HOW TO BE AN INTERACTIVE COMPUTER SCIENCE UNIVERSITY TEACHER: A SHORT BOOK

PROF DR FAISAL RIAZ

MIRPUR UNIVERSITY OF SCIENCE & TECHNOLOGY

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A Short Book

Prof. Dr. Faisal Riaz

Professor of Computing

Department of Computer Science & IT

Mirpur University of Science & Technology   AJK, Pakistan

Abstract

This short book has been written specifically for university level computer science teachers as their job is to produce future leaders in Computer Science, hence their lectures should be very dynamic and interactive. To be an interactive teacher is the first key to make your classes the comfort zones for the students where they love learning instead of feeling boredom. This book is discussing different pedagogical methods which will help the university level teachers to be a successful and popular class teacher and they will be able to improve the cognitive and innovative abilities of their students in a systematic way.

Contents

Introduction to the Author

FAISAL RIAZ received his Ph.D. degree from Iqra University, Pakistan, in 2018, in the field of cyber physical systems (CPS). He is currently serving as a Director of Research and Professor with the Department of Computer Sciences, Mirpur University of Science and Technology. His research interests include vehicular cyber physical systems, cognitive radio, affective computing, and agent-based modeling. He has more than 48 research publications in various national/international research journals and conferences. He is also the author of the three books. Furthermore, he is the Head of the Control, Automotive and Robotics Lab, National Center of Robotics, Department of Computer Sciences, Mirpur University of Science and Technology (MUST), Pakistan. Under the banner of CAR-Lab, he developed the world's first cognitive and emotional autonomous vehicle. He received the Hall of Fame Award, in 2018, in the recognition of his smart innovations. He also achieved the prestigious ICT P@sha award in 2022 for designing the best self-driving vehicle in Pakistan. He is a reviewer of many well reputed journals and has served as a technical program committee member in many international IEEE conferences

1. Teaching Philosophy

In my opinion the purpose of education is to enlighten the human brain, help him to survive in social life with respect and make him capable of earning his livelihood respectfully. While writing this book, I am teaching right now Information, Communication and Technology (ICT) to the 1ˢᵗ semester of BS(CS). Though I am a professor in my department, I selected this very core subject to clear the concepts of ICT from the very beginning of my studies and mentor them in selecting the latest field of computer science to start work right now to master the skills and become a top entrepreneur. My broad learning goals for my students are, they should grasp the basic and advanced concepts of ICT, learn how to read things, learn how to solve critical problems, improve their soft skills and prepare them for their future jobs in a better way.

In my course, students are challenged to learn by exploring things on their own. In each lecture, in the first 5 minutes I give them the overview of the previous lecture, ask them if they have any question or concept which is not clear from the previous lecture then they can ask. Then I share with them new topics and start explaining them using different methods. As I have a very strong research lab related to computer science, I show them things practically regarding the topic under discussion. Then, I give them different challenges related to the topic to explore at home and write a page or two on the topic under discussion. I facilitate students using a Whatsapp group, where students can interact with me by asking questions related to the topic or given assignment at any time. Further, I facilitate them by sharing the related material as well for further study.

Soft skills are as important as hard skills. It is like you have a good gun without bullets. Soft skills can be good communication skills, presentation skills, flexibility, and adaptability, problem solving skills, creativity and critical thinking. These core skills make the students capable of earning good jobs and then performing well during their jobs. In my course, effective communication helps students to ask questions and conveying their brain bits without any hesitation. Effective communication creates leadership quality in my students, which helps them in working more effectively while working in groups. Good presentation skills help in presenting their projects more effectively. To grasp the basic and advanced ideas of course, critical thinking helps my students to think about the subject in depth and creativity helps them in doing their semester group using novel ideas.

My main activities while teaching class circles around engaged teaching philosophy. I try my best to touch all students and plan my lecture activities in this way so that each and every student should get my attention and have interaction with each other as well. To keep the students engaged, I manage question-and-answer sessions. This activity keeps students active and their focus is always high during the whole lecture. I practiced this scheme in my classroom many times and found it very beneficial. Further, I manage group activities. This activity creates harmony between my students while working in groups and it also improves their leadership qualities along with resolving different problems, come during the group project. Last but not least, I use visual aids and gadgets to explain the concepts. Like, when I taught them about the latest topic "METAVERSE" then I showed them Virtual Reality headset (OCULUS Quest 2) and asked them to experience the Metaverse concept practically instead of just understanding it theoretically.

Oculus Quest2 Virtual Reality Headset

2. Exemplary Course

I have selected the course of Information, Communication and Technology (ICT) to use as an exemplary course for writing this short book. ICT is the most basic course which is being offered in the first semester to the computer science degree students. This course builds all basic concepts of newcomers entering in the computer science field. From the nature of this course we can understand the importance of this course. The basic course outline of ICT is very broad from basic terms concepts to the introduction of all courses which will be taught in the coming semesters of computer science degree. Hence, learning this subject in depth helps students in

making the mind map for the coming semesters. Further, this subject also help students in developing interest in one or two fields of computer sciences and then building their skills in future to become a true professional.

3. Benefits of Lectures

Lectures are very beneficial practice in terms of real time interaction between teacher and students. There are many benefits of lectures. For example,

1- Lectures give the teacher full control on the class and he/she can adjust the learning pace of class.

2- Lectures help a teacher to communicate with a large audience at once.

3- Interactive sessions are possible due to lectures and students learn when a lecturer floats multi questions in class during the lecture. In response students give multiple answers, share their experiences and in this way lectures become a useful tool for interactive learning.

4- Lecturers are the best source of inspiring the students by sharing the worthy experiences of the lecturer.

5- Through lecturing, an interactive lecturer transfers his/her best soft skills like communication, confidence, and innovative thinking to the students.

The direct beneficiaries of these benefits are students. However, thorough lecturing the further concepts of lecturers also gets clearer.

3.1. Challenges

Challenges are given as under.

1- The main challenge is delivering up- to-date contents during the lectures.

2- Require up-to-date hardware to demonstrate latest technologies.

The first one is a challenge for me because I am a lecturer of computer science and this field is advancing on rapid pace. Hence, keeping me up-to-date is a challenging task. I have to read on daily basis and mastering the latest skills. The only solution to these challenges is keeping myself-up-to-date by taking the latest courses and reading the material.

To overcome the second challenge, I have to manage the hardware with the help of different funding agencies.

How to overcome these challenges, in this regard few of the points have been discussed as under.

3.1.1. Engaged teaching learning beliefs

According to Harvard University research, an important aspect while teaching students is keeping them engaged. We should touch all students and plan our lecture activities in this way so that each and every student should get our attention and have interaction with each other as well. To keep the students engaged one of the best practices can be question-and-answer sessions. This activity keeps students active and their focus is always high during the whole lecture. I practiced this scheme in my classroom many times and found it very beneficial. Quick writing assignments can be another activity to keep students engaged. This activity also improves their focus because they can only write well if they understand the lecture well. Further, group activities help teachers keep engaging their students with them as well as with each other. This activity creates harmony between different students working in a group and also improves their leadership qualities along with resolving different problems that come during the group project. However, to practice this activity a teacher should be well prepared and he/she has a good grip on his/her subject and the topic under discussion. Last but not least, it has been seen that if the climate of the classroom is nice and it is full of all basic facilities like smart board/ LED screen etc. then students can be engaged in a better way. The smart gadgets can be utilized to make the classroom more engaged. In conclusion, different engaging methods can increase the engagement level of students.

3.1.2. Understanding Terms Equity and Inclusion

Terms equity and inclusion are two closely linked values which are practiced by good educational institutes and engaged teachers. When an engaged teacher treat each student fairly without thinking about color, language, race, and cast then we can say that he/she is practicing equity. If we see the equity on intuition level then it is all students can avail same opportunities without any distinctions. However, there is a difference between equity and equality which makes equity more important concept to be practiced. For an example, if we have few students in class those are from the non-English language background as compared to the English language background students then equity says the non-English background students should be given extra English language classes so they equally enjoy the opportunities for which "know how" of English language is necessary. In my classroom keeping this definition of equity i encourage non-computer background students to have extra coaching from me. I encourage them to visit me or ask more questions to clear their concepts so they be able to compete with the students with the background of computer sciences. If we see inclusion then it is the healthy class culture where every student feels that his/her voice is heard and he/she is given the importance. Inclusion creates confidence in students and they participate in class activities in a more healthy way. To practice inclusion in my classroom i give equal chances to boys and girls that they share their thoughts. I try best i show them how important are their thoughts using encouraging words and giving positive feedback. In the beginning of the lecture i invite whole class for open suggestions regarding the improvement of studies. This inclusion method help students in involving themselves in the improvement process of their studies and they feel themselves as a part of class.

3.1.3. Cultural Background Based Interaction

It is the nature of human beings that they learn things with more interest which are related to them. In the same way when we teach students different things in the context of their culture then they understand the concepts more easily and learn the concept in depth to resolve the problems they are facing in their area/culture. When we explain the topic using their area related videos their brains are in a better position to learn as they are familiar with their culture already. Students of that culture feel proud and consider themselves an important part of society that have

been given weightage. It helps them in boosting their morale which ultimately improves their learning capabilities. If we talk about what students gain from group activities then we have to make sure first that the groups formation should consist of students of different cultural background students. In this way students learn from each other about their cultures, they see the positive and negative aspects of culture and admire each other. This activity helps in decreasing the biases as they establish working bonds with each other and hence promote equity and inclusion. An effective teacher should explain different problems by relating them with the different student's cultures as it help students in learning the concepts easily.
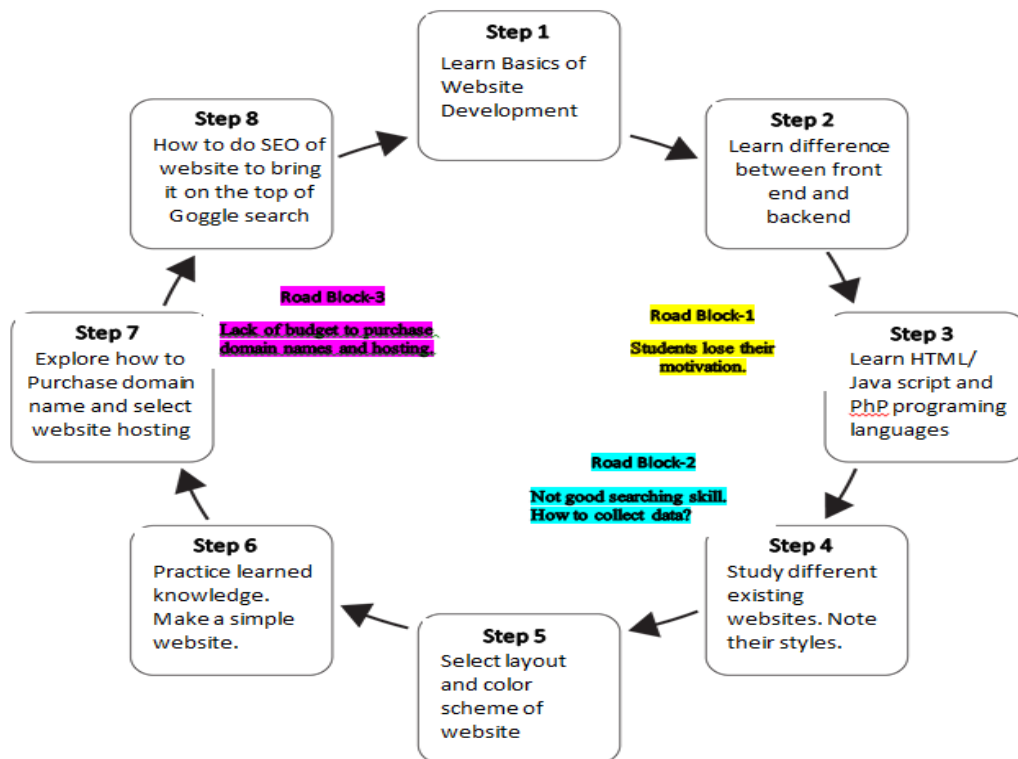
3.1.4. Cold Calling

It is the nature of many students that they hesitate and are shy in expressing their thoughts. It can have many reasons like the ability to communicate in language in which discussion is in progress or having less knowledge of the topic under discussion. Taking these things students hesitate to participate in discussion. Cold calling is one of the best techniques I found in improving the confidence level of students. Most of the time it has a positive impact on the students. Cold calling is the tool through which a good instructor reaches its students and invites them to participate in discussion. To make the cold calling successful a good instructor should know the reasons of students hesitation and try to remove those barriers otherwise cold calling will have a negative impact in the shape that student might leave the subject or class. I often use cold calling in my class. I reach the hesitating students and invite them to share their opinion. I encourage them with good words and make them comfortable. I give them confidence by endorsing their discussion so they feel normal and start participating in discussion with full confidence. Further, I intimate the class so as not to laugh at the less confident student. Other than cold calling I invite students to come on the stage and practice eye contact with their class fellows. I ask them to introduce themselves to their class fellows, this technique makes them comfortable with their class fellows and they feel less hesitation next time while participating in the discussion.

4. Interactive Teacher Tools

In this section we will see different tools which will help a teacher to be more interactive while delivering lectures in the classroom.

4.1. Develop a Process diagram of your lecture.

Process diagram is a diagram, which helps you in breaking down a complete system into small easy to understand steps. It can be visualized as a graphical tool which can help you in defining a complete flow of your process. If we take it in our class lecture reference then a process diagram can help us in defining all small steps involved in our topic to be covered in our lecture. As an example, shown below, I have selected a topic of website development and have broken it into many small activities that I can cover in each lecture. As a better practice such process diagrams should be shared with the students in the beginning of lecture so that they have a complete picture of all website development related activities and study the incoming lectures in advance.

Step 1
Learn Basics of Website Development

Step 2
Learn difference between front end and backend

Step 3
Learn HTML/ Java script and PhP programing languages

Step 4
Study different existing websites. Note their styles.

Step 5
Select layout and color scheme of website

Step 6
Practice learned knowledge. Make a simple website.

Step 7
Explore how to Purchase domain name and select website hosting

Step 8
How to do SEO of website to bring it on the top of Goggle search

Road Block-1
Students lose their motivation.

Road Block-2
Not good searching skill. How to collect data?

Road Block-3
Lack of budget to purchase domain names and hosting.

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4.2. Backwards Design

Backward design is an instructional design approach that starts with defining the desired learning outcomes and works backward to create the instructional plan. This approach was popularized by educators Grant Wiggins and Jay McTighe. Benefits of backward design are given as under:

4.2.1. Identify Desired Results:

Learning Goals/Objectives:

Clearly state the overarching goals or objectives you want students to achieve.

Understandings:

Outline the key concepts or big ideas students should grasp.

Essential Questions:

Develop questions that provoke critical thinking and exploration of the subject matter.

4.2.2. Determine Acceptable Evidence:

Assessment Criteria:

Define the criteria for evaluating student performance.

Performance Tasks:

Specify real-world tasks or projects that demonstrate understanding.

Other Evidence:

Include quizzes, tests, observations, or other forms of assessment.

4.2.3. Plan Learning Experiences and Instruction:

Learning Activities:

Design activities that facilitate the acquisition of knowledge and skills.

Instructional Strategies:

Choose methods that align with the learning goals and engage students.

Resources and Materials:

Identify the tools, texts, or technologies needed for effective learning.

4.2.4. Final Evaluation:

Reflection on Overall Design:

Evaluate the overall effectiveness of the backward design process.

Consider adjustments for future planning.

An Example:

Desired Results		
ESTABLISHED GOALS	*Transfer Objectives*	
	Students will be able to independently use their learning to…	
1- Learn the importance of Information, Communication and Technology (ICT) courses. 2- Explore the different applications of ICT.	The purpose of this course is for students to grasp all basic ideas regarding computer science and then relate them with their real life. Further, they are able to develop their interest in one of different fields of computer science and start thinking of selecting it as a future career. Moreover, they develop their grip over different basic software like MS-WORD, Excel sheets and PowerPoint. Then using these skills they are able to make very good presentations, present them and improve their confidence. Last but not least, students be able to develop critical and innovative thinking skills.	
3- Select the skillset in the beginning of their semester to become a successful professional. Improve their presentation, communication,	*Meaning Objectives*	
	UNDERSTANDINGS *Students will understand that…* ● What is ICT and its	**ESSENTIAL QUESTIONS** ● How to grasp the basic ideas of ICT

innovation and critical thinking skills.	importance ● Know how ICT is changing their common life and which challenges it has solved. ● Grasp ideas of different fields of computer science like Web designing, Computer networking, game development etc. ● How ICT helps in establishing and boosting today's businesses? ● Which field is interesting and how they can improve themselves to get good jobs? ● Tools required to make good presentations and art of presenting them? ● How to work in team and developing harmony while working in groups for coming semesters	terms like Hardware, software, and applications of ICT?. ● How to explore the list of ICT applications and then examine their roles in solving daily life challenges?. How to measure the merits and demerits of ICT usages in daily life?. ● Which field is best according to the market nature and how to develop the skills in that particular field? Which learning platforms should be selected?. ● What is the relation between ICT based social media platforms in establishing and boosting business. ● How to explore the market according to the skills they have already?. What are deficiencies in their current skill set and how to improve it? ● How to understand the human behavior conflicts and then resolve them to become a better team?

Acquisition Objectives	
Students will know…	*Students will be skilled at…*
● What is ICT and its importance ● About their laptop/desktop computer functions in both hardware and software aspects. ● Different applications of ICT ● About their current status in ICT field ● How to improve their current skill set.	● Students will have an in-depth understanding of ICT concepts. ● How computers work using different hardware and software components. ● ICT applications concepts ● Develop basic websites ● Basic level skills in Microsoft office. ● How to present with confidence.

Evidence and Assessment

Evaluative Criteria	Assessment Evidence
1- How well the concepts (basics/advance) of ICT have been developed.	**PERFORMANCE TASK(S):** ● Explain the basic and advanced concepts of ICT in depth using multi-assignments.

2- How well they are relating these concepts with their real life. How well they have mastered MS-Office tools like MS-word, MS-Excel and PowerPoint, basic web development.	● Identify the real life applications which are ICT based. Collect data, present in assignment shapes along with the presentations. ● Design basic websites using online free tools. ● Solve practical assignments related to the MS-office on their computers.
	OTHER EVIDENCE: ● Total 6 different assignments and 5 quizzes will be given ● Five (05) lab assignments will be given ● Small semester projects will be given and evaluated.

Learning Plan and Activities

Summary of Key Learning Events and Instruction

- Students will be given in depth lectures and then will be asked to explore the topic using the internet to develop further concepts.

- Group discussion to exchange their ideas and learning from each other sessions will be conducted.

- Using different gadgets, practical learning will be practiced.

- Practical labs will be conducted.

- Using practical labs experience home assignments will be given and it will be necessary to prepare them using tools they learned during lab lessons.

- Group projects will be assigned which will be concluded on group Presentations

4.3. Assessing Assessments

If I recall my study times then I am very lucky that I have been evaluated using formative, summative and authentic assessment. As I was a student of a very practical field i.e. computer science, so thrice of these assessments were very good fit for my evaluation as well as improvement on both teacher and student side. There was a lab oriented subject called "Data Structure" in which we had to develop different programming mechanisms for computers. I remember, our teacher practiced authentic learning using surprising quizzes. At that time it was looking very difficult to cope with the surprising problems to solve on run time but later on in my professional life that authentic technique helped me in solving real-life new /unexplored programming problems using my acquired skills. So it was the best assessment mechanism that I ever had. Further, most of the teachers in my studies evaluated us using a summative assessment mechanism. They gave us question papers and they had already answered keys to mark our papers and assign us the grades. However, very few times formative assessment was practiced during my studies. I found that the timing of formative assessment was not suitable as it was mostly done at the end of the semester and the quality of teaching contents improved in the next semester. So we were not the direct beneficiaries of this assessment method.

An Example:

Assessment Title: Development of Basic Website in Information, Communication and Technology (ICT) Course

Assessment Description: The website designing is among hot topics of ICT course. As websites are essential for today's business, learning and developing them can lead to a good profession. Web development is a complete course in the 5th semester of the computer science degree. But at

the ICT course it is one of very interesting and useful topics which help students in building their practical capacity and giving them the feeling that they can do something good in future to secure good jobs or business. If we take its assessment mechanism then it can be assessed in summative as well as authentic. We apply a summative method using 03 to 05 different assignments related to the analysis, design, implementation, testing and deployment of websites. Whereas using semester projects we apply authentic assessment to evaluate how the students have utilized their acquired knowledge during the semester to make a practical product. However, among both of these assessment methods, I will prefer authentic assessment methods. Few of the pros and cons of assessment methods in website development are given as under.

Pros	Cons
Existing website designs survey: It will help students in exploring the different websites according to the following questions. ● How they have been designed. ● What are their purposes? ● Why are they successful websites? ● Which design they select. ● Which colors and fonts are eye-catching etc.	As it is in the first semester, students might not be able to search and collect the true market survey of websites.
Learning/ exploring Coding platforms Students will explore different programming languages for website development. It will broaden their programming platform concepts. As	As programming/coding is a little tricky thing. It might lead to difficulty for the basic level students and they can consider a fun thing of website development as a hectic task.

they also learn a subject "Fundamentals of Programming" in parallel in the same semester that is why they can use their acquired knowledge in programming for completing this task.	
Learning website Testing : Students will have the opportunity to learn website testing schemes and acceptability rates.	Students need to learn different testing schemes with experts and need extra efforts.
Learning Deploying websites: Students will learn about different website deployment options/platforms. They will also learn about how to purchase domain and hosting.	It might create little financial burden on the students by purchasing domain names and hosting.
Writing Report: Students will learn about different report types. They will improve writing skills and will learn how to report their project.	Students might feel difficulty in writing a complete report and what are the different chapters or headings of the report. They will need separate training in this regard.
Presenting Projects: They will learn how to make presentations and then soft skills like communication and presenting ideas through these presentations. Ultimately their confidence level will be increased.	The first semester students are shy in presenting their ideas in front of an audience. It is possible that though they know good about the idea to be presented but might be assessed in low grade due to their shyness and inability to present it.

To the best of my knowledge, the authentic assessment technique is best because it has dual benefits. The first benefit is students will learn how to apply their acquired skills in new situation like designing different phases of websites and second is they will improve their innovation skills

by exploring the things from literature (market survey), by asking their seniors and searching the internet.

4.4. Bookends, Overlays, and Interleaves Map

It is sometimes confusing for the instructors to give plane lectures or conduct interactive learning sessions in the class. The answer to this question in my opinion is "Hybrid". Employing concise 10-15 minute lectures interspersed with active learning techniques proves to be a highly effective strategy for learning, applicable to both in-person and online instruction. Yet, it's crucial to purposefully design these class sessions to maximize learning outcomes.

A helpful tool for planning such interactive sessions is the Bookends, Overlays, and Interleaves map, which serves as a graphic organizer. In this context, "Bookends" denote activities positioned before or after a lecture to bolster the presentation. These can manifest as preparatory guides or online activities before the lecture or as brief prediction activities to commence the presentation itself.

"On the other hand, "Overlays" represent activities that students engage in during a presentation to enhance their focus on the material. These may encompass active listening exercises or assignments involving note-taking.

Lastly, "Interleaves" involve instructors seamlessly transitioning between lectures and active learning activities, providing students with time to digest and assimilate the presented material effectively.

An Example

Unit Title: Virtual Reality/ Augmented Reality

Plan Component	Bookend	Overlay	Interleave	Overlay	Interleave	Overlay	Bookend
Time Allotted	5 Minutes	15 Minutes	5 Minutes	15 Minutes	5 Minutes	15 Minutes	5 Minutes

Student Activity	Students will write what they learned in previous class	Introduction to the new topic/ Practical Applications	Students discuss in groups/ share their thoughts with each other what they understand	Presentatio n	3-2-1	Case Study	Summar y/ Conclus ion of the lecture
		Take Notes		Take Notes		Active Reading Document + Take Notes	

4.5. Empathy Map

An empathy map serves as a visual instrument within design thinking and customer experience (CX) design, aiming to grasp and connect with the sentiments, thoughts, and encounters of a specific target audience or user persona. This tool aids teams in delving deeper into the understanding of the individuals they are designing for, ultimately resulting in solutions that are more centered on human needs and are more effective. Typically, cross-functional teams collaboratively construct empathy maps, dividing them into four quadrants that signify distinct facets of the user's experience:

1. **Expresses (Says):** Concentrating on the user's verbal communication, this quadrant includes direct quotes, comments, and expressions associated with the product or experience.

2. **Reflects (Thinks):** This quadrant delves into the user's thoughts and cognitive processes, unveiling concerns, aspirations, and considerations regarding the product or service. It offers insights into the internal dialogue of the user.

3. **Emotes (Feels):** Exploring the emotional dimensions of the user's experience, this quadrant uncovers the likely emotions experienced during interactions with the product or service. These emotions may encompass joy, frustration, excitement, or anxiety.

4. **Acts (Does):** Outlining the user's actions and behaviors, this quadrant encompasses both observable behaviors and concealed actions taken while using a product or service.

The creation of an empathy map involves collaborative efforts from the team, populating each quadrant with insights gathered through user research, interviews, observations, or other methods of understanding the target audience. The visual representation aids the team in developing a comprehensive grasp of the user, fostering empathy and guiding well-informed design decisions.

Empathy maps are frequently employed alongside other design thinking tools and techniques to construct a thorough perspective of the user's experience, thereby informing the design and development process.
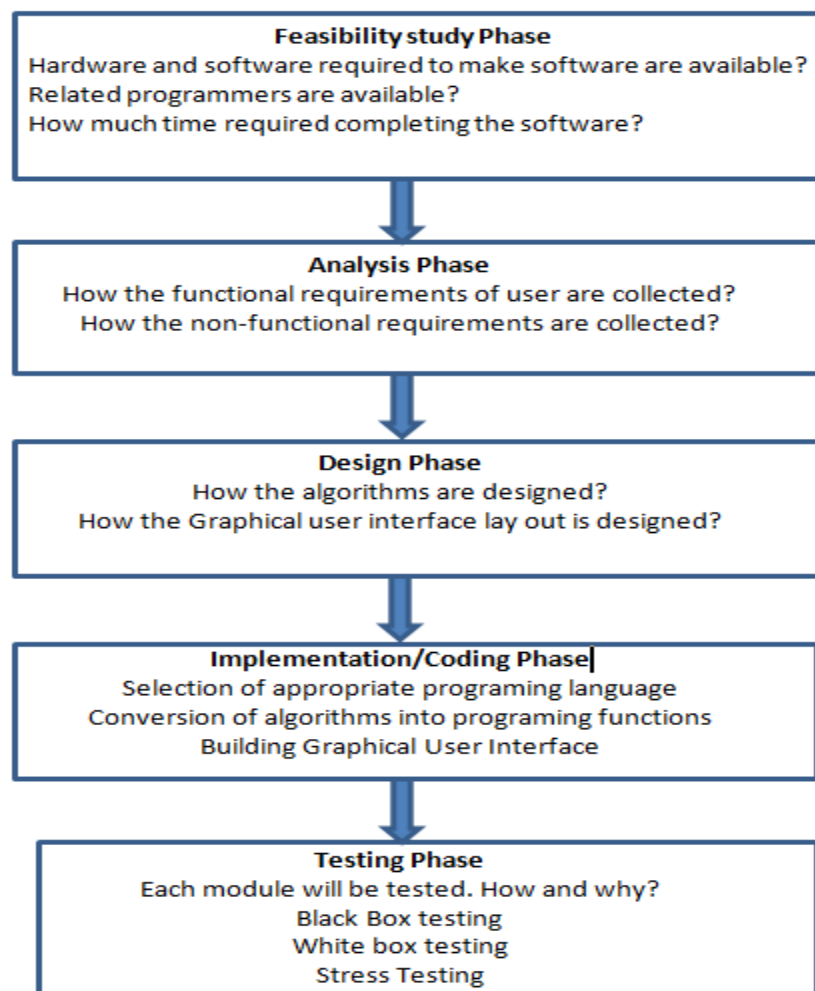
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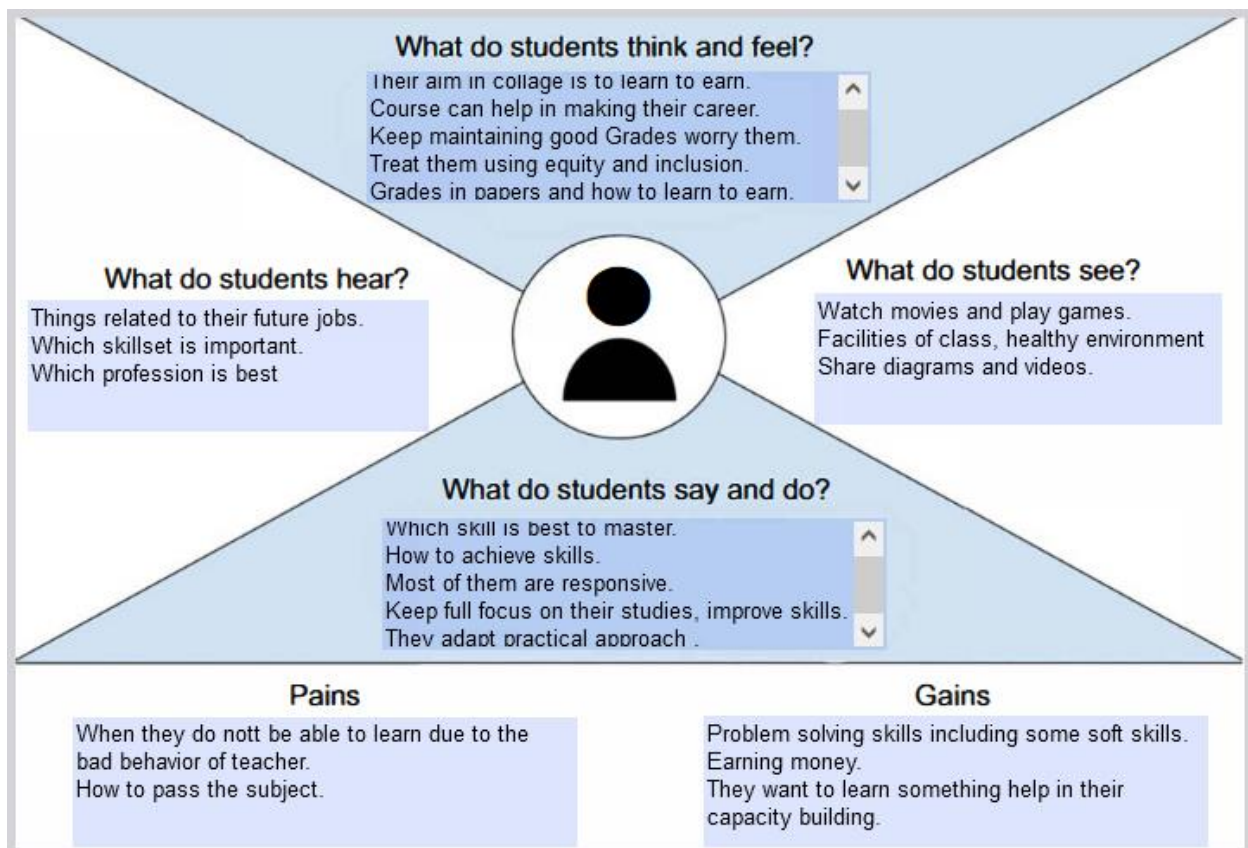
4.6. Logical Structure Lecture Graphic

Selecting content for a lecture poses a challenge due to the abundance of information and the limited time available to convey it to students. Nevertheless, research indicates that enhancing student learning is achievable by focusing on a few well-organized main points. A tool called the Logical Structure Lecture Graphic serves as a systematic pattern organizer, enabling the illustration of these key points. In this exercise, you select the most suitable graphic organizer for your lecture content and proceed to outline the main ideas. Opting for a Logical Structure Organizer and working through it aids in the organization of your thoughts, fostering an understanding that a concise number of main points is essential, along with clarity on supporting details.

An Example:

Feasibility study Phase
Hardware and software required to make software are available?
Related programmers are available?
How much time required completing the software?

↓

Analysis Phase
How the functional requirements of user are collected?
How the non-functional requirements are collected?

↓

Design Phase
How the algorithms are designed?
How the Graphical user interface lay out is designed?

↓

Implementation/Coding Phase
Selection of appropriate programing language
Conversion of algorithms into programing functions
Building Graphical User Interface

↓

Testing Phase
Each module will be tested. How and why?
Black Box testing
White box testing
Stress Testing

4.7. Class Discussion Protocol

Research in education has demonstrated that utilizing discussions can serve as an effective pedagogical strategy. Conversely, when not executed properly, it may become a futile use of time. Successful discussions necessitate thorough advanced planning to guarantee their efficacy. A Discussion Protocol functions as a roadmap for the discussion facilitator, outlining the discussion's structure and providing strategies to foster increased student participation. Developing a discussion protocol allow for comprehensive pre-planning of a class session and consideration of potential challenges. This process ensures that the discussion is purposeful rather than merely a way to fill time.

An Example:

Class topic: What is software engineering and different phases of the software development cycle?

Purpose: To enhance the in-depth understanding of students regarding software engineering and different phases of software development cycle.

Learning Objectives: By the end of the session, students should be able to:What is Software Engineering

- Describe different phases of the Software development cycle.

- What are software development models

- Good practices of Software Engineering.

Introduction: Last day, I gave you a chapter of software engineering and software development cycle to study at home and then write it down. Today, we will share with each other what we have learned from reading about different aspects of software engineering.

Questions:

- What is the difference between common engineering and software engineering?

- How is software engineering more difficult than common engineering? Which risks are involved?

- What are different phases of the software development cycle?

- How is the feasibility study of software performed? What are the outputs of feasibility study?

- How the functional and non-functional requirements of software are collected from the client?

- What is the design phase of the software development cycle and what are its outcomes?

- What are the parameters of selecting a suitable programming language platform?

- What are different techniques of software testing?

- What is the maintenance phase of software development life cycle?

- What are good practices of software engineering?

Comments and questions when students make a good point:

- You are absolutely right.

- Going good, keep it up.

- Awesome, outstanding.

- Brilliant

Comments and questions when students should elaborate:

- "Please elaborate it in depth?"

- "What is your point in literature?"

- "Please explain your logic with simple example"

- "What leads you to that conclusion?"

- "Do we have any evidence to support that?"

- "What next then?

Comments and questions to encourage more input:

- What is your opinion about this point?

- Do you think the same?

- Can you share your personal experience to elaborate it?

- "Are we missing anything?"

Comments and questions for when students are inaccurate:

- You are doing good , but in reality it is ….

- "Are you sure?". Let's explore it in depth again.

- What is opinion of other people about this

Assessment:

- Minute paper on effective teaching

Closing:

Folks, thank you for participating in this discussion with your full zeal and energy. Hopefully, you all have learned a lot from this discussion. But this is not the end of our learning journey. If

any of you are still confused from today's discussion then please discuss with me about your doubts in the next class. Cheers

List of few "Most Dear" things that I would like my students to learn in this course are.

Developing ICT Basic Concepts understanding and relating them with real life

Students should grasp maximum concepts related to computer science, read about them and explore those using different resources like books and the internet.

Learn the applications of ICT

The 2nd dearest thing in my opinion is students explore the real life applications of this course. They study the role of ICT courses in their real life. Like how Computer Networks have made it easy for them that they can communicate with each other very easily. How Artificial Intelligence helped doctors in resolving their health related problems and so on.

Select one ICT application as future skill

This thing is "Most Dear" to me. I love that students should select one of the applications of ICT like Game Development, website designing, Networking, Programming or Block chain development as their future career. Start developing their interest in it and then think of it as their future career.

Start considering themselves as a valuable person

After completing the course I and knowing the depth and breadth of computer sciences they consider them a useful person who can do something for society. They should be proud of themselves as scientists that can resolve real life issues of humankind using the power of computer science.

5. Teaching Techniques

5.1. Digital Story

Digital stories can be the best tool to ask your students to present you with a short story of their achievement/ life experience using computer-based tools like video, audio, graphics, and web publishing. This teaching technique will work in two ways , first one in improving their soft skill which is "Innovative Thinking" and second is improving their hard skills like learning video/ audio editing tools or building a small webpage using readymade tools.

At the end of a lecture, you can practice this technique. You will ask your students to write three things from the contents of your delivered lecture. Two things they found interesting in your lecture and one question. This technique will make your class interactive and each student will participate by presenting two interesting things and will also present his question in the front of class. You can ask your students to answer that question to find out their learning rate.

5.2. Contemporary Issues Journal

A very useful teaching technique which will help students to match their course contents with the real world development. For example you are teaching them web 3.0 in your class then students will search the web 3.0 on the net, find the connection between what you are teaching and what in the world is going on related to web 3.0. They will note these developments and events in their journal. At the end of semester each student will have his/her own technology journal. This will be a guide for him/her to choose his/her job direction.

5.3. JigSaw

An excellent class activity to train the students to learn how to work in a group?. You will break a topic into subtopics and give each member of the group. Further, it is important you should set assessment parameters like "How long the students have time" to complete this task and also set the grading mechanism like assessing the students

performance related to the learning task by asking them to write a "summary paper" in the end. JigSaw technique's basic purpose is that students in a group should prepare their assigned sub topics at an expert level so that they are able to teach that topic to other class groups as well. In this way multi-topics can be discussed among different groups of class.

5.4. Three-Minute Message

In this teaching technique students are given three minutes to select a subtopic from your lecture and then prepare a compelling argument and to support it with in-depth details and examples. The basic purpose is creating the ability for students to use short time to present their idea in a very compressive way using simple language so that it inspires the listener. In the modern world, conveying compact and to the point thought to others is an art.

The basic purpose of Three-minute message is to

- Students get enough confidence to deliver their message with full zeal and enthusiasm.

- Deliver a concept more precisely in a short time with maximum impact.

- write precisely

- Produce appealing intros and closings

- Transfer passion and excitement to your listener

- Influence your listeners.

Last but not least, this book will keep growing with the latest techniques which I will keep learning and practicing in my class.