Students' perceptions of learning experiences from the final-year engineering project

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ABSTRACT: The final-year project (FYP), also known as a capstone course, is usually the principal course, where many learning experiences are realised and gained in an undergraduate engineering programme. Therefore, several exit learning outcomes required by professional accrediting bodies are assessed in the FYP. Programme and instructional designers know the skills and graduate attributes that students should possess, and several studies have been published from the lecturer's perspective. However, whether those attributes are delivered can only be corroborated by the students themselves. Hence, students as primary stakeholders in any evaluation of the FYP have been asked to assess their FYP experiences. The article presents an assessment of students' perception of the FYP that was delivered over two semesters at the Botswana International University of Science and Technology, Palapye, Botswana. A questionnaire type quantitative method based on a Likert scale was used. The questionnaire also included an open-ended section where students were requested to suggest how the FYP could be improved. The questionnaire was administered to 186 completing students in three engineering programmes. It is envisioned that the results of the study will provide a continuous improvement mechanism of the learning experience for students in the context of the three programmes.

Keywords: Graduate attributes, final-year project, students' assessment, accreditation

INTRODUCTION

The Botswana International University of Science and Technology (BIUST), Palapye, Botswana, was established by an Act of Parliament in 2005, and was mandated to deliver quality accredited programmes. The University was to provide equitable access to tertiary education by focusing on science, engineering and technology (SET) capabilities. To successfully deliver its mandate, the University recruits a diverse mix of national and international students, and provides them with quality academic SET programmes to develop their knowledge, understanding and skills for use after graduation.

Accreditation is a good measure of the quality and relevance of any engineering curriculum. Programme accreditation is important because it increases the profile of a programme, and makes it more attractive to prospective students and other stakeholders [1]. Graduate attributes for engineering programmes have been developed by various accrediting bodies, such as the members of the Washington Accord (WA), e.g. the Accreditation Board for Engineering and Technology (ABET) and the Engineering Council of South Africa (ECSA) to assure international standards and comparability of accredited programmes [2][3].

The attributes imply that a graduate engineer has acquired the minimum skills to successfully practise engineering at entry level, and is the first step in eventually becoming a registered professional engineer. Achievement of graduate attributes is demonstrated through well-articulated student learning, curriculum cumulative activities and assessment. The WA graduate attributes consist of engineering knowledge, problem analysis, design/development of solutions, modern tool usage, the engineer and society, environment and sustainability, ethics, individual and teamwork, project management and finance, and lifelong learning [4]. Programmes to be accredited by professional bodies must satisfy these mandatory specific requirements. Many studies have been undertaken to measure and assess graduate attributes [5-11].

The final-year project (FYP), also known as a capstone course, is a principal undergraduate engineering course, where many exit-level outcomes are measured to satisfy requirements of accrediting bodies. The FYP seems flexible because learning can be achieved in different ways, such as follows:

- Independent work in which individual students are given specific tasks, which address certain objectives and aspects of a project. In this case, individual performance can be easily monitored and assessed by the instructor [10].
- Cooperative learning in which three to six students are grouped to work on a selected project without direct supervision of the instructor. In such cases, students work together, but may have individual tasks or project

objective to accomplish for the group's overall performance. Success of the group depends on the cooperation and interdependence of its members [12].

- Collaborative learning in which students work jointly with the lecturer to construct and generate knowledge or promote creativity and innovation. Students may proceed individually on project delivery, while collectively working towards the group's common goal and being accountable to one another [12]. Learners adjust to work with other members of the group who have different ethos or emotional stability [13] and so develop some soft skills and knowledge domains required in engineering practice.

Whichever way the FYP is executed, it is important to establish how learners perceive the efficacy of learning. Cooperative learning approach was adopted in this study.

LITERATURE REVIEW

A project is a typical requirement in the final year of any undergraduate programme in engineering. It is sometimes called a *capstone* [10][14] course as it requires an element of synthesis to combine knowledge from a few or several courses in order to solve a particular engineering problem [7][11]. Normally, it should be a design project or at least have an element of design. Such a project is also a typical requirement for accreditation of any engineering programme.

Students carrying out final-year projects are applying knowledge from different areas or courses, which they have studied earlier in their curriculum. However, through carrying out the project, they may also acquire new knowledge in topics not covered in the curriculum or, more often, extend their knowledge in areas they have already studied [15]. The FYP gives the student an opportunity to use and implement methods, tools and techniques, which they have learned, to a real-world scenario, which an engineer may be expected to face upon graduation. The project has a unique position in engineering curriculum, and some argue that the quality of student output in that course can be used as an indicator of the quality of the programme as a whole [7].

Essentially, the goal of the FYP is to introduce students to professional engineering practice. In project work, students are engaged in the analysis, synthesis and application of courses covered in their studies. It provides links between different areas of knowledge both covered in the curriculum and newly learnt by students. Dealing with issues of liability, professionalism, sustainability and project management should provide students with skills and knowledge of a competent engineer. It exposes students to a range of hard and soft skills, and allows for the holistic evaluation of students' ability and aptitude. The FYP creates a great opportunity for students to value and appreciate life-long learning. It clearly shows that engineering curriculum cannot provide graduates with all the knowledge necessary in practice. Therefore, engineers should have the ability to acquire those elements of knowledge that were inadvertently omitted in their formal education and keep updating their knowledge through passion for developing other relevant skills [15].

Some authors have investigated the performance of students in the FYP and determined whether the required competencies were achieved [16-18]. In this study, there is a paradigm shift from the traditional instructor centredness, where the academic decides on the attainment of graduate attributes in the FYP to a student-centred approach, where learners assess their actual achievements. Students' opinions are sought on issues relating to different aspects of the FYP to identify areas that need modification, enhancement in the programme structure and confirmation that graduates are adequately prepared for professional practice after graduation.

Tien and Lim documented the assessment procedure for the FYP module, which was carried out over a two-semester period [19]. The uniqueness of that study was that at the end of the project, students were mandated to participate in a research conference, where their FYP technical presentations were assessed by external professional reviewers. Both internal and external assessors provided timely feedback to enhance students' learning and development.

Howard et al investigated the assessment methods within FYPs in Australian universities [6]. They identified several challenges faced by students to attain the required learning outcomes up to the professional standard in engineering projects. The main problem addressed was how to maintain consistency in the outcomes of FYPs in Australian universities. The authors observed that universities do not use the FYP effectively, probably because of the lack of clarity among academics on project expectations. Some guidelines, protocols and processes were developed and recommended as benchmarks for engineering programmes in Australia.

Karaz et al described a statistical analysis of students' performance in the final-year project in mechanical engineering [20]. The FYP results over a consecutive six-year period were recorded and analysed comprehensively. The authors assessed the results of students' presentations, progress and final reports, and found a gradual significant reduction in student marks over the period studied. They attributed the observation principally to reduced student performance in mathematics at school leaving certificate. It was recommended that instructors must be consistent in marking the FYP to ensure that students' grades fully and fairly represent their actual performance.

Mrabet et al devised a process to assess all the critical courses in the electrical engineering programme at Prince Sattam bin Abduaziz University, Saudi Arabia [5]. Particularly, they studied the assessment and evaluation protocols of student outcomes in the graduation project course. They used student outcomes to map five domains of learning; namely, design, implementation of design, teamwork, testing and interpretation and analysis, and communication skills. The authors produced a spreadsheet to guide academics effectively on how to assess student outcomes in the graduation project. It was concluded that the results of this study produced continuous improvement of student outcomes in the graduation project.

Moalosi et al assessed delivery of graduate attributes through a major design project in an undergraduate programme [21]. The authors presented a case study that was conducted with 38 students in the University of Botswana's Bachelor of Design (Industrial Design) programme. A five-point Likert scale questionnaire was administered to students who completed a major design in their FYP. The students rated their level of attainment of 15 prescribed graduate attributes. The result showed that graduate attributes were achieved only by those students who successfully completed a major design in their FYP. Therefore, it was concluded that final-year project-based teaching and learning was an effective approach to deliver graduate attributes that are required by industry.

FINAL-YEAR PROJECT (FYP) PROCESS AT THE BIUST

The FYP at the Botswana International University of Science and Technology (BIUST) is divided into FYP1 and FYP2 taken as core courses, respectively in semesters 1 and 2 in the final year of the engineering programme. The two semesters are the active phases of the FYP course as shown in Figure 1. However, students who register for it would have to spend 20-24 weeks of the pre-ultimate year of the engineering programme in an industry as a trainee on full-time attachment. This period, referred to as the preparatory phase in Figure 1, is not regarded as part of the FYP, but students are usually encouraged to obtain topics or problems from industry, which they could work on in their final year. In the absence of topics from industry, students are availed the opportunity to work on projects proposed by academics.

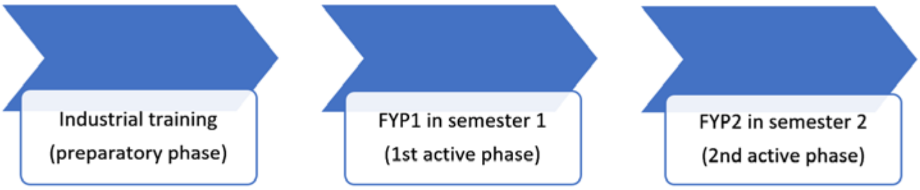


Figure 1: The life cycle of the final-year project (FYP).

During the first active phase, there are a few milestones, such as a project proposal, progress report, end of the FYP1 written report and an oral presentation at timelines scheduled by the staff project coordinator. The second active phase is a continuation of the work packages of the preceding phase. During the second phase, students present a formal continuous progress report, end of the FYP report and their final oral presentation. Each team works under the guidance of an academic who serves as the supervisor. The supervisor conducts a formative assessment of progress and grades participation by members of the team throughout the life cycle of the FYP. The final report consists of introduction, problem statement and project objectives, literature review, methodology, results, discussion of findings and recommendations.

All milestones in both active phases are assessed. The reports (progress and final) are assessed by the supervisor, an internal examiner from the Department of Mechanical, Energy and Industrial Engineering at the BIUST and a panel of assessors who also listens to the oral presentations by the teams. The supervisor is not included in the panel of assessors that attends and grades the oral presentation of his/her teams. The assessors provide constructive and quick feedback to students to improve the team's performance at the next stage. The team's semester grade is the weighted score of marks from the supervisor, internal examiner and the assessors.

METHODOLOGY

The study aimed at determining how the FYP contributes to the development of competencies, learning experiences and graduate attributes associated with three undergraduate programmes in the Department of Mechanical, Energy and Industrial Engineering at the BIUST. The study used a questionnaire approach in which the respondents were the 3rd cohort of completing students in the Department. Apart from the introduction, the questionnaire was divided into four sections; namely, demography, graduate attributes in the FYP, students' opinion about the FYP and a short open-ended section. Section 2 listed 17 graduate attributes and respondents were to indicate how the FYP promoted them.

Section 3 of the questionnaire presented 35 statements and respondents were to use a 5-point Likert scale to indicate agreement or disagreement. The questionnaire was designed for anonymous responses to ensure free expression without any intimidation, and to eliminate fear that negative comments might be penalised. A trial rapid run draft questionnaire was administered to some subjects to confirm that there were no ambiguities in the instrument and that respondents understood the requirements of the study.

The study was conducted for the FYP undertaken over two semesters in the 2018-2019 academic year of the engineering programmes. The final questionnaire was administered at the end of the project, so that students could reflect on the totality of the offering in FYP1 and FYP2. There were 186 students in the group and 112 of the sample participated in the study. Students worked in teams of three or four members per team. Apart from strengthening and enriching students' hard skills, the team approach was used to expose and develop students' soft skills which are highly demanded by industry [21]. There were no individual projects, because of the large number of students involved, and numerous projects would have been demanding in terms of planning and management, supervision and cost.

RESULTS AND DISCUSSION

Forming project teams can be challenging, especially when the number of students is large as in this study with 186 participants. There are a few options identified in the literature to create teams:

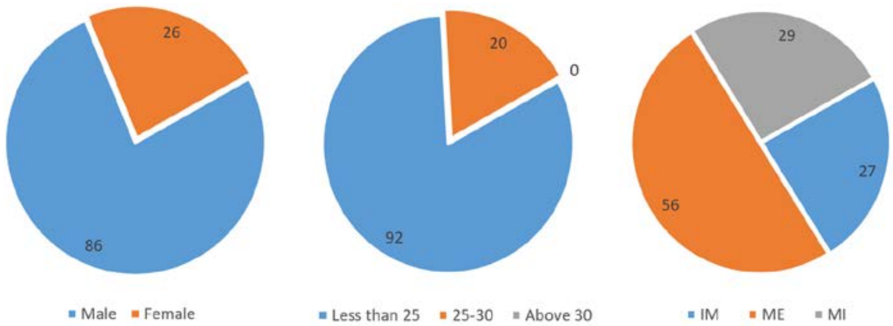
- simple random selection of members;
- group creation by the project coordinator;
- students generating their teams;
- a mixture of any two or more options [22].

Understandably, each option has its advantages and disadvantages. In this study, students were allowed to form their own teams and members were usually friends, colleagues who did the industrial training (preparatory phase in Figure 1) in the same organisation, those who have worked together in other assignments or those within the same programme of study. That method was used to afford students the opportunity to identify mates with whom they could work. The main disadvantage of the method is that a group can become ineffective, and progress of the team can be affected when friends hide poor performance by trailing members. To overcome some of these issues, greater responsibility was placed on supervisors to monitor progress of members, but teams were given the latitude to function and direct their project processes and implementation strategies.

Respondents to the questionnaire were final-year students from three different Bachelor of Engineering programmes; namely, Industrial and Manufacturing Engineering (IM), Mechanical and Energy Engineering (ME) and Mechatronics and Industrial Instrumentation Engineering (MI). The questionnaire was made available to all the completing students in the respective programmes. Out of a total cohort of 186 students registered for all programmes, 112 students participated in the survey, making it a 60% response rate. The responses indicated that the questions and the objectives of the study were well understood and none of the completed questionnaires was voided. All participants in the study successfully completed and passed the FYP course.

Demography of Respondents

Many of the students who participated in the survey were registered in the ME programme, followed by an almost equal number of students from IM and MI as shown in Figure 2c. That was consistent with the number of students registered for those programmes, making the samples representative of their groups. Gender and age distributions of the total number of participants are presented in Figure 2a and Figure 2b, respectively.



a) b) c)

Figure 2: Statistics of the total number of respondents; a) gender distribution of participants; b) age distribution of participants; and c) number of students from different programmes.

Table 1 shows the variation of participants by age and gender, respectively for the three programmes. Approximately 80% of the participants were below 25 years. This is not surprising as most students complete their high schools at between 18 and 19 years of age, and then enter tertiary institutions.

The compositions of females were particularly low at about 19%, 27% and 21% for IM, ME and MI, respectively. Certainly, access and equity must be expanded to afford more opportunities to young girls in engineering education. The Department should mount awareness programmes at lower levels of the education system to inform, attract and nurture more qualified female applicants into the programmes. For example, young female academics from the Department serving as role models can hold promotional seminars in high schools in different communities or during regional and national trade fairs and exhibitions. Performance in the FYP by age and gender was not part of the study, but anecdotal information suggests that there were no substantial differences in the level of performance between age groups and sexes.

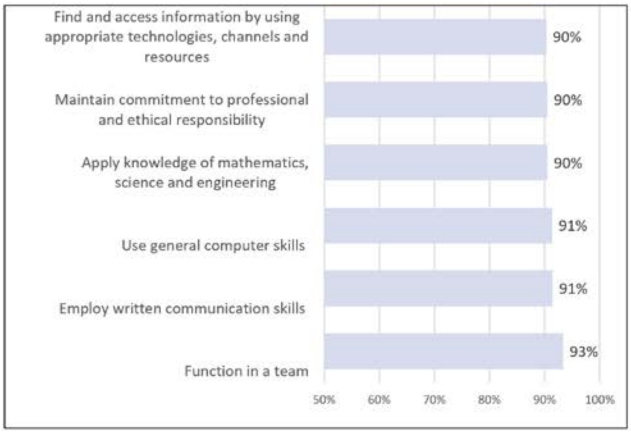
Table 1: Variation of respondents by age and gender.

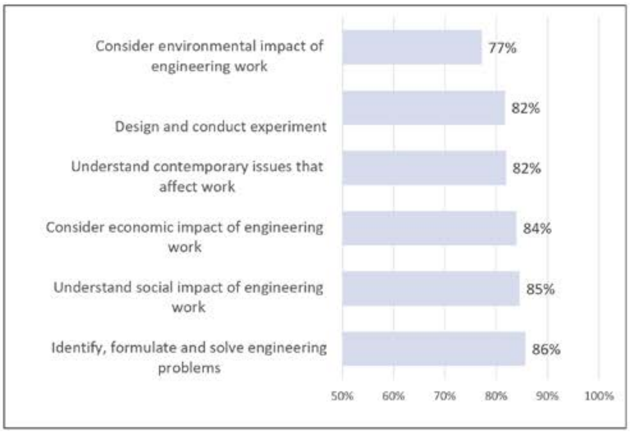
Programmes	Age		Gender	
	< 25 (years)	25-30 (years)	Male	Female
Industrial and Manufacturing (%)	78	22	81	19
Mechanical and Energy (%)	86	14	73	27
Mechatronics and Industrial Instrumentation (%)	79	21	79	21

Most used Graduate Attributes during the FYP

The respondents were requested to use the Likert scale to rank the application of 17 attributes during the FYP. Figure 3a shows six of the most used attributes by all respondents. The attributes are: find and access information by using appropriate technologies, channels and resources; maintain commitment to professional and ethical responsibility; apply knowledge of mathematics, science and engineering; use general computer skills; employ written communication skills; and function in a team. They are critical and indispensable requirements for any curriculum to be accredited by various professional bodies. Each of the attributes was evaluated positively by 90-93% of respondents.

Figure 4 shows a breakdown of the most used attributes by the programmes. For example, it can be observed that at least 92% of ME students indicated that they used the six attributes satisfactorily, about 86% of MI opined that they employed five of the attributes, while about 73% of IM used five of the attributes in their projects.





a) b)

Figure 3: Most and least used attributes during the FYP for all engineering programmes; a) most used; and b) least used.

It is not surprising that IT-related attributes were promoted and rated highly as it is expected that in the delivery of the FYP, students in the three programmes will extensively use a minimum of two of MATLAB, LabVIEW, Ansys, Phyton, Simio, C, C++ CAD/CAM, SolidWorks, and some special applications for optimisation and manufacturing processes. The University is also well resourced in provision of computing infrastructure and IT human capital to assist students during their education and training.

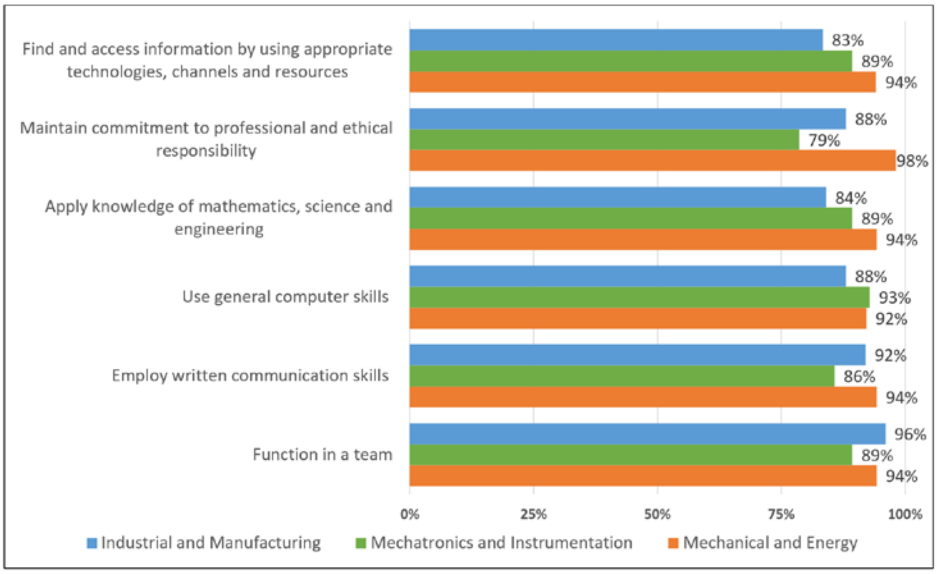


Figure 4: Most used graduate attributes during the FYP at different engineering programmes.

There are different knowledge areas, domains, skills and competencies, which tasks or activities in the FYP can stimulate. Figure 4 shows that some soft skills were promoted in projects within the three programmes. For example, teamwork and written communication skills appear to be recognised by all teams as being very important and mostly used graduate attributes. They are usually essential attributes required by industry and many accrediting bodies for engineering programmes. It seems that the foundation for students to build a successful engineering practice and career has been solidly laid through the FYP. It can also be noted that 88%, 98% and 79% of students in IM, ME and MI, respectively, confirmed that the FYP promoted their commitment to professional and ethical responsibility. Engineering graduates are to understand and be proficient in the application of ethical principles, and be committed to the highest standards of professionalism towards clients, colleagues and the public.

The respondents underwent an introductory course on ethics and professional conduct in the pre-ultimate year. The Industrial Training course taken earlier in the curricula must have exposed respondents to professional engineering practice. Also, they took a core course fully dedicated to professional practice and ethics in the final year. These efforts and offerings seem to have contributed to the respondents' positive ranking of the attribute. In general, it appears that the competency of students is approximately the same or comparable in those attributes that were mostly used during the FYP.

Least used Graduate Attributes during the FYP

Figure 3b shows six of the least used attributes by all respondents. The list consists of: design and conduct experiment; consider environmental impact of engineering work; understand contemporary issues that affect work; consider economic impact of engineering work; understand social impact of engineering work; and identify, formulate and solve engineering problems. Between 71% and 86% of students responded positively to the statements. The rates may appear high and acceptable, but in outcomes-based education, it is expected that learners will achieve the same level of high competency to confidently describe the uniform profile for graduates from the programmes. As these attributes seem not to be perfectly delivered or reflected in the FYP, they must be measured and assessed in other modules within the respective curriculum for the robustness of the graduate profiles. Figure 5 presents the least used graduate attributes during the implementation of the FYP by respondents from individual programmes.

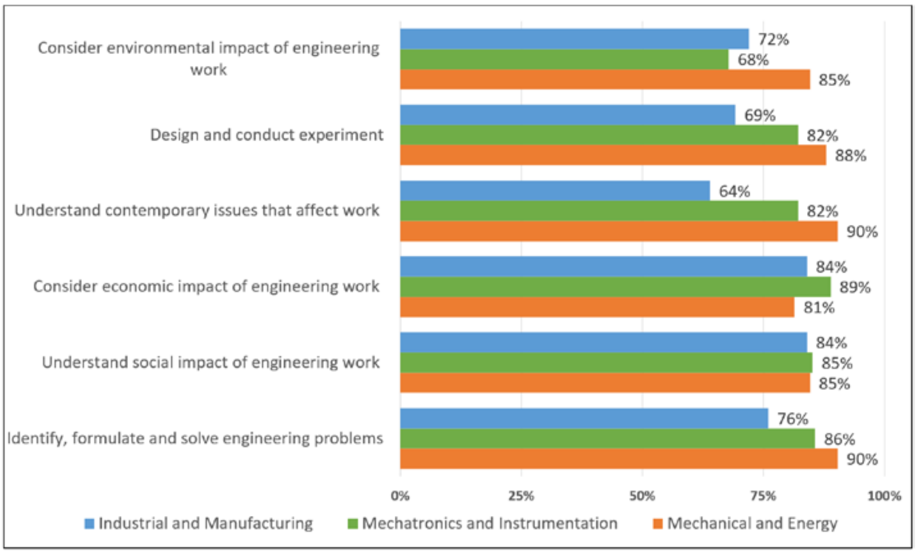


Figure 5: Least used graduate attributes during the FYP at different engineering programmes.

It can be observed that they are comparable for the programmes, but IM students seemed to have lacked behind the ME and MI students in four of the six attributes. Some of the lowest rated attributes are discussed below.

- Design and conduct experiment. The Washington Accord criterion four expects graduates to have the ability to carry out experimental work by using research knowledge and methods to design experiments, analyse and interpret data, and synthesise information to support conclusions from investigations [4]. Since respondents who felt that the exit-level outcome was not satisfactory at 31%, 18% and 12% for IM, MI and ME, respectively, then the curricula must include other modules, where the attribute will be measured adequately. Although not part of this study, there are indeed some modules in the respective programmes that include mini projects to develop and assess this graduate attribute intensely.

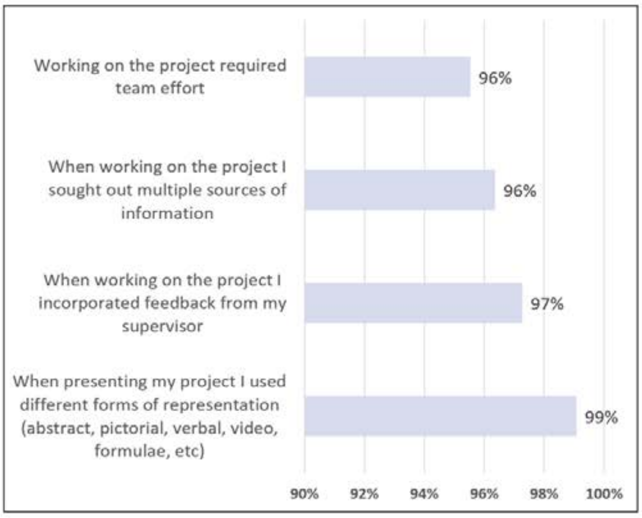
- Consider environmental impact of engineering work. The rating by students who did not apply or consider the attribute was 28%, 32% and 15% for IM, MI and ME, respectively. The Washington Accord criterion seven expects graduates to understand and evaluate the sustainability and impact of professional engineering work on the environment [4]. The effect of engineering practice on the environment continues to exacerbate, such as in production and manufacturing processes, energy generation, transportation systems and complex industrial activities. The curricula contain a stand-alone specialised course on the environmental impact assessment of solutions to various engineering problems to develop appropriate graduate attributes.

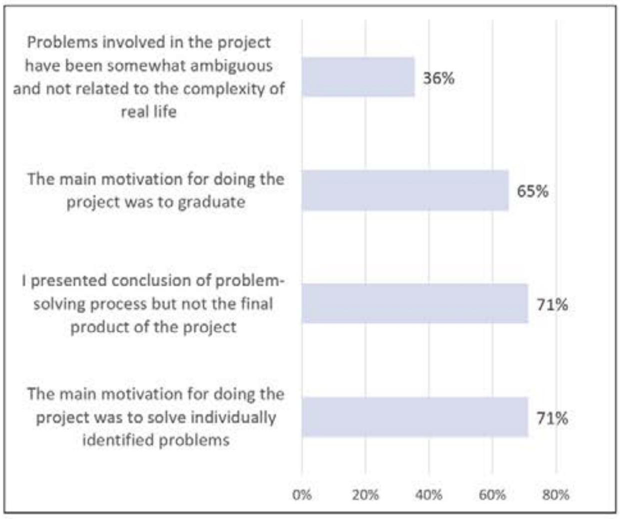
- Understand contemporary issues that affect work. This is an important attribute to ensure that engineering graduates have been exposed to, and are prepared to infuse, contextual knowledge and ethos to professional engineering practice. As a result of continuous rapid changes, the graduate must be adaptable and engage in lifelong learning to proffer solutions to complex engineering work. The rating of students that did not apply the attribute was 36%, 18% and 10% for IM, MI and ME, respectively. As respondents' ratings are high, then the curricula should emphasise and measure it more comprehensively in the FYP or other courses.

Highly rated Opinions about the FYP

Students were presented with a list of 35 opinions that covered various aspects of the FYP and were asked to use a 5-point Likert scale to indicate the level of agreement or otherwise. Figure 6a shows four highest rated opinions about the FYP by a combination of respondents from all programmes. They are:

- work required team effort;
- used multiple sources of information;
- incorporating feedback from supervisor;
- employed different forms of presentation techniques.





a) b)

Figure 6: Highest and lowest rated opinions of respondents about the FYP for all programmes; a) highest rated; and b) lowest rated.

Most respondents highly supported these four opinions, i.e. 96%, 96%, 97% and 99%, respectively. It is interesting and appropriate that respondents acknowledged the importance of incorporating feedback from supervisors in their work. It can be inferred that communication between students and the supervisor was good. Communication is a highly recognised engineering graduate attribute for accredited programmes [11]. Excellent communication usually promotes teamwork. Although there was no formal lecture on project planning and management, and implementation strategies of the FYP, students were encouraged right from FYP1 to have regular face-to-face meetings and consultations with their supervisors. Students usually discussed their progress and challenges with supervisors who provided guidance as required. In view of this positive response, supervisors should be inspired to engage students more fully, and provide timely feedback to enhance the quality of projects and develop learning experiences to achieve specified outcomes of the FYP.

Another highly rated opinion of students about the FYP is teamwork. Many respondents agreed that teamwork was promoted by the FYP. This result corroborates observations from other studies [5][11] and fulfils the requirement of ABET that teamwork be an attribute of engineering programmes [2]. Students' preference for working in teams could be attributed to the project's implementation through co-operative learning, where students seemed compelled to work together to accomplish the collective goal of project delivery.

The two main features of cooperative learning; namely, positive interdependence and individual/group accountability are intrinsic in the FYP. Milestones were succinctly stated in the project proposal at the beginning of FYP1 and team members cooperated to complete individual and group tasks on time, enhancing positive interdependence. Regular face-to-face interaction, sharing of skills and use of different communication protocols to deliver the projects promoted teamwork in the FYP. It is necessary for students to continuously imbibe the ability to work in teams to excel in professional practice, where working in groups is the norm. The supervisor monitored team's progress and was able to assess individual members' contribution to the overall success of the group.

Respondents used multiple sources of information during the duration of projects. Though not explicitly mentioned, the library services must have played significant roles in this positiveness of students' opinion. At the beginning of FYP1, students were encouraged to consult the engineering subject librarian at the BIUST in sourcing information, literature and other texts that were relevant to individual projects. In view of this positive opinion, it will be beneficial for students, if the Department formalised an advanced information literacy and communication course for future students before enrolling in the FYP.

Respondents highly rated employing different forms of presentation techniques. It is pertinent to mention that milestones in the FYP include four presentations; namely, proposal, end of FYP1, continuous assessment in FYP2 and the end of the FYP. Preparing for the activities must have challenged the students, but the tasks gave them multiple opportunities to sharpen their communication and presentation skills.

Figure 7 presents a chart of respondents' four highest rated opinions for the three programmes. The responses from each programme are comparable across individual opinions. For example, 97%, 100% and 100% of students from MI, ME and IM, respectively, indicated that the FYP enhanced their presentation style. This is consistent with good rating for communication, team spirit and IT applications that were discussed previously, and are essential for good presentation techniques.

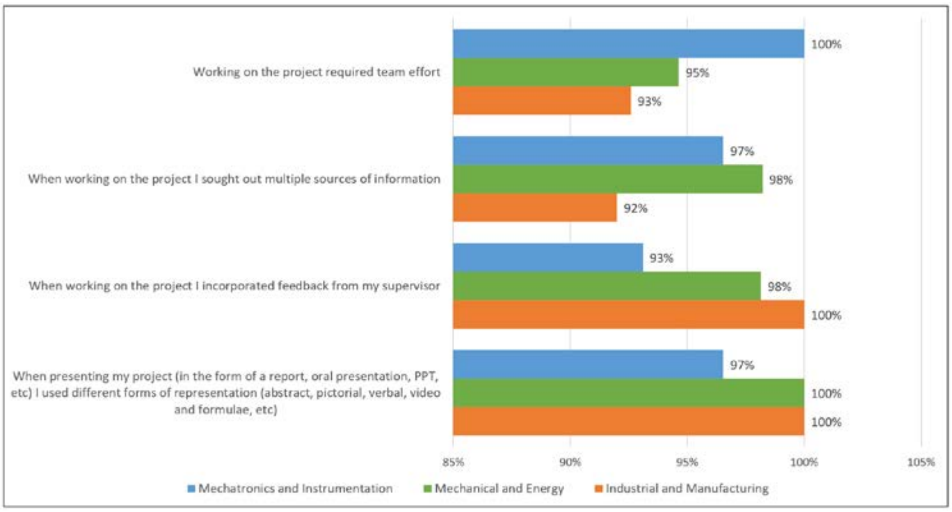


Figure 7: Highest rated opinions about the FYP by respondents from different programmes.

The opinions show that the FYP is achieving its desired objectives of positively influencing engineering education and training, and it should continue to be a regular feature of the respective programmes. Therefore, the coordinators of the FYP should maintain or even improve on the current content, pedagogy and assessment processes to ensure that the knowledge domains achieved in the programmes are consistent with formal codified taxonomy of educational learning objectives [23].

Least rated Opinions about the FYP

Figure 6b and Figure 8 show four lowest rated opinions about the FYP by all respondents and by individual programmes, respectively.

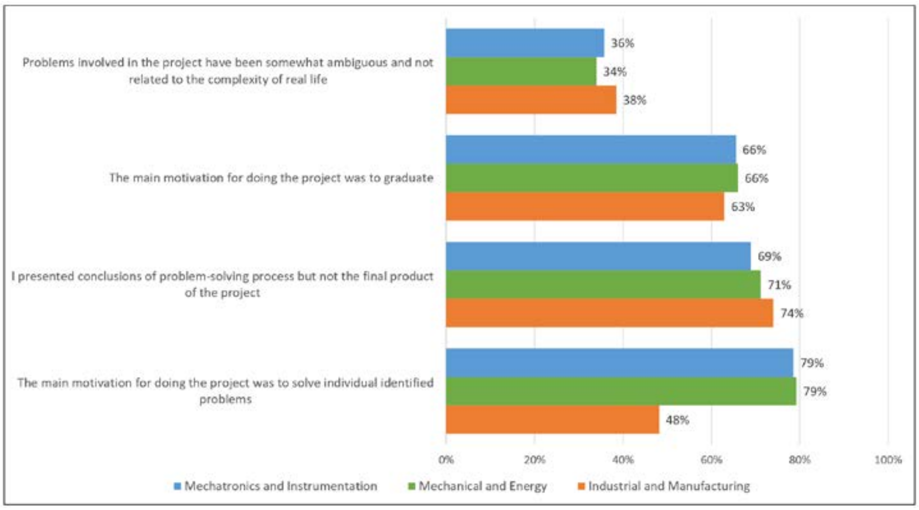


Figure 8: Least rated opinions of respondents about the FYP for all programmes.

Many respondents from all programmes did not support the idea that …*when working on the project I made my own choice on sequence in the project work*. In order words, group work, ideas and decision were preferred to individual choices or inclinations. This is consistent with team spirit that has been alluded to in the preceding paragraphs on teamwork.

In Figure 8, only 66%, 66% and 63% of respondents in ME, MI and IM, respectively, opined that …*motivation for doing the project was to graduate*. It was expected that all students would be enthusiastic to do the projects successfully to meet graduation requirements. It seems that the respondents did not understand the graduation criteria or were nonchalant in responding to the statement or question.

This figure also shows that respondents from all programmes agreed that …*problems involved in the projects have been somewhat ambiguous and not related to the complexity of real life*. The responses indicate that many topics were not proposed by industry where students did internships. The essence of engineering is to proffer solutions to the myriad of human complexities and challenges. It can be confirmed that most of the topics were generated by academics and addressed certain societal needs identified through contacts with external stakeholders.

The projects were based on research and development, design and optimisation, experimental work, and computer applications and technology analysis. Most future projects should model real life situations, where students can gain tacit knowledge, so that the FYP may be contributing positively to solving some problems faced by industry.

Finally, 79%, 79% and 48% of respondents from MI, ME and IM, respectively, indicated that the main motivation for doing the project was to solve an individually identified problem. These responses are not surprising as many students did not have individual projects, but relied on topics that were generated by academic staff. In line with the previous paragraph, students should be highly motivated and encouraged to identify problems and research topics from industry, which they will own and work on during the FYP.

Open-ended Comments

In the open-ended section of the questionnaire, most respondents were delighted that a broad range of essential skills, whether hard or soft types, were satisfactorily acquired through the FYP. There is an overwhelming support for continued delivery of the FYP to ensure that graduates acquire relevant skills and competencies to practice engineering profession for the socio-economic improvement of the community in a borderless world.

Some students offered suggestions on how to enhance the quality of the FYP, its associated assessment procedures and final grades. For example, students seem to favour working in teams as it prepares them for a vibrant and healthy professional future. However, they felt that the number of students in a group must be optimised, as large groups can cause excessive strain, miscommunication, incessant conflicts and poor overall performance. It may be essential to provide future participants with guidelines on conflict resolution, team building exercises and how to handle professional challenges they may encounter beyond the teaching and learning environment.

Respondents observed that equipment and materials required for construction arrived late during the semester, and thereby making it difficult to meet project deadlines. The cause of delays was due to procurement issues and non-availability of equipment and machinery for manufacturing designed artefacts or testing purposes. They opined that supervisors and technical support staff should ensure that resources required for projects are available or procured during the preparatory phase of the FYP shown in Figure 1.

Some respondents indicated that project deadlines and milestones were often difficult to comply with, because of limited or no formal time allocated for the FYP during the semesters. They then suggested that the semester timetable should be reviewed to accommodate more generous time for the FYP and other project-based courses.

Finally, they observed that during formative and summative presentations some assessors were apparently not very familiar with the research topics of teams, and thereby compromising grades awarded to such students.

CONCLUSIONS AND RECOMMENDATION

The educational experiences of students who participated in the study varied, but the skill sets acquired enabled them to hone their competencies in an academic environment before they enter the world of professional practice. The assessment by students presents immense opportunities for academics to enhance undergraduate engineering education by reviewing and indicating how exit-level outcomes will be clearly achieved through the FYP.

It is recommended that skills, such as teamwork and communication that have been promoted in the FYP and highly rated by respondents should be maintained or further enhanced. Graduate attributes that seem to be rated low by respondents should be deliberately strengthened, monitored and assessed to ensure that they reach standards required by engineering accrediting bodies. The students' opinions and suggestions discussed in the previous section should be strongly considered to partly form the basis of programme review to improve the standard of the FYP. For example, it is recommended that future groups should have a complete supply of resources on time for proper and successful project management.

In conclusion, it seems that the FYP is fulfilling its objectives to enrich engineering education and produce graduates with exceptional skills for industrial practice. The respondents can confidently carry the imprimatur of the University to confirm that teaching and learning have been successfully provided through different modes including the FYP.

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