2023

SKILL BUILD APPLICATION

REQUIREMENT SPECIFICATION

Catherine Doo (vntt37)

Emmanuel-James Bertland (mknd43)

Muhammad Ali Asad (sxgx37)

Muhammed Qasim Qureyshi (jlzc57)

Ngai Tsz Yan Peony (dxgd33)

Nneka Ikeyi (gsnb85)

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1. Introduction

This document consists of the **Requirements Specification** for our IBM Skills Build Application project and is divided into three major parts. The first part **Introduction** provides an overview of the project, including the purpose, the project scope, and a comprehensive system description which aligns with the client's interests. The major content **Solution Requirements** provides the detail of functional and non-functional requirements before taking potential risks and issues into account. The concluding part is **Project Development**, including our development approach and the project schedule.

1.1 Overview and Justification

Under the guidance of **Mr John McNamara**, who will henceforth be referred to as 'the client', we are developing an application to facilitate access to online learning. The client as the IBM UK University Programs Lead was concerned a lot about education and the career aspirations of people. He came up with this concept after considering the change of technology at an ever-increasing rate. The client wants us to develop an immersive web app with which individuals can equip and embrace themselves with new technologies in order to prepare for new occupations, careers or hobbies. There are numerous main project objectives:

1. Develop an engaging and interactive web application which can be accessed by any mobile device to direct users to IBM online courses.
2. Select relevant courses through the input of the users.
3. Embed elements of gamification to foster participation and commitment from users to enhance their learning experience.

1.1.1 Purpose

The solution is designed for adults, especially for University students who have a strong desire to learn new skills and are interested in innovative technology. Our Skill Build Application aims to offer a stimulating and pleasurable scheme for self-enhancement.

1.2 Project Scope

1.2.1 Problems

In the midst of the rapid evolution of technology, there has been a dynamic shift in the professional and personal landscape. Individuals are compelled to adapt swiftly to the changing technological field, and the importance of acquiring new skills has become more critical than ever.

1.2.2 Solutions

In pursuit of the objectives, it is imperative to develop a sophisticated application. We shall provide the users with a comprehensive and enriching learning experience by understanding their requirements, precisely tailoring course recommendations based on their needs, tracking their learning process and challenging them with the knowledge gained in the courses.

1.2.3 Stakeholders and Users

The application is designed for both beginners and professionals hoping to upskill, which will henceforth be referred to as the user base. The functionality of the app will be customised for the users, who also serve as stakeholders along with the client and IBM Skill Build team, whose courses we are essentially advertising. The success of the project also relies on the collaboration and contributions of various potential stakeholders. We, as the project team, are responsible for the technical implementation, design and overall management. University administrators guide us throughout the project, providing valuable insights and advice based on their expertise. University faculty members may participate in the testing phase, offering perspectives from an educational standpoint. There may also be collaboration extending to university career services, aiming to integrate career guidance services within the app. The input from these stakeholders, along with the valuable feedback from students in the testing phase, will shape the development and refinement of the project, ensuring it meets the diverse needs of its intended users.

1.2.4 Future Features

There is substantial potential for expansion in the application's functionality beyond our plan, including the integration of Artificial Intelligence and Data Analysis.

Utilising Artificial Intelligence, we could take data from previous users to develop a language learning model to make better course recommendations for future users. Data analysis could also be used to identify user patterns, preferences, and challenges, enabling personalised content, adaptive features, and continuous improvement in the learning app.

1.3 System Description

1.3.1 Details of System Design

Proposed System:

1. Mobile-compatible web application.
    a. A web application which is applicable to any mobile device, ensuring seamless functionality on various mobile devices.
2. User Authentication and registration system.
    a. New users shall undergo a registration process, providing essential information including name, date of birth, email address, and create their own username and password to establish a personalised study record. This facilitates the tracking of their academic process.
    b. The users shall be able to login to see their profile, study record and continue their learning journal.
3. Chatbot Integration.
    a. New users shall be required to engage in an initial conversation with the chatbot where they click through options that describe their professional or educational backgrounds and subsequently their aspirations.
    b. Subsequently, the chatbot shall guide them to relevant courses within the platform.
4. A Comprehensive database is established.
    a. To store and manage data collected during interaction with the chatbot.
    b. The database shall serve as a repository for user information, enabling the tracking of their progress from time to time and facilitating future analysis and improvement.
5. Guided learning pathway presentation on the homepage.
    a. The users shall initiate their learning journey by activating the "Start the journey" button, accompanied by a comprehensive display of instructions and terms and conditions.
    b. The users shall only be able to click to the next step after they agree to the terms and conditions.
6. Accessibility to IBM Online Courses.
    a. The learning pathway shall direct users to pertinent IBM online courses, ensuring a targeted and relevant educational experience.
7. Implementation of educational games and quizzes.
    a. After the course completion, the users shall engage in games or quizzes to test their level of understanding of the courses.
    b. These activities shall be presented in the subsequent step of the learning pathway, marked as completed

only after the courses have been finished.

8. Social integration with leaderboard feature.
    a. A leaderboard, accessible through the 'trophy' button in the top-left corner, showcases different users' learning progress.
    b. This feature shall foster engagement and healthy competition, motivating users to actively participate in the learning journey.
9. Enhanced course search functionality.
    a. Users shall explore additional courses beyond the learning journal offerings by clicking the "Search New Courses" bar in the top-left corner. Courses shall be located through keyword searches or specific course type, facilitated by effective tagging and categorization.

Key System Design Points:

• The web app shall be created using JavaScript, HTML5, React.js[1] and CSS3 for the front-end, because of their versatility, compatibility and ability to ensure a consistent, dynamic and responsive user interface across various browsers. Utilising Node.js and Express.js as the back-end as well as the user authentication and registration platform due to their asynchronous nature, scalability and unification with JavaScript, fostering efficient and responsive systems throughout the application stack.

• For the database, we shall use MongoDB[2] due to its scalability and flexibility, making it well-suited to handle the diverse data generated by user interaction within the app.

• For the game, we shall implement Phaser which is available for JavaScript, offering a powerful and versatile game development framework. For quizzes, we shall use the framework and library provided by IBM as required by the client.

• For the integration of Calendar functionality which did not include in the above part as it is categorised as a "could have" issue",, we shall apply Google Calendar API because of its widespread use and robust features.

1.3.2 Research of Existing Similar Solutions

After identifying three existing solutions that aligned with the project brief, we meticulously evaluated each with regard to their suitability, benefits, drawbacks, and noteworthy features. Subsequently, we discussed what sets our app apart and positions it as uniquely capable of addressing our specific challenges.

Solution	Summary	Benefits	Drawbacks
1. Brilliant[3]:	Brilliant.org is an online learning platform, which prioritises active learning in mathematics and science. With a focus on problem-solving and critical thinking, users engage in interactive courses, discussions, and hands-on activities to deepen their understanding of concepts, fostering an engaging educational experience.	• Gamification aspect which includes a points system to improve engagement. • Community and collaboration features which contribute to a sense of belonging and shared learning experiences.	• Underdeveloped personalization of course. • High subscription fees may alienate half of the user base (University students). • Not suitable for individuals trying to learn advanced computing topics.
2. edX[4]:	EdX provides online courses from universities and institutions worldwide. It also targets learners seeking university-level education and professional development.	• High-quality courses from reputable institutions. • Flexible learning capabilities; for	• Very academically focused and may alienate user based only interested in practical skills.

		example, self-paced courses. • Certificates and micro-credentials available.	• High enrolment fees may alienate some of the user base (students)
3. Khan Academy[5]:	An online platform with free educational content, targeting a diverse audience from K-12 to higher education.	• Useful resource for learning fundamentals of the sciences, maths and the humanities • Adaptive learning and personalised capabilities.	• Limited advanced courses deeming it unsuitable for a large amount of the target audience of university students and professionals.

While existing platforms cover a broad spectrum of topics, our app's focus on aligning courses with career aspirations and current roles provides a more targeted and personalised learning experience.

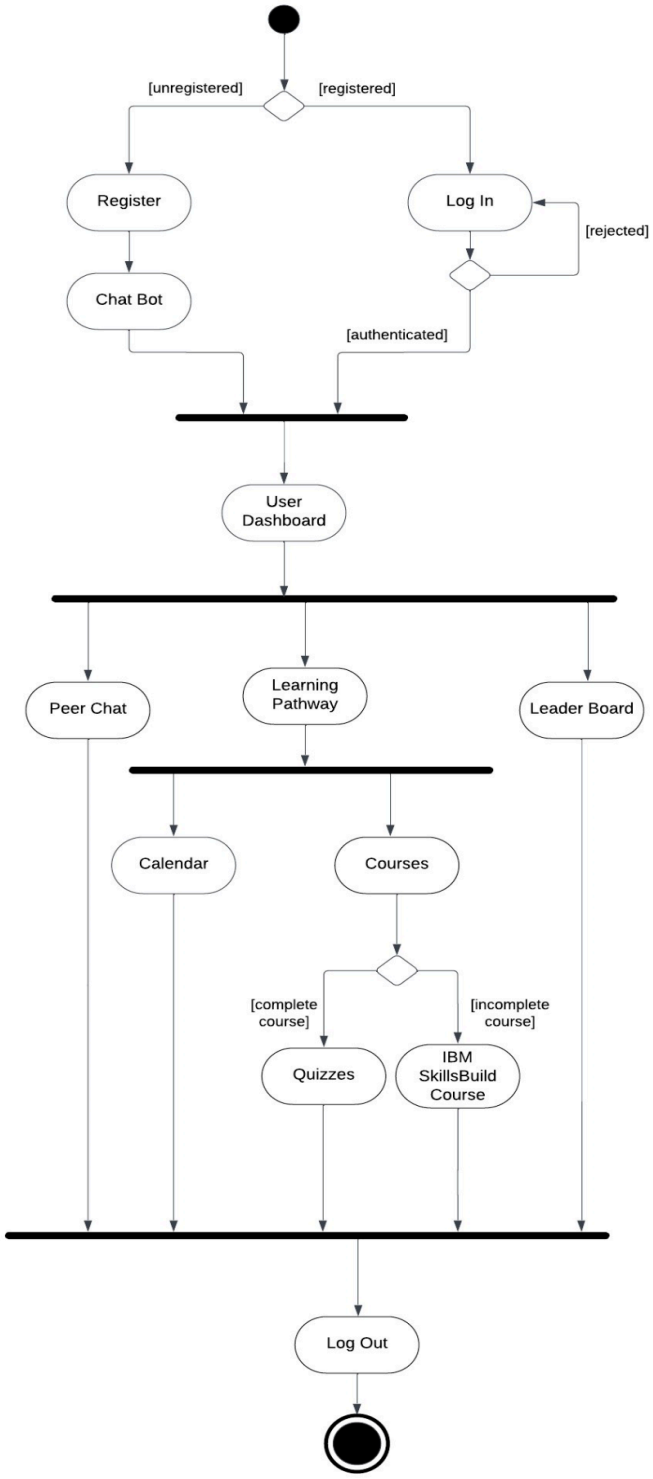
1. In terms of the gamification elements, a leaderboard feature sets our app apart by fostering user engagement, creating a sense of competition, and enhancing engagement.
2. A chatbot for user onboarding and course recommendations will guide users through the platform based on their backgrounds and aspirations.

1.3.3 Integration into Current Systems

The user will have access to the relevant courses suggested by our application through external links to the course page on IBM's skills build platform as the client suggested. These recommendations will be based on the user's information. Implement gamification elements by the library provided by the client to enhance user engagement within the learning experience. The integration shall ensure a cohesive and dynamic platform that aligns with the existing resources available through IBM Skills Build. No API will be required as the links have already been provided through the RAG analysis as explicitly said by the client. The RAG analysis, or Red, Amber, Green analysis, is a document we made during the first stages of our project to get a better understanding of the project.It involved each project team member exploring and independently evaluating Skills Build content related to IBM Learning, categorising artefacts as Green (relevant to course, career, and project), Amber (relevant to course or career), or Red (not relevant) in a spreadsheet.

Capstone	Name	Link	RAG	Rea
	Getting Started with Enterprise-grade AI	https://skillsbuild.org/college-students/digital-credentials/getting-start		For
	Getting Started with Enterprise Data Science	https://skillsbuild.org/college-students/digital-credentials/getting-start		In p
	Getting Started with Threat Intelligence and Hunting	https://skillsbuild.org/college-students/digital-credentials/getting-start		To
	Getting Started with Cloud for the Enterprise	https://www.ibm.com/academic/badges/getting-started-with-cloud-for-th		
	EDT Practitioner	https://www.ibm.com/design/thinking/page/courses/Practitioner		Bei
	EDT Co-Creator	https://www.ibm.com/design/thinking/page/courses/Co-Creator		So
	IBM Design Equal Access Toolkit	https://www.ibm.com/able/toolkit/		Use
	Garage Method	https://www.ibm.com/garage/method/		He
Artificial Intelligence				
	IBM Maximo Visual Inspection	https://www-40.ibm.com/isc/esd/dswdown/home?ticket=Xa.2%2FXb.Z7L		
	AI Fairness 360	https://aif360.mybluemix.net/		
	Project CodeNet	https://github.com/IBM/Project_CodeNet		
	AI Explainability 360	https://aix360.mybluemix.net/		
	AI FactSheets 360	https://aifs360.mybluemix.net/		

2. Solution Requirements



2.1 Functional Requirements

The functional specifications for our application are described in this section. These specifications were gathered through meetings and discussions with the client. They are divided into two main categories: “User Interaction and Engagement”, and “Data Management and Analysis”.

FR1 – User Interaction and Engagement

Essential features ensure optimal engagement and user interaction in the web application.

ID, type and title	FR1.1 - Web Application – Mobile-compatible web application
Description	A web application applicable for any mobile devices, ensuring seamless functionality on various mobile devices.
MuShCo - Priority	Must have - High
Dependencies	N/A
Expected results	The web application should be fully functional and accessible on any mobile device without any loss of features or usability.
Exception handling	N/A

ID, type and title	FR1.2 - User management – User Authentication and registration system
Description	In order to create a unique study record, new users must first register. During this procedure, they must enter basic details such as their name, email address, and date of birth. They must also create a username and password. Users will be able to access their learning journal, study log, and profile by logging in.
MuShCo - Priority	Must have - High
Dependencies	N/A
Expected results	Users should be able to successfully register, log in, and access their personalised study records.
Exception handling	Display an error message if the registration or login process fails.

ID, type and title	FR1.3 - Chatbot – Chatbot Integration
Description	In order to initiate a talk with a chatbot, new users must first click through options that define their educational or professional backgrounds, and then their aspirations. After that, the chatbot will direct users to pertinent courses on the website.
MuShCo - Priority	Must have - High
Dependencies	N/A
Expected results	Users should have an interactive chatbot experience guiding them to relevant courses based on their preferences.
Exception handling	Provide alternative options or assistance if the chatbot interaction encounters errors.

ID, type and title	**FR1.4 - Learning Pathway – Guided learning pathway presentation on homepage**
Description	By clicking the "Start the journey" button, users begin their educational journey and are presented with terms and conditions and comprehensive instructions. You can only move on to the next step if you accept the terms that have been offered.
MuShCo - Priority	Must have - High
Dependencies	N/A
Expected results	Users systematically follow a structured learning pathway, guided by explicit instructions and terms. Display a prompt if users attempt to proceed without agreeing to the terms.
Exception handling	Display a prompt if users try to proceed without agreeing to terms.

ID, type and title	**FR1.5 - Course Access – Accessibility to IBM Online Courses**
Description	By guiding users to important IBM online courses, the learning pathway guarantees a targeted and relevant educational experience that is customised to each user's unique learning pathway.
MuShCo - Priority	Must have - High
Dependencies	N/A
Expected results	Users effortlessly access IBM online courses aligned with their unique learning pathways. Provide a straightforward pathway or link for accessing IBM online courses.
Exception handling	In the event of any technical issues or disruptions in the pathway to IBM online courses, users will be provided with clear error messages or guidance on resolving the issue promptly.

ID, type and title	**FR1.6 - Progress Tracking – Progress Tracking through checklist implementation**
Description	Once users have finished all required courses, a clearly visible checklist with checkboxes for every course they have completed provides a visual depiction of their learning progress.
MuShCo - Priority	Must have - High
Dependencies	FR1.7
Expected results	Users view a checklist showcasing completed courses, providing a visual representation of their progress. Dynamically update the checklist as users complete courses.
Exception handling	If there are delays or inconsistencies in updating the checklist dynamically due to unforeseen technical issues, the system will prompt users with a notification, ensuring they are aware of any potential discrepancies and providing guidance on resolving the issue.

ID, type and title	**FR1.7 - Calendar Integration – Integration of Calendar functionality**
Description	Online course scheduling and organisation is made possible by the ability for users to set completion deadlines, which improves time management and organisational effectiveness.
MuShCo - Priority	Should have - Medium
Dependencies	N/A
Expected results	Users seamlessly schedule and organise online courses using a calendar feature. Implement notifications and reminders for upcoming deadlines to ensure effective time management.

Exception handling	Should any disruptions occur in the scheduling or organisation of online courses through the calendar feature, users will receive timely notifications and reminders, allowing them to address the issue promptly and manage their time effectively.

ID, type and title	**FR1.8 - Gamification – Implementation of educational games and quizzes**
Description	Users take part in educational games or quizzes to gauge their comprehension after finishing courses. These tasks are offered in the learning pathway's next step and can only be marked as finished once the related courses have been completed.
MuShCo - Priority	Must have - High
Dependencies	FR1.6
Expected results	Users have the option to participate in educational games or quizzes to reinforce their learning. Provide alternative learning options for users not interested in gamified activities.
Exception handling	Provide alternative learning options for users not interested in gamified activities.

ID, type and title	**FR1.9 - Social Integration – Social integration with leaderboard feature**
Description	The 'trophy' button provides access to a leaderboard that displays users' learning progress and encourages healthy competition amongst users.
MuShCo - Priority	Should have - Medium
Dependencies	FR1.6
Expected results	Users can view a leaderboard highlighting the learning progress of different users. Implement privacy settings for users who prefer not to participate in social features.
Exception handling	Implement privacy settings for users who do not wish to participate in social features.

ID, type and title	**FR1.10 - Course Exploration – Enhanced course search functionality**
Description	By selecting the "Search New Courses" bar, users can discover more courses outside of those that are available in the learning journal. Effective tagging and categorization make it possible to find courses by using keyword searches or by looking for particular course types.
MuShCo - Priority	Should have - Medium
Dependencies	N/A
Expected results	Users actively search for and explore additional courses beyond the predefined learning journal. Provide intuitive search options for users to discover new courses effectively.
Exception handling	Provide clear and intuitive search options for users to discover new courses.

ID, type and title	**FR1.11 - Personalized Recommendations – Personalised Course Recommendations**
Description	The system could analyse user preferences, completed courses, and progress to provide personalised course recommendations for users.
MuShCo - Priority	Could have - low
Dependencies	FR1.4, FR1.6, FR1.7

Expected results	Users would receive suggestions for courses tailored to their interests and progress.
Exception handling	No specific exception handling required, as this is an additional feature.

ID, type and title	**FR1.12 - Peer Collaboration – Chatbot Peer Collaboration space**
Description	A space where users could collaborate with peers, share insights, and discuss course materials.
MuShCo - Priority	Could have - low
Dependencies	FR1.4
Expected results	Users would have the option to collaborate with others, enhancing their learning experience.
Exception handling	Display an error message if the registration or login process fails.

ID, type and title	**FR1.13 - Virtual Classroom – Virtual Classroom Integration**
Description	Integration with virtual classroom tools for live sessions and discussions.
MuShCo - Priority	Could have - low
Dependencies	FR1.4, FR1.7, FR1.8
Expected results	Users could attend live sessions or discussions, enhancing the interactive learning experience.
Exception handling	Provide alternative methods for users unable to attend live sessions.

FR2 – Data Management and Analysis

Critical components ensure effective data handling and analysis in the web application, facilitating secure storage, insightful analytics and informed decision-making, supporting continuous improvement and customization of the educational platform.

ID, type and title	**FR2.1 - Database Management – Comprehensive database establishment**
Description	To store and manage data collected during interaction with the chatbot. The database shall serve as a repository for user information, enabling the tracking of their progress from time to time and facilitating future analysis and improvement
MuShCo - Priority	Must have - High
Dependencies	N/A
Expected results	The database should store user information securely and allow for efficient tracking of user progress.
Exception handling	Implement data validation and error handling to ensure data integrity.

ID, type and title	**FR2.2 - Learning Analytics – Learning Analytics dashboard**
Description	An analytics dashboard displaying users' learning patterns, areas of strength, and areas needing improvement.
MuShCo - Priority	Could have - low

Dependencies	FR1.7, FR1.9
Expected results	Users could gain insights into their learning habits and progress.
Exception handling	Ensure data privacy and anonymize analytics to maintain user confidentiality.

ID, type and title	**FR2.3 - Data Analysis for user patterns and preferences**
Description	The system could employ Data Analysis techniques to identify user patterns, preferences, and challenges within the application.
MuShCo - Priority	Could have - low
Dependencies	FR1.4, FR1.6, FR1.7
Expected results	Through data analysis, the application identifies user patterns, preferences, and challenges. This information is utilised to tailor content, adapt features, and continually enhance the learning app's effectiveness.
Exception handling	In cases where data analysis encounters anomalies or inconsistencies, the system should default to standard adaptive features and content, providing a seamless user experience.

2.2 . Non-Functional Requirements

The non-functional requirements have been categorised into distinct key areas, namely **Performance**, **Security**, **User Experience** and **General Non-functional Requirements**. Within each of these areas, essential details have been included, descriptions, metrics for measuring the requirement's performance, security aspects, and any constraints associated with the requirement.

NFR1 - Performance Requirements

Performance requirements are essential for ensuring a system meets expected service levels and handles its designed workload. They guide benchmarking, performance testing, and decisions on system architecture to meet performance goals. These requirements are critical for systems emphasising speed, responsiveness, and reliability, like web applications, databases, and real-time systems.

Type	**NFR 1.1 - Web application optimisation**
Description	- The website should respond to user queries and requests within an acceptable time frame. - It should be able to handle a large number of users without a significant decline in performance.
Metrics	- Response time: The time taken to process and respond to a user's request. - Resource utilisation: Monitoring CPU, memory, and disk usage to ensure resources are used efficiently.
Security	N/A
Constraints	- Resource limitations related to available hardware resources, such as CPU, memory, and disk space, may limit the system's performance and scalability.

Type	NFR 1.2 - Scalability
Description	- The system should be designed to handle an increasing number of users and data as it grows over time. - It should be scalable to accommodate additional features and integrations.
Metrics	-
Security	N/A
Constraints	- If the system serves a global user base, network latency and bandwidth constraints may impact the response time and scalability.

Type	NFR 1.3 - Availability
Description	- The website should be available at all times, with minimal downtime for maintenance or upgrades. - It should be designed to handle issues and/or errors if they do occur.
Metrics	- Uptime Percentage: This measures the percentage of time the website is live. The higher the better.
Security	N/A
Constraints	- High availability solutions, such as redundant infrastructure and failover mechanisms, can be costly and may be limited by budget constraints.

NFR2 - Security

Security requirements are vital for protecting the web application against unauthorised access, data breaches, and other threats. Security measures can be implemented through the use of encryption, authentication, and access controls.

Type	NFR 2.1 - Security
Description	- User data should be stored securely, following industry best practices for data encryption and protection. - Access to sensitive user information should be restricted to authorised personnel only. - The system should provide secure authentication and authorization mechanisms for user accounts.
Metrics	- Vulnerability assessments: Regular security scans to identify and address vulnerabilities. - Authentication success/failure rate: Monitoring the success and failure of user authentication attempts.
Security	- Implement strong authentication mechanisms, including multi-factor authentication (MFA). - Enforce proper authorization to ensure users can only access data and features they are authorised to use.
Constraints	- Integration with external services or APIs may have specific security requirements

	that need to be met. - User convenience and compliance requirements may influence the level of authentication security that can be implemented.

Type	**NFR 2.2 - Data and Privacy**
Description	- Ensure compliance with data privacy regulations such as GDPR or CCPA. - Provide users with options to control their data and privacy settings.
Metrics	- Data access logs: Recording and analysing who accesses and modifies sensitive data. - Data encryption: Ensuring encryption is applied to sensitive data at all points of use or dormancy.
Security	- Encrypt sensitive data in transit using secure communication protocols. - Encrypt data at rest, ensuring that data stored in databases or files is protected.
Constraints	- Legal and regulatory compliance may impose constraints on data handling and security practices that must be strictly adhered to.

NFR3 - User Experience

User experience is particularly important in systems where a seamless and enjoyable user interface is essential, especially as a web application providing an engaging training and learning experience. These requirements focus on aspects like ease of navigation, responsiveness, aesthetics, and overall user satisfaction to create a user-friendly and effective system.

Type	**NFR 3.1 - Usability and Accessibility**
Description	- The user interface should be intuitive and user-friendly. - Ensure accessibility features for users with disabilities, such as screen readers and keyboard navigation.
Metrics	- Usability testing scores: Gathering user feedback and measuring ease of use. - Accessibility compliance score: Ensuring compliance with accessibility standards (e.g. WCAG). - Error rate: Monitoring the frequency of user errors while interacting with the system.
Security	- Integrate security considerations into usability testing to ensure that security features are user-friendly. - Ensure that security features, such as CAPTCHAs or authentication, are accessible to users with disabilities. - Test with assistive technologies to ensure compatibility with screen readers and other aids.
Constraints	- The technical proficiency of the user base may limit the complexity of security features or accessibility features.

Type	**NFR 3.2 - Cross-Platform Compatibility**

Description	- The web app should work seamlessly on a variety of mobile devices, browsers, and operating systems. - It should be responsive to different screen sizes and orientations.
Metrics	- Browser compatibility: Tracking the compatibility with various web browsers and versions. - Mobile device responsiveness: Ensuring the web app functions well on different mobile devices. - Screen reader compatibility: Verifying support for screen readers and assistive technologies.
Security	N/A
Constraints	- The choice of platforms and technologies may impose constraints on cross-platform compatibility and accessibility.

NFR4 - General Non-functional Requirements

These are the general miscellaneous requirements that are relevant to the web application.

Type	**NFR 4.1 - Integration with IBM Skills Build**
Description	- The system should integrate with IBM Skills Build to access and retrieve relevant course and software information. - Ensure data consistency and real-time updates from IBM Skills Build.
Metrics	- Monitor the time it takes for the website to make API calls to IBM Skills Build and receive responses. This metric should be kept within acceptable time limits to ensure a responsive user experience.
Security	N/A
Constraints	- Constraints imposed by IBM Skills Build's API usage policies and rate limits can impact the level of integration

Type	**NFR 4.2 - Compliance and Legal Requirements**
Description	- Ensure that the web app complies with all applicable laws and regulations in the regions where it operates. - Implement mechanisms for managing legal agreements, such as terms of service and privacy policies.
Metrics	- Compliance audit results: Periodic audits to ensure compliance with relevant laws and regulations. - Legal agreement acceptance rate: Tracking user acceptance of terms of service and privacy policies.
Security	- Regularly audit and monitor the system to ensure compliance with security and privacy regulations.

Constraints	- Legal constraints related to contracts, industry standards, or intellectual property may affect certain aspects of the project.

Type	**NFR 4.3 - Documentation and Training**
Description	- Provide comprehensive documentation for users and administrators. - Offer training materials for users to make the most of the system.
Metrics	- Documentation completeness: Ensuring all necessary documentation is available and up-to-date. - User training completion rate: Measuring the percentage of users who complete training materials.
Security	N/A
Constraints	- Constraints related to available time, budget, and personnel for creating and maintaining documentation and training materials.

Type	**NFR 4.4 - Backup and Disaster Recovery**
Description	- Implement regular data backups and a disaster recovery plan to prevent data loss in case of system failures or data corruption.
Metrics	- Recovery time objective (RTO): Defining how quickly the system should be restored after a disaster. - Backup success rate: Monitoring the success of data backup processes.
Security	- Include security testing in load testing scenarios to assess the system's resilience under heavy loads and potential security vulnerabilities. - Test for denial-of-service (DoS) and distributed denial-of-service (DDoS) attack resilience.
Constraints	- The cost of implementing a robust backup and disaster recovery solution may be limited by budget constraints. - Legal or compliance requirements may mandate specific data retention periods, which could affect how long data backups are kept.

Type	**NFR 4.5 - Cost Efficiency**
Description	- Optimise the system to operate within budget constraints, including cloud service costs, infrastructure expenses, and maintenance.
Metrics	- Cost per transaction: Evaluating the cost associated with processing each user transaction. - Infrastructure cost tracking: Monitoring and managing infrastructure expenses.
Security	- Implement cost-effective security measures, such as open-source security tools, to optimise security while managing expenses. - Periodically assess the cost-effectiveness of security solutions.

Constraints	- The project's budget may impose constraints on the extent to which cost-efficiency measures can be implemented.

2.3 Risks and Issues

2.3.1 Technical Issues

Inappropriate Software	Choosing inappropriate software may pose significant risks and issues. For instance, for the application of artificial intelligence, choosing inappropriate models and training data could undermine the quality of chatbot and may further lead to system failures as the project expands, costing the delays of the project. In addition, outdated and unsupported technologies can limit the implementation of essential updates, jeopardising the project's sustainability.
Unprotected Data	Although the data used may not be highly sensitive, the web application still requires users to provide personal details during login and share information about their current career and education. It is crucial to address the risk of potential legal issues related to personal information protection, leading to misuse of data or having security breached. Ensuring compliance with data protection laws and safeguarding against security breaches is the top priority to maintain user trust and uphold legal standards.
Technological Changes	There is a risk of the software used to build the web application changing – for example, a software used to set up the backend may decide to update their software or no longer offer the service for free use. There is also the risk of the web application not being adaptable to changes in the IBM SkillsBuild website – such as if courses are removed or if the links they are accessed at change.

2.3.2 Project Risks

Lack of Leadership	Although there are project managers involved to give advice, there is no clear leader or manager within the team. This may allow for more ideas and a more flexible approach to the project, but the risk is that the project may lack direction, with the sections each team member is working on becoming disparate. Another risk is that the team will lose sight of important deadlines and steady work without clear management.
Inappropriate Software Methodology	The project is encouraged to use the Scrum software methodology. Scrum comes with the risks of having a lack of emphasis on planning – which may be compounded by the more flexible leadership structure. Scrum may also not always be the most efficient strategy – the daily reviews during sprints may not always be productive. Another risk is client and academic commitments may disrupt planned sprints.
Insufficient Communication with Client	IBM is a large technology vendor with many obligations, so contact may be limited. IBM is also involved in multiple projects, which may make remembering and interacting with different groups less likely. Although there is a company contact, Mr. John McNamara, that doesn't remove the risk that lack of communication will lead to misunderstandings about the client's expectations and requirements.
Scope Creep	Many team members have experience with web development, so it is a risk that our expectations will be increased by our perceived ability – moving the focus from required functionality to unnecessary features. The scope for the web application is

	ill-defined – for example, gamification can refer to many features and risks being given too much focus.

2.3.3 Business Risks

Competitive Product Market	There is already software designed to suggest courses based on user input – edX is a good example of this. Although none are specifically targeted at the IBM SkillsBuild website, it does mean comparisons will be made and the target market will have expectations in terms of user experience and efficiency. There is the risk of falling short in comparison to the competition.
Poor Scheduling	There is also the risk of missing deadlines by poorly planning the timeline for work on the project or not considering the other academic and extracurricular responsibilities that team members have.
Unclear Documentation	Unclear and inconsistent documentation is likely to confuse team members and lead to the final product not being cohesive or not fitting the requirements. The client may also be misled by poor documentation, and as such the final product may not fulfil the needs of the client.
Adverse Circumstances	There is the risk of illness or unfortunate circumstances impacting the project. Adverse circumstances may affect communication within the group, scheduling and team members ability to complete the work needed. Depending on the circumstances, the impact on mental health may also affect a team member.

2.3.4 Risk Matrix

		Impact		
		Low	Medium	High
Probability	Improbable	**Competitive Product Market**	**Inappropriate Software Methodology** **Technological Changes** **Unprotected Data**	
	Possible	**Inappropriate Software Methodology**	**Lack of Leadership** **Unclear Documentation**	**Scope Creep**
	Probable	**Adverse Circumstances**	**Poor Scheduling**	**Insufficient Communication with Client**

2.3.5 Mitigation Strategies

Priority	Impact	Probability	Risk	Mitigation Strategy
Very High	High	High	Insufficient Communication with Client	As we are more likely to have a flexible schedule than the client, we can work around their schedule and plan meetings in advance. When the client is particularly busy, queries and updates can

				be sent by email. We have already agreed to send an email with updates every Friday.
High	High	Possible	Scope Creep	Clearly defined functional and non-functional requirements, which are implemented based on priority, will help prevent scope creep. In addition, using UML modelling - particularly Use Case, Class and Activity diagrams - will help clearly define the scope. The review after each sprint would be an ideal opportunity to review scope.
High	Medium	Probable	Poor Scheduling	Using the Scrum methodology, particularly the daily stand-ups, should encourage the team members to do at least a bit of work daily during the sprints. The sprint planning allows for both consistent work and flexibility in terms of how sprints are scheduled. Prioritising learning how to use software in advance would also help mitigate the risk.
Medium	Medium	Possible	Lack of Leadership	Communication between team members is key - a WhatsApp group allows for planning logistics, a Google Docs folder to share resources, a GitHub repository and a Trello board is being used to track the work done and to plan future work. The sprint planning will also allow for managing the project.
Medium	Medium	Possible	Unclear Documentation	Documentation should be updated regularly in order to account for changes. Allowing for peer review in documentation, and group meetings to discuss issues, will mitigate the risk of poor documentation.
Low	Medium	Improbable	Inappropriate Software	Thorough research of the software options available and ensuring that team members start learning to use the software (if necessary) before implementation begins. Therefore, there is time to ensure the software works as promised and that team members can learn the software in the available time.
Low	Medium	Improbable	Technological changes	Although there are very few ways to mitigate the risk of the software used for the project changing, we can ensure that the web application integrates well with the IBM SkillsBuild by thoroughly studying the IBM SkillsBuild webpage and taking into account that more courses may be added.
Low	Medium	Improbable	Unprotected Data	Considering security for each of the functional and non-functional requirements, in addition to researching privacy protection policies, will mean we have done our due diligence in terms of security.
Low	Low	Probable	Adverse	Unfortunately the majority of adverse

			Circumstances	circumstances cannot be prevented, but scheduling consistent work throughout will help mitigate the impact. The timing of the sprints can also be adjusted based on circumstances.
Low	Low	Possible	Software Methodology	Scrum has many advantages, even those that will help mitigate other risks - such as the sprint planning helping with leadership. There are ways to compensate for its disadvantages, such as having the daily catch-up online with a time limit. As Scrum involves iterations of sprints, adjustments can be made based on previous sprints if needed. The flexibility of Scrum means many of the risks can be mitigated.
Very Low	Low	Improbable	Competitive Product Market	Adjusting the requirements based on research around currently offered products which perform similar functions will help. In addition, user testing will reflect the needs of the target market.

3. Project Development

3.1 – Development Approach

Introduction:

We chose the Scrum methodology because it aligns with the project's objectives, team composition, client requirements, and organisational capabilities. This section discusses the Scrum methodology and justifies its selection in the context of the Skills Build App as opposed to other methods: Agile, waterfall, extreme programming.

1. Iterative and Incremental Development:
   Advantage: Scrum's iterative and incremental approach allows our team to focus on delivering small, functional increments of the Skills Build app in each sprint. Given the team's inexperience this is appropriate as we may need flexibility to adapt to evolving requirements depending on the pace at which we progress.

2. Client Collaboration and Flexibility:
   Advantage: Scrum encourages regular client collaboration through sprint reviews, ensuring that the development aligns closely with client expectations. This adaptability is particularly valuable for our client-centric project, where features and priorities may change over time.

3. Clear Roles and Responsibilities:
   Advantage: Scrum defines clear roles, ensuring that each team member understands their responsibilities. This is crucial for our group of inexperienced developers, as it provides a structured framework for collaboration, with the Scrum Master (our more experienced team member) supporting the team in overcoming challenges.

4. Continuous Feedback Loops:
   Advantage: Scrum incorporates frequent feedback loops, allowing us to receive insights from stakeholders and end-users regularly. This continuous feedback ensures that the project stays within the scope, meeting user needs and expectations throughout its development.

5. Learning Opportunities and Skill Building:
   Advantage: Scrum's emphasis on continuous learning and improvement aligns with our team's need to acquire new skills, such as learning MongoDB or React.js. The framework provides opportunities for regular reflections, fostering a culture of learning and skill enhancement.

Comparison with Alternative Methods:

1. Agile: Scrum is a specific framework under the broader Agile umbrella. While Agile principles are followed in both cases, Scrum provides a more structured and prescriptive framework, which is advantageous for our team's level of experience and the project's complexity.

2. Waterfall: Waterfall's sequential approach is less suitable for our dynamic project, as it does not allow for adjustments once a phase is complete. Scrum's iterative nature allows us to respond to changing requirements, ensuring a more flexible development process

3. Extreme Programming (XP): Comparison: While XP's focus on technical excellence and continuous delivery is good, Scrum's balance of flexibility and structure, combined with its defined roles, aligns better with our team's composition and the project's scope.

Potential Disadvantages and Mitigations:

Scrum incorporates daily stand-ups, daily full-on meetings may be too much of a commitment due to our busy schedules as students. One way we sought to mitigate this was by implementing brief daily check-ins instead.This will be carried out on the WhatsApp group chat and will be led by the Scrum Master, to hold team members accountable.

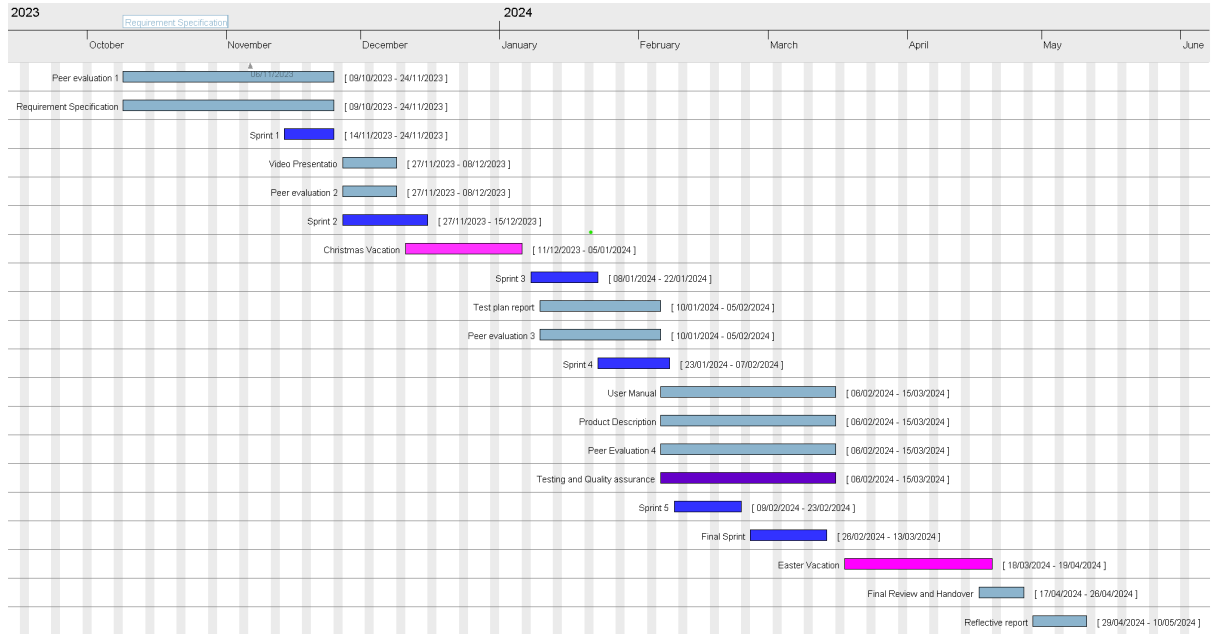
3.1.2- Modifications and Implementation

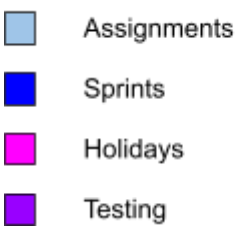
Define Roles:	● Product Owner: Our product owner is to be in constant contact with our client and have a clear understanding of his needs and priorities ● Scrum Master: We decided to appoint our Scrum master based on the fact that he has some experience with Scrum and will be able to facilitate the Scrum process and ensure the team adheres to Scrum practices. ● Development Team: Our team consists of all the team members
Product Backlog:	● We will work with the Product Owner to create a prioritised Product Backlog. This backlog will contain all the features, user stories, and tasks required for the Skills Build app, with the most pertinent items at the top.
Sprint Planning:	● We will conduct sprint planning meetings at the beginning of each sprint. Selecting a sprint duration that suits the team's capacity and the project. ● During these meetings, the team, along with the Product Owner, will discuss and select items from the Product Backlog to work on during the sprint.
Daily Stand-ups:	● We will hold daily check-ins on the WhatsApp group to keep the team aligned and address any issues. Each team member shares progress and touches on any challenges they are facing. ● The Scrum Master will facilitate these meetings.
Sprint Review:	● At the end of each sprint, we will conduct a sprint review to showcase the completed work to the Product Owner and gather feedback. ● We will use this feedback to adjust priorities and update the Product Backlog.
Sprint Retrospective:	● After the sprint review, we will hold a sprint retrospective to reflect on the team's performance. We will identify what went well, what could be improved, and any necessary adjustments for the next sprint.
Backlog Refinement:	● We will regularly refine the Product Backlog with the Product Owner to ensure it reflects evolving priorities and requirements. This would involve breaking down large tasks, adding new user stories, or reprioritizing items based on feedback and changing circumstances.

Learning and Skill Building:	• We will identify opportunities within the sprint planning or retrospective meetings for knowledge sharing sessions, especially for team members unfamiliar with MongoDB and React.js. This will encourage collaboration and mentorship within the team to facilitate skill development.
Client Collaboration:	• We aim to maintain regular communication and hold meetings with the client through sprint reviews. We will involve the client in discussions about priorities, changes, and feedback.
Adaptability:	• We will take advantage of the iterative and adaptive nature of Scrum. Adjusting priorities and plans based on the feedback received during sprint reviews and retrospectives.

3.2 Project Schedule

The plan for the project schedule is outlined in the Gantt chart below. We have planned for the project development to be completed in sprints, following the Scrum methodology, as this will provide a structured yet flexible way to manage the development. A nominated Scrum Master will be a part of, and lead, a development team. The initial project plan will create a list of backlogged features to be implemented. These features will then be looked at by the development team and applied in sprints. Each sprint will have a sprint review to measure the success of the sprint, and a retrospective to consider how it could be improved. We will have daily “Stand-ups” to check individual progress on the sprints. The breaks in the chart represent holiday periods where time spent on the project is likely to be reduced. The dates for the sprints are just for guidance and are not exact; they may change. They have been decided partially based on the dates of assignment submissions.





4. References

[1]:https://react.dev/

[2]:https://www.mongodb.com

[3]:https://brilliant.org/

[4]:https://www.edx.org/

[5]:https://www.khanacademy.org/