

BRIDGE++

A PERSONLIZED AND ADAPTIVE E-TRAINING SYSTEM USING AI

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ABSTRACT

Making education more responsive to labor market needs can assist increase university students' employability, reduce skill mismatches, and strengthen the workforce's adaptive capacity changes in labor market demand. This involves providing the students with right training during collage period to make them armed with knowledge, technical and soft skills and extended experience that fit the current economy trends and match the student's characteristics. This can be achieved through implementing and adaptive and personalized e-training system which help students to gain such experience, skills and knowledge even beyond academia. This document aims to study the concepts of adaptive and personalized training and the current algorithms to be integrated in e-training systems. It also, provides an extensive comparison study between current adaptive hypermedia e-training system and studies their strengths and weaknesses. At the end, this study proposes a solution to develop an adaptive and personalized e-training AI based system called "Bridge++". To help in getting better understanding of what student's needs. A survey was conducted to collect data from UKM students about their experience and expectations about the learning process and labor market needs in general. This document presents systems requirements and models for "Bridge++" in which briefly described functional requirements, non-functional requirements, hardware requirements, and software requirements to develop the proposed system. Finally, it illustrates the design of the system using System Models, Interrupt Driven Model and Class Diagram. In addition, Data Dictionary was used to present the data of the system to be developed.

Keywords—Adaptive training, Personalized training, e-training, AI, student characteristics, intelligent training systems, adaptive hypermedia systems.

1. INTRODUCTION

In this digital age, technologies are advancing daily, considering the knowledge, technical, technological and communication revolution. In the era of open skies, the idea of being satisfied with e-training only became insufficient, and since educational technology as a field is placed at the forefront of its goals, taking into account the different individual differences between trainees, and based on this goal and principle, the so-called adaptive training appeared, which took care of the development of digital training environments and sources, By creating an adaptation process for those environments with the different characteristics, needs and styles of trainees.

Every trainee has individual ways of learning and personal styles through which he learns and acquires knowledge quickly. There is a visual learner, an auditory learner, and a third kinesthetic learner, there is a quantitative verbal learner and a qualitative learner, there is a sequential learner and a reflective learner. The training environments and their contents had to take into account those patterns. During its design and preparation of electronic content to be presented on the platform.

The idea of adaptive training is gaining more popularity today, and it refers to interactive training electronic programs that modify their presentation of materials and content from one moment to another according to what the user enters and in accordance with his characteristics, needs and training style, which makes it truly revolutionize the training of the future, and is already considered by investors and companies as a revolution in the field of training today, as it will bring about a qualitative change in all areas of the training process.

Quite simply, training environments will be more flexible, and able to change the way the content is presented according to what that environment deduces from the characteristics and needs of the learner's training style, and thus choose the appropriate content for his learning style and present it to him in the manner that suits him.

Implementing AI in these adaptive training platforms will help to achieve these goals in a very effective way considering the powerful abilities that AI will contribute to develop an effective training platform that can help to predict trainees' training styles, determining their needs, analyzing their progress and aiding them tools to grow such as personalized reports which are essential to get effective training process.

2. PROBLEM STATEMENT

On one hand, about one in three graduates end up being “mismatched” to the jobs they find after leaving university, Universities UK suggests (UUK, 2020). These mismatched graduates have a lesser chance of finding work and earning less money than their classmates who go into occupations that are more suited to their knowledge and abilities from three or four years of school. It implies that conventional career guidance is ineffective.

The previous report shows that supply is less than demand for higher-level skills, with few graduates where their skills are appropriate for future labor market demands, and to high extent, most of students lack the general employability, practical, and technical skills demanded by a modern knowledge economy.

With that in mind, essential questions arise. “What are the best channels for university students to enhance their skills?” At the same time, “how can this be conducted in a guided environment that emphasizes students' knowledge, skills and motivation?”

To answer these questions, we must look at traditional education systems and understand what they lack to provide suitable learning and training experience to students to assure that they are ready for labor market with full potential.

Trainers have long dominated traditional educational training systems. Perhaps the method is linked to social hierarchy, which requires a trainer or mentor to lead learning from the "top." While useful and known to work, it typically fails on one point: the concept that one size fits all. The student group is supposed to be a homogeneous entity with identical learning styles, degrees of skill and prior knowledge, learning needs, and motivation levels in traditional trainer-centric models. This form of educational training delivery produces the following results:

- There is no content variation.
- Limited access to learning for a specific group of learners or trainees.
- Reduced motivation.
- Worsen return on investment (whether monetary or in terms of the time and effort put in by trainers and students).

It is necessary to shift the paradigm and shift the educational training system to a student-centric model through the use of technology (Murray & Pérez, 2015).

Although a student-centric approach does not address all of the flaws of the traditional trainer centric method, it does achieve the following:

- Increase content diversity.
- Make content more accessible to learners.
- Allow students to choose their own learning path.
- Account for different skill/competence levels among students.

On a different spot, the current educational e-training systems are following the traditional training model and ignore all researches that have been made in the field of delivering more effective learning and training process and the most important, these platforms don't take the personalized and adaptive learning in consideration.

In this axis, we will compare the traditional training system in the educational system, the electronic training system, and the intelligent adaptive training system, in order to

come up with many conclusions that help us determine the effectiveness of each of these systems and which one achieves better training productivity, and to help everyone to come out with contemplative conclusions that enable him to judge. It's explained through the following table:

Table 1 Different Training Systems' Type Comparison

Comparison Factor	Traditional Training System	E-Training System	Adaptive E-Training
Flexibility	Rigid	Flexible	Intelligent Flexibility
Delivery	For one student	For Multiple Students	For each student individually according to his learning style
Student Rule	Introduction and memorization " A passive role"	Navigating and interacting " An Interactive role"	Adaptive Interaction "A participatory adaptive role"
Trainer Rule	Prompted	Guide	Advisor and Counselor
Environment	Natural & Traditional	Digital	Digital, Intelligent and Proactive
Interests	Content	Content & Student	Content, student, environment and the nature of educational training

View Methods	Content	A traditional method of presentation and Trainer	Digital methods	Presentation for each student according to their learning style
Adapting with Students/Trainees		It adapts to all students as if they were only one student	It adapts to students who have high technological skills	It adapts to all students to deal with their different styles
Support for students/trainers with Disabilities		No Support	Limited Support	Unlimited Support

3. RESEARCH OBJECTIVE

To create a personalized and adaptive AI based e-training system called “Bridge++” for undergraduate level to try to help them to get skills, knowledge and experience with the labor field and deliver adaptive and personalized training content that fit their needs and motivation. This system has THREE modules:

- Student Portal which will enable learners to test their soft and technical skills besides testing their motivation and interests. Also, it will suggest the best industries, and departments and the related training courses that suit him/her based on the analysis of the pre-assessments results. Finally, it will track the learning path of every training course that can go beyond academia.
- Lecturer Portal in which trainers can build their courses in an intelligent environment supported by needed tools to deliver the best training experience such as analytical tools, tracking tools, smart material, and related contents suggestions.
- AI Unit which will be responsible for analysis, tracking, data mining, report delivery and visualizing and intelligent suggestions for both trainers and students.

4. METHODOLOGY

The project is developed using SCRUM, a lightweight, iterative and incremental framework for developing, delivering, and sustaining complex products. The framework challenges assumptions of the traditional, sequential approach to product development, and enables teams to self-organize by encouraging physical co-location or close online collaboration of all team members, as well as daily face-to-face communication among all team members and disciplines involved.

The framework is within which people can address complex adaptive problems, while productively and creatively delivering products of the highest possible value.

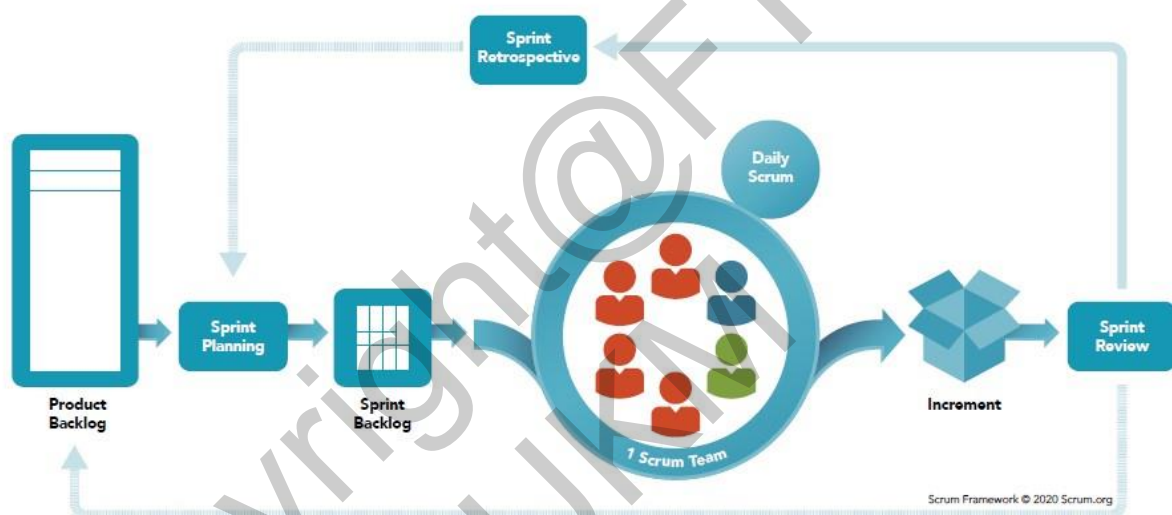


Figure 1 SCRUM Framework

Figure 1 shows the phased development methodology. Basically, there are five general phases involving in the System Development Life Cycle which are planning, requirements analysis, design, coding and unit testing. Agile Methods break the product into small incremental builds. These builds are provided in iterations. Each iteration typically lasts from about one to three weeks. Every iteration involves cross functional teams working simultaneously on various areas.

At the end of the iteration, a working product is displayed to the customer and important stakeholders.

4.1 Planning Phase (Phase 1)

This phase is the beginning of the System Development Life Cycle. Discussions with supervisors are carried out to ensure that the developed system can meet the characteristics of the user's needs in order to solve the problems encountered. Information gathering activities are also carried out to understand the objectives and scope of the study in more detail.

4.2 Analysis Phase (Phase 2)

In this phase, the analysis of the research problem is carried out to identify the weaknesses and shortcomings of the existing system. The activity of gathering user requirements is done to find out the functions of the system. Functional requirements and non-functional requirements are also identified to facilitate system process modeling. At the end of this phase, the Software Requirements Specification document is produced as a guide in project development for the next phase.

The study of Bridge++ system needs was done by distributing questionnaires that were distributed among students' groups using Google forms. The results of the feedback have been examined and summarized in a table according to the type of user. Table 2, Table 3 for functional requirements and non-functional requirements subsequently.

Table 2 Functional Requirements for Bridge++

FUNCTIONAL REQUIREMENTS	DETAILS
UR1	The system shall allow students to sign-up
UR2	The system shall allow admin to register trainers
UR3	The system shall allow users to sign-in
UR4	The system shall enable students to take pre-assessments tests/surveys
UR5	The system shall suggest industries for students to choose from, based on their pre-assessments combined result
UR5.1	The system shall suggest departments related to chosen industry for students to choose from, based on their pre-assessments combined result

UR6	The system shall allow students to register training courses related to industry/department they previously chose
UR6.1	The system shall enable students to view materials related to their training courses
UR6.2	The system shall enable students to take assessments related to their training courses
UR7	The system shall enable trainers to manage training course
UR7.1	The system shall enable trainers to create training course
UR7.2	The system shall enable trainers to add materials to their courses
UR7.3	The system shall enable trainers to approve material suggested by AI unit
UR7.4	The system shall enable trainers to add assessments to their courses
UR8	The system shall enable trainers to view reports about students or courses
UR9	The system shall allow trainers to create a ZOOM session
UR9.1	The system shall allow student to join a ZOOM session
UR10	The system shall allow students/trainers to collaborate in the discussion board
UR10.1	The system shall allow students/trainers to add posts in the discussion board
UR10.2	The system shall allow students/trainers to reply posts in the discussion board
UR10.3	The system shall allow students/trainers to delete their posts in the discussion board
UR11	The system shall allow students/trainers to collaborate in the chat
UR11.1	The system shall allow students/trainers to add send messages
UR11.2	The system shall allow students/trainers to reply messages
UR11.3	The system shall allow students/trainers to delete messages
UR12	The system shall allow admin to manage users
UR12.1	The system shall allow admin to block users
UR12.2	The system shall allow admin to unblock users

Table 3 Non-Functional Requirements for Bridge++

NON-FUNCTIONAL REQUIREMENTS	Details
Security	All passwords shall be encrypted before they are stored in the database.
Availability	The system shall be at least 99.9% available between 6am and midnight, and 95% between midnight and 6 am local time. Portability This system can be accessed anywhere, anytime as long as there is internet connection.
Reliability	Good validations of user inputs will be done to avoid incorrect storage of records.
Responsiveness	The system must respond to every request from the user in very few seconds in order to decrease the waiting time of the Learner as well as Lecturer and Parents.
Usability	The system must fulfill its' own objectives. All the modules and functions of the system should be usable. It is important to ensure that every function is meaningful to the system.

4.3 Design Phase (Phase 3)

Because of the software for the project itself is a multi-layer, multi-dimensional spectrum and its design has multiple intermediate steps therefore; different types of software level design. Therefore 4 sections will be included for the whole design phase, which is Architecture design, Database design, Interface design and Algorithm design. An architectural pattern is a general, reusable solution to a commonly occurring problem in software architecture within a given context. And the architecture used to develop Bridge++ is Model-View-Control (MVC) pattern. This pattern, also known as MVC pattern, divides an interactive application in to 3 parts as:

- model — Contains the core functionality and data
- view — Displays the information to the user (more than one view may be defined)

- controller — Handles the input from the user

The following figure 2 illustrates the flow of the user's request in MVC.

MVC Architecture Pattern

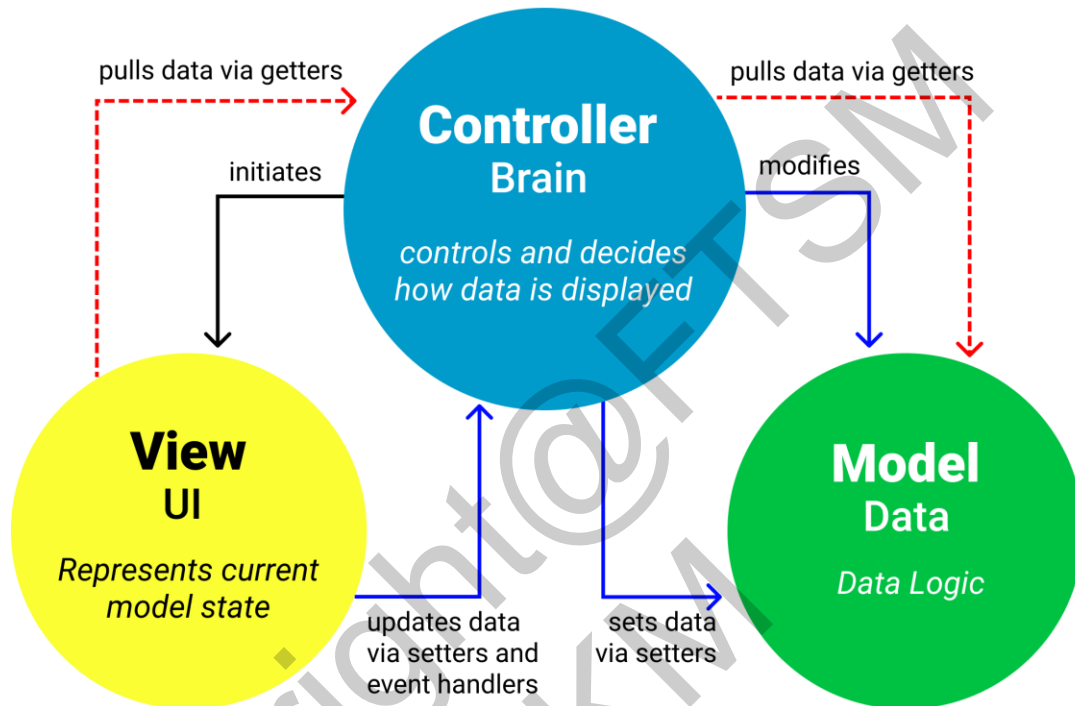


Figure 2 Request Flow in MVC Architecture

4.4 Testing Phase (Phase 4)

The functions of the Bridge++ System will be developed from the design built in the previous phase. After the system functionality is built, code testing will be performed, if necessary, after some part of the coding has been completed. If a system defect is found, repairs can be carried out immediately.

The Bridge++ System uses the *black box* testing method, which is by applying the *Use Case Testing* technique. At the end of the testing phase, the test results have been formulated into a test log as in Table 4, where all system functions have passed the use case testing.

Table 4 Test log

Test Case ID	Tool	Result	Test Incident ID	Remark
TC-01-001	Manual	Pass	-	-
TC-01-002		Pass	-	-
TC-01-003		Pass	-	-
TC-01-004		Pass	-	-
TC-02-001	Manual	Pass	-	-
TC-02-002		Pass	-	-
TC-02-003		Pass	-	-
TC-02-004		Pass	-	-
TC-02-005		Pass	-	-
TC-02-006		Pass	-	-
TC-03-001	Manual	Pass	-	-
TC-03-002		Pass	-	-
TC-03-003		Pass	-	-
TC-03-004		Pass	-	-
TC-03-005		Pass	-	-
TC-03-006		Pass	-	-
TC-03-007		Pass	-	-
TC-03-008		Pass	-	-
TC-03-009		Pass	-	-
TC-04-001	Manual	Pass	-	-
TC-04-002		Pass	-	-
TC-04-003		Pass	-	-
TC-04-004		Pass	-	-
TC-08-001		Pass	-	-
TC-08-002		Pass	-	-

TC-08-003	Manual	Pass	-	-
TC-08-004		Pass	-	-
TC-13-001	Manual	Pass	-	-
TC-13-002		Pass	-	-
TC-13-003		Pass	-	-

4.5 Use Phase (Phase 5)

At the end of each step, the result of the iteration will be presented to the user. Feedback from users will be collected and if there are any new changes in terms of system requirements, planning in the next iteration step will address those issues. In addition, the short system development period is also very suitable for using the *SCRUM* model.

5. RESULTS OF STUDY

As the result of the testing, all functions in the Bridge++ system works perfectly fine, and all the requirements have been fulfilled. And in this chapter, the major functions of the system will be demonstrated in the figures blow

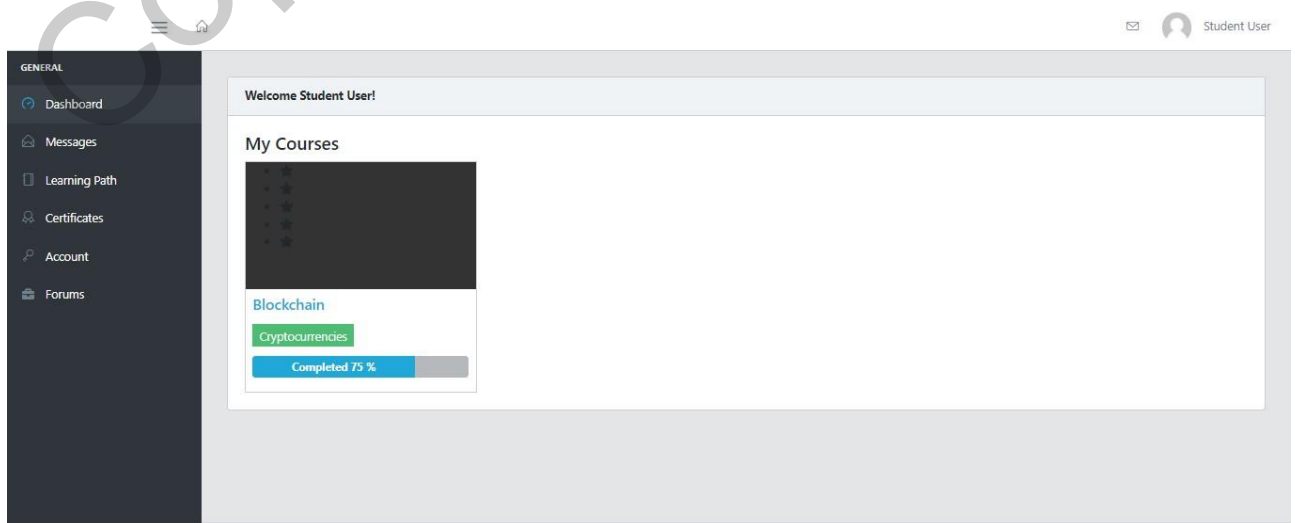


Figure 3 Final Student Dashboard Screen UI

The figure above, shows the final dashboard screen for the student after finishing all preassessments tests and choosing the courses that suits their results. It will show courses as cards view containing the course title, course category and the completeness percentage of every course.

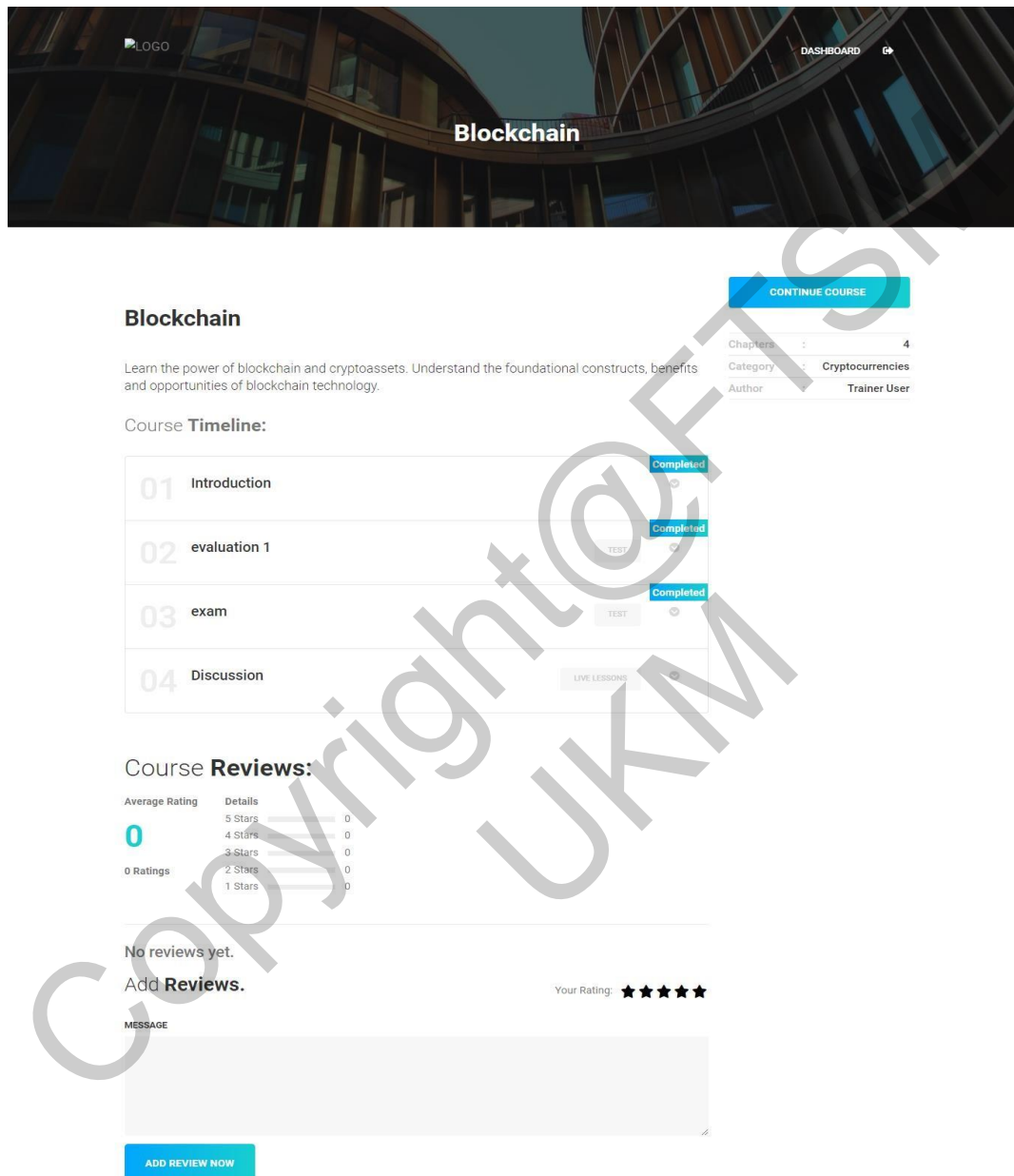


Figure 4 Training Course Screen UI - Student Side

The figure above, shows the course screen in which student can view the course details and the timeline. Also, it will show the course structure where the student can view lessons and assessments with label for every section.

The student will be able to submit his/her review and comment on the training course and view other student reviews.

The screenshot displays a student's interface for a 'Blockchain Introduction' lesson. At the top, there is a 'DASHBOARD' link. The main content area is titled 'Introduction' and contains a video player. The video player shows a slide with the following text:

Answer ALL questions (20 Marks)

Consider the following case:

Doleh Maju Sdn Bhd is a new software house based in Dengi. This company's main operation are developing system and application. It is also involved in system integration solution. Recently, Doleh Maju Sdn Bhd has successfully acquired a RM15.5 million project for developing a medical software solution for a well-known client. The final product is expected to have the following features:

- 1) **Electronic Medical Records (EMR):** It manages data about the patient, their visit, and treatments performed. It is typically used as a replacement for a paper patient chart, but often provides much more functionality such as e-prescribing and clinical decision support. (3)
- 2) **E-Prescribing:** It allows clinicians to send prescriptions electronically to pharmacies. It eliminates the task of typing or deciphering handwritten prescriptions and typically forces the user to specify enough information so that the drug can be dispensed without a call back from the pharmacy. (3)
- 3) **Medical Billing:** It provides the mechanism for the clinicians to get paid for providing treatment. It can be linked to other module such as an electronic medical record. (3)
- 4) **Medical Coding:** It provides the necessary tools to write standardized information about a patient's condition(s) and appropriate treatment. It is used by Medical Billing Module to calculate payment from the insurer or government agency. (3)
- 5) **Medical Scheduling:** It provides an easy way to schedule patients, clinicians, resources, and locations so that procedures or exams can be performed. (3)

As a project manager, you are required to i) devise a project plan, track time and effort against initial estimations, ii) devise and maintain quality standards, and iii) provide all necessary documentation. Deliverables of the project include complete user manuals and documentation to avoid pitfalls. Doleh Maju Sdn Bhd has also agreed to provide free

The video player interface includes a 'NEXT' button, a 'Course Timeline' sidebar with 'INTRODUCTION' (checked), 'EVALUATION 1 - TEST' (checked), and 'EXAM'. The video player also shows a progress bar at the bottom with a timestamp of -05:59.

Figure 5 Lessons Screen UI - Student Side

The figure above, shows the lesson screen in which student can view any lesson details he can view all materials such as PDF files, videos etc.

Dashboard

Trainer User

Create Lesson

View Lessons

Course: Blockchain

Title*: Title

Covered Topics: Topics

Lesson Image (max file size 5MB): Choose File No file chosen

Short Text: Input short description of lesson

Full Text: [Rich Text Editor]

Downloadable Files (max file size 5MB): Choose Files No file chosen

Add PDF: Choose File No file chosen

Add Audio: Choose File No file chosen

Add Video: Select One

Youtube : Go to Youtube -> Go to video you want to display -> click on share button below video. Copy that links and paste in above text box
Vimeo : Go to Vimeo -> Go to video you want to display -> click on share button and copy paste video url here
Upload : Upload mp4 file in file input
Embed : Copy / Paste embed code in above text box

Published

Save

Figure 6 Trainer Add Lesson Screen UI

The picture above, shows the UI of adding lesson by the trainer. He must input the main lesson information such as, the course, lesson title, covered topics by this lesson, and the lesson image if there is any, short description about the lesson and full text where the trainer can add all lesson text. Besides that, the trainer can upload any downloadable supporting files for the lesson, PDF materials, audio files, and video if there is any. Finally, the trainer can choose to publish the lesson or just save it for further modifying.

Dashboard

Trainer User

GENERAL

- Dashboard
- Categories
- Courses Management
- Courses
- Lessons
- Tests
- Questions
- Live Lessons
- Live Lesson Slots
- Reports
- Messages
- Reviews
- Account

Tests

Course: Blockchain

All | Trash

Show 10 entries

Search:

CSV PDF Column Visibility

<input type="checkbox"/>	Sr No.	ID	Course	Title	Questions	Published	Actions
<input type="checkbox"/>	1	2	Blockchain	exam	1	Yes	View Edit Delete
<input type="checkbox"/>	2	1	Blockchain	evaluation 1	2	Yes	View Edit Delete

Showing 1 to 2 of 2 entries

Previous 1 Next

Figure 7 Trainer view tests Screen UI

The figure above, shows the UI tests screen in the trainer dashboard. The trainer shall choose the course and all related assessments will be listed in a table displaying all main information about the test. It also contains action column that have three action buttons, view, modify, or delete.

Finally, the add test button should take the trainer to adding test screen.

Dashboard

Trainer User

GENERAL

- Dashboard
- Categories
- Courses Management
- Reports
- Students
- Messages
- Reviews
- Account

student user

Practice

Activity Timeline

- 31st Jan 2018 1:51 am Tissue Injury and Aging Activity completed
- 31st Jan 2018 1:16 am Nervous Tissue Mediates Perception and Response Activity completed
- 31st Jan 2018 1:2 am Epithelial Tissue Activity completed
- 30th Jan 2018 2:36 pm Types of Tissues Activity completed
- 22nd Jan 2018 4:50 am The Cell Membrane Activity completed

Score 60 / out of 60

Attempt 2

Type -

Considered for assignment grading? Yes

Time taken to complete the quiz 0:02:39

Proficiency 100%

Correct attempts 12

Partial correct attempts 10

Incorrect attempts 0

Skipped items 0

Total tries 6

Solution seen 0

Figure 8 Individuals' Reporting Screen UI

The figure above, shows the UI of individual student' report. The screen should present all data about every activity in the course related to any student by displaying the score, attempts, and time taken for every attempt.

5.1 Results of Usability Study

Interface usability testing is conducted to get feedback on the functionality of the Bridge++. This test gives priority to the interface functionality and the effectiveness of the system in delivering information. Table 1 shows the results of testing the usability of the Bridge++ system interface. A total of 15 respondents gave feedback on the use of the Bridge++ system. A scale of 1 - 5 refers to strongly disagree – strongly agree.

Table 4 Results of Usability Testing of the Bridge++ system

QUESTION	1	2	3	4	5
1. I found that it is easy to learn to use this system.					100%
2. I found that it was easy to get the system to do whatever I wanted.				6.7%	93.3%
3. My interaction with the system is clear and understandable.					100%
4. I find this system flexible to interact with.					100%
5. I found that it was easy for me to become proficient in using the system.					100%
6. I found that the system is easy to use.					100%
7. I feel comfortable while using this system.					100%
8. I found that it was easy to find the information I needed.					100%
9. The organization of information displayed on the system screen is clear.					100%
10. The system interface is pleasant.					100%

6. CONCLUSION

In Conclusion, Bridge++ development was challenging yet successful. All the encountered problems had been solved either by doing researches or consulting supervisor.

Bridge++ will be a step ahead for better e-learning in general and e-training in specific. It has potential to grow by these improvements:

- More detailed reporting
- Add projects to thesis to the tests and assessments
- More enhanced gamification

Developing such functions will provide a better user-friendly experience in the system.

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