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FACULTY OF ELECTRICAL ENGINEERING, MATHEMATICS AND COMPUTER SCIENCE

IMPROVING THE CHALLENGE UP USER EXPERIENCE

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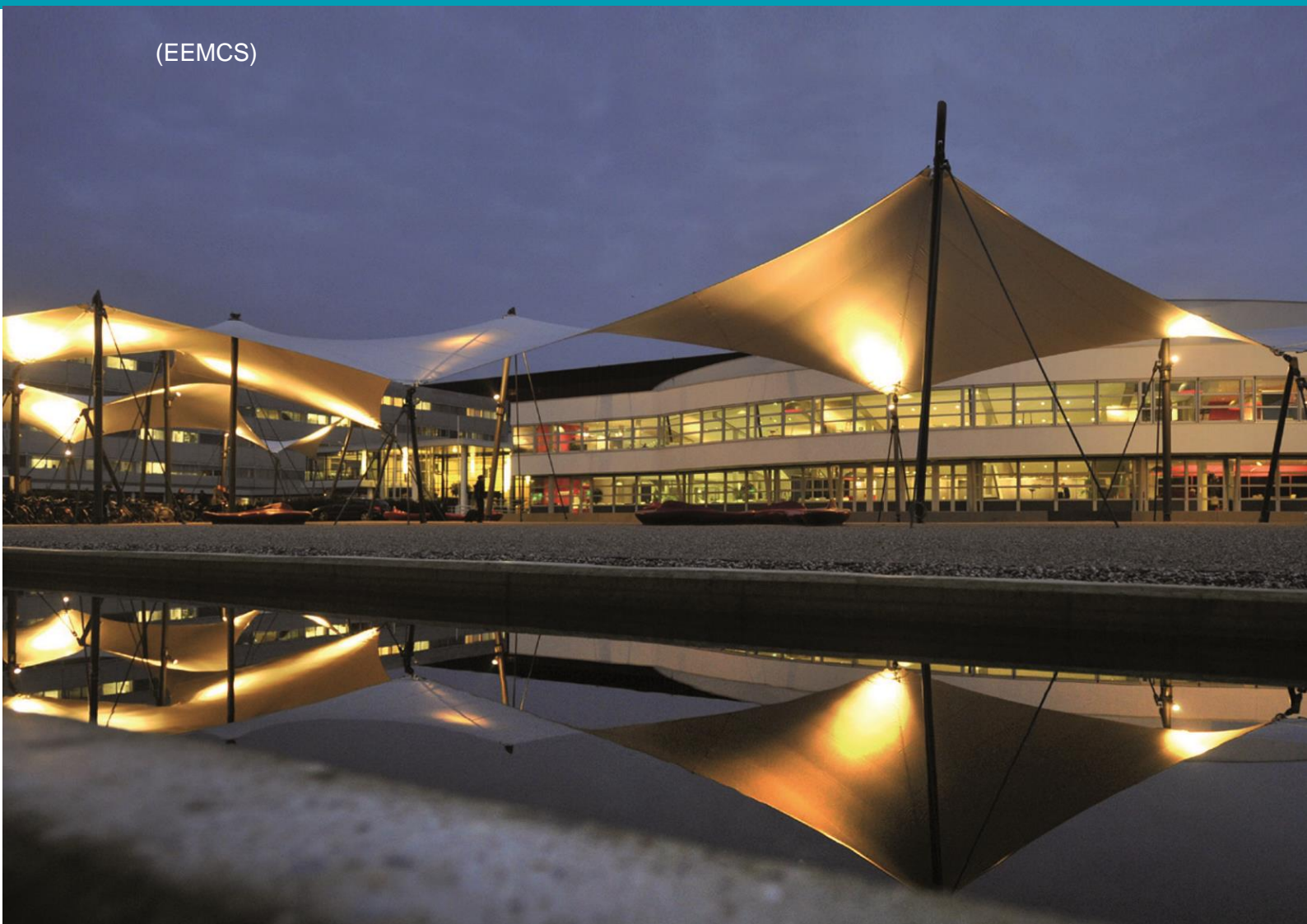
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ABSTRACT

In recent years, Challenge Based Learning (CBL) has become increasingly significant in the education field. The thesis investigates the improvement of the Challenge Up tool, a tool developed at the University of Twente to help teachers implement CBL in their courses. The project aimed to improve the tool's usability and User Experience by following the Creative technology Design process which involved identifying user requirements, developing a prototype using the Bubble platform, and conducting user testing to gather feedback. The findings showed that the developed prototype meets most user requirements, but some steps are still needed to facilitate teachers in implementing CBL using this tool. The results demonstrated the need for a clear introduction, intuitive navigation, effective error-prevention mechanisms, and a balance between text and visual elements.

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1. INTRODUCTION

“The role of the teacher is to create the conditions for invention rather than provide ready-made knowledge” [1]. This quote by Seymour Papert very well highlights the current state of education in today's day and age. Traditional lecture-based learning has been predominant in universities for over 900 years. Recent studies have however highlighted that this method, although effective is not as effective or preferred by students [2]. Studies have highlighted that lecture-based teaching is effective in providing large numbers of content and in making students memorise certain content but that students are more likely to fail courses compared to when they use active learning techniques [3]. Active Learning is a type of learning which involves having students engage and participate during lectures [2]. Freeman [4] highlighted that students are 1.5 times more likely to fail in traditional lecture learning compared to when they are taught using an active learning technique which is a learning method involving learning by thinking, investigating, and creating through struggling and problem-solving. Kin et al. [2], highlighted an increased student preference towards active learning methods due to their perceived benefits, activities, and discussion. and use of multimedia. Furthermore, the perceived understanding post-lecture, satisfaction and perceived understanding, satisfaction, and performance when active learning approaches such as Problem-Based Learning (PBL) or Team-Based Learning (TBL) [5] [6]. One popular active learning approach is Challenge Based Learning (CBL), which aims to teach while solving real-world challenges [7]. It is an approach which encourages hands-on experiential learning by asking different stakeholders (i.e., students, teachers, and community members) to identify key issues and try to solve them while gaining in-depth knowledge developing relevant and useful skills and sharing the results with the world [8]. Its popularity has increased in part due to studies demonstrating that it not only has a dramatic influence on the engagement, creativity, and critical thinking of students of all ages [9].

The great potential of CBL has encouraged many educators to try and implement it in their classrooms, but they have faced the issue of how it can be implemented. This is where Challenge Up comes into play. It is a tool being developed at the University of Twente aiming to aid teachers in implementing CBL in their classrooms. This aid comes in the form of advice which is personalised after the teacher provides input on their current and desired level for components of Van den Akker's Curricular Spider Web, a framework used to connect the different components in a curriculum [10]. The advice is meant to guide teachers in implementing CBL at their desired level. An initial version has been developed that focuses on the tool's content and not on user interactions and experience. Thus, the clients proposed the challenge of improving the Challenge Up tool regarding its user interactions and user experience.

This Bachelor's Graduation Project aims to develop an improved prototype of the tool supported by existing literature and provide advice on improving the tool's user experience. The main research question is thus:

How can the Challenge Up tool be improved by incorporating necessary web-based elements to enhance user experience and support teachers in implementing Challenge-Based Learning (CBL) in their courses?

The main RQ can be further broken down into a set of sub-problems to get a clearer understanding of the problem at hand which are:

Sub-RQ 1: What information does the target audience want on the platform?

Sub-RQ 2: How can a web-based platform support teachers in implementing CBL in their courses?

Sub-RQ 3: What web-based elements can enhance a teacher's user experience while using the Challenge Up tool?

Sub-RQ 4: What factors influence teachers' adoption of a web-based platform for CBL implementation in courses?

Designing an effective tool and in this case, a website is “not just what it looks and feels like. Design is how it looks” as Steve Jobs said [11]. A literature review followed by a user analysis was conducted to understand the necessary design components to improve the tool's User Experience. This enabled the development of a list of requirements translated into a website design. This design is then assessed and evaluated by relevant users.

Chapter 2 will delve deep into the existing literature and state of the art. Chapter 3 will present the methods and techniques used throughout the project. Chapters 4 and 5 will follow with ideation and specification. The thesis will end with a realisation, evaluation, and discussion.

2. BACKGROUND RESEARCH

The Following Chapter will delve deeper into what CBL is, and the distinctive design elements in websites and will analyse the existing state of the art such that the development of the prototype can be backed up by relevant literature.

2.1 CHALLENGE-BASED LEARNING

Challenge Based Learning (CBL) is a learning framework which uses real-world challenges/problems as its core [12]. Students are tasked with solving a challenge which has a real-world impact and are expected to collaborate with their peers in sharing their different skills to solve the issue. It is a framework where teachers do not assign specific learning objectives and they allow teachers to define their personal learning goals. CBL aims to aid students in becoming problem solvers by providing them the space to explore, discuss, and build solutions that can have a real-world impact [13]. CBL is a powerful framework in modern education as it encourages students to use collaborative learning, implement transdisciplinary fields, develop the intrinsic and extrinsic motivation of students, promote reflection, and encourage scientific rigour and combination of theory and practice [14]. CBL can be traced back to Apple, Inc. in 2008 with the “Apple Classrooms of Tomorrow-Today” project which aimed to discover key elements of a modern (21st century) classroom [15]. Since first being documented by Apple, Inc. (Nicholas and Cator, 2009), educators have implemented the framework to improve the learning experience and outcomes of students [16]. Johnson et al., (2009) [9] studied the impacts of CBL in six schools in the United States with 29 teachers teaching in 17 disciplines. The findings indicated that CBL was highly effective on students, particularly for students at risk of dropping out. A follow-up study in 2011 by Johnson & Adams [17] with a larger test group of 19 schools, 90 teachers and 1500 students in three countries highlighted the effectiveness of CBL in motivating students, meeting curriculum requirements, and gaining relevant 21st-century skills.

The 21st century skills were defined by numerous companies including Apple, Microsoft, and Delta in the Partnership for 21st Century Skills (P21) in 2002 [18]. A range of skills were developed and categorised into three skills. Learning skills include Critical Thinking, communication, collaboration, and creativity. Life Skills involve competencies like flexibility, initiative, social skills, productivity, and leadership. Finally, literacy skills focus on how to find and understand literature and various sources of information. These skills include Information, media, and technology literacy [19]. As research on CBL has continued, the framework has also been updated. In 2016 Apple updated the framework and introduced the three phases of CBL which are Engage, Investigate and Act [20]. These phases are an iterative cycle which allows learners to move on to the next phase whenever they are ready.

2.1.1 The Three phases

The first phase is the Engage phase. During this phase, the objective is to find an actionable challenge. This entails going from a big abstract idea into a feasible challenge. During this phase, learners also find the link between academic content and the problem. In the Engage Phase, a topic that comes up often is Essential Questioning, which could be understood as the main research question in an academic context. The second phase is the investigative phase. This phase involves researching the topic which will allow learners to produce actionable solutions. During this phase, learners use guiding questions to help them find relevant information and learn how to synthesise and present their findings clearly and effectively. The final phase is the Act phase where the solution is developed and implemented. Throughout the entire process, learners are encouraged to reflect on their progress,

document what they are working on and share their findings thus enabling a learning community that is united and ever-growing.

2.1.2 Link to behavioural theories

Links have also been found between CBL and existing behavioural theories. One popular link is between CBL and Social Cognitive Theory (SCT). SCT is a theory developed by Albert Bandura which emphasises that learning occurs in a social context and is highly dependent on the environment, the people, and the behaviour [21]. Three key elements can be found linking SCT and CBL. First, there is active learning. CBL promotes active participation, problem-solving [22], and critical thinking whereas SCT proposes observational learning and social interactions to acquire knowledge [21]. Despite not being the same they both promote active learning and suggest learners should actively engage with the content and surroundings. Secondly, there is self-efficacy. One of SCT's main components is self-efficacy which refers to completing tasks using your skillset. CBL supports this as students are encouraged to use their skills to problem solve and, in the process, learn and grow personally. Finally, there is the contextual learning aspect. The significance of learning within a specific context is crucial according to both CBL and SCT. SCT defines it more in the context of environmental factors. In contrast, CBL places it in a real-world context allowing the learning to be more relevant and expanding the horizon of learners.

2.1.3 Challenges in CBL implementation

Despite the benefits of CBL, there are some identified obstacles. The clearest ones are the constraints with resources available, limited time, the need to fulfil curriculum requirements concerning the content, being taught and difficulties in assessment. Additionally, the students should be independent and think critically throughout the process which can be counterproductive when not trained. Furthermore, teachers are important as they should be facilitators rather than teach and they should know how to implement CBL in their subjects/courses in an effective way. This of course requires practice and training, but it is hard to do so [23]. Tackling these issues would involve utilising technology to facilitate the process, providing training and coaching to students and teachers and establishing changes through educational policymakers. Overall, CBL is a dynamic framework where learners are responsible for their learning and can learn to work transdisciplinary to solve meaningful and relevant problems. This allows students to think critically, reflect on their actions and develop 21st-century skills such as technology usage, teamwork, and effective communication.

2.2 WEB DESIGN ELEMENTS

Numerous studies have been conducted where key web design elements have tried to be defined and determined. Studies have varied outcomes on which key elements but there is usually an underlying narrative. Carlos Flavian [24] suggested three essential elements when designing a website. These three are aesthetic appearance-making, navigation (focusing on simplicity and personalisation) and content. In the study, Flavian emphasises the importance of selecting images, graphics, or colours that offer a lively response from users. The study also emphasises the importance of using a hierarchy, having an easily accessible backward button and a search engine. Flavian emphasises the importance of content being up-to-date, comprehensive, and relevant. He also suggests backing it up with relevant visualisation tools (i.e. images or graphs). In the study, Flavian also looks at the back end and emphasises the need for a comprehensive content management system to ensure content can be easily updated. Allison et al. [25] similarly concluded that the key elements affecting user experience are Usability/ease of use, content, web design criteria, functionality, appearance, interactivity,

satisfaction, and loyalty. Ceci Dehil's [26] study took a different approach and defined elements in two categories: Level 1 which is universally applicable, and generic, and Level 2 which is tailored for particular solutions and more specific. There were twelve Level 1 elements found, including navigation, consistency, visuals, content, and feedback. The study noted 174 different sub-elements, but these have not been extensively developed.

In 2022, Jongmans [27] investigated the impact of visual design on UX and web evaluation. During the study, she highlights the increased value of having a web interface with appropriate visual design elements. These elements can not only increase perceived usability but also pleasure. Furthermore, an emphasis is placed on making the website accessible. Similarly, Hsu [28] identified crucial elements and categorised them into functional and emotional features. Functional elements include structure, usability, readability, and title/logo. The emotional features include attraction, colours, layout, or images. Hsu highlights that emotional features impact how users perceive and use the website. Garret's [29] study on website design and user engagement defined seven key design elements to focus on. These elements were navigation (referring to search features and aids for navigation), graphical representation, organisation (referring to the hierarchy and consistency), content utility, simplicity, and readability. Garret emphasised that these elements often overlap, and they are most effective when combined. Regarding content, it is highlighted that it should be easy to update and keep to date. De Angeli [30] supports this by highlighting that effective navigation should allow for free navigation and timely and accurate information. Furthermore, the increased emotional satisfaction and user experience are caused by the interaction. Deng [31] showed the importance of reducing the cognitive load of users. This is achieved by refining the layout and ensuring the user interaction is intuitive and user-friendly.

The studies provide numerous elements of web design. A diagram is made where the key elements are identified based on the synthesis from the different studies. The studies highlight the importance of other elements such as usability, functionality, or content. The six elements identified can be found in Figure 1 below and are a way to systematically identify both functional and emotional aspects of web design which are considered important by academic sources.

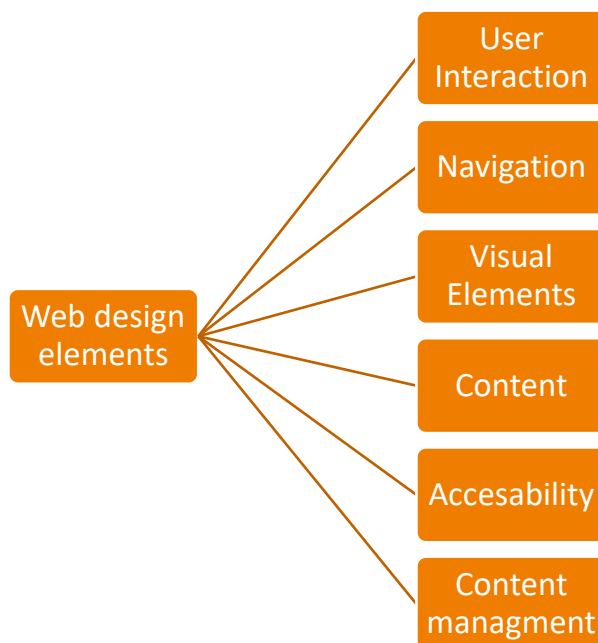


Figure 1 Diagram of key elements in web design User Interaction

In web design, user interaction refers to how users engage and interact with the website. These interactions range from clicking buttons to scrolling to filling out a form [32]. One of the key aspects of user interaction is the experience the user has while using the system. This experience should consider the users' emotions as when done right, it can make the user feel comfortable when interacting with the website and they will thus feel more engaged and likely to remain on the site [33].

User experience (UX) is a crucial aspect of any successful website. Studies have highlighted that a good user experience can be the determinant between beating out a competitor with a similar website [34]. For the user, the experience begins the moment they enter the website. According to Thomas Corley's theory, someone decides whether or not you want to do something within the first 7 seconds of starting an activity/action. For a website, the user knows if they intend to stay or leave within the first 7 seconds of entering the website [35]. Lalmas [36] suggests "the quality of the user experience that emphasises the positive aspects of interacting with an online application and, in particular, the desire to use that application longer and repeatedly". This definition is also in line with Sutcliffe's works which describe UX as an extension of User engagement and describe it as the how and why an (interactive) product is attractive to the user [37]. Looking deeper at User engagement, it is useful to look at the framework developed by O'Brien and Toms [38]. In their developed framework, they identify three phases of user engagement with technology. The first phase is called the Point of engagement. This is where the user begins interaction with the technology and looks for details that will keep the user's attention and interest. This is followed by the Engagement Period where attention and interest are sustained during the interaction. During this phase, users focus on aesthetics, interactivity, novelty, feedback, and positive affect. The process concludes when the users stop interacting with the technology. This period depends on internal and external factors such as usability, interruptions (potential) impact or time.

2.2.1 Navigation

Website Navigation refers to the process of a user navigating through the website. Navigation is a key factor influencing the experience users have on a website [39]. Studies have been conducted trying to identify what are best practices when looking at navigation systems of websites. According to Weideman [40], there are two types of navigation schemes. You have the ones that are easy for humans and those optimised for engine crawlers. Weideman highlights the importance of recognising that engine crawlers might prefer simpler, text-based links but that it can lead to visual clutter leading to a poor user experience. In the study, he also emphasises the importance of keeping important information visible and easy to access for a satisfactory user experience. He suggests that navigation buttons are useful but that images should be simple and consistent throughout the website. Regarding menus, he highlights the importance of having a defined structure so that users know what to look for and how to look for it. Despite flash elements and drop-downs being appealing, he stresses that users can become irritated by them as they affect the website's visibility and that it can be avoided by using active or hover effects and search functionality. Wojdyski [41] identified three dimensions related to website navigation including clarity of target, clarity of structure and logic of structure. In his study, he identified that it is important to have corresponding takes between a link and an expected task, the importance of have a coherent and consistent structure throughout the site, the use of navigation bars that can aid the users and the ability to reach to different points of the website easily without having to navigate through many steps. Lee's [42] findings concur with the findings of Wojdyski but also suggest that one of the key features of navigation is its simplicity. This refers to not getting confused while using the website. It is important to have a navigation bar which provides relevant, significant, and that navigation is simple, easy to find and has a coherent structure throughout the site.

2.2.2 Visual Elements

The visual elements in a website are one of the key determinants for how long you are willing to engage on a particular site. The visual elements on the website tell a story and provide meaning which makes users feel a certain way [43]. It is thus of utmost importance that the visual elements on the website are effectively determined and distributed. According to Sundström [44], the most common elements in visual web design are Image & Multimedia (AKA Imagery), Typography, Colour, and Layout. When enhancing the design of a website, Typography, Colour and Layout are highly valuable [45].

2.2.3 Imagery

Images are a medium that is much faster to analyse than text which is why it is commonly used on websites [46]. A 2010 study by Nielsen & Pernice [47] used eye-tracking on users navigating an e-commerce website and the results showed that consumers are highly dependent on the images presented to them. If the image doesn't satisfy them, they will likely not proceed to purchase that item. Despite the target group being different from Challenge Up's, it shows a correlation between images and engagement. Comparably, Jeannot [48] evidenced that visual elements, in specific images, have positive effects on user intentions but this is only true when the users already have a "high level of expertise using the website". The study also suggests that more experienced WB users can take in more design elements than less experienced users which means that for a less experienced user, including more easily identifiable elements (i.e., images) could be more effective. In essence, imagery allows for displaying and conveying messages quickly. It is important to select relevant imagery that matches the aesthetic of the website such that it engages the user.

2.2.4 Typography

Typography involves fonts, colours, sizes, and structures to make the text legible, clear, and appealing to the reader. When looking at typography on a web interface, it is important to use a good selection of typography and keep it consistent throughout the website as it provides satisfaction to the user and thus increases user satisfaction. When looking at typography, the typeface¹ is also relevant. There are three kinds of typefaces: serif, sans serif and decorative. Sans serif is considered to be the most legible while serif is arguably to be the most readable with the difference between legibility and readability being that the first focuses on how easy it is to read in the short text whereas the latter is for longer pieces of text [49].

2.2.5 Layout

The placement of the imagery and typography is essential to fulfil the user's aesthetic preferences. Users should be able to find what they are looking for without much struggle when navigating through a website [46]. In many ways, layout is highly related to navigation as it is the piece which enables users to be able to access the different tools in the web interface easily. Web designers tend to agree on certain principles for an effective website layout. They tend to suggest that a good layout has a balance of text and non-text (image, audio, video) as this allows the content to appeal to the user as it has a heightened importance. Furthermore, the layout of a web interface should maintain a balance of aesthetics and functionality but if it is well designed, the functionality becomes part of the design.

2.2.6 Colour scheme

Colour is a powerful tool in web design. It can influence users' emotions and influence their engagement in a web interface [50]. Different cultures have different understandings of colours [51]. To simplify the process, Western definitions will be used for the thesis. Research has shown that

¹ Design style with different sizes and weights.

applying the three-colour rule for websites is the most effective tool for creating a pleasing website. These three colours are a primary colour which is used to catch the user's attention and is used for the key elements in the site, a secondary colour for elements which are not as important, and an accent colour used to highlight specific features. The background and text colour are not part of this colour scheme [52], [53]. The combination of colours should be based on the geometric relationships created by the colour wheel [52]. Such combinations include the Complementary, split-complementary, analogous, triadic, tetradic, square, and monochromatic. An overview can be seen in Figure 2 below [54].

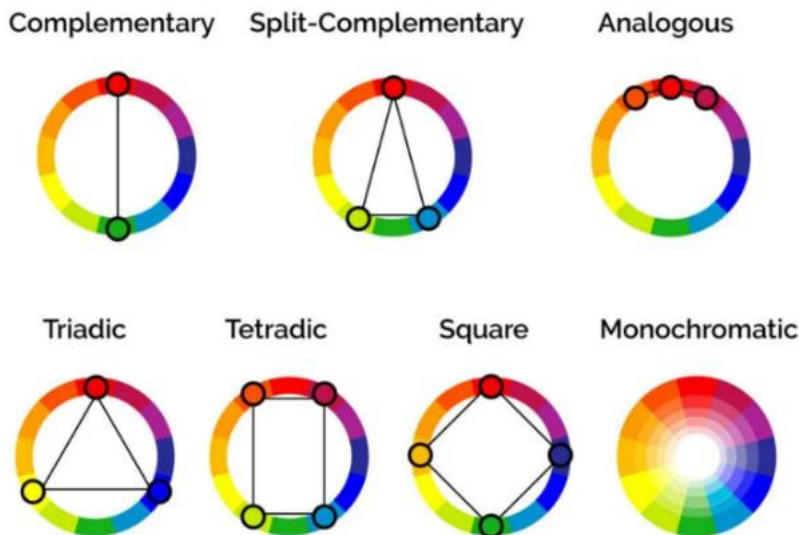


Figure 2 Different colour harmony techniques

2.2.7 Content

Website content should be of high quality and relevant to the topic. The content should be accessible by using adequate wording and templates (linking to typography). The content can be presented in a set of ways. It is effective to combine different content mediums into the site i.e., text, multimedia, and interactive content. When done, however, it should be kept at a balance and should not become obtrusive and disrupt the user experience while engaging in the site [55]. Similarly, Rosen [56] highlighted that content should be attractive. Rosen suggested achieving this by balancing eye-catching imagery and text, keeping the text clear, concise, and well-structured so the user can intuitively find the relevant information. Using such recommendations would improve user experience and satisfaction thus increasing the likelihood of revisiting the site.

2.2.8 Accessibility

Web accessibility is the concept of making the website usable for users. According to Miniukovich [57], it is important to make content accessible and readable for everyone which can be achieved by using a short and direct style, using an adequate font selection, font size (12-14), and avoiding underlining and italics. This has evident links to typography, but the study also refers to having a good contrast ratio that is easier for the reader to view. According to Miniukovich, this can be achieved by using an off-white colour for the background and a dark grey (instead of black) for the text as it would improve the contrast ratio. A similar study focusing on web disabilities with people with disabilities suggested that it is crucial to make a website accessible as it engages the user and provides an element of trust in them. The study offers a set of recommendations such as using alternative text for images,

ensuring the media content is accessible (through different mediums) and using an appropriate contrast ratio that does not confuse the user [58].

Cynthia Ng's [59] study provided a guide for improving web accessibility. In the paper, she argues that it is important to promote a universal design which benefits everyone such that it can enhance usability, findability, and user experience. Throughout the paper, numerous practices are described. Regarding content, an emphasis is placed on providing detailed content which is clear and has simple language to improve readability and accessibility. Longley and Elglaly [60] suggested that it is important to provide proper text replacements including alt text for images, improving the response time, providing relevant titles, and providing clear instructions if needed. Notably, studies have shown that despite being a crucial aspect of web design, webmasters and designers don't tend to focus too much time on it due to roadblocks such as time constraints or lack of client support [61].

2.2.9 Content Management

Content management refers to how the content can be created and modified. It is commonly known as a Content Management System (CMS) [62]. When designing a website, it is important to have an adequate CMS, so it is easy to update when needed. A study by Langer [63] stressed the effectiveness of a central content/workflow system for the website's content management. In the study, an emphasis is made on having an intuitive design that allows for ease of updating, the ability to easily add dynamic content (i.e., change from text to images) and having a system that can easily and safely archive the information. Likewise, Rude McDaniel [64] arrived at similar conclusions as Langer and suggested that the CMS should be of high value, that it should be easy to add changes, and easy for third parties to integrate it into their workflow (in essence making someone without experience able to edit it), and allowing for archiving the content. All in all, in Content Management, it is crucial that it can provide personalisation to the website, that it can allow for dynamic content and that it can be a secure environment for users [62].

The literature review suggests that there are numerous elements behind successful web design. These elements encompass visual appeal, content, and usability of the tool. The review suggests that successful websites should consider the interconnectedness of different elements, the need for a user-centric design, the balance of functionality and aesthetics and the need to have the tool accessible to different types of users. With the information provided, Figure 1 can now be further expanded with more detail. In Figure 3, an expanded diagram of the key elements of design can be found.

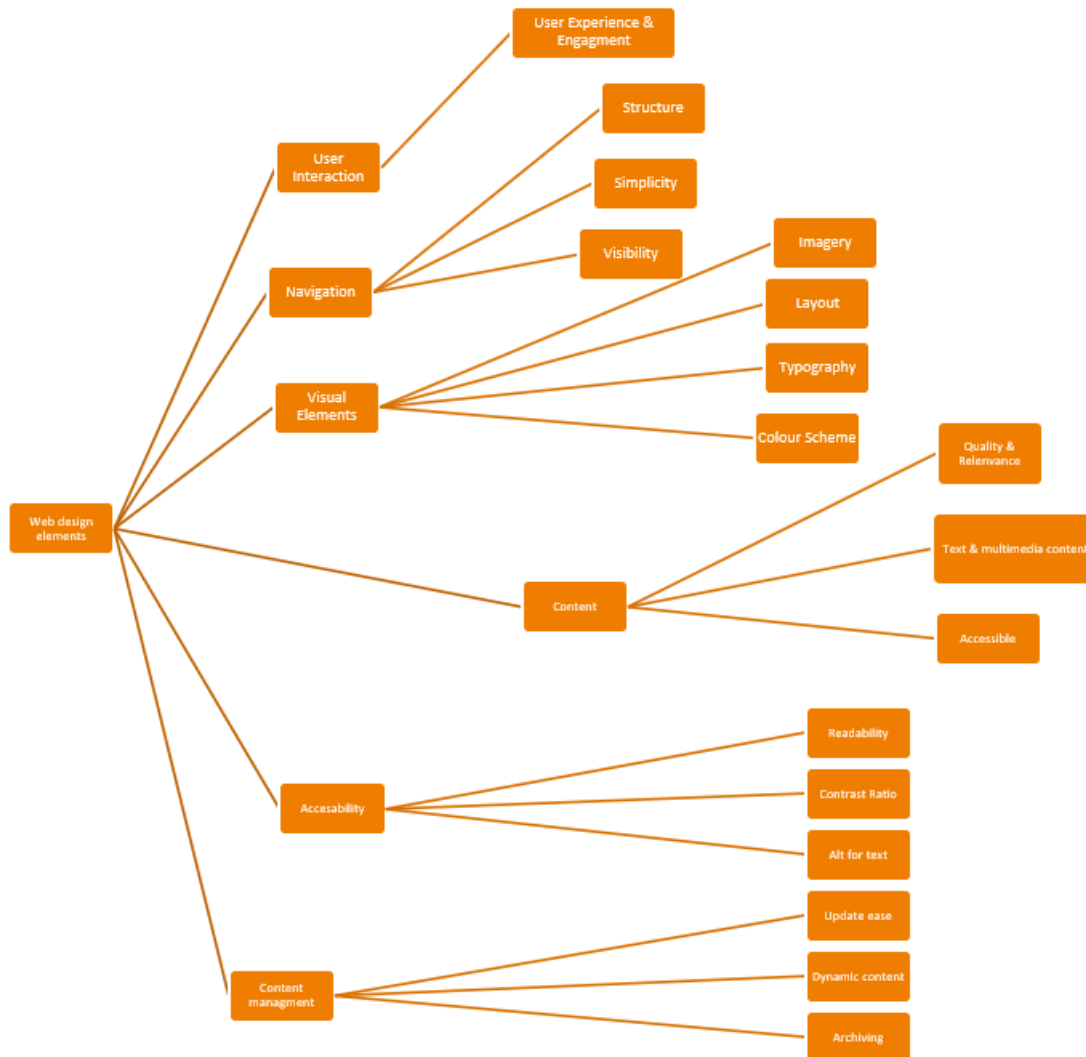


Figure 3 Expanded diagram of key elements of web design

2.3 E-LEARNING PLATFORM DESIGN ELEMENTS

Having looked at web design elements, it is also important to examine relevant features related to e-learning due to the relation with the Challenge Up tool. Despite Challenge Up not being an e-learning platform, elements in e-learning platforms can enhance the tool due to the objective of getting users to stay motivated to use the tool and retain information while using the tool.

One study by Chengfeng Xue and Xiting Zeng [65] focused on designing a web-based e-learning platform for middle school students during the COVID-19 pandemic. They highlighted the emphasis on users with specific preferences for learning through gamified elements. This might not fully suit a platform for implementing CBL in the classroom, but certain gamification elements could be considered. The paper also discusses the usage of different roles on the website i.e. students, teachers, administrators and guests and the importance of understanding what each party wants and enabling a customisable learning experience. A similar study focused on building an interactive and collaborative e-learning platform. The presented result combined social software with traditional learning management systems to foster interactive and collaborative learning since they recognised the requirements of modern learners and educators. The study recognised that in the current environment, students are very fluent with technology and thus, the platform should incorporate

cognitive, constructive, and social processes in learning. The researchers believed that through this, and by allowing for personalised experiences, a more engaging platform could be developed. The final result enables users to access a wide resource library, which includes recommendations and search functionalities to enhance the learning experience. Through this, they developed a system that was interactive and collaborative meeting the requirements of modern-day students and teachers [66].

In another paper, Isman [67] studied the role of an effective web design in distance learning environments. He emphasised that a user-friendly environment that engages users along with a simplistic design combined with meaningful content ensures that the learning outcomes for the user can be met. The study also referred to having an environment where performance can be tracked, supported (i.e., performance support) and of proximity, intuitiveness and cohesive design that ensures that users are motivated to return and use the website regularly. Similarly, Faghih [68] focused on elements in User Interface design for e-learning platforms. He recommended using visual (text and image) and auditory elements to ensure that content is engaging and accessible while avoiding a memory overload of unnecessary information. The study concludes by emphasising the need to psychologically understand the users and how that can drastically impact the effectiveness of e-learning platforms by making them more user-friendly and interactive. A paper by Brown and Voltz [69] studied the elements of effective learning in e-learning design. The study identified six key elements in e-learning design: Activity, scenario, feedback, delivery, context, and influence. These elements combined can create an effective e-learning environment. Aside from this, it is important to create engaging activities to enhance the learning experience and provide meaningful feedback to the learners (i.e. via progress trackers) and that the design is context-aware so that it caters to the needs of the particular users.

Looking away from research papers and looking at web designers the elements seem to agree on similar elements. One article by Crissa Aguilos highlights that to develop a successful e-learning tool, it is important to make it accessible to all. This requires having well-spread-out content, the typography includes bold fonts and alt text for images and any videos have relevant captions and transcriptions to ensure everyone can access and understand the platform [70]. An article by Daavin [71] aligns with Aguilos and suggests that clean layouts, engaging visuals, informative pages, and user-friendly navigation are crucial in developing an effective and engaging e-learning website. LTE [72] discussed different strategies to promote a collaborative e-learning environment and emphasised the need to shift towards engaging the users and ensuring high-quality learning materials can be provided for deeper learning and improved performance. The article discusses that effective collaborative learning involves understanding different user perspectives, fostering a positive mindset, and using technology to promote collaborative and interactive learning.

All in all, when designing an e-learning platform it is important to not only focus on having high-quality content which is engaging and interactive, but the platform should enable a collaborative space to work together, a way to track and receive feedback on progress, a vast resource library and user support to guide them through the journey.

2.4 TARGET AUDIENCE

The target audience for the tool is higher education teachers who want to implement Challenge-Based learning in their courses. The tool is mainly targeting teachers with little prior experience in CBL. However, due to the use of CBL Levels in the tool, the tool is also useful for teachers with some experience in CBL as it can provide them with insights into how to get further in their implementation process.

2.5 STATE OF THE ART

Having looked at existing literature, it is also important to look at existing works (AKA State of the Art) to identify best practices and techniques. The section will look at a set of existing tools related to CBL or in the field of helping teachers. This will provide good insights and inspiration for what could be added or improved in the Challenge Up tool. The websites were also discussed with an expert in user interface and User Experience design. Throughout the last chapter, six main elements were distinguished as being key elements in web design (see Figure 4 below), except the Content Management element (due to its issues with accessing this part of the tool), these elements will be the determinants for the evaluation. Content will be based on the advice it offers rather than theoretical description.

The different elements will be rated on a scale of 1-10 based on features found in the literature and the expert's opinion. In Table 1 below, the website ratings can be found.

	User Interaction	Navigation	Visual Elements	Content	Accessibility	Total
CBL	6	9	8	7	10	40
CBL (Apple)	9	9	9	5	9	40
Digital Promise	8	9	8	3	10	38
TU/e CBL Wheel of Life	9	9	6	7	8	39
Jigsaw classroom	7	6	8	8	7	36
PBLWorks	7	9	7	5	6	34
Challenge Up (v1)	7	7	7	9	8	37

Table 1 Grading of Existing Websites

2.5.1 Challenge Based Learning

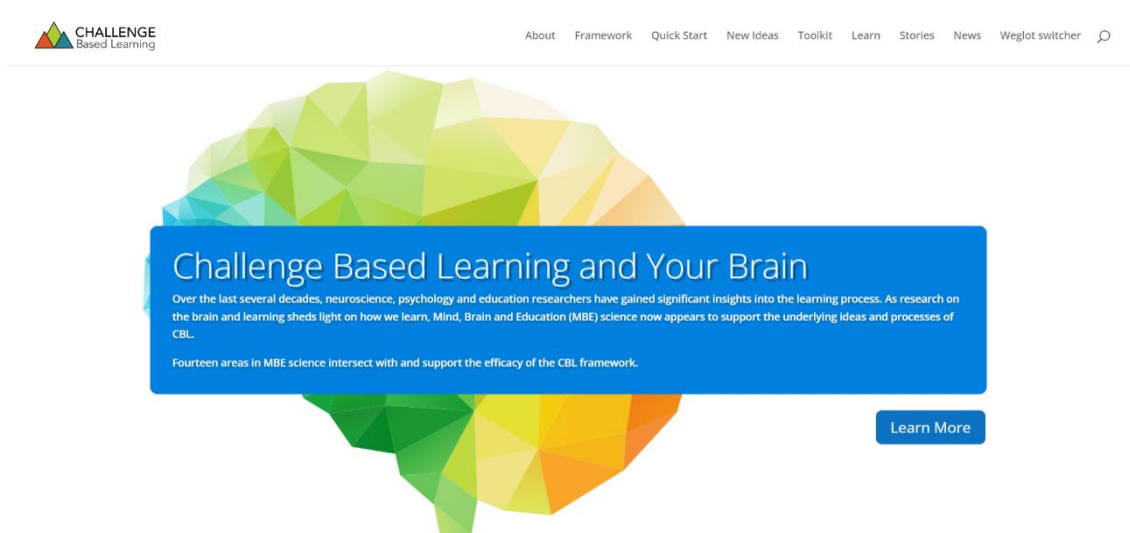


Figure 4 Challenge Based Learning Homepage

Challenge Based Learning is a website developed by *The Challenge Institute* (shown in Figure 5), that aims to give users an overview of what CBL is, provide resources on it and provide guidance for educators and students on how to implement it. The tool also provides users with a toolkit on

implementation steps and a section where examples of CBL have been used. The website contains a clear structure and separation of content seen within the Navigation bar (Navbar). The navbar has a simplistic design providing users with an overview of what they can find on the site. The Navbar has a language feature allowing users to change languages although some sentences still appear in English despite changing language. On the top right of the screen, users also have an “Accessibility button”. When clicked, this feature allows users to gain accessibility features such as text reader, image descriptions, button size, and colour contrast... This feature highlights the care in which the tool was developed. These features allow users with certain disabilities to use the issue without issues making the tool much more user-friendly.

The Interactions that can be done throughout the tool are intuitive, useful, and engaging. The buttons such as “Learn More” facilitate user engagement as they can access a library of resources if they want to but are not overwhelmed with information from the start. The one issue with the user interactions identified is in the Frequently Asked Questions (FAQs) where the responses to questions do not appear when clicking on the question frustrating the interaction and experience for the user. This however is not the only instance where it happens, and it happens a few times throughout the site. There are also pages where references are made to resources but there is no link to the resources page which disappoints the user and loses the user's engagement. One commendable feature however is the Active button state. When the user is on a specific page, that section in the navbar will turn blue while the rest remain grey allowing for a clear and immediate identification of where the user is. The visual elements are modern yet simplistic allowing for a visually appealing experience. The font used is Sans Serif and the standard text size is 12, fitting into what studies such as Tomita [49] suggest. The tool also provides a combination of typography, images and in some cases videos. This balance allows users to visually understand what is being explained and associate certain themes with specific images. These features also increase the readability and user experience of the website.

Regarding content, it is well-organised and structured. Users can navigate through the website learning about the different facets of CBL and gaining inspiration from existing works. The language used is simple enough to be readable but also content-specific. One highlightable page in terms of content is the *Framework* page. On this page, the CBL framework of the three phases is described. Noticeably, the different sections are labelled with different colours allowing users to generate a proper and clear distinguishment of the different sections in the framework. The tool includes tips and tricks to help teachers implement CBL in the classroom which is a good addition as it provides actionable advice for users. These steps lack depth and do not consider the to what extent teachers want to implement CBL in their classrooms. In terms of accessibility, as previously highlighted there is a specific button tackling highly commendable accessibility. When discussing with the expert, he suggested that the website is well-structured and offers a great user experience by presenting a smooth and intuitive navigation framework and having visuals to accompany the textual information provided. The expert highlighted the great job the tool did in terms of accessibility by having a button where users could easily change certain elements on the website as this ensures all users can have a smooth experience while using the tool.

<https://www.challengebasedlearning.org/>

2.5.2 Challenge Based Learning (Apple Education)

Challenge Based Learning

This is your space to connect with colleagues to learn more about CBL and to share your experiences.

Challenge Based Learning provides a framework to acquire knowledge and develop strategies for life-long learning. The framework empowers anyone to address personal, community, and global Challenges while acquiring content knowledge in areas such as literacy, math, science, technology, and the arts.

[Learn more in the Learning Center.](#)

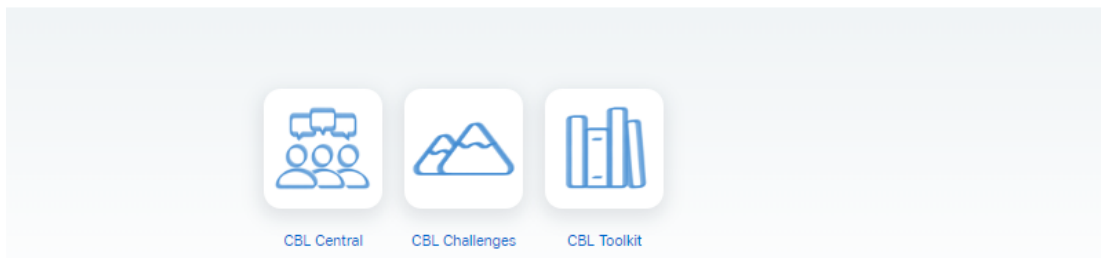


Figure 5 Challenge Based Learning (Apple) Homepage

The Challenge Based Learning website of Apple's Education Community seen in Figure 5 is essentially a handbook on how CBL and how to apply it. It is a great introduction to beginners and provides details on what steps to take. The user interaction is clean and simple. It is clear where you have to click, and the user intuitively knows what to do and how to do it. The navigation is in line with the interactions and presents no major flaws. A slight flaw however is that before accessing the different chapters of the handbook you are forced to scroll down the main page. This might be an intended design as it forces users to read the description but a navigation bar as is seen once in the handbook could already be handy. Concerning the colour scheme, it uses mainly black or white text keeping in line with Apple's brand. The different phases of CBL are given specific colours which makes the user associate a colour to a phase. The content is simple and to the point. It provides a basic understanding of what each phase is and what the main building blocks are. This is combined with PowerPoint slides which go a bit more in-depth into what the phases entail but can only be accessed after downloading the PowerPoint. The provided information is mainly theory and thus there are no actionable steps that a teacher could use to try implementation in their classroom. This is slightly addressed in the discussion forum where users can ask their questions, but this page is hard to find.

The expert was impressed with the Apple tool. He noted that Apple has put a lot of work into mastering a good user experience and interactions and that it is evident within the tool. He highlighted the smoothness of using the tool and the smart combination of colours, icons, and texts to make the information readable and simple for the user. He also complemented the smart use of scrolling animations that appear as you scroll making it a visually appealing experience for the user. He highlighted the lack of depth in terms of content and suggested that it is hard to find examples and that it might not encourage users to continue using the tool. All in all, the CBL tool by the Apple Education Community is visually and in terms of interaction and navigation up to a great standard. Its content could be described in more depth and some of the buttons made more visible to enhance the clarity of what can be done while using the tool.

<https://education.apple.com/learning-center/R006554>

2.5.3 Digital Promise

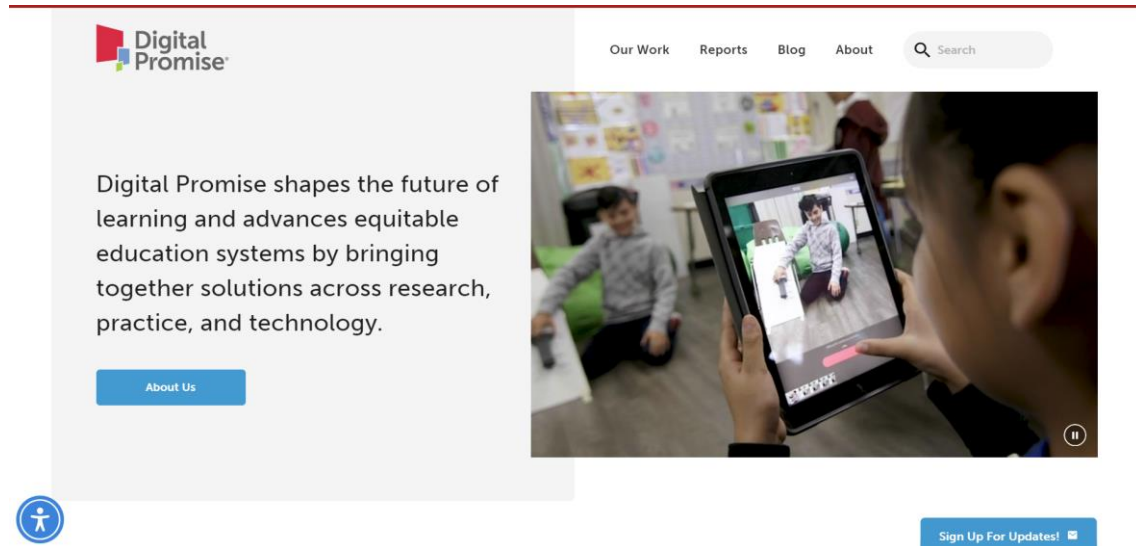


Figure 6 Digital Promise Homepage

The Digital Promise website (shown in Figure 6) aims to innovate education by emphasising the use of technology. It is a tool where educators, researchers and technology developers can collaborate and share resources in educational strategies and tools. One of the pages in the tool is focused on CBL thus its inclusion. When looking at User Interactions, they are simple, user friendly and intuitive. Notably, when hovering over an image which is a button, it increases a bit in size, so it becomes evident that is a button making it clearer and engaging for the user. There is also no noticeable delay when pressing which makes the experience smooth. As for navigation, it has a simple yet effective navigation. The Navbar underlines a specific page and when hovering over it provides immediate feedback to the user which makes them feel in control. Furthermore, the Navbar has a non-intrusive search button. The Navbar, however, does not include any dropdowns and the user might be forced to go through numerous pages before arriving at the end location, then again with the search tool this can be mitigated. The contact section can be found in the footer and is not intrusive to the user.

The visual elements in the tool combine the use of images and text. This combination is useful to the user as they do not feel overwhelmed by the tool. The tool's boxy design provides a natural structure making it easy to use and nice to see. Furthermore, the use of sans serif along with size 14 text makes it visually attractive and easy to read. The tool also uses a simple colour scheme mainly blue and white. This simple colour palette is visually attractive and user-friendly. The content is very diverse and has a wide range of sources which might prove to be an issue if it is not peer-reviewed but it seems to be validated so it is not an issue. Looking specifically at the CBL page, the content provided is clear, providing relevant and clear information and examples of existing works. There are however no steps provided on how to implement CBL in the classroom and thus leaves the teacher confused and unsure of what to do if they find CBL interesting. Finally, regarding accessibility, there is a button focused on accessibility. This button allows users to change certain aspects of the website such as text size, text spacing, and contrast... to put the user in control and give them the freedom to tailor it to their needs. The expert highlighted the relevance of the content and the consistency throughout the tool in terms

of colour scheme and typography. He suggested that although accessible to a general audience, it is hard to read some of the text due to the clashing background. He suggested enhancing the contrast between text and background colour to ensure accessibility. Furthermore, he emphasised the need to have a simple layout to reduce visual clutter and allow for a balance between text and visuals.

<https://digitalpromise.org/>

2.5.4 TU/e CBL Wheel of Life

HOME GETTING STARTED WHY CBL METHODS CASES

HOW TO USE THE CBL WHEEL OF LIFE

You are now going to determine how much motivation you have to make improvements in each CBL dimension and find out which dimensions are top priority for you.

Download CBL Wheel of Life

STEP 1: Download the CBL Wheel of Life template and read the definitions of all the different CBL dimensions.

STEP 2: Consider your own course/project and give yourself a score from 1 (= performing poorly, or not present at all) to 10 (= performing in an excellent way and fully implemented) for each CBL dimension, by marking it on the wheel.

STEP 3: Connect the marks on the wheel: the resulting "spiderweb" is the visualization of how you currently perceive each CBL dimension in your course/project. What insight does this give you?

STEP 4: Report each score you gave yourself on the wheel, in the first column (Score) of the table provided.

STEP 5: Then go to the Improvement column and indicate how much room for improvement there is per each dimension in the second column. This number is calculated with the formula 10 minus the score you gave in the first column (Score).

STEP 6: Go to the Motivation column: Indicate how much motivation you have to make improvements on each dimension. Give a score between 1 (no motivation) and 10 (great motivation).

Figure 7 Challenge Based Learning (TU/e) Homepage

The Challenge Based Learning Wheel of Life by Technical University Eindhoven (TU/e), seen in Figure 7 provides users with an understanding of what CBL is and of ways it has/can be applied by providing examples of applications within their university. Users can download a spiderweb which indicates different aspects of CBL and understand what level of CBL they are currently in. The user interaction is smooth and intuitive and there are no glitches present. Before pressing the Download button, the button goes slightly larger so that it is when it is hovered on. The navigation is simple and with no clear delays or bugs. The navigation bar is fixed on the top of the screen so you can easily access the different pages on the site. The colour scheme is simple using mainly black blue and red. The font and text size are adequate but cannot be adjusted for people with any visual impairments. Considering it is part of the TU/e main website, it remains consistent and has a clear image that everyone associates with that university. The short pieces of text combined with bullet points, make it readable too. Regarding the content, it provides a good understanding of what CBL is and provides a step-by-step guide on how to use the CBL tool. This feature allows anyone to use the tool and understand what level of CBL they are in. No steps are provided for teachers to guide them in CBL implementation. The tool seems to indicate what level you are in but now how to improve it further. This could be due to it being mainly tailored to prospective students, but it would still be a useful feature regardless. There is however a contact button for if anyone has any doubts focus which is only on the page with examples which means that a user who is unsure of CBL as a concept would be uncertain of who to contact/where to go as there are also no additional resources that one could access.

After reviewing the tool, the expert was very positive about the tool. He remarked that a lot of work had been put into the development and that he was impressed by the polished look of it. He

highlighted the user-friendliness while using the tool and the clarity in CBL explanations and how it could be applied. He did however remark that there was a lack of support for the users in terms of content as there was no way to get additional information or content if one was unsure or curious to learn more. Furthermore, he suggested that a visual representation of the Wheel is helpful as the user gets an idea of what to expect. Overall, he was impressed with the overall quality and content of the tool. The TU/e CBL tool is a great addition to the TU/e website as it provides an understanding of CBL and how to implement it. Its coherent colour scheme and intuitive user interactions add to the smooth experience the user would have with the tool. Furthermore, the structure and purpose are similar to what is being developed within the project's scope and can provide valuable insights.

<https://tueinnovationspacetoolkit.com/index.php/getting-started/>

2.5.4 The Jigsaw Classroom



Figure 8 The Jigsaw Classroom Homepage

The Jigsaw Classroom website (seen in Figure 8) aims to provide educators with resources and guidance on implementing the Jigsaw teaching technique. This learning strategy involves cooperative learning to improve student motivation and increase the learning experience. The tool offers steps, tips, and methods to implement the Jigsaw classroom technique. In terms of user interactions, the website is smooth and usable. There are no apparent lags or issues when interacting with the tool. The tool is designed to be a single-page site, so the user is always scrolling to provide more information. The sections have buttons to subpages with more information and details, but these can also be accessed through that single button. This irritates the user because they must take unnecessary steps rather than finding it through a dropdown menu or search bar. There is no way to contact developers if you find an issue or have a doubt. The navigation, similar to user interactions is intuitive to use and simple. The Navbar is fixed to the top of the screen so you can always see the different sections. This allows the user to have the option to reach a different section easily and intuitively on the website. The page contains text and icons to help associate different elements of the Jigsaw method. The text has a sans serif font and a font size of 18. This allows for easy readability and for the content which is easy to access. The tool uses a blue and white colour scheme making it easy to view and user-friendly. The content is clear and to the point. This enables a comprehensive understanding of the method at

hand and provides a good rationale for using the method. The process is broken down into 10 steps and is visually presented with an indication of what should happen during each step. The “Tips” page guides teachers on how to deal with different types of students. It provides a simple explanation of what could be done to deal with different students, but this is a very general description and there are no other tips on implementing the method in the classroom. The website also has a section with “Related Links” where users can access a library of different tools and websites discussing relevant topics. There are no specific accessibility features to highlight.

The expert described the navigation as straightforward and logically organised. He complimented the interactive timelines and the combination of visuals that added value to the tool rather than acting as fillers. He suggested that it is hard to achieve but highly. Furthermore, he remarked that the structure of the content was clear and of high quality. However, he suggested that the visuals needed alternative text for all images and that more interactive features could be added to enhance the user experience. Furthermore, he suggested adding a few more visuals as it was currently a text overload for the user. The tool is well-designed, clear and to the point. The website shows that a well-designed navigation bar is important and shows how a fixed navbar might be useful in certain scenarios. Furthermore, it is nice to have icons and step-by-step instructions to help associate key points and information clearly and systematically.

<https://www.jigsaw.org/history/>

2.5.5 PBLWorks

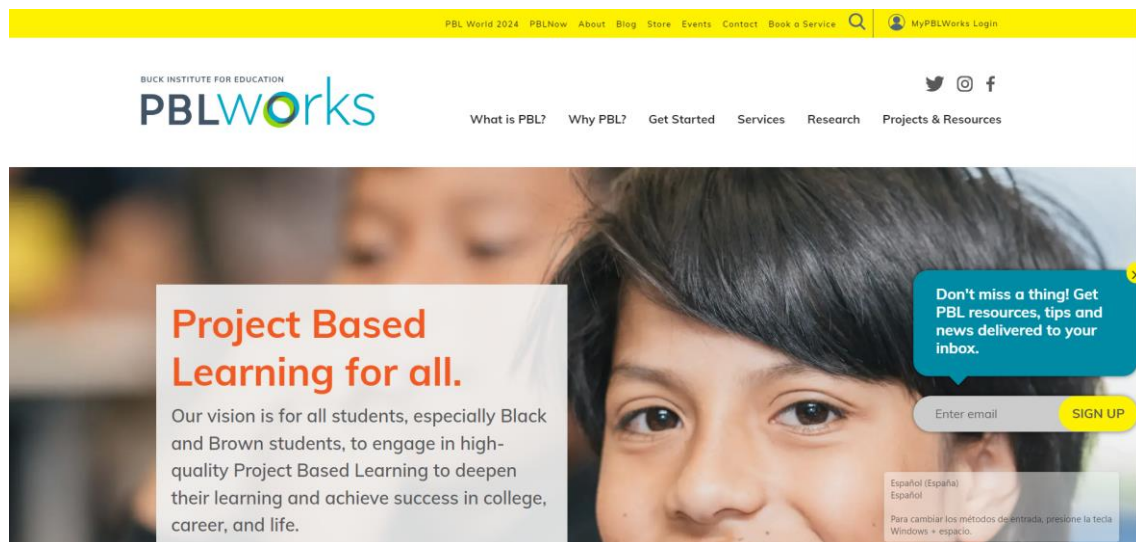


Figure 9 PBL Works Homepage

The PBL Works website (as shown in Figure 9 above) promotes Project-Based Learning (PBL) by offering insights into what it is, resources, training and support for educators implementing CBL in their classrooms. The tool provides users with workshops, research, and success stories to promote the learning technique and enhance the educational experience. Regarding User Interactions, the tool has intuitive user interactions allowing users to click and navigate smoothly through the website. There is a slight delay when hovering over the buttons, but it is not a major distraction. The tool also has an easy-to-find contact button making it easy to contact the developers. When a button is triggered, it is

evident it has been done as the specific page in the navbar becomes underlined making it clear where the user is. The navigation is for the most part user friendly aside from the delay mentioned above. Compared to the Challenge Based Learning tool, the navbar offers a hover effect which when hovered over, provides a dropdown of subpages you can travel to which allows for shorter trips to the desired end location. The navbar is not at the top of the page, it is slightly under as there is a smaller navbar at the top. The specific navbar seems more tailored to a consumer-based side as it does not provide access to buttons explaining PBL in detail but on a more general aspect. This Navbar also has a yellow background which seems a bit off the rest of the colour scheme. Regarding visual elements, the website is mainly text-focused with context images for users to associate the content with the image. This feature is useful and increases the user engagement. The tool uses primarily IBM Plex Serif and size 19. This is not the ideal choice but still readable and understandable. The tool uses colours to its advantage by having the different headings have an orange colour which allows for a good contrast and allows users to see what will be discussed below. The content is focused on PBL so clearly is not related to CBL. It is however useful to see how the tool's content is also a social aspect to it has rather than just focusing on what PBL is. Rather, it emphasises how to help students and the importance of equity in education. This of course is in line with the developers of the tool, *The Buck Institute* and it is a nice feature as it provides users with valuable insights into why it is important and relevant to use the framework. There is a "Getting Started" section aiming to provide advice on how to implement PBL. This however only lists a set of books and videos to read. Although useful, it does not per se provide actionable stapes that can be implemented in the classroom and does not consider the extent to which a teacher may want to implement PBL in their classroom. The content also has sections dedicated to research, project ideas and training opportunities which is very useful to educators trying to implement it in their classrooms. Regarding accessibility, while no specific features stand out, the overall layout, ease of use and font size make it an accessible tool.

The expert suggested that the tool although containing clear navigation lacks some features such as calls to action such as a "Learn more" feature. Furthermore, he highlighted that the navigation might feel like an overload to users as there are so many options. He emphasised the importance of balancing providing important information and visual clarity. He complimented the clarity and structure of the content but proposed adding some more visuals and bullet points to make the information more appealing to the users as they might not feel as engaged if they see long paragraphs of text.

<https://www.pblworks.org/why-project-based-learning>

2.5.6 Challenge Up (Current Version)²

The current tool is entering its final phase of development. In the current version, when users enter the website, they are asked to select their current and desired level for the different facets of Van den Akker's Curricular Spider Web. This framework was developed to show the interconnectedness of different dimensions of a curriculum. The framework has nine dimensions which are Learning Activities, Content Knowledge (CKS), Learning objectives (LO), Learning Rationale, Assessment, Location & Time, Grouping, Materials & Resources and, Teacher role [10]. The dimensions are broken down into different levels of CBL: Non CBL, Mild CBL, Moderate CBL and, Intense CBL. The users are aided in the selection by a short description under each level describing what should be present at that

² The version referred to was checked on the 20th of March 2024

CBL level. After entering this data and prioritising these dimensions, tailored advice is provided to the user where the teacher receives advice on how to reach the desired goal for each facet.

As a user, one is immediately taken into the curricular component selection without knowing what to do/expect. The tool offers a simplistic design which displays information. The tool uses a colour scheme combining white and blue with the text being font Arial and size 14. The colour scheme is simple but dull and lacks an engaging colour. The tool allows the user to select the Current and Desired Level of each facet. To re-select levels, the “reset selection” button can be pressed. There is an easy way to go back to the previous facet, but this can only be done one by one which may become annoying for the user if they made a mistake in the first facet and are already in the fifth facet. There is a reset button that resets the whole selection and an error prevention feature to make sure all data is not lost. The tool also has a progress indicator to show how far the user is in the process making it easy to understand how far they are. There is a feedback button which is easy to find and intuitive to use. The Motivation section allows users to move the different factors in order of motivation. It only works when pressing the side buttons so does not allow for a click-and-drag approach which seems more appropriate. The advice section provides users with a radar chart to visually see their current and desired levels for each facet. This is followed by specific advice on how to get to the desired step, from the current level. The advice is only text-based and thus the user might lose some engagement during this phase of using the tool. Furthermore, the advice does not provide further resources that could be used to achieve the goal, rather it presents one set of advice. The section provides the option to print so the teachers can access this advice at any time. The content overall is useful and provides a good understanding of the different levels of CBL but some descriptions for the different levels in certain facets that seem to contradict each other or be the same. The advice’s content provides steps that a teacher can understand and implement in their course. The clarity of some of these steps is lacking on some occasions but in general, it is quite clear. The content has no visuals to accompany it. It is important to find a good balance of this and given the large quantity of text, a balance might be relevant to ensure that the tool remains engaging and attractive to the users as they use the tool. Regarding Challenge Up, the expert was pleasantly surprised with the tool. He commended using Current and Desired Levels to develop tailored advice to the user. The lack of instructions left him unsure of what was expected from him. He emphasised the need for a cohesive page design, suggesting that the levels should be boxed to avoid any appearance of favouritism, For the Advice, he noted the overwhelming amount of text and recommended presenting a summary of actionable steps to improve readability. Finally, he highlighted that some of the elements within the level selectors could be reformatted such as the restart button being placed next to the “Next” button.

The literature review and State of the Art provide a solid formation which can be used to help respond to some of the RQs posed in Chapter 1 and help in coming up with ideas of how to improve the Challenge Up tool.

3. METHODS AND TECHNIQUES

The following chapter will delve into the methods and techniques used throughout the development of the prototype. The different elements will be described to understand why and how they were used throughout the project.

3.1 DESIGN PROCESS

To allow the project to run smoothly, the project should follow a validated framework. The selected framework is the Creative Technology Design Approach (visually represented in Figure 10 below). This framework is divided into three phases. The process starts with an ideation phase where user needs and ideas are developed; this is followed by the specification phase where the idea is refined to arrive at more specific product requirements by using early prototypes. The final phase is the realisation phase which is when the final product is realised and refined further [73].

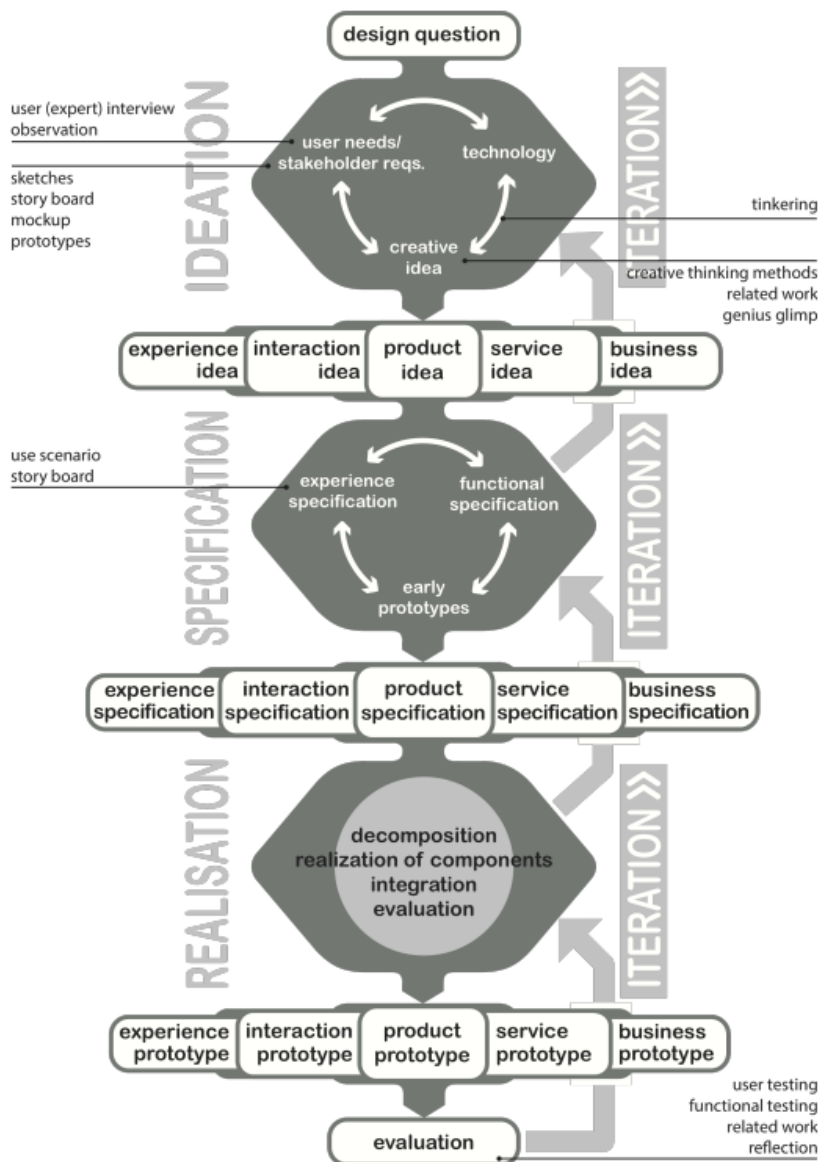


Figure 10 Creative Technology Design Process

Considering that an initial version of the Challenge Up tool has already been developed, means that the approach taken will in principle, unless the tool is not up to standard, not involve creating a whole new tool but rather, developing a set of recommendations to improve the existing tool. Except for the ideation phase, the framework could be used as is. During the ideation phase, the goal will still be to understand the user, but new ideas will not be developed as it is irrelevant to try to come up with a whole new solution when a base is already in place. For this GP, it will be referred to as understanding the current situation. The realisation and specification will in essence remain as is and will have the name of Prototyping a new version, Testing & Evaluating. A final section will be added to the process focusing on providing advice to the client.

3.2 USER TESTING IDENTIFICATION

3.2.1 Understanding the current situation

To gain an understanding of the current situation with the platform, a user test will be conducted. The objective was to see what users' opinions are on the current system regarding its usability and content. The user test was broken down into two components, a survey and a feedback session which aimed to dig deeper into what users think of the system and how it could be improved.

3.2.2 Survey

Surveys are a common and effective method of identifying user behaviour and understanding what their needs are [74]. Because of this, a survey was chosen to gather initial insights and perspectives of (potential) users of the tool. To identify what sort of questions to use, research was done on existing surveys to test websites and their usability. A common method for testing usability is the System Usability Scale (SUS), a 10-question questionnaire designed to evaluate the usability of a product or service. It is an effective method which has been validated and is easily scalable. This method like most usability surveys is made of statements that users rank on a 1 to 5 Likert scale [75]. A Likert scale is a rating scale used to measure the attitudes or opinions of users. It is composed of a question or statement which respondents can respond to by rating it on a scale of 1 to 5 or 1 to 7. These scales have the slight disadvantage that they are prone to some response bias due to fatigue or social desirability but if scaled properly, this issue is diminished. The scale used can be framed in terms of agreement, satisfaction, likelihood, intuitiveness, and familiarity... [76]. Using a Likert scale in combination with space for short answers is also recommended as it allows for quantitative comparisons and getting a good idea of the usability of the tool being tested [77]. The short nature of these statements allows for quick responses not tiring or frustrating the user.

Two papers provide valuable insights into how to effectively evaluate a website. The first is by Sanne Elling, Leo Lentz and Menno de Jong [78]. In their 2007 paper, they develop the Website Evaluation Questionnaire (WEQ) an instrument to evaluate websites through nine dimensions in a reliable way. These dimensions include relevance, comprehensibility, comprehensiveness, user-friendliness, structure, hyperlinks, speed, search options and layout. Similar to the SUS, the WEQ also uses a five-point Likert scale. This questionnaire has proven to be highly effective in evaluating websites. The second study by Allison et al. [25] discusses what elements are needed for the successful evaluation of a website. They discuss elements like who, and how it should be tested. (They suggest that questionnaires are a good way to collect the data.) Notably, they discuss elements that affect a user's experience on a website and thus imply that these elements can be used as guidance as to what should be evaluated. They discuss that the key elements are Usability/ease of use, content, web design criteria, functionality, appearance, interactivity, satisfaction, and loyalty.

Looking at these papers it is evident that there are numerous factors to include in the survey. To get the most out of the survey, a combination of the WEQ and Allison et al.'s paper was used. This final combination included the following sections:

- 1) Usability/ease of use where questions on user-friendliness, section structure and intuitiveness were asked.
- 2) Content where questions on relevance, comprehensibility, completeness, and relevance were asked.
- 3) Functionality where questions on buttons, logging in and out were asked.
- 4) Appearance where questions on the layout, the colour & font selection, use of media, general attractiveness and readability were asked.
- 5) Interactivity where questions on feedback options were asked.

Using this as a base, the survey was composed of a combination of a 1 to 5 Likert scale with an agreement scale and short answer questions. These were selected as they would provide interpretable and accessible data to be analysed later on. The survey length was kept short to respect the busy time schedules of teachers. The form was created digitally using Microsoft Forms and communicated to the users via an email through the client. The responses were analysed using Microsoft Excel to help identify and determine trends from the users.

3.2.3 Feedback session

The individual surveys would provide good individual surface-level insights into the tool but to gain a deeper understanding of the tool, a feedback session was organised to gain further insights. The feedback sessions would allow us to obtain qualitative data to help understand the user, and the user interactions, identify issues, suggest design changes and overall, provide a space to voice opinions more freely and in detail. Furthermore, the collaborative aspect allows for an exchange of ideas allowing for the feedback to be richer. During this feedback session, a small workshop was organised in which the users got to discuss issues that were found and discussed potential solutions to this problem. This collaborative aspect allowed me to provide valuable information and insights. During the session, the discussions were open and were designed to encourage teachers to voice out their opinions and experiences using the tool. During the session, minutes were taken to determine relevant themes and patterns. To take minutes effectively, "The Cornell Note-Taking System" was used. This note-taking method was developed in the 1950s by Walter Paul, a professor at Cornell University. The method involves dividing a piece of paper into four sections: A horizontal block on the top of the page (1), two vertical columns in the middle of the page (2,3) and one horizontal block in the bottom of the page (4). In block 1, the title and date are put, in block 2 keywords and questions are put. In block 3 the main notes and thoughts are jotted (with abbreviations) and in block 4 the summary is made [79]. Using this method would enable me to summarise relevant information, take notes with a specific intention and have notes that could be revisited at any time.

3.2.4 Interviews

The surveys and feedback sessions would both be useful to gain a general understanding of the perceptions of the tool. But to truly understand the users, interviews were also conducted with teachers. The teachers were found by walking around the University of Twente buildings and asking professors from different faculties if they were willing to discuss the tool. 9 teachers were asked to be interviewed out of which 4 said yes and were experts in the fields of psychology, electrical engineering, and public administration. Additionally, 2 students were also interviewed as they had experience in

User Experience design. Using interviews, specifically semi-structured interviews, would enable a flexible and in-depth conversation suitable for understanding how users feel when using the tool. This would allow us to properly understand what was being researched and understand user behaviour and experiences. Furthermore, it would allow us to uncover the specific details that may not be highlighted via other data collection methods [80]. The data from the interviews will be collected through notetaking. The interviews were analysed by reading through the notes taken and finding relationships with the different interviews. To determine if the information provided can be of use, their level of experience with CBL and User Experience design was considered along with using the literature review, survey and, feedback session to find any relations.

3.2.5 Requirement development

With the feedback gathered and analysed and combining it with existing literature a set of requirements were developed using the MoSCoW method. These requirements were designed based on the requirements of the teachers as they were the primary stakeholder. This method allows us to arrive at a set of requirements and label them in terms of their priority. The requirements are divided into the following categories:

- Must have: Essential requirements to have.
- Should have: Important requirements that are not essential but would enhance the tool's functionality.
- Could have: Requirements which are desirable but not needed and are thus a lower priority.
- Will not have: Requirement that will not be involved in the project due to constraints such as budget or scope of the project [81].

3.2.6 Functional vs non-functional requirements

Having developed the MoSCoW developments allowed for distinguishing between functional and non-functional requirements. Functional requirements are those focusing on what the function does i.e. functionality and behaviour. Non-functional involves those requirements which focus on features such as quality and performance. Functional requirements can be used to evaluate the functionality. Non-functional requirements on the other hand can be used to test the usability and performance of a system [82].

3.2.7 Techniques for Ideation

With the requirements developed, before developing a final prototype, ideation will be conducted to identify potential solutions to the identified problems and to solve the developed requirements. To complete this ideation of ideas, two ideation methods were used. Firstly, a mind map was used as ideation to identify key issues and keywords were noted down of what potential solutions could entail/include. This method was selected as it is a method which allowed for visually organising information around the key theme. It would enable critical thinking and provide a good base for decision-making. This method also allows to show of existing links between ideas adding a deeper level of analysis and critical analysis [83].

Having the keywords and ideas identified, a round of IdeaStorm sketching was conducted. This method entails generating quick sketches dynamically to come up with new and unique ideas in a specific amount of time. A time of 30 seconds per idea/keyword was used. This method would also allow for all ideas to be considered and the feasibility and details were not considered in the beginning

to come up with the most creative and innovative solutions [84]. These sketches were then narrowed down to a select few which were deemed more suitable to tackle the issue.

3.2.8 Develop a new version

A new version of the tool will be developed based on the user's requirements. On request of the client, the original tool will be left untouched until the end of the project, thus the new version of the tool will be developed using Bubble. Bubble is a visual programming language launched in June 2012. It is designed for users to be able to create web applications with an intuitive and user-friendly interface [85].

3.2.9 Test & Evaluate

The following phase was the testing phase which involved testing the new version. This is achieved via interviews and surveys. Having conducted the testing, the data gathered was analysed and evaluated.

3.2.10 Provide Advice

Having an analysis and evaluation in place, an advice document was developed. This document explains what implementation changes would need to be made to ensure the Challenge Up tool becomes more user-friendly.

4. SPECIFICATION

The following chapter will dive into the relevant stakeholders involved in the process and will determine what the main requirements are through the analysis of the initial user interactions that were measured through a survey and a group feedback session.

4.1 STAKEHOLDERS

It is important to determine who the relevant stakeholders are, their roles within the project and what they want to obtain from the project. This will allow to ensure that the best possible result is obtained. The four stakeholders identified in terms of importance and relevance are the teachers who will use the tool, the content developers of the tool (Adina & Robin), the technical tool developers (Mendix team) and the University of Twente.

4.1.1 Teachers

The Teachers that will use the tool are the users. They will interact with the tool and will aim to receive advice on how to implement CBL in their courses clearly and effectively by using the tool.

4.1.2 Content Developers

The content developers' and clients' roles within the project are evident, they are the decision-makers. They provide access to the tool, resources, and connections to potential users. They aim to receive advice on how the tool could be improved in terms of usability in future versions.

4.1.3 Technical Tool Developers

The technical developers are the Mendix team. They realise the ideas from the client to the actual tool. They aim to receive a list of technical changes that should be made to the current version of the tool to enhance its usability.

4.1.4 University of Twente

The University of Twente is the final stakeholder whose role is to support and assess the work. They can provide experiences and similar projects that will help guide the development process. Their aim is to ensure that a reliable final product is made that is useful and keeps the good name of the study and university.

4.2 INITIAL SURVEY

With an initial version of the tool almost ready to launch, it was decided to analyse the current version first. To do this, a survey was sent out to potential tool users. These were teachers who were (potentially) interested in implementing CBL in their classrooms. In Chapter 3.2, the development of the survey was explained. Using the sections that were described, the following questionnaire was developed. The first section focused on knowing if the respondents were teachers and if they were interested in implementing CBL in their teaching. The second section focused on usability. The questions focused on understanding if the users found the tool usable, and user-friendly, how they found the selection of the curricular components, and how they felt when progressing through the tool. The third section focused on content by asking questions about the different descriptions and the usefulness and clarity of the advice. This was followed by the Functionality section which asked

questions on providing feedback to developers and the provided instructions. The next section was on the appearance and asked questions on the design, text colour font and layout. The next section was on interactivity and asked questions on liking using the tool. The final section asked users questions on the perceived usefulness of the tool to help teachers implement CBL in their classrooms. The full questions can be found in Appendix A.

The users were sent an email where they were provided access to the tool along with the questionnaire. In total, three users filled out the questionnaire of which two were teachers interested in using CBL and one was a student assistant with experience using CBL. The graphs and tables of the results can be seen in Appendix B to G. Out of the three respondents, regarding usability (Appendix B), users tended to agree with the statements provided. There were three statements which had varying results which were “The tool is intuitive to use”, “It was easy to go back to a specific curricular component”, and “It was easy to restart the entire selection process”. These statements remarked that there was a need to tackle the tool’s intuitiveness and that the curricular component needs to be further developed to be more efficient. Notably, users strongly agreed that the tool was very consistent and that it was clear that the process was completed. The users remarked that there was a lack of an introduction and that it was slightly confusing to understand the difference between current and desired level meaning that it should be made more explicit what users should be doing in the tool and how they will be doing it.

Regarding the content (Appendix C), users tended to agree with the statements but there was disagreement with the curricular components’ clarity. This means that the curricular component descriptions, along with the design of it need to be rethought to be made clearer for the users. The Functionality strategies (Appendix D) were also received positively but there was a disagreement with the statement on the easiness of giving feedback to developers which implies that it might not have been clear how or what the feedback button is for which is a point for improvement. The Appearance (Appendix E) was well received with a slight disagreement on the colour, fonts and sizes being adequate meaning that some information might not be clearly or effectively presented to the users which should be addressable in a simple yet effective way. The interactivity (Appendix F) showed a concerning level of disagreement (2 of 3 users) of liking using the tool. This is an issue to tackle as if users do not enjoy working with the tool, they might not recommend it to others and they might not get the most out of it. Regarding the advice, the results showed that users found the advice useful and clear but that there was still room to make it clearer. One of the comments remarked that the different aspects of CBL were not present meaning that a clearer connection should be made with the first section and the advice. A final remark suggested adding real-life examples to enhance the tool’s experience.

4.3 INITIAL FEEDBACK SESSION

After filling out the survey, the users were invited to a feedback session. The goal of the feedback session was to gain more insights into the responses from the survey and understand what potential users felt they were lacking and would like to see in the tool. The feedback session took place on the 26th of March 2024 at the University of Twente where the clients and three participants (who had filled out the survey) were present. The structure of the session was organised in two parts. The first focused on the selection of the different curricular component levels and the second on the advice. Within each section, an explanation was made of what the survey results were followed by an introduction to the key issues that were determined. After introducing these issues, group discussions were held on

each specific issue that had been identified or that the clients wanted to discuss. The notes of the session can be seen in Appendix H.

The session provided some useful insights as highlighted by the notes. There were seven main outcomes from the session. The first outcome is regarding the introduction. The current version of the tool lacks any sort of introduction. The users need an idea of what to expect and understand what the tool is for and why it is useful for them. This can be done in numerous ways but should be kept simple and to the point. The second outcome was regarding the intuitiveness of the tool. For the most part, the tool is intuitive for the users but some buttons such as current and desired should be made more intuitive by i.e. changing their colour. Furthermore, there should be more usage of error prevention mechanisms to ensure that users don't do something wrong or click anything by accident. Regarding the motivation selection, it was not intuitive to have to click one by one. It should be made more intuitive and manageable for users by i.e., implementing a drag-and-drop system. Regarding the Curricular Component Selection, it is currently not designed efficiently. It should be designed to be able to return to a component rather than restart the entire selection. The motivation selection should also be simpler for users as it currently seems overwhelming. It could be an option instead of having all components just having a top 3 of wants and a top 3 of not wanting to focus on. In addition, this should be clarified further in the introduction.

The fourth outcome regarded the feedback to developers. Currently, it is not clear where the feedback goes. It should be made clear who receives the feedback and make it accessible to everyone. Furthermore, in the Advice section, there should be an option to provide feedback on the advice itself so the content developers can get information on the effectiveness of the advice. This should also be explained further in the introduction. Moving onto Font, Size & colours, the users were generally happy with it, but key information should be changed in colour and highlighted. Furthermore, an emphasis was made on making some pieces of text shorter (at least on screen) and then providing the option to expand upon that if the users want to so they are not overwhelmed. The next outcome was regarding the general liking of the tool. It highlights that currently; it provides a good overview of CBL and that it is a good introduction to it but that some terms could be further explained and that there is the possibility to add attachments and information so users can have inspiration and ideas of what and where CBL can be applied. The outcome was regarding the advice. The feedback highlighted that first and foremost, there is a need for examples and attachments to get an idea of how the advice could be applied. Furthermore, there should be access to further points of contact to discuss the steps to be taken. The advice should also not be as text-heavy, it should make use of features such as icons and expandable text to make it easier to read and more accessible for the users. A table overview might be an effective way to show the information.

4.4 INTERVIEW RESULTS

A set of interviews were also conducted to gain further insights. The interviews were conducted with teachers and students with experience in User Experience and User Interface design. In total 4 teachers and 2 students were interviewed. The users were first allowed to interact with the tool and were then interviewed with questions that were linked to questions asked in the survey. The interview questions can be found in Appendix I and the summarised notes of each of the interviews in Appendix J. The interviews served as a way to back up the insights gained through the survey and feedback session. The interviewees highlighted the need for a clear introduction to explain what users were expected to do and what they would gain by using the tool. One teacher suggested defining CBL in the introduction, so beginners also understand what the tool is about.

Regarding the curricular component selection, the interviews highlighted that it should be re-designed to be made more user-friendly by firstly making the different levels the same size and then making the (re)selection clearer so there is no confusion by making it clearer when a user is selecting their current or desired level of CBL. Some of the explanations of elements within the different levels could be made clearer by adding sources to definitions of those terms. The motivation selection lacked an intuitive method to prioritise which could be fixed by implementing a drag-and-drop interface alongside a definition of what the components each mean as users might forget what each component meant. This also links to what the students highlighted regarding error prevention. They suggested having more error prevention to avoid any unnecessary user mistakes. The interviewees suggested that the tool was visually consistent which was appreciated but some visual elements could be added to make the tool more attractive such as a progress bar to see how far the user is (and also making it easier to return to specific curricular components), a light background image instead of a white background, a more clear header rather than just “Advice Wizard” and highlighting keywords and information such that it is more visually appealing for the users. The interviews also suggest that there is currently a text overload, especially in the advice section. Interviews suggested limiting the amount of text per page or limiting what is visible by adding dropdown options and specific visual aids related to the advice components.

According to the interviews, the advice section would largely benefit by including real-life examples and case studies from different fields to help the teacher get an idea of what can be done but the teacher remarked that breaking the advice down into actionable steps is already a good step forward as a teacher will have a good indication of where to go next. The teachers also highlighted the positive side of having a print button but highlighted the need to have a button to contact experts i.e., CELT so they know how to proceed with the given advice. The interviewees also suggested that the tool is more targeted towards newer teachers and that more experienced teachers might be less inclined to use the tool but that is not an issue. They emphasised the importance of making the tool provide clear and actionable steps so teachers find it useful and that it could be further improved to cater to personal contexts and fields as the way CBL is applied might vary within fields. All in all, the interviews provided insights that backed up the survey and feedback session.

4.5 DESIGN REQUIREMENTS

The initial user tests (survey, feedback session, and interviews) provided good insights into the requirements needed to make the tool even more effective. This is backed up with the key web design elements determined in Figure 3. Figure 3 is now updated into a relevant selection of elements which is seen in Figure 11 below.

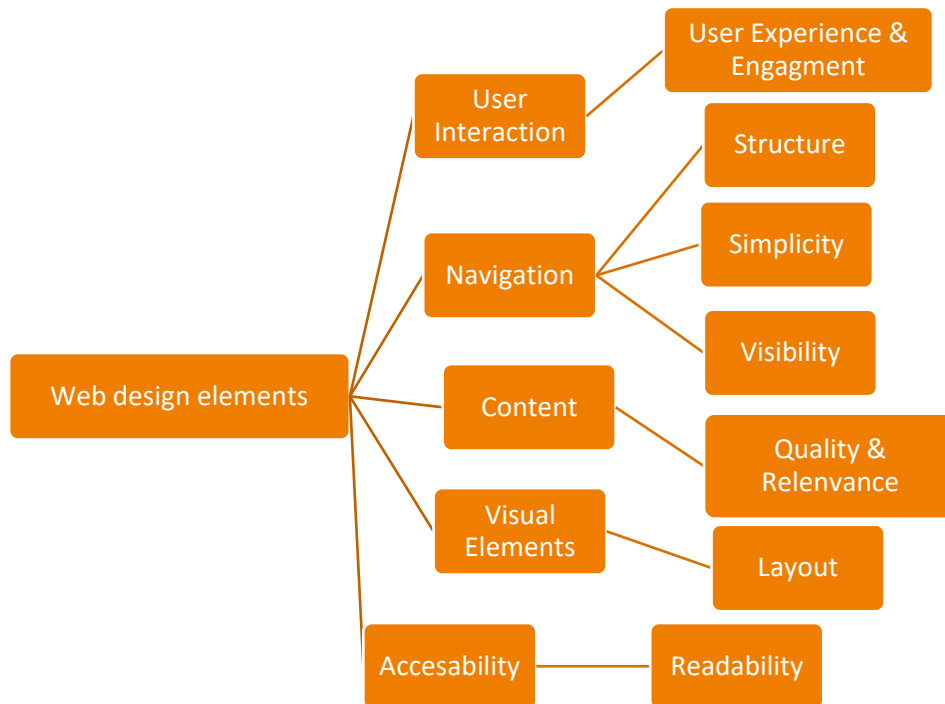


Figure 11 Web design elements that will be focused on during the project

Figure 11 highlights the elements that the project will focus on. This provides more clarity when developing the tool and allows one to find relevant information and literature if needed. Comparing Figures 11 and 3 shows that there will be no focus on Content management and that for the other elements, there will be a focus on particular elements, not multiple which allows for a more specific solution. Using insights from these components, a set of requirements for the new version can be developed focusing on teacher requirements. The requirements are categorised into four categories: Must, Should, Could, and Won't. These requirements are further labelled as functional or non-functional requirements to get a good idea of the necessary tasks to be performed. Furthermore, the requirements are categorised into what design element(s) they belong to. This can be seen in Table 2 below.

Requirement	Type	MoSCoW	Web Design Element	Explanation
Introduction Section	Functional	Must	Content (Quality & Relevence) User Interaction (User Experience & Engagement)	An introduction to the tool explaining the purpose, usefulness and what to expect.
Intuitive curricular component selection	Functional	Must	Navigation (Simplicity)	The curricular component must be intuitive and avoid confusion.
Feedback clarity	Functional	Must	Navigation (Visibility)	Specify what happens with the feedback and how it is used.
Easy-to-read Advice	Functional	Must	Accessability (Readability)	Make it easier for readers to understand the advice.
Clear re-selection process of	Functional	Should	Navigation (Structure)	Easy to return and re-select different curricular component levels.

curricular components				
Error Prevention mechanisms	Non-functional	Should	Visual Elements (Layout) User Interaction	Prevent unnecessary clicks and errors by users.
Improved motivation selection	Functional	Should	Navigation (Simplicity) User Interaction (User Experience & Engagement)	Less overwhelming and more intuitive motivation selection.
Keyword enhancement	Non-functional	Should	Accessibility (Readability)	Highlight and emphasise Keywords and information.
Enhanced Advice section	Non-functional	Should	Visual Elements (Layout)	Add icons and expandable text to make it more accessible.
Feedback on Advice	Functional	Could	User Interaction (User Experience & Engagement)	Users provide feedback on the advice that has been provided.
Additional CBL resources	Non-functional	Could	Content (Quality & Relevance)	Attachments and additional information on CBL to provide users with a more comprehensive understanding.
Contact to experts	Functional	Could	Content (Quality & Relevance)	Link users to experts to discuss further steps in more detail.
Feedback on progress	Non-functional	Could	User Interaction (User Experience & Engagement)	Provide feedback on how far along the user is to achieve their goal.
Link to other learning methods	Non-functional	Won't	Content (Quality & Relevance)	Provide advice or associations to other learning methods such as Problem Based Learning.
Customisation options	Non-functional	Won't	User Interaction (User Experience & Engagement)	Provide options to customise the themes and layouts of the tool.
Real-time collaboration	Non-functional	Won't	User Interaction (User Experience & Engagement)	Enable users to collaborate with other users or experts in real life while using the tool.

Table 2 MoSCoW Requirements

4.6 IDEATION

Having the requirements in place allows us to start coming up with solutions to the problem at hand. The initial version of Challenge Up is a strong first version of the tool which thus means that a major re-design is unnecessary. The tool does, however, have some points where it needs improvement. A prototype will be built to keep the working elements and implement the elements to improve. The elements that would be improved would be those based on the input by the user and the existing literature and state-of-the-art. The methods and techniques for ideation were described in Chapter 3 but in essence, involved first generating a mind map of issues to tackle and rough keywords of what could be done and then using IdeaStorm sketching and writing of solutions to come up with rough, creative, and innovative solutions to the problems identified. The sketches were done on paper. The mind map can be found in Appendix K and the key issues determined were that there was no introduction, that there was too much text, it was hard to restart the curricular component selection, there were limited visuals, it was hard to understand the motivation selection, the level selection was

confusing and that the keywords should be made clear. With the issues identified, the IdeaStorm was conducted for which the sketches and words of solutions can be found in Appendix L. The sketches were drawn using gut instinct as it would allow us to come up with the most creative and innovative solution.

Having some Ideas of what can be made before realising the prototype, quick sketches were made of the different pages with the new features that will try to be implemented. In Figure 12 below, the sketch of the introduction page can be found. Figure 13 shows how the design of the component level selection and Figure 14 shows the design of the Advice page once realised.

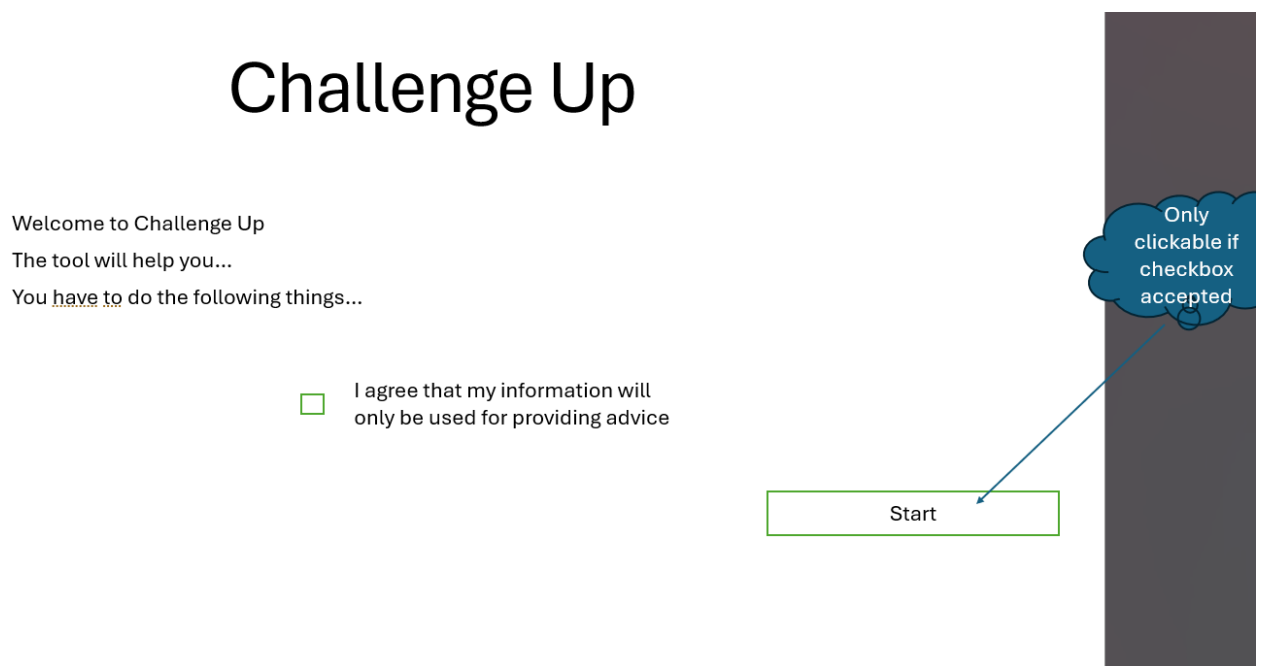


Figure 12 Design of the Introduction page

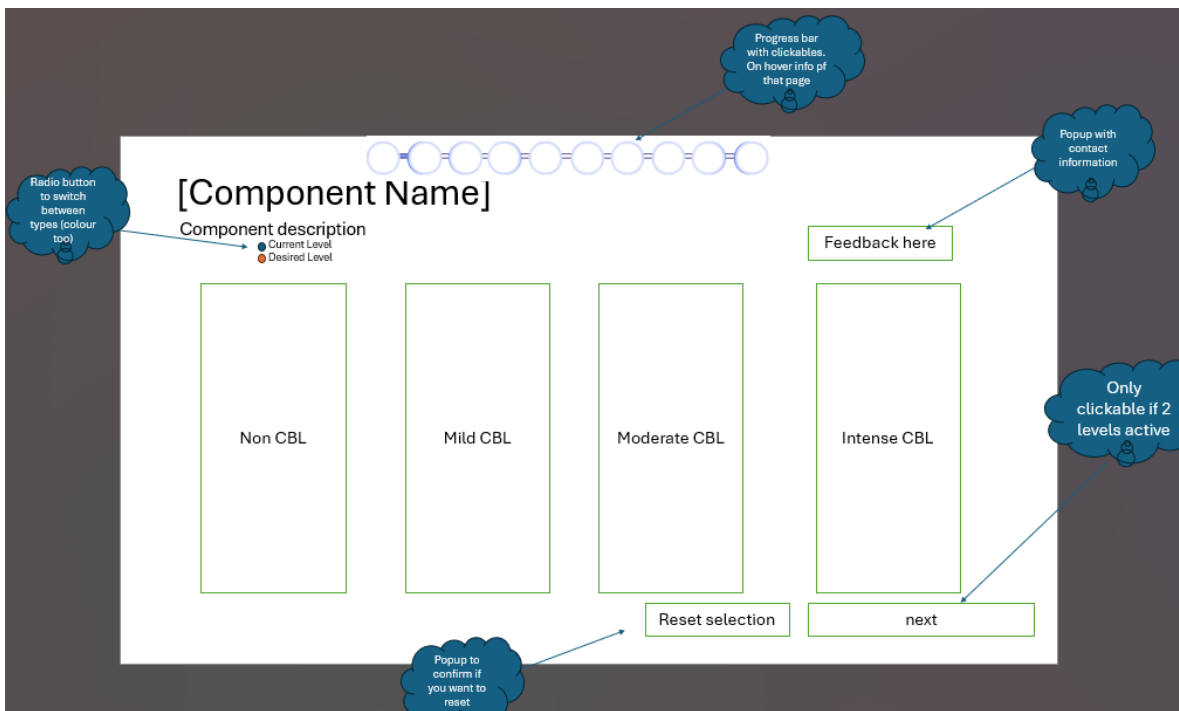
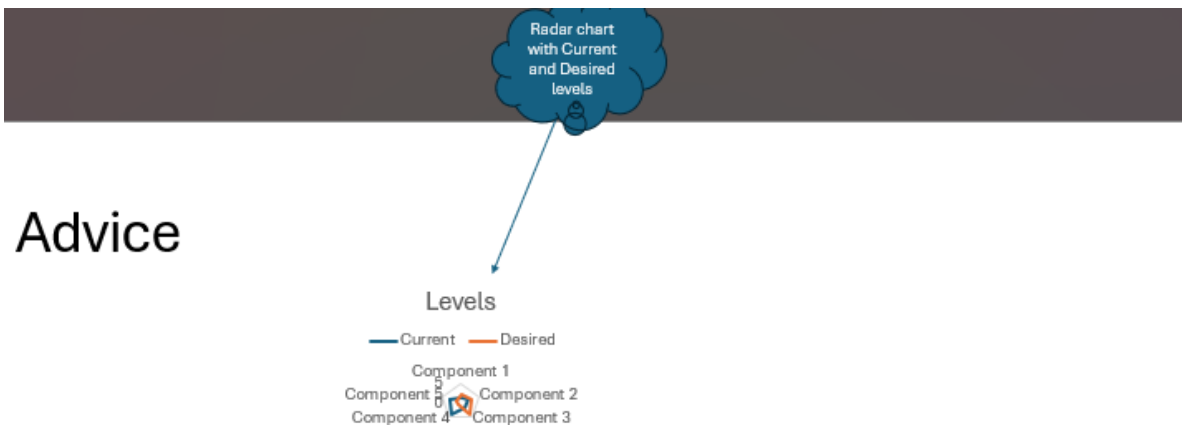


Figure 13 Design of Component-level selection page



For Component x the main points needed are:

- 1) [short task]
- 2) [short task]
- 3) [short task]

See more

Download Summary

Contact an expert

Figure 14 Design of Advice page

5. REALISATION

Having developed a set of requirements and having an idea of what could be developed, a prototype is developed using Bubble.

5.1 PROTOTYPE DEVELOPMENT

The prototype, as explained in Chapter 3 was developed using Bubble. Originally, the intention was to develop the tool using Wix.com but it was rejected after realising that the tool was a web application and thus required the ability to add more features with Logic and conditionals which Wix.com did not offer. The prototype was developed to comply with the requirements in Table 2. The different interactions were completed using the Workflow feature of Bubble. This feature allows the user to create different Logic scenarios to enable different features to work such as changing colour, changing the page, etc. Bubble allowed for a tool to be designed with User Experience at its core allowing to focus and modify elements that would have a direct impact on the experience the user has while using the tool. 18 separate databases were used in the making of the prototype. Nine of them were used for each component selection page individually. This database stored the current and desired levels selected for each component. The latter nine databases were used in the Advice page and displayed the advice specific to each component based on the most recent current and desired level selected for each component. The databases allow for a smooth user experience as they can experience the tool and receive advice instantly after filling out all of the current and desired levels. With the prototype, when the user enters the tool, their first view is an introduction. This can be seen in Figure 15 below. The introduction page acts as an introduction to the tool and explains to the user what they will be doing and how this will help them. Furthermore, this initial page includes a mandatory checkbox which explains how the data will be used to ensure there are no complications in terms of data security. The button to start the process only becomes active once the checkbox is selected to ensure that only users who want to use it can use it. The Introduction page was developed to ensure the user would understand what was happening and what to expect. While designing it became clear that the information should be concise and clear to ensure a rapid transition into starting the process. The workflow for activating the next button was designed by creating a Logic statement which made the button state active only when the Checkbox is checked.

Challenge Up

Welcome to Challenge UP
Through this tool, we aim to help passionate educators like you implement Challenge-Based Learning (CBL) in your classroom

What Challenge Up can do for you
The tool is designed to provide you with personalised advice of how to implement CBL. Furthermore, actionable steps are provided for what action to take. Finally, through the tool, you can get access to a wide network of CBL experts who can support you in your CBL journey

How to use Challenge Up
1) Before receiving the personalised Advice you will be asked to fill out the Current and Desired Level (in terms of CBL) of different Curricular components.
2) After completing this, you will be asked to rank these components in terms of preference. This will then be enough to generate the personalised Advice for you to use.

How Your data is used
When you log in, as an anonymous user, data is stored temporarily for only one browser session. When you close your browser, all data is removed. When you log in with your SSO credentials, the data you enter into the tool is stored and linked to SSO credentials. In this way the data remains available when you log in again. Data is stored indefinitely until you delete it yourself. Data may be used to improve Challenge Up. Data may also be used for research purposes, but will never be traceable to individual and personal data.

Keyword Assistance
If there is some CBL-specific terminology you do not understand, you can use this Glossary to guide you through the process: [Glossary-Terms](#)

Stay Inspired, Stay Innovative!

I consent for data being used. to generate advice.

start

Figure 15 Introduction page of Challenge Up prototype

Following the development of the Introduction, the component selection pages were developed. To do this, a working Curricular Component Page was first designed and was then duplicated and modified to the relevant Curricular Component content. In Figure 16 below, an example of the Curricular Component pages can be seen. Figure 16 shows how the component's title along with key terms are highlighted in bold to emphasise their importance. There is a space to add links to external resources which the user can access to understand the topic further. To select the current and desired level, a radio button is used. This button allows to dynamically switch from Current to Desired Level by a simple click allowing to change back and forth between levels. The text next to the radio button changes dynamically as well to ensure the user knows what they are currently selecting. When selecting for the Current Level, the textbox goes red whereas when selecting the desired, it goes blue. These colours are simple and non-obtrusive for the user. The level descriptors can all be found within rounded textboxes which are designed to provide the user with a sense of calmness and a low barrier of entry. The different levels also have space to add an example to make it clearer for the user. A reset button which allows to reset the component's selection. As seen in Figure 17 below, an error prevention mechanism has been added to ensure a user does not click it accidentally and lose their progress. Next to this, there is a next button which only becomes blue when and clickable once two components have been selected. The page was designed such that a current and desired level were selected before this button became active. The workflow for changing colours was developed by creating a counter that increased by one once selected and the "next" button would only become active when the counter had a value of two.

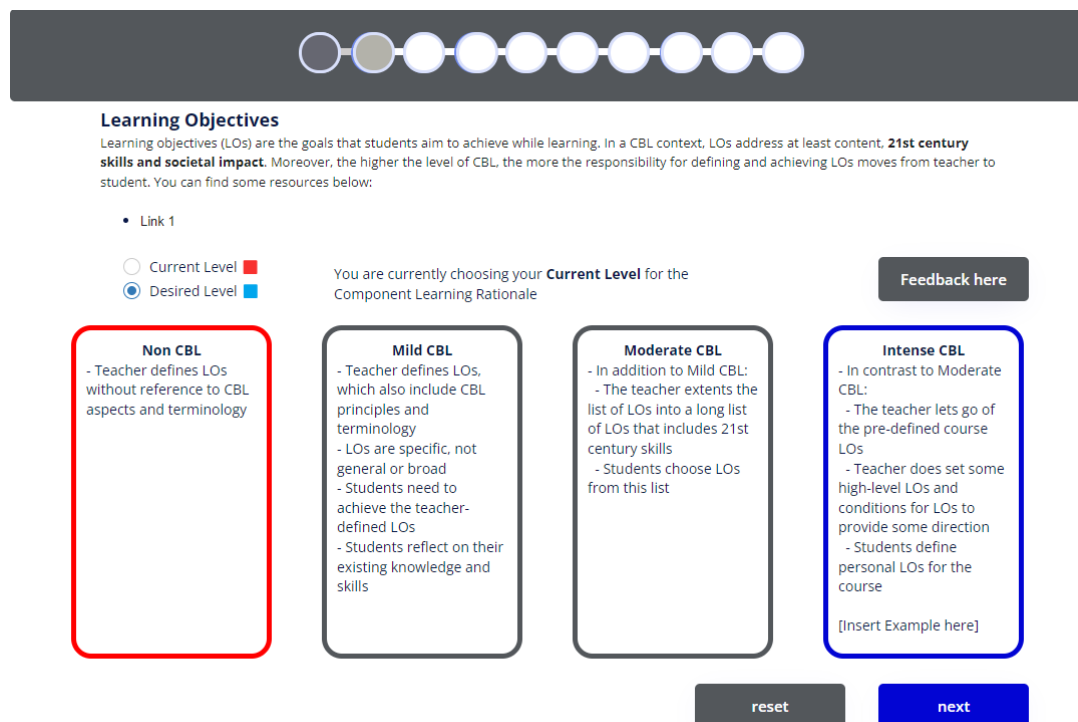


Figure 16 Component Selection page of Challenge Up prototype

Are you sure you want to reset this component



Figure 17 Error Prevention popup for resetting component of Challenge Up prototype

Unfortunately, the prototype does not allow users to select the same current and desired level. The Component Selection page has a feedback button providing a popup which provides the contact email of both the Mendix team and content experts (i.e., CELT). The final feature added to the Component Selection is the navigation bar. It is designed such that you can visually see how far ahead you are in the process and how much is left. Figure 16 also shows how the navigation bar has three distinct colours. The dark grey indicates complete, the light grey indicates the current component, and the white indicates what is remaining. As a user, you can press a previously completed page but are unable to press on a page after yours as that would disrupt the flow of the page. The different circles have an on-hover text indicating what page you would be going to prevent any errors from the user. After completing the design for one curricular component, the design was duplicated eight times, and its content was replaced by the different Curricular Components and their respective content. Having completed this, the Motivation selection was designed as seen in Figure 18 below. Similar to the component level selection, the title was added in bold. The motivation ranking is designed as a drag-and-drop system in which a user can drag and drop the different components into the desired position. The prototype, however, only switches the position of two items and does not re-order them according to the new position which would ideally be a feature in the final version. The different components are accompanied by a number to ensure the user knows what position they are ranking them in. A button to Recap the components was added where when clicked, a brief description of all the curricular components is shown so the user can recall any components if unsure. Similar to the Component Selection, there is a feedback here and a next button along with a progress bar. A choice was made to make this page the last element in the navigation bar and not to include the Advice in the navigation bar itself.

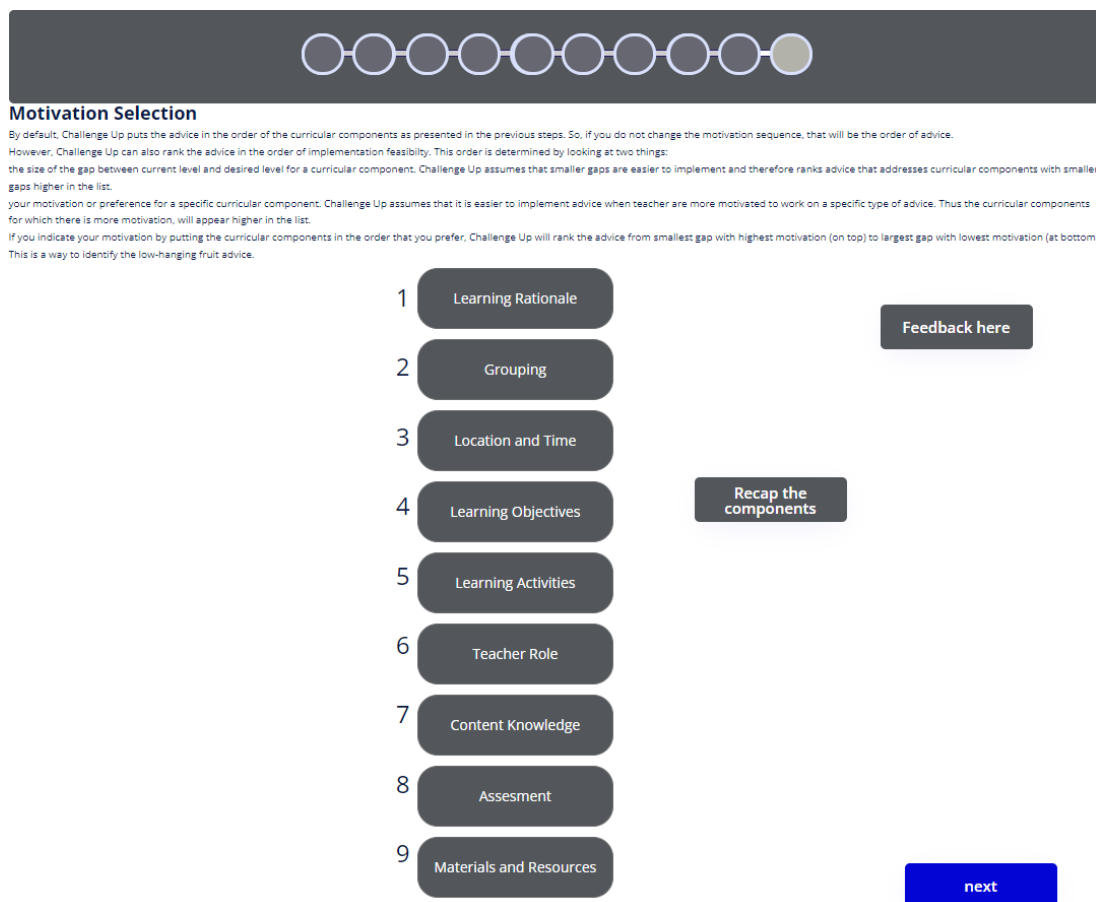


Figure 18 Motivation Selection page of Challenge Up prototype

After completing the motivation selection, the advice page was created as seen in Figures 19 and 20. As seen in Figure 19, the Advice page follows a similar design to the introduction page with the title in the place where the navigation bar was as it is the central focus for the process now. As in all pages, there is a feedback button where users can contact the developers and experts for more help. A radar chart is displayed with the same colours used throughout the component selection to help users associate what they had selected previously. This chart, also present in the current version provides visual guidance of where the user is and where they would like to be for the different components. Below this chart is a description of how to achieve the desired levels for each component which can be seen in Figure 20. Each component has a See More button beneath it which can be expanded to provide more detail. Before expanding a simple overview of key steps can be provided. Using this, the user can get a clear idea of actionable steps before expanding further and diving into more detail. The title of each component and current to Desired Level should also be highlighted in bold but this was unable to be done with the prototype. After going through all the components, the user gets four clickable buttons. They have the option to contact experts from CELT, they can (theoretically) access a database with multiple examples of CBL implemented into classrooms, and they can reselect the entire selection, this is only done after confirming that they want to do this via a popup that serves as an error prevention tool. Finally, there is a Print button where the users can print the full advice in detail to have it easily at hand. The workflow for the drag-and-drop was designed by inserting a drop area into each component. If an item was dropped in that area, the dropped item would become true for that box and would switch with the item that was originally in that position.



Figure 19 Beginning section of Advice page of Challenge Up prototype

Assesment: Non to Mild
 - Key Point 1
 - Key Point 2

[See More](#)

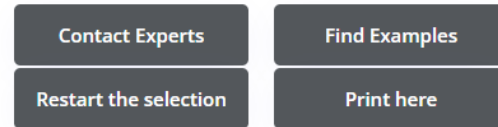


Figure 20 The content section of the Advice page of the Challenge Up prototype

To show the advice, a database was created including all the content. The prototype stores the last item of Current and Desired selected for each component and when it arrives at the Advice page, after checking the last Current and Desired Level for each component, a specific Advice per component is shown. The workflow consisted of checking each component’s Current and Desired Levels through the database. After checking this, a specific dataset is displayed which is truncated while the “See More” button is active”. The prototype does not however rank the advice in terms of the motivation selection but should be done in the final version. Importantly, since the tool is part of the University of Twente, the same colour scheme was tried to be used. The background colour of the navigation bar and buttons were all #53575B, the UT’s official background colour. The text font should ideally have been “Linotype Univers,” but it could not be added due to a cost limitation. When opening the prototype, it would usually not adjust to the screen size automatically, leading to a blank margin appearing on the screen. This was unable to be solved and the problem was found within the Bubble interface.

5.2 COMPLIANCE WITH REQUIREMENTS

Having built the prototype using Bubble a quick verification with the requirements developed in Table 2. A personal check with the requirements is conducted and in Table 3 below, the requirements are assessed based on the extent to which each requirement is complied with based on a personal opinion. The Table does not show the Won’t Requirements as those are not deemed necessary. A user test of the prototype is however required to ensure that the requirements are met and that the own opinion is not taken at face value.

Requirement	Compliance
Must	
Introduction Section	Fully Complies
Intuitive curricular component selection	Completely Complies
Feedback clarity	Fully Complies
Easy-to-read Advice	Fully Complies
Should	
Clear re-selection process of curricular components	Fully Complies
Error Prevention mechanisms	Fully Complies
Improved motivation selection	Mostly Complies
Keyword enhancement	Fully Complies
Enhanced Advice section	Mostly Complies
Could	
Feedback on Advice	Fully Complies
Additional CBL resources	Complies to some extent

Contact to experts	Fully Complies
Feedback on progress	Fully Complies

Table 3 Table on Personal opinion of compliance with design requirements

Table 3 shows how from a personal perspective, most of the requirements have been fully complied with. A few requirements have not been fully complied with due to either not being sure if it fully satisfies the users as is the case with the “Intuitive curricular component selection” requirement or the “Improved motivation selection” requirement and due to not being an expert on content-specific information as is the case with the “Additional CBL resources” requirement.

6. EVALUATION

6.1 PROTOTYPE USER TESTING

To conduct the user testing, interviews were conducted with teachers and UX designers. In total, 3 teachers were interviewed along with 2 students with UX design experience and a professional UX designer. Two additional teachers were asked to complete an evaluation form as they could not conduct the interview. In total, there were thus eight users tested. The interview questions and questionnaire used were the same as those used in the initial test with the added remark of hinting towards specific features implemented in this prototype if the user did not mention them in their response. All users differed from the original test except the two students with UX design experience. This was done to ensure that, a wider pool of teachers could learn about the Challenge Up tool and thus provide critical insights into how they feel about it. Secondly, this allowed the two users who provided significant feedback to see if the tool had improved and recall previous elements which they found lacking in the original version. The structure of the interviews consisted of users being given 5-10 minutes to use the tool and then being interviewed with the tool in front of them so that they could also refer to specific details they noticed. While the interviews took place, notes were taken and their summary along with the survey results can be found in Appendix M.

Regarding the user's overall experience using the tool, the overall response was positive experiences with one of the teachers describing the tool as “a pleasant experience for users”, intuitive, and easy to use. The users highlighted that they thanks to the introduction, the user knew “what to expect and what to do”. The introduction explained what to expect while using the tool and how to use it effectively. Moving onto the curricular component selection, users described it as clear, and logical. They highlighted the effective use of curved edges for each level and different colours as effective measures to guide the user through the experience. One of the teachers found it irritating that “you can only return via the navigation bar”. The interviewees highlighted that some of the descriptions missed detail but including that space for additional links could deal with that. About the motivation selection, users found that when the drag-and-drop was fully fixed it would be an effective means to rank importance. Users also enjoyed having a small button describing the components once again.

Moving onto the navigation between components, users described navigation as being smooth, clear, and consistent. This was thanks to the navigation bar which indicated the progress. One user with UX experience highlighted that “the use of natural colours made it smoother and made it a pleasurable experience”. One teacher suggested that the button hovered could expand a bit so that it is clearer, what is going to be pressed. Users found the navbar to be a nice visual tool to show progress throughout the tool. Multiple users did suggest that a go-back button would be nice as this would make them less reliant on the navbar and make it easier to return to the previous component. The advice was received quite positively. Users were happy to see the radar chart in the advice as it provided a visual guide of where they wanted to go. They found that the expandable text did not overwhelm them with text which was a nice feature. Multiple users highlighted that highlighting keywords and including specific examples for clarity could be an effective way to make the advice even more effective for the user trying to implement CBL. Concerning error prevention and prominence throughout the tool, users appreciated the double-checking by the system when they wanted to reset the selections. The feedback buttons were positively received and seen as useful aids for teachers in doubt. The visual design was generally described as being simplistic and visually appealing. Multiple users found that the font was not adequate, and that some alignment of different components was needed. They complimented the user of natural colours to not strain the user's eyes but also suggested highlighting keywords in the advice section for better emphasis. All in all, teachers found that the tool had potential for educators if they had an interest in CBL but highlighted that for someone with no

interest, it would not be useful, and the user would not be engaged in the tool. Users suggested that the tool, spacing and alignment between elements could be improved, using professional-looking fonts, using links, and using AI to make the advice more personalised could make the experience for the user better and more pleasurable.

6.2 COMPLIANCE WITH DESIGN REQUIREMENTS ACCORDING TO USERS

Having seen what the users had to say about the tool, the user requirements can be verified once more and updated in terms of compliance according to the users' opinions. A table with the updated requirements can be found in Table 4 below.

Requirement	Compliance	Feedback
Must		
Introduction Section	Fully Complies	Clear and effective as it gives guidance to the user
Intuitive curricular component selection	Mostly Complies	Effective selection with some small improvements needed in the go-back function
Feedback clarity	Fully Complies	Clear, simple, and effective
Easy-to-read Advice	Fully Complies	Expandable text works well
Should		
Clear re-selection process of curricular components	Fully Complies	For the most part clear and effective. Only missing a go-back button instead of only relying on the navbar.
Error Prevention mechanisms	Fully Complies	Good, useful but occasionally might feel excessive
Improved motivation selection	Mostly Complies	Effective once drag-and-drop works as a list and does not replace the item
Keyword enhancement	Fully Complies	Effective, more needed in Advice section
Enhanced Advice section	Fully Complies	Effective and clear thanks to expandable text and radar chart
Could		
Feedback on Advice	Fully Complies	Clear and present.
Additional CBL resources	Complies to some extent	Should still be added
Contact to experts	Fully Complies	Nice touch
Feedback on progress	Fully Complies	Good to have a navigation bar as visual guidance

Table 4 Table on perceived compliance with design requirements

Table 4 shows the requirements for compliance based on the user testing. The table shows how most of the requirements have indeed been met. Only three requirements that are not fully complied with which are “Intuitive curricular component selection” requirement and “Improved motivation selection” which are currently Mostly Complies could be considered as Fully Complies if minor details/bugs are fixed.

7. DISCUSSION AND ADVICE

7.1 DISCUSSION OF RESULTS

The tool was found to provide a pleasant, easy-to-use, and intuitive user experience. The introduction of the tool allowed users to understand what was to come and how to navigate through the tool. This allowed us to effectively tackle one of the issues identified in the first version and shows how a well-designed introduction is crucial for setting expectations and ensuring that is a smooth start. This improvement was likely the cause for a better overall user experience. Regarding the curricular component selection, users for the most part found it to be logical and clear. The consistency of the tool was an appreciated detail in this section. Using curved edges and diverse natural colours helped the users navigate the tool with a pleasant experience. This demonstrates how having certain elements can significantly enhance the user experience by making the interface more intuitive and aesthetically pleasing. However, users expressed some frustration with the navigation which despite having a navigation bar allowing them to travel to the different sections seamlessly, users seemed to like having the option of a go-back button to enhance navigational ease of use. The motivation selection was positively received in terms of its drag-and-drop feature and the presence of a button to show what each descriptor meant was also positively received. The navigation shows how a smooth interface is an important feature and that it is important to have clear elements that are also valued for understanding what the user should be doing/expecting.

The navigation was praised for being smooth, clear, and consistent throughout the tool. The navbar was a useful detail to show the progress being made but there were a few small features that could be added such as a go-back button or an expanded area when hovering over a button to ensure that the navigation was smoother and thus that the User Experience was also improved. The visual design received mixed feedback. While its simple and visual design with natural colours was complimented, users remarked having the page elements aligned and highlighting keywords in the advice section for more emphasis. Furthermore, improving the spacing between elements would allow for a more polished and professional-looking user interface. The advice section was complimented for its use of the radar chart and the expandable text used to not overload the user. Users did highlight the need to highlight keywords and use more examples for better clarity and effectiveness. This provides insights into the importance of balancing visual elements with textual elements and ensuring that there is no textual overload for the user. Regarding error prevention, while the double-checking was much appreciated, it might have felt slightly excessive at some points. The error prevention should be kept but maybe made more integrated within the system by for instance having the button expand before clicking it. The feedback buttons were seen as useful tools to contact both developers and experts as they reinforced the tool's user-friendliness. These insights show that despite error prevention being important, finding a way to integrate it seemingly is equally as important for the experience. All in all, teachers found that the tool had a lot of potential to aid teachers in implementing Challenge-Based Learning in their courses, but they noted that this tool would only really engage users with interest in CBL and not those without any interest in it. This highlights that the tool has been designed for a specific target group.

When comparing these results to the first user test, in terms of the guidance, the second test highlights how the issue raised initially of a lack of an introduction has successfully been tackled and that users now felt like they had a clear understanding of what to expect thanks to the introduction page. The curricular components were previously seen as needing a user-friendly design with the need. With the new version, the selection is perceived as clear and logical with features such as curved edges and colours as being an effective addition. Furthermore, the navigation bar is a nice addition to the tool although it could do with a go-back button which the original tool contained. The motivation selection was considered to be improved thanks to its drag-and-drop system (although it could be

refined further) and the feature to see what each component consisted of. The visual design was complimented for the use of its natural colours, but the font was still seen as slightly unprofessional, and alignment of elements was still needed. Regarding the Advice section, the original test suggested that using real-life examples and a button to contact experts would be appreciated. In the new version, these features were tackled successfully. The error prevention measures were lacking in the first version and the second version although present, they might become a bit intrusive in some points. All in all, the prototype seems to be better received in terms of usability and user experience for the user when compared to the initial version of Challenge Up. Comparing both versions also shows how in the new version, there is still needed to add a go-back button, integrate error prevention within the tool such that it is not as intrusive, ensure the drag-and-drop feature is fully functional, ensure the advice section has keywords highlighted and ensure the tool has examples implemented that can help guide and inspire the teachers.

The results can also be compared with the literature review from Chapter 2. The positive feedback on the tool's easy-to-use and intuitive nature correlates with Allison et al. [25] and Garret's [29] emphasis on a tool needing to be simplistic and usable at its core. Furthermore, the introduction helped to ensure that users felt confident while using the tool which reflects Flavian's [24] view on needing to guide the users effectively through effective content delivery. regarding the navigation, Wojdyski's [41] and Lee's [42] findings suggested that navigation should be simple, logical, and easily accessible and this is also evidenced by the user testing where users also emphasised the need for an additional return button highlighting the importance of flexible and user-friendly navigation. The user testers highlighted the use of simple natural colours which prevented eye strain and contributed to a pleasant user experience. This feedback along with the desire of users to have a more professional font aligns with Jongmans [27] and Hsu [28] both show that visual design such as colour, layout, and typography, and crucial elements in successful user experience and engagement. The use of the radar chart is also linked with the idea of using relevant visual aids when needed as highlighted by Flavian [24] and Garret [29] who suggest that using visual aids can maintain simplicity and enhance user experience.

The user testing showed how consistency throughout the tool is one of the most important elements needed for the success of a digital tool. Users highlighted the need for better alignment, better font selection and enhanced options in navigation. Such suggestions from target users and UX designers provide valuable insights, evidencing the importance of professional evaluation in improving and validating a prototype. The differences in the feedback can be attributed to different factors. The diverse pool of users ensured comprehensive feedback, which helped find new and persistent issues. Furthermore, the user testing allowed for more detailed feedback resulting in actionable results. Through this, it is also possible to develop the Advice that will be provided to the client on improvements to make to the Challenge Up tool. The user feedback and analysis provided an opportunity to understand what the users feel about the prototype and are a driver for any changes and recommendations that should be given to the client.

7.2 ADVICE TO CLIENT

The feedback has demonstrated that some adjustments in the technical implementation would still have to be made such as improving some of the navigation features, completing the drag-and-drop functionality and making the error prevention more integrated within the system. Given this, to improve the Challenge Up tool in terms of usability and User Experience, the client can implement a set of features into their version of Challenge Up. The following features described are labelled in terms of priority ranging from High priority Recommended to Medium Priority and Low Priority. The suggestions can be found below:

1. **High Priority:** An Introduction Section explaining what the tool is about, what to expect from the tool, and how to use the tool.
2. **Medium Priority:** Use a consistent visual identity (consistent with the UT)
 - a. Background colour for the header: #53575B.
 - b. Font Type: Linotype Univers.
3. For the Curricular Component Selection
 - a. **Low Priority:** Make textboxes of the same size for each level and make that whole area clickable.
 - b. **High Priority:** Colour code the Current and Desired Level and keep it consistent (also in the Radar Chart)
 - c. **Low Priority:** Show textually what Level is being selected (i.e., you are selecting for Desired Level)
4. Motivation Selection
 - a. **High Priority:** Make the selection a drag-and-drop which keeps an item in a list (does not replace item positions).
 - b. **Medium Priority:** Add an option to easily see what each component entails.
 - c. **Low Priority:** Make sure there is enough spacing between elements and that they are aligned with other elements.
5. Advice
 - a. **Medium Priority:** Keep the Radar chart but use the same colours as used in the component selection.
 - b. **High Priority:** Make the Advice appear expandable with a See More option.
 - c. **Medium Priority:** Provide access to examples within the advice.
 - d. **Low Priority:** (Potentially link a repository of examples).
6. Content
 - a. **High Priority:** Highlight keywords and terms using bold or underlined.
 - b. **Medium Priority:** Add examples throughout the tool (i.e., during the component selection and in the Advice).
 - c. **Medium Priority:** Have links to external sources which expand on the provided information.
7. Navigation
 - a. **High Priority:** Add a progress bar (which is clickable) that visually shows the progress made by users.
 - b. **Medium Priority:** Add a go-back button to return to the previous section.
 - c. **Low Priority:** Make the buttons being hovered slightly larger or change colour to integrate error prevention within the experience.
8. Feedback
 - a. **Low Priority:** Make sure feedback buttons are on all pages in similar positions.
 - b. **Medium Priority:** Make this feedback provide access to the developers of the tool but also experts in CBL, i.e., CELT.

8. CONCLUSION & FUTURE WORK

8.1 CONCLUSION

The Graduation Project aimed to develop a new version of Challenge Up, a web-based tool to guide teachers in implementing Challenge-Based Learning in their courses. This improved version would focus on the User Experience and usability of the tool. The GP aimed to answer the question: How can the Challenge Up tool be improved by incorporating necessary web-based elements to enhance user experience and support teachers in implementing Challenge-Based Learning (CBL) in their courses? To answer the question, a literature review was conducted along with a user test of the current version and concluded with the development and testing of a new and improved version of the tool. The initial literature review and user testing provided insights that helped answer the sub-questions posed during the introduction by suggesting that the new version should focus on elements such as User Interaction specifically User Experience, Navigation specifically structure, simplicity, and navigation, Content specifically Quality & Relevance, Visual Elements specifically layout and Accessibility specifically readability. Furthermore, the tool should contain clear instructions on what to do as this influences the likelihood of using the tool further.

The new version was developed using Bubble, a visual web-based programming application. This improved version of the tool includes an introduction, a clear and consistent navigation bar, a clean and simplistic visual design, an emphasis on keywords and external resources, and an Advice page with text that can be easily expanded such that the user is not overloaded with text. After testing this new version, it became evident that the user experience would improve due to these features. This evaluation allowed for the development an advice that will be provided to the client on tips on how to improve the Challenge Up tool. The main Research Question can thus be responded to by suggesting that to enhance the user experience of the Challenge Up tool, the tool should contain an introduction page with clear steps, a simple and consistent navigation bar, a clear Curricular Component Selection by using colours and larger clickable areas, an intuitive drag-and-drop tool in the motivation selection, an advice section which does not overload the users and a feature that allows users to provide feedback and ask questions to experts throughout the whole process of using the tool. The improved version of Challenge Up brings several implications to the table. First and foremost, if the advice is implemented, the Challenge Up tool will provide users with a smooth User Experience while using the tool and will ensure that users get a pleasant experience while interacting with the tool. This new version also brings some implications on the importance of finding a balance between what is shown and how it is shown in a platform intended for learning.

8.2 LIMITATIONS AND RECOMMENDATIONS

Throughout the project, several limitations arose. The first and most evident limitation is that of time. With the given timeframe of about 3 months, it meant that a full prototype from top to bottom could not be developed completely, thus an alternative of a visual web-based tool was selected. If more time was available, a prototype using programming could have been developed ensuring that some of the minor details could be fixed with more ease. To prevent such a limitation in the future, a more iterative approach could be used where the project is broken down into smaller components to make the tasks more manageable. Secondly, there was the limitation of money. Some features in Bubble were only accessible through a paywall. These features would have allowed for an enhanced database and enhanced features allowing the prototype even more developed with the time given. Due to this constraint, time was spent finding a longer solution when simply paying for it could have solved it in less time. This can be tackled by trying to find sponsors or discussing further with the client if any budget can be allocated to help the prototype's development. The final limitation that can be identified is the access to specific target users. Despite having access to many teachers at the

university, their busy schedules meant that some were unable or unwilling to help. This and the fact that it was not possible to get a wide pool of teachers with limiting levels of interest in CBL, limited the thoroughness of the evaluation conducted with the current and new version of the tool. Without this input, one cannot be fully sure if the target users are in favour as it was only tested with a fairly small pool of users.

The project and evaluation have also provided some insights into recommendations for improvement. For the prototype itself, the improvement could be achieved by ensuring that small features such as selecting the same current and desired level, the drag-and-drop in the motivation, and the keywords highlighted in the advice are functional. Secondly, a return button is present throughout the curricular component level selection and finally, the error prevention is integrated more smoothly into the user experience. In terms of general improvement, the communication with the client, although consistent throughout, could have been a bit clearer by providing more regular updates on progress made throughout the project so that they did not get worried or concerned. Furthermore, improvement could be made in ensuring that what is being written and delivered is up to a certain standard without spelling or grammatical mistakes as that hinders the experience for the reader. This prototype is a small action out of the many that can be taken. The Challenge Up tool can be further improved by researching how to implement Artificial Intelligence into the system, ensuring that even teachers with no current interest in CBL can become engaged with the tool, and finding a way to have more subject-specific advice.

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APPENDICES

APPENDIX A: SURVEY QUESTIONS

Section 1 :

- What is your name?
- Are you a teacher?
- Are you aiming to implement CBL in your teaching?

Section 2: Usability

To what extent do you agree with the following statements on Challenge Up's Usability.

- The tool is intuitive to use
- The steps are simple and easy to follow
- The tool is user-friendly
- It was easy to restart the selection within the curricular components (i.e., non-CBL, mild, moderate, intense).
- It was easy to go back to a specific curricular component
- It was easy to restart the entire selection process
- There is consistency in the navigation throughout the tool
- Progressing through the tool is logical
- Progressing through the tool is consistent
- It is easy to progress through the different curricular components
- It is easy to go back to different curricular components
- It was easy to log out of the system at the end of the session
- It was clear when the process had ended
- It was clear that you could print and save the advice to your computer

Are there any missing features that could make Challenge Up more usable? Please mention them here.

Section 3: Content

To what extent do you agree with the following statements on Challenge Up's Content.

- The different curricular components (i.e., Learning Rationale, Aims...), are clear
- The different CBL levels (non-CBL, mild, moderate, intense) are clear
- The level descriptions (presented under each level) are clear
- The final advice provided is useful
- The final advice provided is clear

If you miss any content, please add them here.

Section 4: Functionality

To what extent do you agree with the following statements on Challenge Up's Functionality.

- It is easy to give feedback to the developers

- The instructions of what had to be done were clear

Section 5: Appearance

To what extent do you agree with the following statements on Challenge Up's Appearance.

- The graphic design is visually appealing
- The colours, fonts and sizes are adequate
- The layout is engaging for the users

Section 6: Interactivity

To what extent do you agree with the following statements on Challenge Up's Interactivity.

- I liked working with the tool
- I felt confident about my personal information while login in

If you miss any features, please mention them here

Section 7: Closing Questions

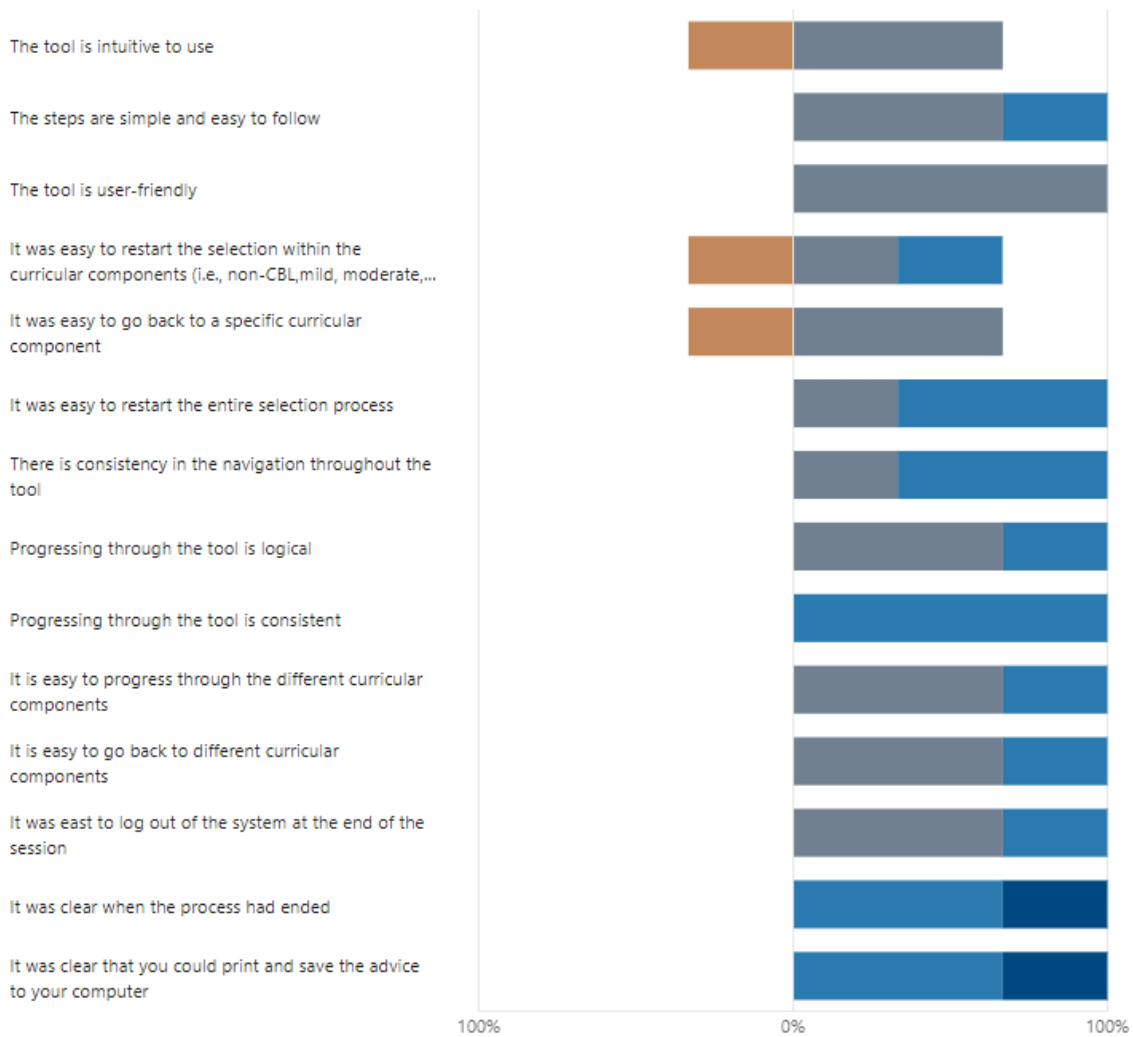
To what extent do you agree with the following statements.

- Challenge Up can help me transition towards CBL in my teaching
- Challenge Up can help other teachers transition towards CBL in their teaching

Any Final remarks

APPENDIX B: SURVEY RESULTS CONCERNING USABILITY

■ Strongly disagree
 ■ Disagree
 ■ Neither agree nor disagree
 ■ Agree
 ■ Strongly agree
 ■ Not Applicable



5. Are there any missing features that could make Challenge Up more usable? Please mention them here.

2 Responses

ID ↑	Name	Responses
1	anonymous	An introduction of what is going to happen, now the first question pops up out of the blue
2	anonymous	Difference between current vs desired levels could be highlighted better

APPENDIX C: SURVEY RESULTS CONCERNING CONTENT

6. To what extent do you agree with the following statements on Challenge Up's Content

[More Details](#)

■ Strongly disagree
 ■ Disagree
 ■ Neither agree nor disagree
 ■ Agree
 ■ Strongly agree
 ■ Not Applicable

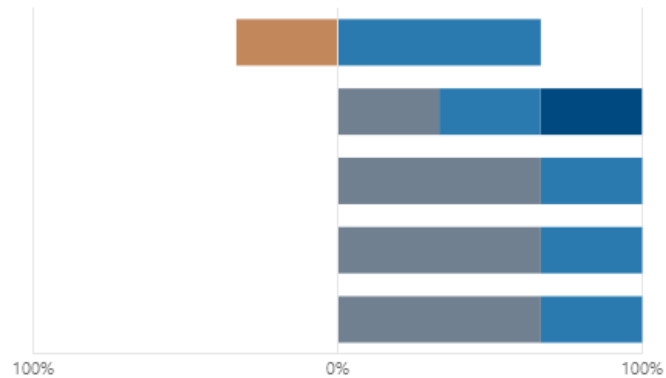
The different curricular components (i.e., Learning Rationale, Aims...), are clear

The different CBL levels (non-CBL, mild, moderate, intense) are clear

The level descriptions (presented under each level) are clear

The final advice provided is useful

The final advice provided is clear



APPENDIX D: SURVEY RESULTS CONCERNING FUNCTIONALITY

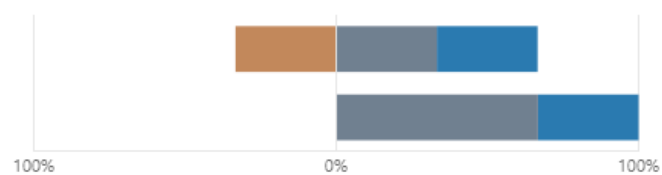
8. To what extent do you agree with the following statements on Challenge Up's Functionality

[More Details](#)

■ Strongly disagree
 ■ Disagree
 ■ Neither agree nor disagree
 ■ Agree
 ■ Strongly agree
 ■ Not Applicable

It is easy to give feedback to the developers

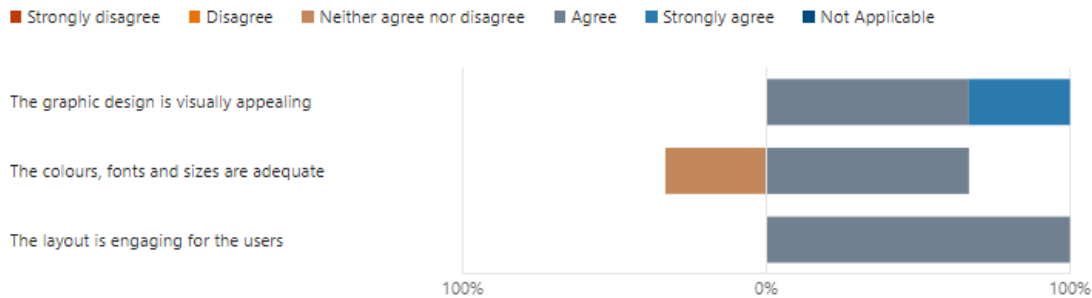
The instructions of what had to be done were clear



APPENDIX E: SURVEY RESULTS CONCERNING APPEARANCE

9. To what extent do you agree with the following statements on Challenge Up's Appearance

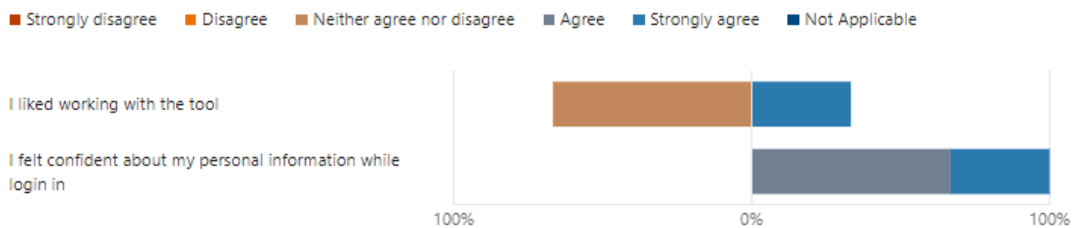
[More Details](#)



APPENDIX F: SURVEY RESULTS REGARDING INTERACTIVITY

10. To what extent do you agree with the following statements on Challenge Up's Interactivity

[More Details](#)



11. If you miss any features, please mention them here

1 Responses

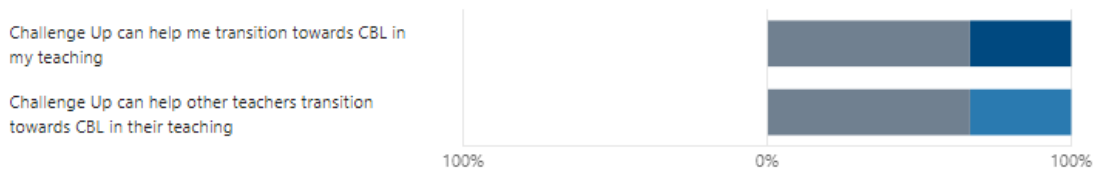
ID ↑	Name	Responses
1	anonymous	let the different aspects of each CBL level come back in your advice: how can you work on each of the aspects? In this way you can select as a teacher which topics you would like to focus on

APPENDIX G: SURVEY RESULTS CONCERNING GENERAL REMARKS

12. To what extent do you agree with the following statements

[More Details](#)

■ Strongly disagree
 ■ Disagree
 ■ Neither agree nor disagree
 ■ Agree
 ■ Strongly agree
 ■ Not Applicable



13. Any Final remarks

1 Responses

ID ↑	Name	Responses
1	anonymous	Still like the idea! Maybe you can add some links to existing examples

APPENDIX H: FEEDBACK SESSION NOTES

Template based on Pauk et al. (2010) "The Cornell System: Take Effective Notes"

UNIVERSITY
OF TWENTE.

CHALLENGE UP

Date: 26-03-2024

Topic

Challenge Up Usability

Main Ideas / Key Words

Notes

Lacking Introduction

- No idea what is coming up when using the tool
- The first question was very in-depth (might discourage users)
- Introduction should include:
 - o What to expect from the tool
 - o Clarity within Current and desired (Not clear from the beginning)
 - o Purpose of tool: Diagnose and then propose a solution.
 - o Highlight the benefits of using the tool.
- Introduction should have:
 - o Minimal text
 - o Add links → Opportunity to learn more if needed.
 - o Expanding text (more information)
- Consent
 - o Introduction should go before consent.
- Currently, consent is for functional (cookies) and data logging (when and how teachers use it)
- Consent is more on what is stored when using the tool. Use UT General policy.
- No discussion yet on how data will be used.
- The consent button sounds too serious. (Keep it simple)

Intuitiveness

- Current and desired levels are not clear.
 - o Should be explained before what to do with them.
- Next does not work until you press both (No pop-up or anything)
- The steps should be clearer about what has to be done.
- It is nice to see the current and desired level on the same page.
- Visuals and colours to see current and desired levels.
- Motivation selection (Should be click-and-drag)
- Make the purpose of the motivation clearer.
- There should be a button reminding you to act (when Next does not work)

Curricular Component Selection

- When pressing restart selection of a specific component, it restarts the whole selection.
 - o Not wanted
- Motivation selection
 - o Currently it is pressing arrows.
 - o Drag-and-drop is more intuitive.
 - o It is useful as it allows for a tailored experience.
 - o Categorizing all of them might not be the best.
 - o Not sure where it should be placed.
 - o Maybe just prioritise 2-3 which you want and 2-3 which you want to work less on
- The Introduction should clarify that you are going to each of the components.

- A sidebar showing each component (easier to go back) and shows checkpoints.
- Not being able to skip until the selection is made is good.
- Teachers might be overwhelmed starting with the Learning Rationale component as it is a hard one.
 - o Should it be changed from simple to harder?
 - o Sometimes there is a lot of text

Feedback to developers

- Feedback is stored in the background of the tool.
- Make it clear that it is not sending email.
- The Feedback is currently mainly for content developers.
- It should be made clear that feedback is used/how it will be processed.
- The role of the Feedback and how It is used could be mentioned in the introduction.
- Feedback button: Clarify what is in the button and how it will be used.
- Feedback button logs where specifically you give it. Not clear if it is explained that it is done.
- Check if Feedback is possible in the Advice section.
- The Feedback on the Advice should also be evaluated the effectiveness.
- Clarify where feedback goes, who, what will happen (process)
- Say “We value your feedback...” and “This is what we use it for”.
- Explain that we welcome Feedback in the introduction.

Fonts, Sizes, Colours

- Change the colour of the button (current vs desired)
- A lot of text in some sections
- Highlight keywords and make them shorter.
- Current vs desired different colours

General liking of the tool

- Overall satisfied with the tool
- The tool can give teachers a glimpse into CBL.
- Quick way to get information.
- A More Introductory level tool
- Using the continuum is helpful. Provides ideas on how to do it on different levels.
- It could be used to compare the level of CBL within different courses.
 - o Currently the only way to do this is by printing the advice (as data is not stored)
- Giving the option for mild gives confidence and makes steps easier

Remarks

- Add Attachments/links to specific components.
- Specific definitions and terms need links for further understanding.
- Wording seems adequate for the level.
- Check for R.D.G comments.
- It is Not clear what the difference between moderate vs Intense levels is in Materials & Resources
- Is there a possible link to PBL?
 - o Depends on rationale.
 - o The tool could be in the future used to compare CBL or PBL (a bit less intense than CBL).

Advice

- Should all use cases be considered?
 - o Maybe someone wants to do less CBL.
- Blue box
 - o Confusing and not sure where it came from
 - o That information could be explained in the introduction.
 - o It explains how to interpret the findings.
- Spiderweb
 - o Useful and nice to see visuals.
- There should be a summary of actions to be done.
- Actions should be based on user objectives.
- The summary could include expandable text.
 - o Teachers with less experience and knowledge of the topic need this extra information.
- Advice should include attachments, best practices, real-life examples/applications, links to external sources...
 - o This is hard due to learning materials changing.
- Advice could also have contact persons (experts that can help further i.e. CELT)
- YouTube miniseries for each component could be an option.
- Constructive alignment warning
 - o Should be clearer.
 - o Use colours or highlight to evidence it.
- Use icons and imagery to add points of context.
- There is not a lot of link between level descriptors and the advice.
- Component descriptors should be reflected in the advice (currently not done)
 - o Maybe provide a summary of what they were about (with a button)
- Keywords should be underlined or highlighted.
- Intro to advice:
 - o How it works (building on each other), summary based on motivation + key issues
- Tabel overview might be effective.
- Feedback should be given on how well you are doing in achieving your objectives.

Summary

The current version of Challenge Up still has room for improvement. For starters, the lack of an introduction leaves users uncertain of its purpose, benefits and how to use the tool effectively. The introduction should be clear and to the point with the information on consent clearly outlining how the information will be used. Regarding intuitiveness, there needs to be a clearer distinction when selecting the current and desired level of each component. Regarding the motivation selection, a drag-and-drop system would increase usability along with visual cues.

The curricular component selection needs to be polished in terms of some explanations and should be made easier to restart selection for a specific component by using, for instance, a sidebar showing the progress.

Fonts, size, and colours require minor adjustments to increase readability and key information should be highlighted to make it more accessible for the user.

Regarding the Advice, there is a need to have a clearer more actionable summary with the option to expand (with expandable buttons). Additionally, the use of attachments, real-life examples, and contacts for further assistance would be useful information. This could also be done with the help of icons to enhance the engagement of users.

APPENDIX I: INTERVIEW QUESTIONS TO USERS

- 1) How was the experience using the tool?
- 2) Was it clear what you had to do/expected from you?
- 3) How did you experience the Curricular component selection (and restarting)? What about the motivation selection?
- 4) How useful was the advice? And its structure?
- 5) Did you notice any methods of error prevention? And feedback providing?
- 6) How did you find the visual design of the website?
- 7) Do you think teachers could use this to implement CBL?
- 8) What features would you add to improve the tool?

APPENDIX J: INTERVIEW SUMMARIES

Interview # 1 notes

- Confusion during usage, can't re-select the components.
- Text explanation does not pop up, Colour and size change (text box)
- Graphic design should change.
- Have an Introduction and explain what it's about.

- Levels of CBL should be the same (Same width) --> Structured.
- Pretty easy to understand. An introduction is needed.
- Have to restart everything. No drag and drop.
- Too much text. Shorter summary or highlighting keywords Expandable text.
- Restart button. Provide feedback is there?
- Missing images related to CBL.
- Not see it for now. More for the newer teachers' Older teachers are less inclined to use the tool.
- More error prevention (redo instead of redo). Structure to know where to focus.

Interview # 2 notes

- Practical. Sequential
- Order in which information is given to you. Hard to realise curricular components were changing.
- Same-size boxes. Outline box Outline selects. Select the button at the bottom (less important). Clear indicator in Curricular header Line with steps to do. The percentage does not give much.
- Do not split current and desired. Have an option selector (automatically change once one is chosen). Have the option to go back manually. Restart and reset selection flipped. No need for reset selection. Need a drag-and-drop for motivation. Number changing is necessary. The number on the side. does not change.
- Too much text. Should have expandable text. Links to examples
- No clear error prevention detection
- Blue box to introduction. Intro to advice. Printed is useful.

Interview #3 notes

- Define CBL
- Remark that it is not the only way. There are different approaches.
- Sometimes the definition is not too logical (within levels)
- Implied that you need others before moving up a level.
- Different advice based on the type of course.
- Introduce a topic and what to expect and why.
- Depending on the field, it might not be relevant.
- Explain motivation.
- Context needed.
- More experienced teachers might be less willing.

Interview #4 notes

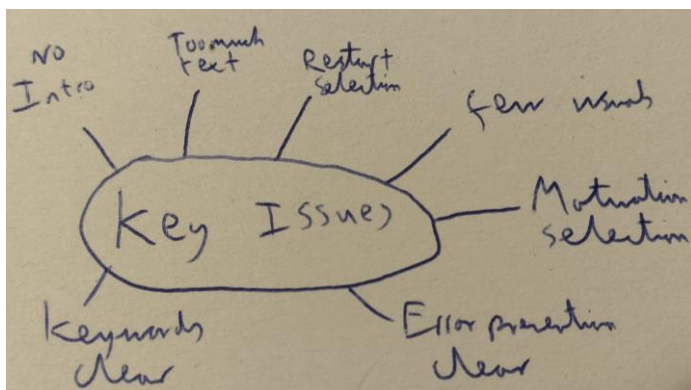
- More concrete definitions
- Makes it very concrete.
- Hard to have it introduced.
- Examples courses.
- Advice is more concrete.
- Personalised is difficult.
- Examples from different domains
- Graphical elements missing
- Break up text.

- Limit text to one page.

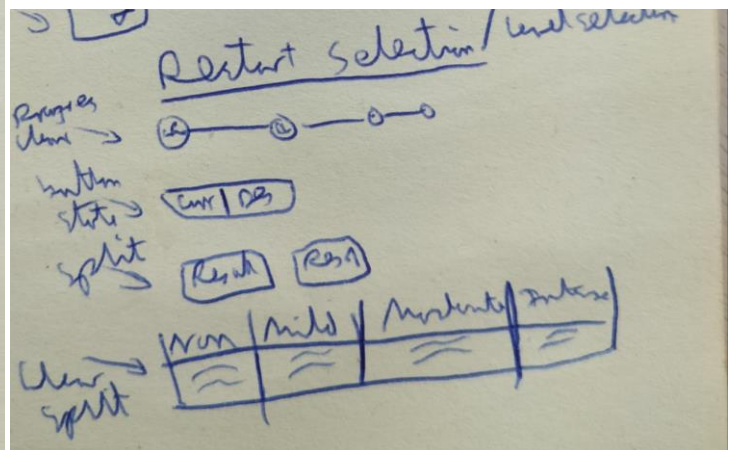
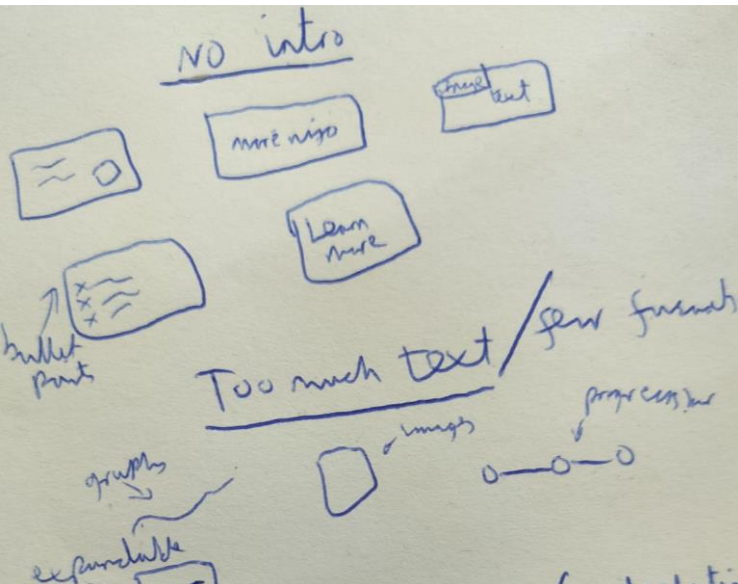
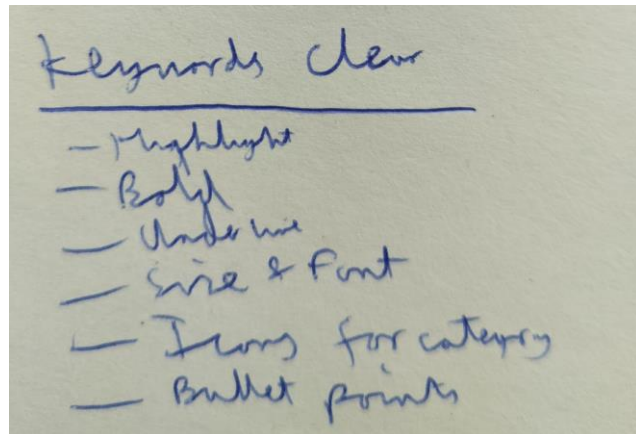
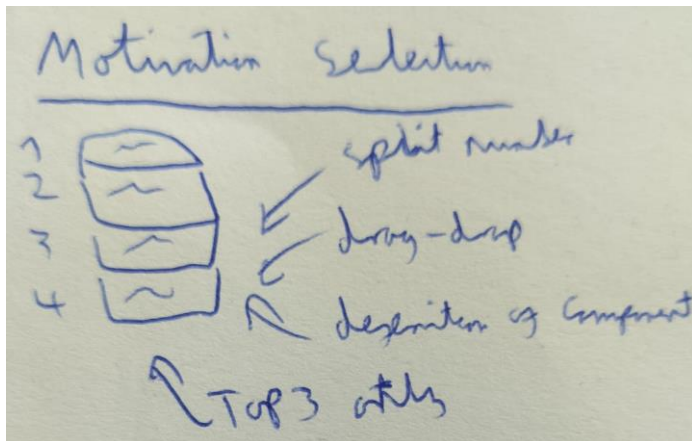
Interview #5 notes

- Not sure what mild-moderate intense difference
- The problems could be redefined.
- Curricular components should be clear.
- Forms specific to abstract.
- Make clearer.
- Like stepwise.
- Useful is yes and no.
- Hard to restructure the course.
- Content criteria set.
- Not much space to move around.
- For new courses useful
- Small changes incremental is good (allows to pick and choose)
- More actionable steps
- Should not be binding advice.
- Save to PDF is useful.
- Very text-heavy
- More visuals
- From specific to less specific visual aid
- Nice to be able to go back.
- Progress back to specific steps
- Actionable steps
- Concrete examples
- Case studies to refer to.
- Contact to CELT
- More help for higher level

APPENDIX K: MINDMAP OF ISSUES TO TACKLE



APPENDIX L: IDEASTORM FOR ISSUES IDENTIFIED



APPENDIX M: INTERVIEW SUMMARIES PROTOTYPE USER TEST

Test 1 notes

Student with UX design experience

- 1) Good, pleasant, with error prevention prominent
- 2) It was clear. Thanks for the introduction. The explanation is very useful so the user knows what to expect even for those with less CBL experience
- 3) Round edges give a relaxed/chill, low pressure. Not visually impairing. The colours are smooth, not too bright but still visible enough to show the message.
- 4) The navigation bar is nice. Easy to go back. Neutral colours are not overwhelming. Different colours give different information. On hover is useful for what page you would go to. Prevents errors. The user is less overwhelmed. It is a good aid to visually guide the user through the process.

- 5) Clear. Good use of Radar Chart. See More is useful as it doesn't overwhelm the user. It is missing Bold and keywords.
- 6) Error prevention is there such as resetting and being able to restart. Clear button and is always placed on the same area so users always know where they can go
- 7) Good, and fits UT scheme, font could be better. Maybe the same as UT works better.
- 8) Hopes that they do. The database seems quite complete.
- 9) More space between elements. Make sure elements are aligned.

Test 2 notes

Teacher, with some intentions to implement CBL

- 1) Useful, could see what was trying to be implemented, good visual elements (Radar Chart), easy selection process.
- 2) Introduction was clear and concise. Drag and drop is good (if fixed)
- 3) Made sense, no clear/evident glitches, aids to restart and help to progress. Good visual aid
- 4) Navigation was clear and simple, navigating through previous components makes sense.
- 5) Expanding text makes sense. It gives clear guidance.
- 6) Reset button and back button usable. See More is also useful.
- 7) Minimalistic but clear
- 8) Teachers could use this in implementing. Usage is clear.
- 9) Advice tailored to your field.

Test 3 notes

UX design professional

- 1) Pleasant
- 2) Useful introduction. Explained stuff with clarity.
- 3) Clear and intuitive. Motivation descriptors are useful.
- 4) Smooth but was missing a more intuitive go-back button (rather than only through the navbar)
- 5) The advice was clear with a good structure and easy to read.
- 6) Error prevention techniques were prevalent and useful.
- 7) Clear, simple, clean. Good balance between visualising and providing the content.
- 8) Yes, it has got potential.
- 9) More personalised

Test 4 notes

Teacher, with no intentions to implement CBL

- 1) Good
- 2) Clear and intuitive
- 3) Simple and logical process. Although restating sometimes was irritating with error prevention (but needed). Fix the drag and drop but if not, it is also smooth and effective
- 4) Navigation was clear and intuitive.
- 5) Advice was useful and clear. Nice to have expandable text.
- 6) Error prevention was there. Although it might seem to stop the natural flow, it is useful.

- 7) Visually appealing with clear content and keywords highlighted was a good touch for emphasis. This could also be done in the Advice section.
- 8) Teachers with interest could be interested but for someone with no interest it might not be useful.
- 9) Maybe try to have a link to certain fields.

Test 5 notes

Teacher, with some intentions to implement CBL

- 1) Intuitive and pleasant experience
- 2) The steps of what to do/what was expected were clear from the start.
- 3) Smooth experience. Restarting was also good but some of the descriptions were not too clear. They required more detail. Maybe the links would provide that extra detail.
- 4) Navigation was smooth and consistent throughout the tool. Maybe make the navbar buttons go a bit bigger when hovered.
- 5) Advice was useful but lacked some clarity. Maybe more examples within the text and highlighting keywords would be useful.
- 6) Error prevention was there and was nice to have.
- 7) Simplistic design but not the most appealing due to insufficient interest. The font selection looks too unprofessional. The layout is consistent but some minor differences that don't allow for a completely pleasant experience.
- 8) Doesn't see many teachers using it. But for those with interest already yes
- 9) Provide context on the impact of using CBL (more introduction to those with no knowledge of CBL)

Test 6 notes

Teacher, with some intentions to implement CBL

- 1) Good experience and easy to use.
- 2) The introduction explained clear steps of what to do/expect and was accurate.
- 3) Intuitive and clear selection. It had clear descriptions but additional links are missing (useful if they are there). The additional description button in the Motivation selection is a nice detail.
- 4) Navigation was smooth, intuitive, and visual. The navbar was clear and useful.
- 5) Advice was clear and the structure was nice to be able to expand. Highlighting keywords and links would be useful.
- 6) Error prevention was there but sometimes felt excessive.
- 7) Visual design was simple and had an adequate usage of sizes. The font could be changed. Consistency is good in layout.
- 8) Teachers with interest would use it if no interest they probably won't.
- 9) Maybe some usage with AI

Test 7 (summary of survey)

Teacher, with intentions to implement CBL

- 1) It was easy and intuitive to use.
- 2) The steps were clear from the beginning.

- 3) The experience was overall good, but you could only go back by pressing the navbar. Restarting the whole selection was not possible but not fully needed until the end.
- 4) The navigation was smooth and consistent throughout. Also, logical
- 5) Advice was useful and clear. It is nice to be able to see visually what you have chosen.
- 6) Error prevention was there and useful in some cases.
- 7) Was not a big fan of visual design. The colours are fine but the font is not adequate. Try to ensure keywords are highlighted more. The layout is alright but missing small details such as the back button.
- 8) It has potential and could offer good results for educators.
- 9) More direct examples

Test 8 (summary of survey)

Teacher, with no intentions to implement CBL

- 1) Nice tool which is intuitive and simple to use
- 2) The introduction gives a good expectation of what to expect.
- 3) Component selection was easy to understand. Nice to have colours and text as guidance.
- 4) Smooth navigation experience. Consistent throughout the process. Nice to be able to navigate with the navbar buttons.
- 5) Advice was a nice way to end. The advice should include examples, but it is nice to have the key points summarized before expanding the text.
- 6) Error prevention was there and a nice touch but might feel unnecessary.
- 7) Simplistic and effective design. The font should be more professional.
- 8) For someone with no interest it doesn't help. But if there is already interest it can help
- 9) Make it more accessible to people with no interest in CBL.

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