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INVESTIGATION OF PERFORMANCE OF STUDENTS IN ENGINEERING DRAWING IN ETHIOPIAN UNIVERSITIES – A CASE OF WOLAITA SODO UNIVERSITY

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Abstract— In Ethiopian higher education curriculum, engineering drawing is the basic engineering skills needed by all engineering professionals to increase their creativity and productivity. It is the main communication language within professional engineers. However, the performance of students in the course has been declined in recent years in most Ethiopian universities. Therefore, this research was aimed to identify the problems that had contributions for law performance of students and suggest some possible solutions. Study of pre-engineering students' performance in engineering drawing course was the first phase of the study, using Wolaita Sodo University as a case study. The eight consecutive year's results of students were collated and

analyzed. Then constraints encountered in poor performance of students were surveyed. Interviews were designed and held with some students and instructors in the university. Finally, the author suggested some possible solutions to overcome these problems. The results of the research indicated that only 68.49% students scored pass mark. The factors behind this are lack of teaching facilities, negative attitude of students, old style teaching methodology, and poor classroom management. Fulfilling teaching facilities, exploring modern instructional methods, creating peaceful classroom environment are some feasible suggestions for improving students' performance in engineering drawing.

I. Introduction

In Ethiopian higher education curriculum, engineering drawing is one of the basic engineering skills needed by all engineering professionals to increase their creativity and productivity. It is given as a common course for pre-engineering (fresh man engineering) students [1], [2] The course has objectives to offer a wide range of advantages such as effective and efficient communication among all engineering professionals involved in design and production process. In other words, it is used as a basic communication language within professionals in engineering disciplines.

Engineering drawing, as a communication media, has word language and graphical language parts; in which the graphical language is somewhat complex to design and understand. Thus, to be a real engineer, engineering drawing is one of the most important courses for engineering students during

their undergraduate study.

Engineering drawing is the correct language to serve as professional communication media within engineers by accurately describe and show the intricate shapes of an object. Without engineering drawing, it would have been impossible to produce objects requiring many different components which is difficult to express with speech or verbal (written) languages [1-3].

The Engineering Drawing course in Ethiopian universities is a three-credit-hour course (2 lecture hours + 3 lab (practical) hours per week). The manual sketching is employed to introduce graphical concepts to the students. Limited number of tools are used when constructing manual drawings (e.g., triangles, scales, compasses, dividers, and mechanical pencils). The course syllabus includes lettering, free hand sketching, orthographic drawings, isometric view, pictorial drawings, dimensioning, auxiliary views, section views and developments.

Information gathered from preliminary study indicated that the students' performance has been poor and continuously declined in engineering drawing in most Ethiopian universities (as the case of Wolaita Sodo University). Even though the implementation has not been encouraging, different strategies have been designed and applied in Wolaita Sodo University to improve the performance of students in engineering drawing. This indicates that there are some prominent problems hindering the understanding of engineering drawing in Ethiopian universities.

This paper therefore was targeted to investigate the continuous performance of students in engineering drawing and identify the problems that contribute to the continuing debility in performance in the course in Ethiopian universities using Wolaita Sodo University as a case study. The result of the study is significant, in that it proffers solutions for these identified problems. It would also help university administration to make adequate plan towards the performance improvement of students in engineering drawing course in Ethiopian universities.

II. Methodology

This study was broken down into two phases. The first phase was a study of the performance of pre-engineering students in engineering drawing and the second phase was a survey of the problems encountered in engineering drawing poor performance in college of engineering using Wolaita Sodo University as a case study. Moreover, the possible solutions have been suggested to overcome the problems identified within the university.

In the first phase data were collected on the students' performance in engineering drawing in the last eight years and data were also collected on student entry qualification into the college of engineering in Wolaita Sodo University. The data collected were then analyzed and interpreted for further investigations.

In the second phase the semi structured interviews were conducted with the students and mechanical engineering staffs, who handle the course, to explore the factors contribute for poor performance in the course engineering drawing. This approach was used to clarify the problem encounter in quantitative approach. The interview was conducted in a face-to-face manner.

III. Result and Discussion

The ability to produce, read and correctly interpret engineering drawings is critical for the successful communication and work of professional engineers; hence, there is a great need for the improvement in engineering language [3], [4]. The author here was aimed at identifying the constraints to the performance of students in engineering drawing course in Ethiopian universities. The case study was conducted in Wolaita Sodo University. The results from this study are presented in the following sessions.

A. Performance in Engineering Drawing

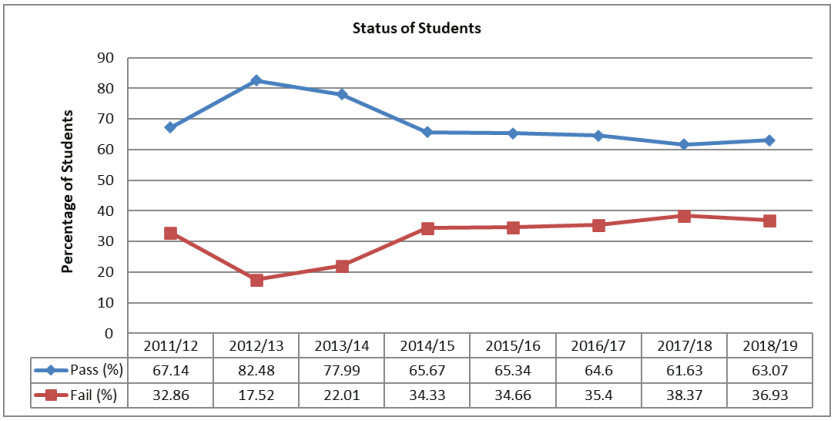
According to Ethiopian higher institutions (universities and colleges), students are evaluated by taking continuous assessments (assignments, quizzes, case studies, mini projects, etc.), mid-term

examination and final examination. The sum of marks of all these evaluation types should be out of hundred. A student who accomplishes less than fifty out of hundred (< 50%) has to sit for re-exam to gain the pass mark, otherwise may fail on that specific course and obligate to take it again [2].

The performance of students in engineering drawing was analyzed by taking the eight successive academic years data from the students' record management team in the registrar and alumni directorate of the university. These data were categorized in to three classes: first class those whose achievement was eighty and above out of hundred (> 80%); the second-class achievement was between fifty and eighty out of hundred [50% up to 80%) and the third one was achieved below fifty out of hundred (< 50%). The result is presented in Table 1 below.

Table 1: Engineering drawing course performance evaluation results of Pre-Engineering students in Wolaita Sodo University

Academic Year	No. of students taking the course	Excellent Grade (> 80%) %	Moderate Grade [50% - 80%] %	Low Grade (< 50%) %
2004 EC. (2011/12)	765	3.92	63.22	32.86
2005 EC. (2012/13)	627	17.12	65.36	17.52
2006 EC. (2013/14)	549	17.98	60.01	22.01
2007 EC. (2014/15)	1005	7.16	58.51	34.33
2008 EC. (2015/16)	859	10.00	55.34	34.66
2009 EC. (2016/17)	945	6.46	58.14	35.40
2010 EC. (2017/18)	1436	4.87	56.76	38.37
2011 EC. (2018/19)	602	11.44	51.63	36.93



	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
Pass (%)	67.14	82.48	77.99	65.67	65.34	64.6	61.63	63.07
Fail (%)	32.86	17.52	22.01	34.33	34.66	35.4	38.37	36.93

Figure 1: Students' status based on their performance evaluation results in Wolaita Sodo University

At the end of the first semester of each year, the students' status was determined based on their performance evaluation results. The chart in Figure 1 shows the summarized status of students in engineering drawing in the specified academic years.

The chart clearly shows that the percentage of students scored enough grades to pass engineering drawing course were declined spontaneously. In 2012/13 academic year 82.48% students passed engineering drawing examination and this amount is reduced for the next consecutive academic years.

Totally, among the students joined the university in pre-engineering field from 2011/12 to 2018/19 academic year, only 68.49% could have passed to the next level in engineering drawing course examination.

B. Factors that Contribute to Poor Performance in Engineering Drawing

The author was conducting a survey and interviews with some students and mechanical engineering staff members (engineering drawing course instructors) to identify the causes of poor performance of students. As a result, there are some constraints that may act as barrier to bring educational quality, especially in engineering drawing course, in Ethiopian universities. Some of these factors are discussed below.

1. Teaching Facilities in the University

Teaching facilities are important to deliver a quality education as per the standard and produce competitive graduates at the end [4-6]. Some physical facilities that contribute positively to students' academic performance are fully equipped drawing studio, drawing instruments, wall posters in the studio, 3D models, etc.

Observation of teaching facilities at the time of this study showed that there were visibly no engineering drawing teaching facilities in the university. The course has given in the normal classrooms provided with benches which are not suitable for drawing exercise sessions. Due to this, students were not enthused to spend more time in practice what they have learnt.

2. Number of Teachers and Students

The class size (number of students per class) is another factor for poor performance of students in engineering drawing. In the university, in average, 50 to 60 students have been assigned in a class. Together with the classroom quality, this affects the course delivery. In addition, one department (mechanical engineering department) is saddled with responsibility of teaching engineering drawing in Ethiopian universities. During this study there was a gross short fall in academic staff requirement of the department deployed to teach engineering drawing. Thus, staffs were overloaded and had no time to support students when they need out of class schedule.

3. Teaching Methods

Traditional and theoretical teaching methods must supported by modern teaching methods, such as, power point presentation and audio video interleave for a better visualization and understanding of the course [4], [6]. The trend in Ethiopian universities looks like that, initially the theoretical knowledge, concepts, procedure, and solution to the problems are taught in a conventional classroom and then these are exercised in practical at drawing studios/laboratory rooms. Instructors spent most of the

time in classroom to cover the course syllabus so that, students could not get enough time for practical session, which is very important to cop up the course objectives. This may lead the students to be under poor performance.

4. Students' Attitude Towards Engineering Drawing

One of the most important elements in the learning environment necessary for understanding and improving the educational processes is attitude. Attitude means the predominating tendency of an individual to respond to an object or events with or without prejudice [7]. The response from interview with some students indicated that they have negative attitude towards engineering drawing. They have a belief that manual engineering drawing which is very strenuous and time consuming is not necessary in this computer age. This might have negative contribution on the performance of students in a subject. In addition, some academic staffs (instructors) also have the same understanding.

5. Course Content and Difficulties

Engineering drawing course is an introductory course in many engineering or technology curricula, presented to freshmen students who are joining the university in engineering fields [3], [8], [9]. Since the course is vast and given in one semester only, instructors face difficulties to cover the whole portion of the course syllabus in the given time. Students also need more time for practicing meeting the needs and objectives of the course. But the students did not have enough time to complete the whole syllabus well. Therefore, a course became slightly difficult compare with other courses in the program. Unfortunately, this could turn-off some students, making them to become less motivated. If their stamina is not strong enough to help them survive this frustrating period, students may undergo painful experiences, or even resign the discipline altogether.

C. Feasible Suggestions to Improve Performance in Engineering Drawing in Ethiopian Universities

The nature of the course, Engineering drawing, is highly practical and time consuming; hence it appears to be difficult, and the course instructors and students have to be patient and committed to achieve their goals [10], [11].

Adequate facilities such as, drawing instruments, drawing studio furnished and equipped with the required materials are an essential requirement to improve the performance of students in the course by encourage the teaching-learning process of engineering drawing.

The teaching methodology of engineering drawing in Ethiopian universities need to be reviewed and other methods of teaching must adopt. Exploring new instructional methods that use technological tools adds an important aspect to the cognitive abilities and visualization skills of students [12]. The course by itself need not be such a complication. Indeed, instructors can make it easy for many students using different teaching aids and/or facilities such as, create effective animated multimedia graphical presentations by using Microsoft PowerPoint software, 3D models of common features to boost the student's visualization skills that in turn, meets the individual needs of undergraduate students as they learn concepts that require special visualization skills. This would help majority of students in the engineering disciplines to see drawing not just as a burden but as an important communicative media in the fulfillment of their ambitions to become professional engineers.

In order to develop adequate interaction between instructor and students, more staff members should be deployed into the teaching of engineering drawing. The ration of number of instructors to student has to be as minimum as possible. This may improve the teaching methodology by facilitate the effectiveness of discussion and tutorial methods.

IV. Conclusion

Engineering drawing is the first step in the process and discipline of composing drawings that visually communicate how something functions or is constructed. This

study arises from the concern for the level of teaching of engineering drawing at higher educational institutions (universities and/or colleges) in Ethiopia.

The following conclusions can be drawn from the study results of this paper:

- The performance of students was decreased from year to year. The analysis was done by taking the performance of students in eight consecutive academic years. Within these years only 68.49% students had scored enough points to pass by engineering drawing course.
- There is a lack of engineering drawing teaching facilities in the university to support the teaching-learning process of engineering drawing.
- The students had negative attitude towards engineering drawing course. This might have direct influence on their performance.
- The teaching methodology is basically laid on lecture and assignment method. This method has less power to motivate students and create positive attitude towards the course.
- Fulfilling crucial teaching facilities, exploring modern instructional methods, create peaceful classroom environment are some feasible suggestions for improving students' performance in engineering drawing course.
- Moreover, well trained, and enough academic staff members must be assigned and engaged in teaching of the engineering drawing.

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