QFD applications for quality improvements online student learning

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Abstract. Online student learning is in great demand by students both junior and senior high school, but there are still dissatisfaction and complaints about online student learning, such as software factors, teaching factors, customer services, and learning materials. This study aims to identify the quality of online student learning based on the dissatisfaction of junior and senior high school students and to give improvement priority to improve the quality of online student learning using the QFD (Quality Function Development) method. QFD, which is arranged with 2 phases and each phase is arranged based on VOC (Voice of Customer) of junior and senior high school students. Phase 1 has two dimensions. The First dimension is the process dimension, and the second dimension is the factor dimension. Process dimension phase 1 was designed using VOC and online student learning process to get the rank of dissatisfaction of junior and senior high school students in the online student learning process. Factor dimension phase 1 was designed using VOC and online student learning critical factor to get the rank of junior and senior high school student dissatisfaction from online student learning factor while in phase 2 QFD was designed using online student learning critical factor and improvement programs to get priority ranking and effectiveness of these improvement activities. So that the two phases of QFD that have been designed can identify problems in the processes that occur in the online student learning and the factors that influence them and make effective improvements for junior and senior high school education.

1. Introduction

Technological progress in the current era of globalization is so fast and has greatly influenced life in all fields, including education. Offline student learning is one of the institutions that focus on the field of education, such as Primagama, Ganesha Operation. The offline student learning is increasingly in demand by students and parents. This is due to the establishment of a minimum passing grade standard set by the government, the level of competition in schools, or competition in university entrance exams. Offline student learning has also begun to utilize technology to achieve progress. One of the technological advances in student learning is the change of learning methods that were previously offline to online. Online student learning is a study guide that uses learning methods that can be done without having to face to face and do not depend on time, distance, and transportation costs. Online student learning provides learning via the internet with a view to saving time, resources in implementing learning activities. The use of online student learning methods has now been used by several online tutors, such as Ruangguru, Zenius.

Based on Table 1, it can be concluded that has many users, and features are more attractive compared to offline student learning, but the quality for the online student learning process still has some dissatisfaction. There are several things that influence the dissatisfaction in the learning process of online student learning, namely the factor of the software used, the ease of users in using online student learning, the quality of the instructor who is lacking in providing lessons to features in online student learning and incomplete material.
Table 1. Student learning comparison.

| Student Learning | Years | Student Time Learning | Place          | Features                      |
|------------------|-------|-----------------------|----------------|-------------------------------|
| Primagama        | 1982  | 90,000/years          | Determined by the institution | Primagama Book, Try-out Offline, Classroom |
| (Offline)        |       |                       |                 |                               |
| Ruangguru        | 2014  | 6 million users       | Determined by the student | Everywhere Learning Video, Try-out Online, Application |
| (Online)         |       |                       |                 |                               |

Online student learning has students from different levels of education, and the majority of users are junior and senior high school students. Junior and senior high school students have different characteristics, such as the ability to master technology and an understanding of learning material. In addition, senior high school students have more material and exams needed than junior high school students, such as TPA lesson/test and university entrance examination exams, which can cause the level of need or dissatisfaction from each level of education to be different from online student learning. From this description, it can be seen that the organizers of online student learning need to improve their quality at every level of education, such as junior high and senior high school.

The application of QFD has been implemented in many research areas. Authors [1] uses QFD to identify key process and critical halal factors and propose priority improvement programs for halal meat factories. Author [2] uses the QFD to use QFD to identify quality procedures and propose improvements in service quality at ATPM authorized workshops. Author [3] applied the QFD to select process of sustainable production indicators. Process dimension phase 1 QFD is designed using VOC and online student learning process to get the junior and senior high school student dissatisfaction ranking in the online student learning process. Factor dimension Phase 1 QFD was designed using VOC and online critical factor lessons (critical factors in online lessons) to get the junior and senior high school student dissatisfaction ranking from online student learning factors, Phase 2 in proposed model was designed using online problems critical factors and improvement action to get the ranking of activities priority or improvements priority. Two phases of QFD that have been designed can identify problems in the processes that occur in online student learning and the factors that influence them to make effective improvements for junior and senior high school education.

2. Research Design

The research method was carried out by distributing questionnaires, then weighting the questionnaire and from the weighting values in designed process dimension phase 1 QFD, dimension factor phase 2 QFD, and QFD phase 2 to determine the ranking of dissatisfaction and the effectiveness ranking of improvement programs.

2.1 Characteristics of Online Students Learning

The characteristics of online student learning are carried out from the demographic aspect of the level of education so that the questionnaire data will be grouped based on the level of education, namely junior and senior high school. Characteristics are done in order to identify the needs and dissatisfaction of junior and senior high school students for the quality of online student learning.

2.2 Phase 1: Process dimension

Process Dimension phase is designed using the VOC of junior and senior high school students with the online student learning process. The making of the questionnaire will be classified according to the dimensions of e-service quality, according to [4] and the attributes are adjusted to online student learning. Attributes obtained from complaints contained in the online student learning comments.
column on google play and then checking the suitability between complaints on google play with complaints known by online student learning management. The attributes are described in Table 2.

**Table 2. Quality attributes dimensions online student learning.**

| Dimensions                  | Attributes                                                                 |
|-----------------------------|-----------------------------------------------------------------------------|
| Efficiency                  | 1. Ease to install, register, and log in                                    |
|                             | 2. Ease of running online student learning applications                      |
|                             | 3. Ease of finding the desired material and information                       |
| Fulfilment                  | 1. Completeness of learning material                                        |
|                             | 2. Completeness of the test and discussion                                   |
|                             | 3. The ability of online tutors instructors in explaining the material       |
| System availability         | 1. The ability to have no problems (errors) during install, registration, login |
|                             | 2. The ability of online student learning applications to have no problems (errors) when running. |
|                             | 3. Update online student learning application                                 |
| Responsiveness              | 1. Responsiveness and handling of customer service in answering questions and complaints of students |

The VOC obtained from the student questionnaire is then entered into the matrix, and the relative dissatisfaction calculation is used to determine the priority of dissatisfaction with the process in online student learning such as (1) install, registration and login, (2) learning text, (3) test and test answer, and (4) review. A Likert scale value of the VOC from 1 to 5. The VOC will be weighted relations with the online student learning process based on the perception of online student learning management with the [5]. Factor Dimension phase is designed using the voice of customers of junior and senior high school students with online student learning critical factors is shown in Table 3. Factor dimension phase IQFD will be generated online student learning critical factor priorities. Adding a score will determine the priority of things that must be improved.

**Table 3. Online student learning critical factor references.**

| Process                          | Online Student Learning Critical Factor | References |
|----------------------------------|----------------------------------------|-------------|
| Install, Registration and Login  | Technology                              | [6,7,8]     |
| Learning Text /Video Material    |                                        |             |
| Test and Test Answer             |                                        |             |
| Install, Registration and Login  | Student                                | [6,7,8]     |
| Learning Text Video Material     |                                        |             |
| Test and Test Answer             |                                        |             |
| Review                           | Instructors                            | [6,7,8]     |
| Learning Text /Video Materials   |                                        |             |
| Test and Test Answer             | Support                                | [9,10]      |
| Review                           | Learning content                       | [10,11]     |
| Learning Text /Video Materials   |                                        |             |
| Test and Test Answer             |                                        |             |
3. Data Analysis

3.1 Voice of Customer

The Voice of a Customer is obtained through a questionnaire. The questionnaire is intended for respondents who use online student learning. The majority of online student learning users are junior and senior high school students, so the respondent data used are students from junior and senior high schools. Respondents filled out questions regarding the quality attributes of online student learning dimensions (see Table 4).

Table 4. Respondents data.

| Level Education       | Online Student Learning A | Online Student Learning B | Online Student Learning C | Total |
|-----------------------|---------------------------|---------------------------|---------------------------|-------|
| Junior High School    | 81                        | 1                         | 0                         | 82    |
| Senior High School    | 138                       | 4                         | 2                         | 144   |
| Total                 | 219                       | 5                         | 2                         | 226   |
| Percentage            | 96.90%                    | 2.21%                     | 0.8%                      | 100%  |

Respondent data that can be used only one online student learning is online student learning A. The respondent data from online student learning has a percentage of 96.90%. Respondent data from another online student learning are not used because it does not meet the required amount of data. Phase 1 QFD is based on the voice of customer from online student learning A and improvement programs designed to be used for online student learning A.

Junior high school student dissatisfaction higher than senior high school students is described, such as (1) the ability of online student learning applications to have no problems (errors) when running, (2) ease of running online student learning applications, (3) the ability to have no problems (errors) during install, registration, login, (4) ease to install, register, log in, (5) ease of finding the desired material and information, (6) responsiveness of customer service in answering questions and complaints of students, (7) the ability of customer service in answering questions and complaints of students, and (8) update the online student learning application.

From the dissatisfaction, it can be concluded that junior high school students tend to have higher dissatisfaction with the use of application systems compared to senior high school students. This can happen because junior high school students do not have much experience using smartphones or know online student learning than senior high school students so that in junior high school students feel more difficult and ask more about customer service and because a large number of questions allows customer service to not respond properly.

The dissatisfaction of senior high school students that is higher than junior high school students is described, such as (1) completeness of the test and discussion, (2) completeness of learning material, (3) the ability of online tutors instructors in explaining the material. From the dissatisfaction, it can be concluded that senior high school students tend to have high dissatisfaction with the content of learning materials ranging from examinations to instructors. This can happen because the subjects of learning and variations of senior high school student exams are more than junior high school students, such as TPA, UNAS, SBMPTN, and UM. Dissatisfaction comparisons are described in the Table 5.
Table 5. Junior high school and senior high school dissatisfaction comparison.

| Dissatisfaction Ranking | Attributes of Junior High School Quality Dimensions | Attributes of Senior High School Quality Dimensions |
|-------------------------|----------------------------------------------------|--------------------------------------------------|
|                         | Score | Attributes                                                                 | Score | Attributes                                      |
| 1                       | 2.82  | The ability of online student learning applications to have no problems (errors) when running. | 2.68  | The ability of online student learning applications to have no problems (errors) when running |
| 2                       | 2.75  | The ease of running online student learning applications The ability to have no problems (errors) during install, registration, login | 2.60  | Complete exam and discussion                     |
| 3                       | 2.70  | Ease to install, register and log in Ease of finding the desired material and information The responsiveness of customer service in answering questions and complaints of students | 2.50  | The ease of running online student learning applications |
| 4                       | 2.60  | Ease to install, register and log in Ease of finding the desired material and information The responsiveness of customer service in answering questions and complaints of students | 2.34  | Completeness of learning material                |
| 5                       | 2.58  | The ability of customer service in answering questions and complaints of students The ability of customer service in answering questions and complaints of students | 2.32  | Ease of finding the desired material and information |
| 6                       | 2.51  | The ability of customer service in answering questions and complaints of students The ability of customer service in answering questions and complaints of students | 2.27  | The responsiveness of customer service in answering questions and complaints of students |
| 7                       | 2.50  | Completeness of learning material | 2.25  | The ability of customer service in answering questions and complaints of students |
| 8                       | 2.32  | Complete exam and discussion | 2.23  | The ability of online tutors in explaining the material |
| 9                       | 2.21  | Complete exam and discussion | 2.03  | Ease to install, register and log in |
| 10                      | 2.06  | Update online student learning applications | 1.86  | The ability to have no problems (errors) during install, registration, login |
| 11                      | 1.84  | The ability of online tutors in explaining the material | 1.67  | Update online student learning applications |

3.2 Process Dimension Phase 1 QFD Analysis

In the process dimension phase 1 QFD was designed using the results of dissatisfaction questionnaires for online lessons and online process lessons. (see Table 6). The value of online student learning process dissatisfaction from junior high school students which is higher than senior high school students is described, such as: (1) Install, Registration and Login, (2) Review. The dissatisfaction of the online student learning process is connected to the dissatisfaction of the dimensions of the online student learning quality dimension so that it can be concluded that junior high school students tend to have a higher dissatisfaction with the use of the application system compared to senior high school students. This can happen because junior high school students do not have much experience using smartphones or know online student learning than senior high school students so that in junior high school students feel more difficult and ask more about customer service. Because a large number of questions allow customer service not to respond properly.
Table 6. Online student learning process dissatisfaction comparison.

| Dissatisfaction Ranking | JHS Online Student Learning Process | SHS Online Student Learning Process |
|-------------------------|-------------------------------------|-------------------------------------|
|                         | Score | Details                  | Score | Details                  |
| 1.                      | 4.33  | Learning Text/Video Materials | 4.57  | Learning Text/Video Materials |
| 2.                      | 3.69  | Test and Test Answer       | 3.85  | Test and Test Answer     |
| 3.                      | 1.84  | Install, Registration and Login | 1.70  | Review                   |
| 4.                      | 1.74  | Review                    | 1.46  | Install, Registration and Login |

The dissatisfaction of senior high school students which is higher than junior high school students is described, such as: (1) Learning Text / Video Materials, and (2) Test and Test Answer. From the dissatisfaction, it can be concluded that high school students tend to have high dissatisfaction with the content of learning materials ranging from exam variations to instructors. This can happen because the subjects of learning and variations of senior high school student exams are more than junior high school students, such as TPA, UNAS, SBMPTN, and UM.

3.3 Factor Dimension Phase 1 QFD Analysis
Factor dimension phase 1QFD was designed using the results of the dissatisfaction questionnaire on online student learning and online student learning critical factors. The comparison of the critical factors dissatisfaction with online student learning is described in the Table 7.

Table 7. Online student learning critical factor dissatisfaction comparison.

| Dissatisfaction Ranking | SHS Online Student Learning Critical Factor | SHS Online Student Learning Critical Factor |
|-------------------------|--------------------------------------------|--------------------------------------------|
|                         | Score | Factor            | Score | Factor            |
| 1.                      | 4.77  | Technology        | 4.4   | Technology        |
| 2.                      | 2.16  | Student           | 2.28  | Learning Content  |
| 3.                      | 1.93  | Learning Content  | 2.05  | Student           |
| 4.                      | 1.67  | Support/ Customer Services | 1.97  | Instructor       |
| 5.                      | 1.62  | Instructor        | 1.63  | Support/ Customer Services |

The online student learning critical factor dissatisfaction score for junior high school students which is higher than senior high school students are described, such as: (1) Technology, (2) Student, (3) and support / customer Services. The dissatisfaction of online student learning critical factors is connected to the dissatisfaction of the dimensions of online student learning quality dimensions. It can be concluded that junior high school students tend to have a higher dissatisfaction with the use of the application system than senior high school students and is evidenced by the dissatisfaction of student factors that are ranked 2. This can occur because junior high school students have not had much experience using a smartphone or getting to know online student learning than senior high school students so that in their use junior high school students feel more difficult and ask more about customer service and because a large number of questions allows customer service to not respond properly.
The dissatisfaction of senior high school students that is higher than junior high school students is described, such as: (1) learning content, and (2) instructor. From the dissatisfaction, it can be concluded that senior high school students tend to have high dissatisfaction with the content of learning materials ranging from examinations to instructors. This can happen because the subjects and variations of senior high school student exams are more numerous than junior high school students, and the difficulty level of senior high school learning materials is more difficult than junior high school.

3.4 Phase 2QFD Analysis

In phase 2QFD, it was designed to use online student learning critical factors problem and improvement programs. Online student learning critical factor problems are based on existing problems of junior and senior high school dissatisfaction students. The QFD phase 2 aims to determine the priority of improvements that must be done first. The highest improvement programs are found in IT staff training programs on mastering safe, efficient, and efficient programs so that improvement is a priority for improvement programs that must be carried out. There are differences in the ranking of effective improvement programs between junior and senior high school students. These differences cause the priorities of improvements that can be done will be different. There are several effective improvement programs for junior high school students higher than senior high school students, and it can be concluded that the level of education has an effect on effective improvement programs. The value of effective improvement dissatisfaction programs for junior high school students is higher than senior high school students described, such as: (1) training IT staff on mastering an efficient, safe and attractive program, (2) provide clear information regarding instructions on each feature or application usage, (3) check the program and test the program before uploading the program on various types of android and smartphone versions, (4) create a place or feature so that students can ask questions and report complaints about the application system, and (5) training on customer service regarding online student learning application knowledge collaborating with IT experts and experts who can overcome these problems.

Effective improvement programs are connected with dissatisfaction with the dimensions of online student learning quality dimensions and senior high student factors so that effective improvement programs that are carried out tend to improve the use of application systems so that junior high school students are much easier to use online student learning. The dissatisfaction of senior high school students that is higher than junior high school students is described, such as: (1) gather material that often appears on exams and collect various types of exams, (2) providing questions and learning discussions for students and instructors, (3) training on online student learning instructors on how to teach and deepen related knowledge, (4) discussion or ask the opinions of others about the location of errors how to teach course.

Improvement programs effectiveness is connected with dissatisfaction with the dimensions of online student learning quality dimensions and senior high student factors so that effective improvement programs undertaken tend to improve the quality of learning material, examinations, and instructors in order to meet the needs of senior high school students. The improvement programmes comparison is described in the Table 8.
Table 8. Improvement programmes comparison.

| Ranking | Improvement Programmes (JHS) | Score | Details | Improvement Programmes (SHS) | Score | Details |
|---------|-----------------------------|-------|---------|-------------------------------|-------|---------|
| 1       | Training of IT staff on mastery of efficient, safe and attractive programs | 5.17  | Provides clear information about the instructions on each feature or application usage | Training of IT staff on mastery of efficient, safe and attractive programs | 4.71  | Provides clear information about the instructions on each feature or application usage |
| 2       | Provides clear information about the instructions on each feature or application usage | 3.85  | Check programs and program tests before uploading programs on various types of android and smartphone versions | Check programs and program tests before uploading programs on various types of android and smartphone versions | 3.57  | Provides clear information about the instructions on each feature or application usage |
| 3       | Check programs and program tests before uploading programs on various types of android and smartphone versions | 3.40  | Create a separate place or feature so students can ask questions and report complaints about the application system | Create a separate place or feature so students can ask questions and report complaints about the application system | 3.06  | Provides clear information about the instructions on each feature or application usage |
| 4       | Create a separate place or feature so students can ask questions and report complaints about the application system | 2.82  | Gather material that often appears on exams and collect various types of exams | Gather material that often appears on exams and collect various types of exams | 2.66  | Provides clear information about the instructions on each feature or application usage |
| 5       | Gather material that often appears on exams and collect various types of exams | 2.39  | Training on customer service regarding online student learning application knowledge | Training on customer service regarding online student learning application knowledge | 2.65  | Provides clear information about the instructions on each feature or application usage |
| 6       | Training on customer service regarding online student learning application knowledge | 1.67  | Collaborating with IT experts and experts who can overcome these problems | Collaborating with IT experts and experts who can overcome these problems | 1.63  | Provides clear information about the instructions on each feature or application usage |
| 7       | Collaborating with IT experts and experts who can overcome these problems | 1.42  | Provides a means of asking questions and learning discussions for students and instructors | Provides a means of asking questions and learning discussions for students and instructors | 1.39  | Provides clear information about the instructions on each feature or application usage |
| 8       | Provides a means of asking questions and learning discussions for students and instructors | 1.1   | Training on online student learning instructors on how to teach and deepen related knowledge | Training on online student learning instructors on how to teach and deepen related knowledge | 1.4   | Provides clear information about the instructions on each feature or application usage |
|         | Training on online student learning instructors on how to teach and deepen related knowledge |       | Discussion or ask for opinions of others about the location of errors how to teach it | Discussion or ask for opinions of others about the location of errors how to teach it |       |         |

4. Conclusions
The highest dissatisfaction ranking of junior and senior high school students on the online student learning process is found in the learning process text/video materials and the lowest in the review process. The difference in the level of dissatisfaction between junior and senior high school students is in the process of install, registration, and login, where junior high school students have higher dissatisfaction while in the test and test answer process where senior high school students have higher
dissatisfaction scores. That is because junior high school students do not yet have enough knowledge and experience about smartphones and online student learning compared to senior high school students, while senior high school students have more types of examinations and subjects than junior high school students.

The highest dissatisfaction ranks of junior and senior high school students on the online student learning critical factor are found in the technology factor. The difference in the level of dissatisfaction between junior and senior high school students is on the student factor where junior high school students are dissatisfied with technology while in learning content factors where senior high school students have a higher dissatisfaction value. That is because the factors of junior high school students who do not yet have enough knowledge and experience about smartphones and online student learning thus affect the various dimensions of online student learning quality attributes while senior high school students require more variations in subjects and examinations, such as TPA, UM (Independent Test).

The highest-ranking effectiveness of the improvement program for junior and senior high school students is found in the training program for IT staff on mastering an efficient, stable, and attractive program. The difference in the ranking effectiveness of improvement programs between junior and senior high school students. In the improvement program, development new feature to students can ask questions and report complaints about the application system where junior high school students score higher effectiveness while the program collects material that often appears on examinations and collects various types of examinations where senior high school students value higher effectiveness.

This is due to the needs and dissatisfaction at each different level of education. Junior high school students are beginners in the use of smartphones and online student learning more in need of direction or answers to questions or complaints on the online student learning application, while senior high school students have enough experience of online student learning more in need of a variety of material and examinations. Firstly, online student learning can carry out improvement actions in accordance with effective improvement programs ranking priority that researchers have made to improve their quality. Secondly, Future research can focus on specific or more specific online student learning and add elementary education level segmentation or regional segmentation.

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