure, indentify and look the big picture of the problem. Ilie and Ciocoiu (Ilie & Ciocoiu, 2010) applied the fishbone diagram for risk identification for an event in order to develop the appropriate risk treatment strategies. Dhandapani (Dhandapani, 2004) applied the fishbone diagram by combining with Pareto principles for Software industries. Behnam and Alvelos (Behnam & Alvelos, 2011) applied the fishbone diagram in tire industries in order to find the root cause that exist during retreading process. Chang and Lin (Chang & Lin, 2006) applied the fishbone diagram for the analysis of the root cause in tanker storage accident. Chow chin et al (Chow-chin, Chun-wei, &
In simple terms, FBD is brainstorming in a structured format (Ilie & Ciocoiu, 2010). The technique uses graphical means to relate the causes of a problem to the problem itself, in other words, to determine cause and effect. The diagram focuses on the causes rather than the effect. Because there may be a number of causes for a particular problem, this technique helps us to identify the root cause of the problem in a structured and uncomplicated manner. It also helps us to work on each cause prior to finding the root cause.

Quality improvement at higher education has also been attempted on the basis of the implementation of six sigma. Kuashik and khanduja (Kaushik & Khanduja, 2010) implemented six sigma in order to improve the pass percentage rate of students at technical institute. It is observed that the implementation of six sigma as strategy has enhanced the passing rate by improving the sigma level of the technical institute to 4.17 from 2.28. There are various methodology proposed in order to address the issues related to research in engineering education (Case & Lighta, 2011).

In this paper, FBD is used to find out the possible causes of low passing rate of students and structure the various possible causes. A team comprising of experienced lecturers was formed to list out all the possible causes of low passing rate based on their experiences in teaching and industry.

The tasks of the team are:

i) To come up with list of as many as possible causes with the aid of FBD.

ii) To reach on consensus on the most probable causes (root causes) for low passing rate.

iii) Propose methods for improving the passing rate considering various alternatives in structuring the possible causes to address the issues related to low passing rate.

The overall research methodology for improving the passing rate at higher education institutions based on the FBD to structure the possible causes is shown in Figure 2.

**Possible causes for passing rate at higher education institution**

There are various fishbone diagram templates which can help to structure the possible causes for a problem. Identifying the various causes to the problem through brainstorming or any other method can be achieved if the proper method to categorize the causes into different groups is used. The possible methods of categorizing include:

- 4Ps or policies, procedures, people, and technology, widely adopted for cause-effects related to service sector (Presentation, 2011)
- 6M, or machines, methods, materials, measurement, mother nature (environment), and manpower, widely used for cause-effects related to manufacturing industries (Dhandapani, 2004)
Since this paper focused on identifying the possible root causes in improving the passing rate, 4Ps method was used to categorize the various causes. The skeleton diagram for the fishbone based on 4Ps is shown in Figure 3. Once the method of categorising has been decided, the brainstorming sessions were conducted in order to come up with list of possible causes. The team came up with 98 possible causes. Several drafts of FBD have been attempted and refined to properly address the possible causes. The complete skeleton of the FBD for identifying the possible causes is depicted in Figure 4. Note that all the possible causes are not in the list to keep the diagram readable.
**Identification of most probable causes (root causes) for low passing rate**

As it is stated in the general methodology for the research (Figure 2), one of the tasks in this research is to come up with root causes. Generally, it is helpful to review the FBD in order to search for the root causes. The process of finding the root causes continued by asking detailed questions for each problem causes until the root cause was indentified. Identification of more detailed levels of causes and organized under related causes or categories. It is observed that, prioritizing the causes using methods such as Pareto diagram (Dhandapani, 2004) is essential in order to alleviate the issues related to passing rate.

Those causes which are very related to procedures and people can be addressed first so that the effect can easily be noticed in improving the passing rate. Some of the causes related to policy and facility can take time to implement as the change of procedure and facilities like buildings might not be addressed within short period of time.

**Propose methods for improving the passing rate**

From people category of various causes, improving student dedication through various motivations, improving student attendance during lecture and tutorial sessions, improving student’s time management skills and improving teaching learning through different methodology can help for improving the major causes under this category. Furthermore, coordination of assignment due dates to distribute the students load in assignment over the teaching weeks, improving the load for conditional students with proper attentions and assistance and conducting tutorials in such a way that students are involved during the discussions could minimize some of the probable causes for improving passing rates.
Conclusions

The expectations from various stakeholders of higher education institutions such as parents, industries and others for better performance in terms of teaching and producing competent college graduates are increasing. Passing rate is an important indication for higher institutions performance and producing successful graduates. There are several factors which attributes for achieving lower passing rate at higher education. Categorizing the various causes for improving passing rate with tools such as Fishbone diagram could help higher education institutions to implement continuous quality improvement. The identification of the vital few cause could help the higher education institutions to focus the resources on the causes which has significant effect on improving passing rate. The use of collective opinion method and supporting with questionnaire data could be essential in order to come up with the accurate root causes. Identifying these factors is essential in order to design a method for improving the passing rate.

References


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Biodata:

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