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Analyse the Mechanical Engineering Curriculum in Compliance with EAC and MQA Requirements

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Abstract

The curriculum is a critical component of teaching and learning sessions. A review of the curriculum is also required once every five years. It is to ensure that the knowledge presented is relevant to current developments. They are strengthening the curriculum from time to time. The engineering field adheres to the Program Standard the Engineering Accreditation Council (EAC) issued for engineering and engineering technology. At the same time, course offerings must comply with the Malaysian Qualifications Agency (MQA). The study was conducted by analysing relevant data involving ten public universities in Malaysia. It aims to explore the content of the Mechanical Engineering Curriculum at the Public University (U.A.) designed to meet the requirements of the (EAC) and (MQA). A checklist was created to see how much compliance has been made. The two main components analysed involved: i. the Mechanical Engineering curriculum content and ii. Soft Skills applied to each course offered. The results show that all public universities that offer Bachelor of Mechanical Engineering under National Education Code (NEC) 521 (Mechanics and Metal Work) meet EAC and MQA requirements. It is worth mentioning that this Mechanical Engineering curriculum has produced a high-quality human workforce. Therefore, Curriculum issues do not meet current needs and are not a matter for discussion as research proof was carried out. Every university has to continually update the curriculum so that it is of international standard to enhance graduates' marketability.

Keywords: Mechanical Engineering, Curriculum, EAC, MQA

Introduction

The design of a curriculum focused on engineering, technology, technical and vocational graduates should be given attention. Therefore, the researcher will go down in the field to make changes based on the findings of the research conducted mainly on the supply of human capital, such as highly skilled Mechanical Engineers, by adhering to the Principles of Engineering (POE). This issue is closely related to the curriculum being formulated and

adopted by institutions of learning that do not meet industry requirements (Tahir, 2014; Wondifraw, 2019)

As is commonly known, engineering is divided into five main sub-fields: i. Civil; ii. Mechanical; iii. Chemistry; iv. Electrical; and v. Electronics. Figure 1 shows the components needed in the Engineering Curriculum to meet the requirements of the Mechanical Engineering Program at the undergraduate level (MQF Level 6). The elements listed must be fulfilled to qualify for a recognised engineering program.

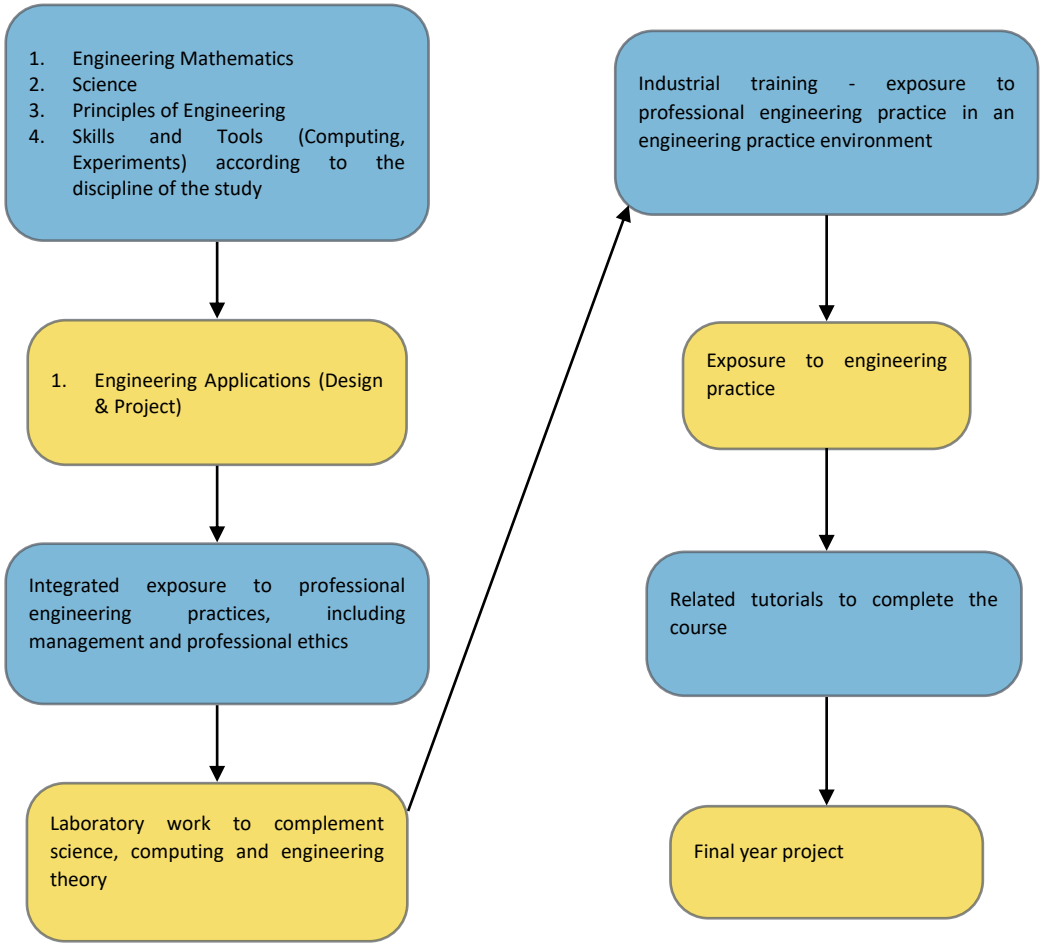


Figure 1. Components of the Engineering Curriculum Content
Source: Program Standard (Engineering and Engineering Technology, 2011

Based on the Outcome of Learning Outcomes (P.O.), engineering students are expected to master skills, knowledge and attitudes through the programs offered. These include the following: i. engineering knowledge; ii. problem analysis; iii. design/development of solutions; iv. investigation; v. use of modern equipment; vi. engineers and associations; vii. environment and sustainability; viii. ethics; ix. communication; x. individual and group work; xi. life-long learning; and xii. project management and finance (Engineering Programme Accreditation Manual, 2012).

Engineering demands skills and knowledge based on Mathematics, Science and technology, and subjects and curricula related to business and management through a specific engineering discipline approach (Shinoda, 2013; Hafni, 2020).

A comprehensive transformation of the engineering curriculum needs to be accelerated to meet professional engineering needs (Goldberg, 2014; James, 2019). The university curriculum involving engineering can no longer ignore the importance of communication skills to provide a professional workforce (Lakshmi, 2016; Andrew, 2020). The need for value-added such as Generic Skills and Soft Skills is often a key topic of conversation among employers and industry.

Collaboration between universities and industry through updates and curriculum development has been suggested as the key to the triumphant entry of graduates into the job market (Plewa, 2015).

Engineering demands skills and knowledge based on Mathematics, Science and Technology, subjects and curriculum related to business and management, and education and professional development through specific engineering techniques (Shinoda, 2013).

Education and training are knowledge of principles for developing practical and skills training (Maclean, 2013; Shore, 2023) based on a scientific knowledge base. Who want to be Engineers in preparing for the curriculum and design of coaching, teaching and instruction individually and in groups, and the impact on training measurement (Gana, 2015). Moreover, students believe teamwork is a skill acquired when applied to the university curriculum (Hart Research Associates, 2013; De Prada Creo et al., 2020), and it is an essential part of each student.

Students are aware that they are learning the work skills of students through the curriculum approach. At the same time, employers believe that students who do not enjoy their studies are not equipped with these skills (McClellan, 2011), which will harm the construction of the skills team. Entrepreneurial education will be integral to the tertiary education curriculum to foster students' entrepreneurial mindset and entrepreneurial skills (Lunenburg, 2011; Momete, 2015).

The industry needs to be involved in curriculum development and training to enable young people to learn about entrepreneurship (Shinoda, 2013). To establish entrepreneurship, education is applied throughout the curriculum and not just in certain areas (Gunes, 2012), and it must be holistic.

Advances in applied learning and curriculum enhancement combine learning leadership methods to accelerate leadership development (Kassotakis, 2015). Given this diversity, the curriculum should consist of technical skills and Soft Skills (Hong, 2014) so that the industry entirely accepts graduates to work (Ahmad & Muhammad, 2012; Barman, 2011).

Methodology

The research method used by the researcher in this study involves secondary data. All the data and information are obtained from ten public universities in Malaysia offering full-time Bachelor of Mechanical Engineering courses. Data collection also includes references to the Standard Program that EAC and MQA have used for each program offering. The documents identified are reviewed and reviewed. Existing data will be used to make comparative analysis transparent. The field specialists are referred to for updates on the improvement process.

Results and Discussion

The field of engineering is vast. Various engineering branches such as Aerospace, Automotive, Chemical, Civil, Manufacturing, and many other engineering types have emerged today (Engineering Programme Accreditation Manual, 2012), including Mechanical Engineering.

The industry should cooperate closely in developing the curriculum (Plewa, 2015) and form the best alternative to education and academia (Ojastu, 2011). It will help the university provide the latest curriculum based on industry needs, and the industry will also receive the best possible supply of Mechanical Engineers from the university due to the strong cooperation given by both parties.

The Mechanical Engineering curriculum has been analysed by researchers involving ten Public Universities (U.A.) in Malaysia who have been awarded a Bachelor of Mechanical Engineering (ISM) degree. This field includes the National Education Code (NEC) 521 (Mechanics and Metal Works). The researchers created a checklist to determine the level of curriculum compliance by the Public University (U.A.) in meeting the requirements provided by the EAC and MQA.

Table 1
Curriculum compliance checklist (U.A.) eligibility (EAC) and (MQA)

Course	**Public University**									
Engineering, Science, Principles and Applications	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Materials	/	/	/	/	/	/	/	/	/	/
Statics & Dynamics	/	/	/	/	/	/	/	/	/	/
Fluid Mechanics	/	/	/	/	/	/	/	/	/	/
Thermodynamics & Heat Tarnsfer	/	/	/	/	/	/	/	/	/	/
Mechanism Design	/	/	/	/	/	/	/	/	/	/
Instrumentation & Control	/	/	/	/	/	/	/	/	/	/
Vibratations	/	/	/	/	/	/	/	/	/	/
Solid Mechanics	/	/	/	/	/	/	/	/	/	/
Manufacturing/Production	/	/	/	/	/	/	/	/	/	/
Electrical Power & Machines	/	/	/	/	/	/	/	/	/	/
Computer Aided Engineering	/	/	/	/	/	/	/	/	/	/
Mathematics, Statistics and Computing	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Computer Aided Design & Manufacturing	/	/	/	/	/	/	/	/	/	/
Economics Analysis for Design Making	/	/	/	/	/	/	/	/	/	/
Database & Information Systems	/	/	/	/	/	/	/	/	/	/
Operational Research	/	/	/	/	/	/	/	/	/	/

Each course offered in the Mechanical Engineering Curriculum (MEC) has already absorbed the industry's elements of soft skills towards graduates in this field. There is usually more than one element of soft skills practised directly or indirectly for each course offered to students. It is clearly shown in Table 2 based on the curriculum practised by each of the universities involved.

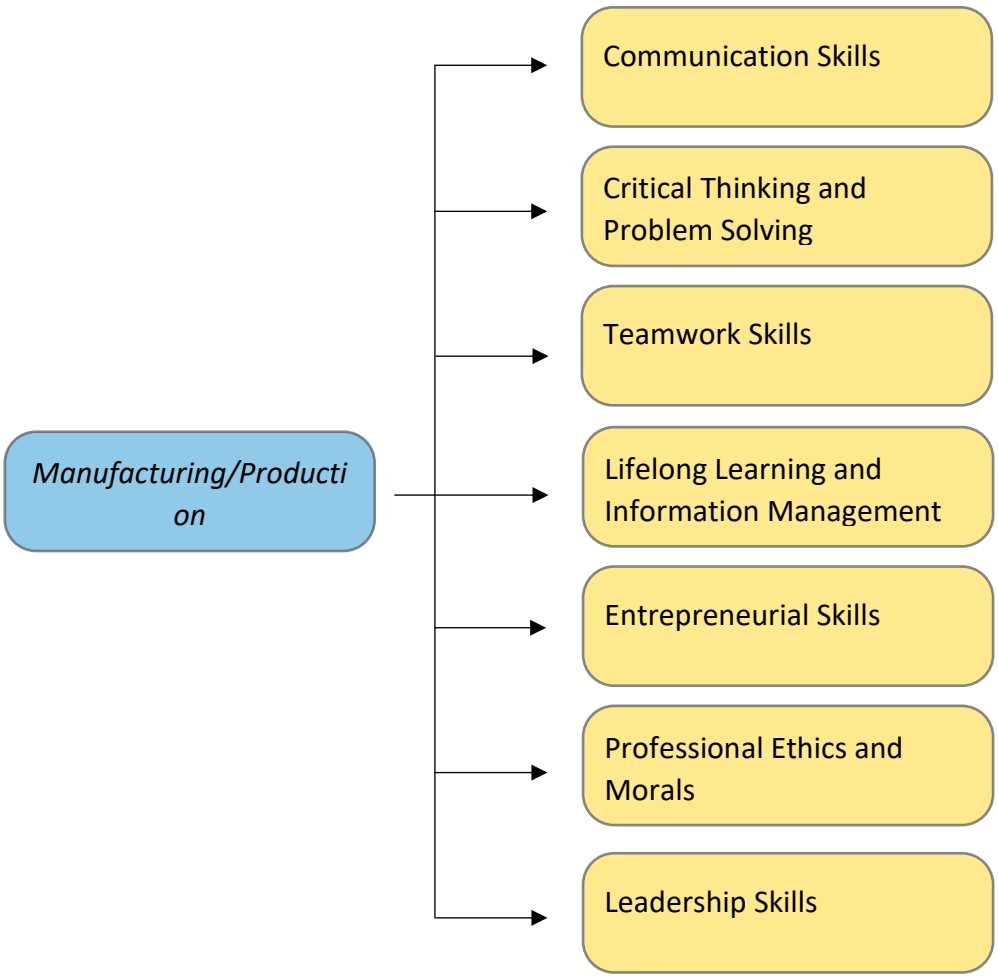
Table 2
List of Soft Skills Integration in Compulsory Courses

Guidance:
Soft Skills
1. Communication Skills
2. Critical Thinking and Problem Solving
3. Teamwork Skills
4. Lifelong Learning and Information Management

The following examples are attached based on the learning outcomes of the Guidance course, including compulsory and elective courses offered by the Public University of Malaysia, as shown in Figures 2, 3, 4, 5, and 6. Examples of courses provided show that all soft skills elements have been included in the class either directly or indirectly. What distinguishes it is the adherence to every Soft skill practised by each course offered. The faculty and experts specialising in structuring the curriculum at the faculty level determine what is more critical or appropriate for a course.

Differences in soft skills must exist between one course and another. These differences will provide the best variation for future Mechanical Engineers/Graduates to be produced by higher learning institutions. It is also the strength and strength of every Mechanical Engineer born. The following is an example of the analysis done by the reviewer on the Mechanical Engineering Curriculum.

i. Compulsory Course



(a) Courses: Engineering, Science, Principles and Applications

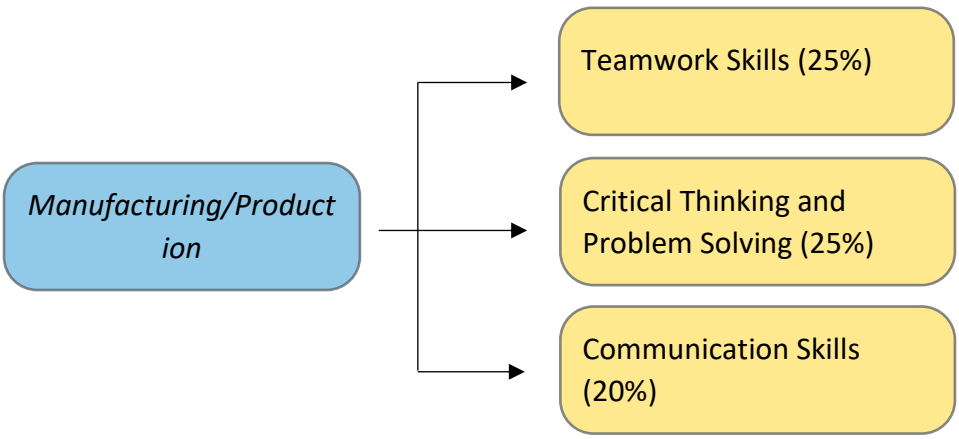


Figure 2. Incorporation of Soft Skills in compulsory courses offered

Based on this Manufacturing/Production course, the most common Soft Skills practised were Teamwork Skills and Critical Thinking and Problem Solving (25%). Communication Skills (20%)

as the course required their cooperation in producing a quality product. The best results are generated through thought-provoking processes. Exciting and realistic ideas to solve the problems encountered in practising effective communication. Besides, Lifelong Learning and Information Management and Professional Ethics and Morals (10%), followed by Entrepreneurial Skills and Leadership Skills (5%).

Therefore, the focus on learning and teaching should be given to the most dominant components or soft skills items, as shown in Figure 3. These are among the content of the learning and teaching objectives that teachers should achieve at the end of teaching for the

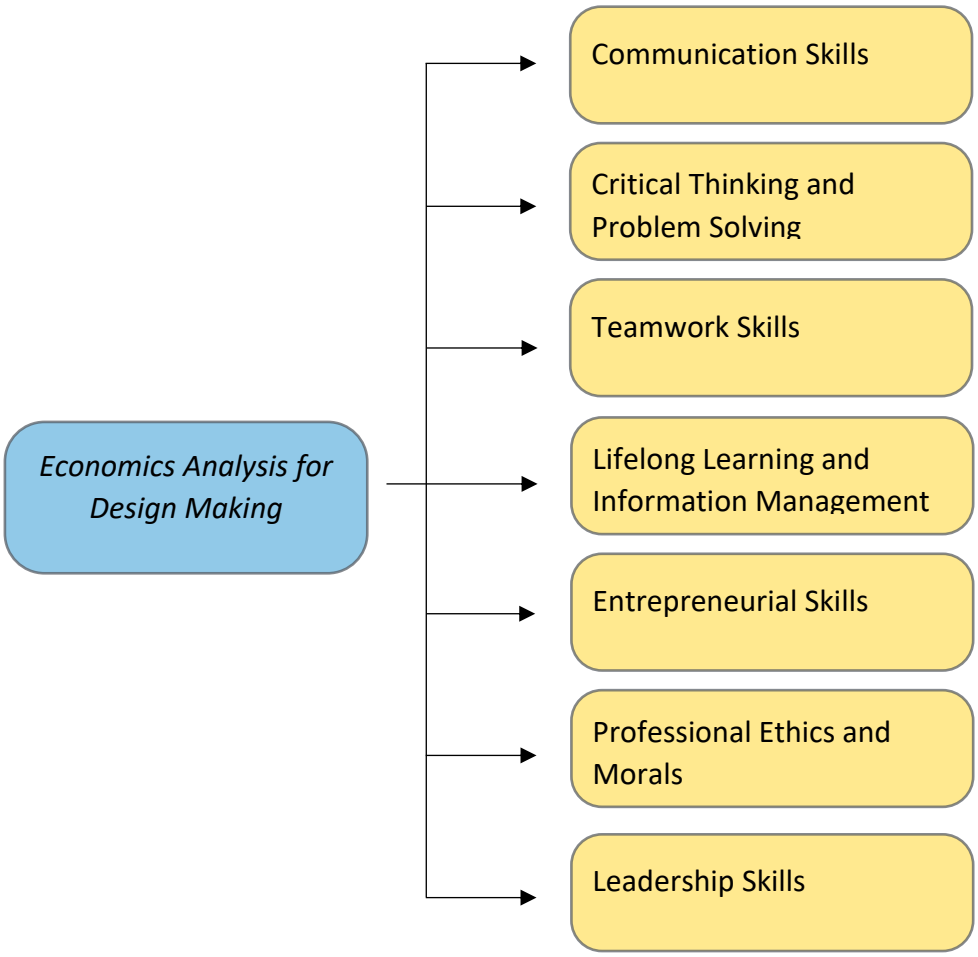


Figure 3. The Dominant Soft Skills in Compulsory Courses Offered

Manufacturing Production course
(b) Courses: Mathematics, Statistics and Computing
For the Economic Analysis for Design Making course, the most dominant Soft Skills are Entrepreneurial Skills (25%), followed by Critical Thinking and Problem Solving (20%) and Continuous Learning and Information Management (20%). This course requires analysing economics to produce a design that is expected by a particular party (customer). Therefore, all forms of information must be managed carefully and collectively through critical and creative thinking. Next, Teamwork Skills were required (10%), followed by Communication Skills (10%), Professional Ethics and Morals (10%) and Leadership Skills (5%).

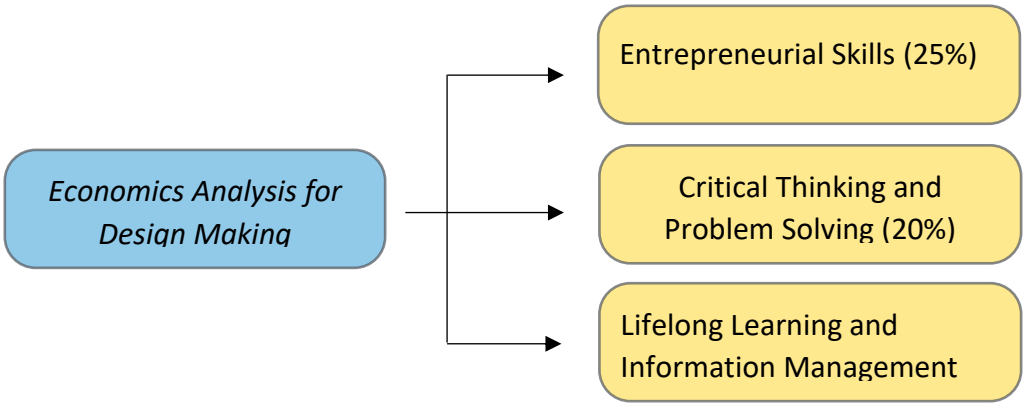


Figure 4. The dominant soft skills in compulsory courses offered

Therefore, the learning and teaching process should focus on the dominant components or components of soft skills, as shown in Figure 4. These are among the content of the learning and teaching objectives that teachers should achieve at the end of the course for the Economics Analysis for Design Making course.

ii. Elective Courses

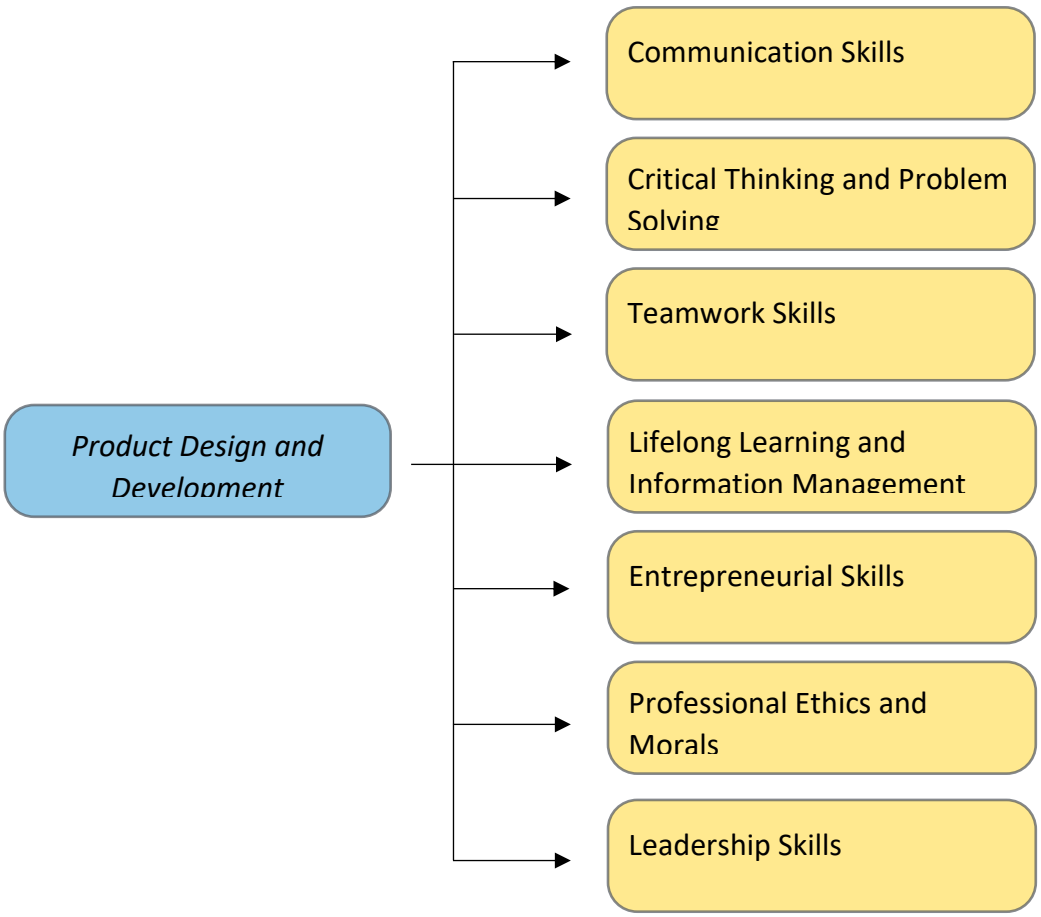


Figure 5. Integration of Soft Skills in elective courses offered

Elective courses involving Product Design and Development provided the dominant Learning and Information Management skills (30%). Communication, Teamwork, Critical Thinking and Problem-Solving skills (15%) because careful planning and best information management are required to practice the course. Effective communication and collaboration between members are also essential in building a product from the idea development at the beginning of the planning process until a product is successfully developed. Next, Entrepreneurial Skills are also required with weighting (10%), Leadership Skills (8%) and Ethics and Professional Skills (7%).

Therefore, the learning and teaching process should focus on the dominant components or components of the soft skills, as shown in Figure 7. These are among the learning and teaching content objectives that teachers should reach at the end of the course for Product Design and Development courses.

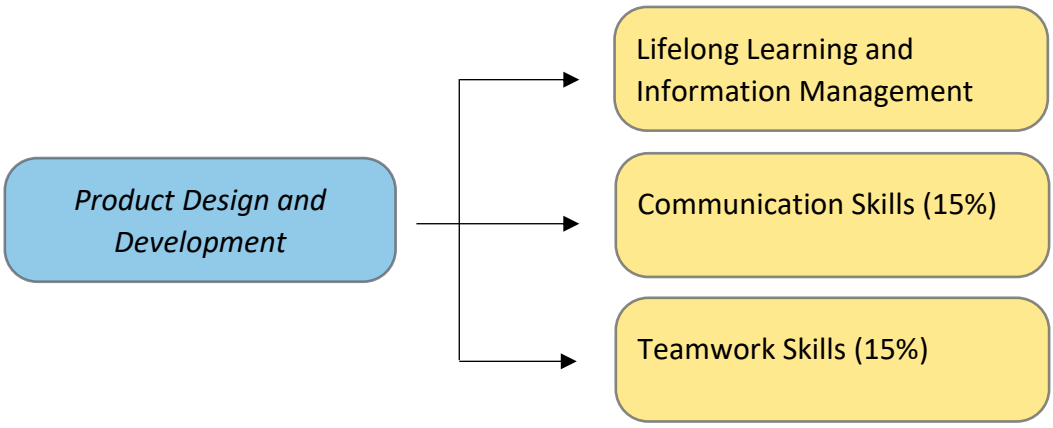


Figure 6. The dominant soft skills in the elective courses offered

The findings of this study are in line with reference (Hong, 2014) has stated that the curriculum should contain technical and soft skills, and this is supported by reference (Ahmad & Muhammad, 2012) and (Barman, & Konwar, 2011) who declared that, with the best curriculum, the graduates are prepared and acceptable by the industry.

The researcher's (Goldberg, 2014) statement supports the result that a comprehensive transformation needs to be undertaken in curriculum engineering to meet professional needs.

Researchers also agree with reference (Hart Research Associates, 2013), who believe that teamwork is a skill acquired while engaging in activities, pursuing a university-wide curriculum, and being recognised by students.

Conclusion

It has already been given attention and action as the Malaysia Plan (11) has directed all Higher Education Institutions to review programs offered to meet the industry's requirements to ensure that quality programs remain secure. Therefore, every curriculum developed at the university level requires the approval and recognition of the senate university, the Engineering Accreditation Council (EAC), the Malaysian Qualifications Accreditation (MQA) and the Malaysian Qualifications Framework (MQF) before being implemented in teaching and learning at the university level.

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