

Perception of Students and Faculties towards Implementation of Concept Mapping in Pharmacology: A Cross-sectional Interventional Study

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ABSTRACT

Introduction: Medical Council of India (MCI) in the current competency based on the undergraduate curriculum for the Indian medical graduate has focussed on the development of critical thinking, reasoning and communicating abilities of the undergraduate students. This would enable them to apply their knowledge effectively and provide better patient care. In this context, concept mapping has proved to be a simple yet powerful tool.

Aim: To assess the feasibility of implementing concept mapping module and perception of the students and faculty about use of concept mapping as complementary teaching aid in pharmacology using peer validated questionnaires and Focus Group Discussion (FGD).

Materials and Methods: This cross-sectional interventional study was conducted in the Department of Pharmacology of a tertiary hospital in Eastern India. Study duration was six months, from September 2019 to February 2020. After obtaining permission from Institutional Ethics Committee (IEC), 64 consenting students of 2nd year professional Bachelors of Medicine and Bachelors of Surgery (MBBS), Dean of student affairs, Medical Education Unit (MEU) Co-ordinator and 10 faculties of the Department of Pharmacology were sensitised about the concept mapping. A module for implementation and assessment rubric was decided. Participating students were randomly divided into eight groups (Group A, B, C, D, E, F, G, H), each group comprising eight students. Each group had to prepare one concept map on an

allotted topic from General Pharmacology. They had to submit the maps within seven days. Students could use pen and paper or they could utilise computer software to prepare the maps. After submission, faculties other than the researcher assessed and gave feedback to the students. After one month, the second set of assignments was allotted on topics from autonomic nervous system. As before, submission had to be done in seven days. This set was also assessed and feedback given. At the end of second submission, perception of the students and faculties about implementation of the module was assessed through peer validated open as well as closed ended questionnaires. A FGD was also held among participating faculties. Open ended questions were analysed using verbatim and closed ended questions were analysed as percentage using Microsoft Excel. FGD was analysed using content analysis method.

Results: Among the 64 participating students, 63 (98.43%) preferred concept mapping as complementary teaching tool in addition to traditional tutorial format and 62 (96.9%) students enjoyed making the concept maps. On analysis of students' feedback, 56 (87.5%) students opined that this module could be included in Pharmacology curriculum. Out of 12 faculties, 7 (58.33%) graded feasibility of the module as 4 out of a maximum of 5.

Conclusion: This study concludes that with proper selection of topics, concept mapping may be included as complementary teaching learning tool in Pharmacology curriculum for undergraduate students.

Keywords: Active learning module, Curriculum, Undergraduate medical students

INTRODUCTION

Since the last formulation of Regulations on Graduate Medical Education in 1997, there has been felt need of a revised curriculum focusing on development of critical thinking, critical reasoning and communicating abilities among undergraduate students. This would enable them to apply the theoretical knowledge effectively and provide better patient care. This has led to the introduction of the present curriculum of competency based medical education by MCI for undergraduate students [1]. Concept mapping may be of help in this context. Based on Ausubel's assimilation theory of meaningful learning published in 1963 [2,3], Novak JD had first proposed a theory for education in 1977 [4]. This theory ultimately led to the idea of concept map [5]. Various studies have proved concept mapping to be a simple yet powerful tool to foster critical thinking and meaningful learning among students [6,7].

Concept maps are structured maps where concepts and ideas as well as their inter-connections are represented pictorially. This 'one paper-one picture' representation helps to correlate different aspects

of a topic and get a 'bigger picture' [8] or the whole scenario. This is very important particularly for a medical student as while seeing a patient, he/she has to integrate the knowledge gained from different disciplines in his mind. Practice of concept mapping can make this process easier. On the other hand, these maps can also help to break down complex information into a simple, visual format to understand this information "at-a-glance" (a picture is worth a thousand words!). This encourages deep learning and is of great formative value to medical students. Concept mapping also helps to identify gaps in knowledge [9]. Concept mapping however, has its own challenges [10,11].

As the learner has to have some basic knowledge of the topic before he/she can construct a concept map, this teaching tool can only be utilised as complementary to lecture classes. Also, the strict formal rules of drawing concept maps require considerable time and expertise. Thus, regular practice is needed to achieve benefits of concept mapping. Pharmacology is a subject requiring sound knowledge of drugs, their origins, mechanism of action, indications, adverse effects,

interactions, etc. Till now, the students gathered this useful information from literatures, didactic lectures, practical demonstrations, etc. Though few studies have been done in the past assessing utility of concept mapping in pharmacology [12,13], none focused on the actual implementation of this active learning method. As it is known that research conclusions would lose their validity unless and until the research outcome is put into actual practice by implementing it.

This project was conducted with the aim to find out the perception of the major stakeholders i.e., the students and faculties towards implementing concept mapping as an active learning process in pharmacology.

MATERIALS AND METHODS

A cross-sectional interventional study was conducted from September 2019 to middle of February 2020 in the Department of Pharmacology of a tertiary hospital in Eastern India in which 64 students of second professional MBBS who gave consent to participate in the project, Dean of student affairs, MEU Co-ordinator and 10 faculties of the Department of Pharmacology were included. Following approval from Institutional Ethics Committee (ECR/322/Inst/WB/2013) was obtained and informed consent was taken from undergraduate students of 2nd Professional MBBS. Consenting students were sensitised about concept mapping in two batches. As there were 64 consenting students, they were divided into batches of 32 and sensitised about concept mapping by the researcher using power-point and pre-prepared concept maps.

Dean of student affairs, MEU Co-ordinator and consenting faculties of the Department of Pharmacology were also sensitised about concept mapping by the researcher using power-point and pre-prepared concept maps as with the students.

Before starting the project, a departmental meeting was held where the elements of the module for implementation was planned and decided among faculties following the University Association for Contemporary European Studies (UACES) guidelines [14]. The assessment rubric to be followed by the faculties for assessing the concept maps prepared by the students was also structured in this meeting based on the rubric used by Moni KB et al., [15] with some changes [Table/Fig-1].

Variables	A	B	C	D
Content	All relevant concepts are included and correct. All drug names correct. Map is comprehensive	Most relevant concepts are included and correct. Most drug names correct. Map is comprehensive	Concepts not relevant to the topic are also included Most drug names correct Map is clumsy and non-comprehensive	No submission
Logic and Understanding	Understanding of facts and concepts is clearly demonstrated by correct choice of links and active verbs	Understanding of facts and concepts is demonstrated but some links and verbs are inappropriate	Poor understanding of concepts and use of inappropriate links and verbs	No submission
Presentation	Concept map is neat, clear, legible and easy to follow	Concept map is neat, clear, easy to follow but has some spelling and grammatical mistakes	Concept map is untidy and difficult to follow with many spelling and grammatical errors.	No submission

[Table/Fig-1]: Assessment rubric.

All the students who consented for the study (64) were randomly divided into eight groups (Group A, B, C, D, E, F, G, H), each group comprising eight students. Each group was assigned one topic from General Pharmacology. Group A had to prepare a map on Bio-transport of drugs, Group B on Absorption of drugs, Group C

on Distribution of drugs, Group D on Metabolism of drugs, Group E on Elimination of drugs, Group F on Receptors and drugs, Group G on Factors modifying drug action and Group H on Adverse drug reaction. They had to submit the maps within seven days. Students could use pen and paper or they could utilise computer software to prepare the maps. Timeline for submission was strictly followed. After submission, faculties other than the researcher assessed and gave feedback to the students.

After one month, second set of assignments were allotted on topics from Autonomic Nervous System and were as follows: Group A: Glaucoma, Group B: Adrenergic drugs and their uses, Group C: Beta blockers, Group D: Adrenergic receptors, Group E: Organophosphorus poisoning, Group F: Atropine substitutes, Group G: Myasthenia gravis and Group H: Cholinergic receptors.

As before submission had to be done in seven days. This set was also assessed and feedback given. At the end of second submission, perception of the students and faculties about implementation of the module was assessed through peer validated questionnaires. One FGD was conducted among participating faculties to assess their perception. Feasibility and applicability of the module in terms of plan, process, people and points of vulnerability was assessed through open ended questions.

Questionnaires [Annexure I,II] were based on previous studies [12,16] and included open ended as well as close ended questions.

STATISTICAL ANALYSIS

Validation for content analysis was done by two senior professors from other discipline and one from Pharmacology for representativeness of the content domain; clarity, structure and comprehensiveness of the items. Questionnaire for students was pilot tested on 15 students and final version of the questionnaire determined. On reliability testing of the closed ended questions for students, Cronbach's alpha score was 0.73. Open ended questions for both students and faculties were analysed verbatim and semi-structured questions were assessed by 5-point Likert Scale and calculated as percentage. FGD was assessed using conventional content analysis method.

RESULTS

A total of 64 students (out of 170) consented for the project. Out of 64 students who volunteered to participate in the study, 26 were females and 38 were males. All of them filled up the feedback forms. Twelve faculty members filled up the feedback questionnaire and participated in the FGD.

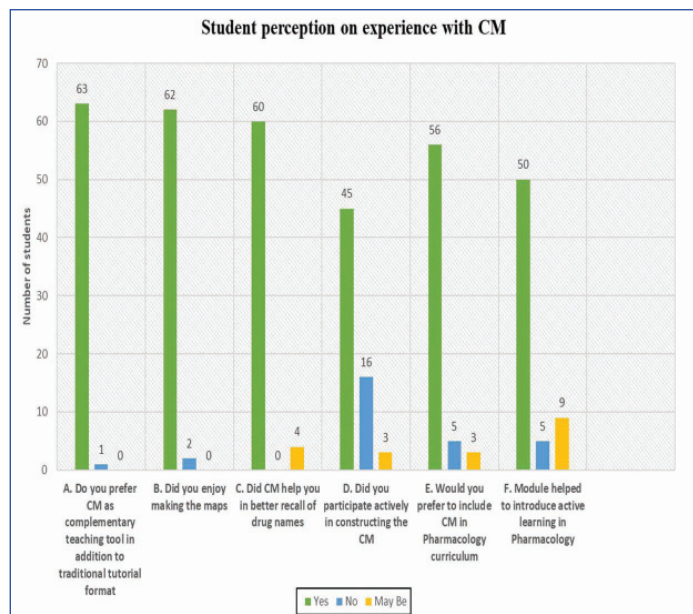
Based on the feedback obtained and the analysis the following observations were seen:

Assessment was done and grades given according to the assessment rubric. To avoid bias, faculties other than the researcher assessed the concept maps. As the submitted concept maps did not include any identifier, the assessing faculty was completely blinded about the participants. As it can be observed from [Table/Fig-2], all the groups performed better in the second assignment.

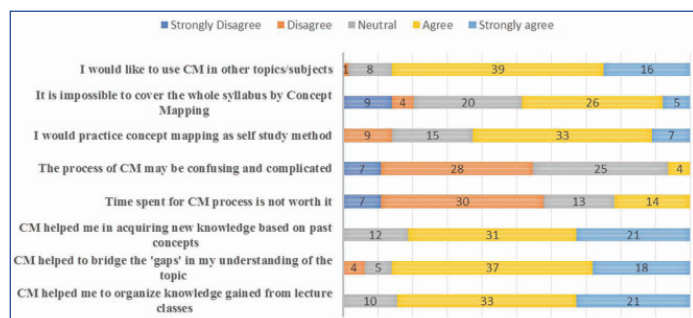
Groups	First assignment			Second assignment		
	Content	L&U	Presentation	Content	L&U	Presentation
Group A	B	B	C	A	A	B
Group B	B	B	B	A	B	B
Group C	C	C	C	B	B	A
Group D	B	B	C	B	A	A
Group E	B	B	B	A	A	B
Group F	C	B	C	B	A	A
Group G	A	A	A	A	A	A
Group H	A	A	C	A	B	B

[Table/Fig-2]: Assessment of submitted concept maps.
L&U: Logic and understanding; A,B,C indicates grading

[Table/Fig-3] represents the responses to closed ended questions. [Table/Fig-4] represents the responses to semi-structured questions using 5-point Likert Scaling. [Table/Fig-5] shows some of the examples of responses given by students to open-ended questions. In [Table/Fig-6], the responses of faculties are depicted. [Table/Fig-7] represents some of the responses given by the faculties to open-ended questions. [Table/Fig-8] represents the gradations made by the faculties on a scale of 1 to 5.



[Table/Fig-3]: Student response to closed-ended questions. CM: Concept mapping

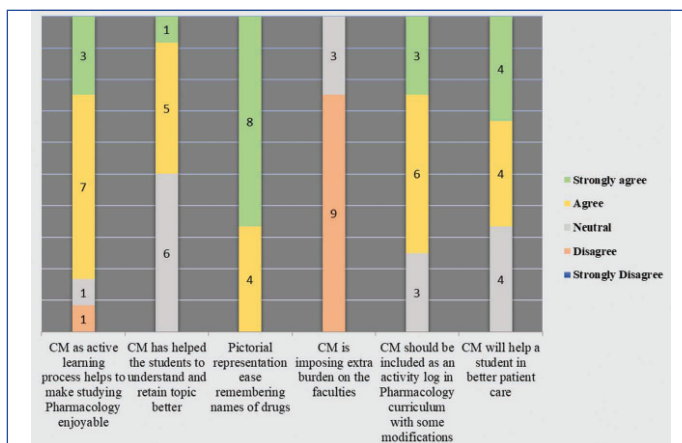


[Table/Fig-4]: Student response to semi-structured questions. The numbers mentioned in the bars represent the number of students CM: Concept mapping

Questions	Emerged themes
What in your opinion may be the main advantages of making concept maps?	Clears the concept and increases the knowledge
	Helps in retaining drug names
	Helps in revision in less time
	Better understanding
	Group work
	Pictorial representation of otherwise complicated concepts
	Filling of gaps after revision is complete
	Systematic learning
	Helps in better correlation
What difficulties did you face while making concept maps?	Recover information from many sources
	Difficult to summarise all the points in one map
	Revising only from concept maps is unsatisfactory
	All topics are not appropriate in making concept maps
	Time consuming
	Lack of co-ordination among group members
	Representing data in interesting way may be difficult
	Correlating information from different sources

Suggestions to improve the module	Maps should be colourful to create interest
	Should be mandatory for all students and all subjects
	More participation is needed
	More stress should be given on how to construct the maps
	Lecture classes should be such that making CMs is easier
	Presentation of CMs in front of the class by the students
	More interesting topics can be included
Should be simple and good	

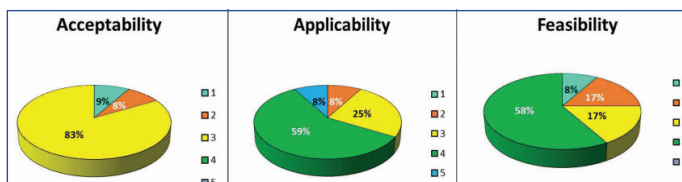
[Table/Fig-5]: Response of students to open ended questions.



[Table/Fig-6]: Faculty feedback on concept mapping. Numbers in the columns denote number of faculties responding to the particular grade in Likert Scale

Questions	Emerged themes
Would you suggest including concept mapping as an activity log in Pharmacology curriculum? If so, why?	Promote active learning
	Organise and structure knowledge
	Help student's learning process
	Can engage students in that topic and induce thinking ability
	Facilitates and improves teaching program
	For better concepts and understanding
	Better student-teacher interaction
Do you think concept mapping could help a student in better patient care? If so, how?	Stimulates team building
	Improving recall of theoretical knowledge
	Improve language ability leading to improved communication skills
	Early detection of gaps in knowledge would help to remove grey areas
	Help building leadership qualities

[Table/Fig-7]: Response of faculties to open ended questions.



[Table/Fig-8]: Faculty feedback on the module (1=Poor, 2=Average, 3=Good, 4=Very Good, 5=Excellent)

Observations from Faculty FGD

A FGD was held among ten faculty members, including MEU Co-ordinator. The focus group lasted for approximately 30 minutes. Prior to FGD, written consent was taken from the participants for audio-visual recording. Data was analysed by considering the verbatim transcribed document of audio-visual record using conventional content analysis method for theme development. Project leader moderated the session [Table/Fig-9].

DISCUSSION

Concept mapping is an active learning method that has been proved to be useful in stimulating meaningful learning. But for proper

Context units (categorical)	Summarised meaning unit	Recording units
Personal experience of Pharmacology classes as students	"Very tedious" "Tough to retain all the name of the drugs" "Too much boring" "Only lecture classes are not sufficient to capture the knowledge"	Pharmacology lecture classes are complex and inadequate
Team based activity in Pharmacology	"Helps to gather knowledge and deliver"	Team based activity stimulate learning process in Pharmacology
Quality of submitted assignments	"Must appreciate them" "Much more than what we had expected" "Understood the topic, meticulously drew the diagram" "Good job done"	Submitted assignments were appreciable
Challenges towards implementation	"Time constraints" "All members in the group may not be active" "Restrict to some topics" "Proper sensitisation needed"	Multiple challenges towards implementation
How to increase the impact of the module	"Presentation of CM by students themselves" "Mappable microtopics should be chosen" "Anyone may have to present" "Individually each participant can prepare a slide" "Peer review to increase impact"	Proper selection of topics and ensuring active participation by all students in the group could increase impact
Can CM improve student-teacher relationship?	"Definitely" "More sessions are required"	CM will improve student-teacher relationship over time
Perception of this module	"In anything beginning is tough, middle is messy, but in the end, it'll be awesome" "Topics should be restricted" "No doubt that it will help students" "Will help in structuring the knowledge"	The module is implementable given some time and proper selection of topics

[Table/Fig-9]: Items identified through content analysis of Focus Group Discussion (FGD) with faculties.

utilisation of this teaching learning method, regular and repeated practice is necessary. In present study, most of the students improved their scores in the second assignment as seen in [Table/Fig-2]. Authors believe that inclusion of the module in curriculum would further improve the performance.

In response to pre-validated closed ended questionnaire, as shown in [Table/Fig-3], 97% of students enjoyed making concept maps and 98.43% preferred concept mapping as a complementary teaching tool in Pharmacology. This is similar to the study by Bala S et al., where 90% of the students were enthusiastic about the new teaching methodology [13]. In open ended questionnaire to the students, when asked why they wished to include concept mapping as a part of their curriculum, opined that "concept mapping helped to chalk out the topics in the brain without the need of mugging" and that "concept mapping helped in organising and retaining knowledge in a short time". An interesting comment was "Concept mapping helped me to look at the forest, not the tree". This was in concordance with previous studies [17,18] that mentions that concept mapping increases student engagement by providing the student with an opportunity to organise, summarise, analyse and evaluate many different ideas.

In present study, 93.75% students commented that concept mapping helped them in better recall of drug names. This was in agreement with a study conducted at Puducherry which concluded that use of mind maps in remembering things better than the routine way of reading texts [16].

One of the qualities of a professional Indian Medical Graduate is to successfully work in a team. In present study students were introduced

to team based work through this concept mapping assignment- they learnt how to involve themselves in group work. Zgheib NK et al., investigated the impact of team based learning for second year medical students in a pharmacology course [19]. They found that team based learning approaches were more effective than traditional lecture based pedagogy for improving student learning of difficult concepts. Thus, concept mapping is advantageous in this respect.

A 5-point Likert scale was used to assess student perception of concept mapping. Most of them wished to apply this process for self-study and to study other disciplines too. This was in contrast to the study by Pao-Nan C who found that concept mapping strategy did not increase students' self-directed learning abilities [20].

When asked, 81.25% of students expressed that concept mapping helped them to acquire new knowledge based on past concepts. This was in keeping with previous researches which have proved that making concept maps can assist in helping a student link basic science to clinical practice and in promoting clinical reasoning. Hay DB and Kinchin IM in their study have also shown that concept maps provide a strategy for navigating the different thought processes [10,21]. Thus, regular practice of creating a network and organised knowledge base by concept mapping would help a medical student immensely in his/her profession.

Among the students, 84.38% opined that concept mapping helped to organise the knowledge gained from lecture classes. Traditional didactic lecture classes without active participation by students encourage mere memorising of isolated and unconnected information and which are difficult to retrieve later. As the students try to make the concept maps, they figure out the connections between topics. As Papert S believed- "better learning will not come from finding better ways for the teacher to instruct, but from giving the learner better opportunities to construct" [22].

In present study, 45.31% of students found concept mapping process complicated. This is expected as concept maps are a new way of learning for them and as such it takes time for both to understand and incorporate mapping as a learning strategy. Time taken to design maps is another point of discontent for the students. Studies have found that increased academic workload, lack of motivation and lack of institutional assessment context are some of the factors that inhibit the students from accepting this process [23].

Some students are unable to match their preferred study methods/ learning styles. They also may not find concept mapping useful. In a study conducted on 121 Stage 2 MPharm and BSc Pharmacology students [18], using pre-prepared concept maps, it was concluded that students desiring deep learning preferred concept maps for studying while those preferring superficial and strategic learning, did not prefer this method.

While considering implementation of a teaching learning module, it is essential to assess the perception of another important stakeholder, i.e., the faculties. Regarding applicability and feasibility of the module, faculties felt that with proper selection of topics, the module is applicable in the curriculum. They felt that as the module required minimal financial, organisational and technological assistance, implementation was definitely possible in future.

According to the faculties, prior sensitisation is very important for the module to succeed. Time required to construct the concept maps was a major point of vulnerability in this implementation process. Choosing appropriate topic could be another challenge. However, faculties felt that regular practice could ease the process of implementation. A 66.67% of faculties thought that pictorial representation of concept mapping would help to remember the names of drugs. This was in agreement with the article [24] "6 Ways to Make Studying Pharmacology Less Intimidating" by Windsor University School of Medicine, where medical students were advised to learn about drugs with the help of an infographic.

On the question about imposing extra burden on faculties, 9 faculties disagreed while 3 faculties remained neutral. Guiding students about designing concept mapping requires considerable time and effort. Moreover, continuous evaluation and effective and immediate feedback is very important for utilisation of concept mapping as an active learning method [25]. This could put extra burden on faculties.

Limitation(s)

A major limitation of the study was very short time period during which it could be conducted. Due to COVID-19 pandemic, only two set of assignments could be distributed to the students and active participation by each and every student of individual group could not be ensured. Moreover, increased number of FGDs with more detailed discussion could have been possible if more time was available.

Increased time period and increased involvement could have strengthened rigor of this qualitative research.

CONCLUSION(S)

This study has revealed that the undergraduate students and faculties of the Department of Pharmacology of our institution consider that with proper selection of topics, implementation of concept mapping as complementary teaching tool is applicable and feasible. Further studies may be required in this field.

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ANNEXURE-I

Student perception about concept mapping

Please take a few minutes to answer the following questions honestly. We need your input so that we can improve on the curriculum in Pharmacology. Please cross the appropriate box and write answers on the dotted lines. You are also welcome to write your suggestions regarding any improvement in the concept mapping module.

1. Do you prefer CM as complementary teaching tool in addition to traditional tutorial format? Why? Why not?
2. Did you enjoy making the maps?
3. Did concept mapping help you in retaining names of drugs better than traditional method of reading?
4. Do you prefer to work in a group or individually or both? Why?
5. Did you participate actively in constructing the CM?
6. What in your opinion are the main advantages of making concept maps?
7. What difficulties did you face while making concept maps? You can mention more than one
8. Will you use concept mapping in future for self-studying Pharmacology?
9. Do you prefer concept mapping to be included as part of your curriculum in Pharmacology? If so, why?
10. Do you have any suggestions for improving the module?

Please mark the following questions on a scale of 1 to 5 (1= Strongly disagree

2= Disagree

3= Neutral

4= Agree

5= Strongly Agree)

Questions	1	2	3	4	5
CM helped me to organise knowledge gained from lecture classes					
CM helped to bridge the 'gaps' in my understanding of the topic					
CM helped me to retain the information better					
CM helped me in acquiring new knowledge based on past concepts					
Time spent for CM process is not worth it					
The process of CM may be confusing and complicated					
It is impossible to cover the whole syllabus by concept mapping					
I would like to use CM in other topics/subjects					

ANNEXURE II

Questionnaire for faculties:

Thank you for taking part in this project. Your valuable feedback is needed to assess the effectiveness of implementing concept mapping as a complementary teaching-learning method in Pharmacology.

Please take a few minutes to give your response to the following questions:

1. Do you think active teaching-learning method create interest among the students towards learning?
2. Were the concept maps well-constructed? Do you think concept mapping has helped the students to understand and retain the topic better?
3. Do you think pictorial representation will help to ease remembering the names of drugs?
4. Do you think concept mapping is imposing extra burden on the faculties?
5. Do you want to include concept mapping as an activity log in Pharmacology curriculum? If so, why?
6. Do you think concept mapping will help a student in better patient care in professional life? If so, how?
7. Considering the following, do you think that the module is feasible and applicable in the curriculum?

Plan (financial and organisational)

Process (technological)

People (socio-cultural)

Points of vulnerability (internal risks)

8. Do you think the module will be acceptable to the students and other faculties? If not, why?
9. Do you think that the module should be modified? If so, how?