# A parent-child eSports e-learning system to foster sustainable gaming for children

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## ABSTRACT

The emerging world of eSports and video gaming is becoming more competitive and popular. Consequently, the game participants expose themselves to several risks that could lead to negative behaviours such as obsessive and compulsive overuse of internet games and video games. The current research proposes the non-functional and functional requirements of an eSports e-learning system that provides correct information and methodologies to emancipate children and their parents to use eSports and video gaming appropriately. Moreover, in the current study, a prototype is proposed and evaluated through a questionnaire. The data found during the user testing shows that the identified requirements could be used in a first step towards an eSports e-learning system that assists both the child and the parent.

## Keywords

esports, video games, education, learning management system, e-learning, gamification, 4cid

## 1. INTRODUCTION

Substantial research has focused on how video games and eSports negative and positive impacts players. By playing video games in ways that sustain healthy behaviours, individuals can experience high increases in skills used outside of the game (Torres, 2000; Gerber & Scott, 2011; Clark & Ernst, 2009). Important areas where sustainable gaming helps individuals see positive outcomes are in the cognitive, educational, motivational, emotional and social spheres (Granic, Lobel, & Engels, 2014). More specifically, studies identified advancements such as improved visual attention and attentional abilities (Wright, Blakely, & Boot, 2012; Uttal et al., 2013), developed problem-solving skills (Chuang & Chen, 2007; Prensky, 2012), increased positive emotion (Russoniello, O'Brien, & Parks, 2009), decreased anxiety levels (Ryan, Rigby, & Przybylski, 2006), increased positive attitude towards failure -that predicts better academic performance- (Blackwell, Trzesniewski, & Dweck, 2007) and acquired prosocial skills that reward effective cooperation (Ewoldsen et al., 2012). Additionally, gamers are part of the eSports ecosystem, which offers many benefits.


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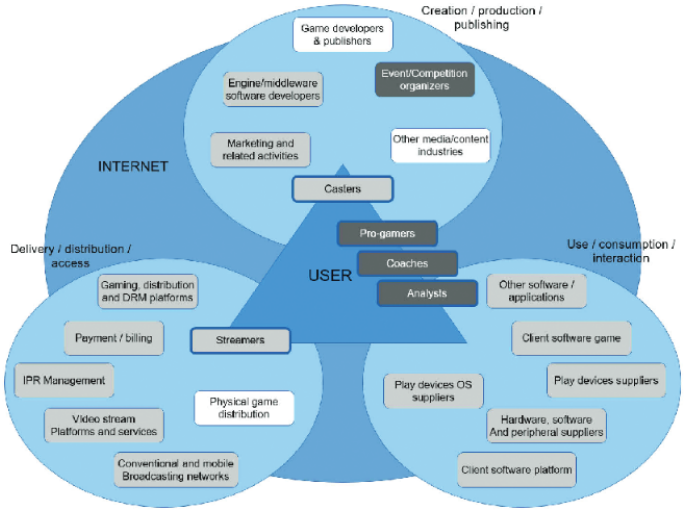


Figure 1: Own construction, ecosystem of the actors and main activities related to eSports. Retrieved from Carrillo Vera and Aguado Terrón (2019)

ESports can be seen as a competitive professional sports in which two or more participants compete utilizing video games as a platform (Scholz & Barlow, 2019). Carrillo Vera and Aguado Terrón (2019) defined three layers of the eSports ecosystem (Fig. 1), and they are all built around the user, which could be a pro-gamer, caster, streamer, coach or analyst. Moreover, the ecosystem's revenue and spectatorship are constantly growing at a remarkable rate (Parshakov & Zavertiaeva, 2018; Wijman, 2021; Newzoo, 2021). Additionally, Kim, Nauright, and Suveatwatanakul (2020) and Carrillo Vera and Aguado Terrón (2019) argue that the professionalisation of eSports is increasing.

The multidisciplinary career opportunities (Besombes, 2020) fit the needs of the users of the eSports ecosystem, as they are more comfortable and optimistic about their future professions (Bingöl & Çakir, 2021). Thus, they are more likely to be connected to high paying sector jobs such as data science, software and web development, social media marketing, and event organising (Anderson et al., 2018). In the same time, the industry creates more and more opportunities to be an e-athlete. For example, Next College Student Athlete (NCSA) offers full and partial eSports scholarships to 151 schools across the USA (NCSA Sports, 2021).

However, it is important to be aware that video gaming and eSports also come with risks. Studies showed associations between the high engagement of eSports/online gaming and unhealthy lifestyle (Achab et al., 2011; Dindar & Akbulut, 2014). Moreover, studies showed dysfunc-

tional coping styles (Gentile et al., 2017), such as behavioral disengagement (Piko, Milin, O'Connor, & Sawyer, 2011), self-blame (Lam, Peng, Mai, & Jing, 2009) or rumination (Shapero et al., 2014). Also, cyberbullying and sexism were identified, which led to decreasing social interaction, and self-esteem (Lopez-Fernandez, Williams, Griffiths, & Kuss, 2019). Fortunately, higher institutions are helping generate the correct awareness so that the right frameworks can be developed. In 2018 the Gaming Disorder (GD) was included in the International Classification of Diseases (ICD-11) by the World Health Organization (Poznyak, 2008), which led to other studies looking for "treatment" or preemptive methods (Bender, Kim, & Gentile, 2020; Zhao & Hao, 2019; Yen et al., 2018; Bonnaire & Phan, 2017).

It is clear that the opportunities for the players are significant, and it is also clear that by playing video games or being part of the eSports ecosystem, the player can get essential skills that can be used outside of the game, and it can also get career perspectives. However, the player needs to avoid all the previously mentioned risks, and this can be done by providing the correct information or methodology. The need for a singular place that considers all these variables is significant. In order to address the need, the current research proposes an eSports e-learning system (ELS) that combines the advantages of eSports and video gaming, mitigates the risks and pushes the player to use all the opportunities of the eSports ecosystem.

The elements of the proposed ELS primarily focus on children aged 12-18 years old and their parents, which further will be referred to as learners. The parent-child link is essential for the ELS, as the parent's active involvement is associated with positive effects on the children's learning process (Cheung & Pomerantz, 2012). The parent-child collaboration will naturally develop into a beneficial way of working, where the parent becomes the "reviewer" and the child the "driver" (Lin & Liu, 2012). This way of working helps the children be systematic and disciplined and helps them be self-reflective, which leads to improved problem-solving skills. This interaction can be generalised as scaffolding (Wood, Bruner, & Ross, 1976), which should occur until the child becomes an independent problem-solver (Wertsch, 1979). Moreover, the guidance should be suitable to the children's level of understanding and age (Wertsch, 1979).

Although we can find research at the intersection of video gaming, eSports, and education, the existing educational tools do not optimally fit the purpose. More specifically, the scientific basis of the procedures and content is unclear. A product that offers an educational platform for eSports is https://learn2esport.com/. The marketing behind the product sustains that it improves critical thinking and provides 21st-century skills. More precisely, no engaging centralised system offers eSports educational content based on a scientifically researched learning framework, implements tools that enable the learner to analyse and evaluate their gameplay, and integrates the parents in the educational journey.

Based on the identified needs of the learner, the main requirements of the e-learning system are:

- it should contain tools that implement a learning framework that supports both the child and the parent to engage and follow in the educational content
- implement tools that help the player analyse its gameplay
- it should contain tools based on a gamification framework that helps the learner stay engaged
- implement tools for parents that monitor the progress of the child

The need for an ELS that fosters sustainable gaming leads to the following research question:

What are the non functional and function requirements of an ELS that is able to implement the epics and how would this translate into a prototype?

The subquestions are:

1. Q1: What are the non functional requirements?
2. Q2: What are the functional requirements?
3. Q3: How does it translate into a prototype?
4. Q4: How is the prototype evaluated by potential learners?

# 2. THEORETICAL FRAMEWORK

For an ELS to facilitate sustainable gaming, content delivery and system design must be facilitated. The first refers to Instructional Design, and the latter refers to the Learning Management System design. On top of these two elements, the ELS also should engage the learner.

The underlying method that stays at the base of every epic is learning. From the *The Internet2Project* (2021) we can extrapolate several principles that the ELS should incorporate in order to facilitate learning:

- find and revise instructional material
- assess learners level of knowledge
- give appropriate material to learners
- constantly follow the progress and intervene when necessary

## 2.1 The Learning Framework

The principal aim of the proposed environment is to learn about sustainable gaming, which could be considered a complex learning activity, and "aims at the integration of knowledge, skills, and attitudes; the coordination of qualitatively different constituent skills; and the transfer of what is learned to daily life or work settings." (Van Merriënboer, Kirschner, & Kester, 2003).Instructional design can facilitate complex learning, which according to Smith and Ragan (2004) is a process that translates principles of learning into materials and activities. It delivers the material in an effective and appealing manner, assists the learner in the process, facilitates dissemination and has congruence among objectives, activities, and assessment.

An instructional design approach that fits the system application area and goal is entitled Four-Component Instructional Design Model (4C/ID) (van Merriënboer, 2019). The framework fits the ELS's needs because it enables the development of complex skills, increases the transfer of the skills to the real world and develops 21st-century skills essential in the learning process (van Merriënboer, 2019). The four constituent components are shown in Figure 2.

To facilitate the practical implementation of the framework, 4C/ID is implemented using the Ten Steps, which is a systematical approach aiming to help the designers build the four components. Table 1 shows an overview of both the 4C/ID framework and the Ten Step model.

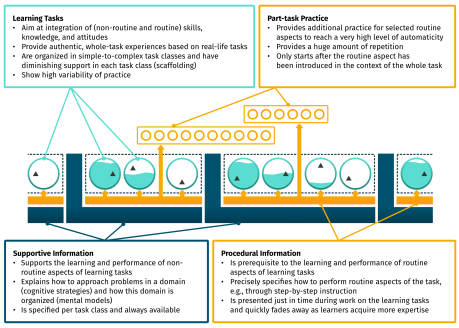


Figure 2: 4C/ID Model

Table 1: 4C/ID framework and Ten Steps model.

| 4C/ID Components | Ten Steps |
|---|---|
| 1. Learning Tasks | 1. Design Learning tasks<br>2. Design Performance Assessment<br>3. Sequence Learning Tasks |
| 2. Supportive Information | 4. Design Supportive Information<br>5. Analyze Cognitive Strategies<br>6. Analyze Mental Models |
| 3. Procedural Information | 7. Design Procedural Information<br>8. Analyze Cognitive rules<br>9. Analyze Prerequisite Knowledge |
| 4. Part-task Practice | 10. Design Part-task Practice |

### 2.1.1 *Learning Task*

For the first step, the ELS should include a holistic form of the primary learning goals. The learner should be able to see all the tasks represented as an ordered sequence.

In the second and third steps, the ELS makes use of the Zone of Proximal Development (ZPD) framework to design the learning task (Vygotsky, 2012). ZPD is where the learner works on a slightly more challenging task, and thus, it needs peer collaboration with a teacher. This way of learning aims to keep the motivation level high. According to Vygotsky (2012), this approach should help the learner internalise new concepts, psychological tools and skills. and could further boost the player's chance to use the skills in the outside world.

To remain in the zone of ZPD is essential to assess the balance between the skills and the challenge the learner is facing. In order to assess the level of the learner at the end of the task, it was mentioned that the learner could imitate a more skilful or experienced player (Shabani, Khatib, & Ebadi, 2010).

By doing so, the ELS could be able to generate quantitative data and evaluate the professional authenticity of the knowledge, skills and attitudes under the Miller Pyramid Assessment framework (Miller, 1990). Moreover, intending to sequence the learning tasks and adapt their difficulty to keep the learner in the ZPD, the ELS also should assess skill formation. It measures the matured skills and those that are in the process of maturing. Dynamic Assessment can provide this step (Shabani et al., 2010). To be more precise, in the first phase of a practical assessment, the learner receives the video recording of specific gameplay that they need to replicate. After the practice session is over, the ELS assesses what to look for in the gameplay of the learner and adjusts the difficulty accordingly.

### 2.1.2 *Supportive Information*

The ZPD process assists the design of supportive information by offering support and guidance for the learner. Guney (2019) uses a similar process where each task starts with a high level of guidance and decreases the amount of guidance while the learner gains expertise. The advantage is that the proposed ELS always aims to keep the learner in ZPD and provide feedback accordingly.

Cognitive strategies such as problem-solving, strategy planning, decision-making, and creative communication are linked with critical thinking, an essential skill that a learner could develop (Leopold, Zahid, & Ratcheva, 2018). Post and Birt (2020) argue that practising critical thinking can be done by reflecting on the skills and how they may be relevant in other contexts. The same authors offer a list of reflective questions that should be used to analyse and boost the cognitive strategies of the learner, presented in Table 2.

The mental models (Craik, 1943) of the learner should be analysed by creating short multiple-choice quizzes after the practical phase of the task. According to Boyan and Sherry (2011), mental models are created by playing the game and learning the game mechanics. To ensure that the learner created the mental models, the ELS will assess if they understand the practised game mechanic.

### 2.1.3 *Procedural Information and Part-task Practice*

Procedural information enables the learner to build long-term cognitive rules. Part-task practice includes repeated practices that form a routine. Through the designed learning framework, the learner should constantly acquire knowledge, practice, and reflect on it, thus creating cognitive rules. Moreover, through the nature of video gaming, once a cognitive rule occurs, it should be repeated in future gameplay. Through the repetition of the learned skills, the routine should form.

## 2.2 Development of the Learning Mananagement System

The current research proposes a Learning Management System (LMS). Such a system helps reach the intended audience, enables the learner to grasp the intended learning outcomes and stimulates learners' engagement (Cigdem & Ozturk, 2016).

An LMS is a server-based software system that manages and distributes learning, primarily asynchronous e-learning (Berking & Gallagher, 2013) that records, tracks and follows the activities of the learners (Shariat, Hashemi, & Mohammadi, 2014). The same authors argue that an LMS can facilitate acquiring new skills (initial learning), extending skills (continued learning), refreshing skills for learners that want to remember past knowledge (remedial learning), getting to a higher level of skills (upgrade skills) and the transfer of skills to the real world (transfer learning). Furthermore, LMS comes with essential benefits that perfectly fit the proposed ELS, such as:

- cost reduction through reduced operational error that might occur in the standard educational systems
- maximize efficiency by creating content for the individual learner's needs
- being able to make use of the new established policies and procedures

Watson and Watson (2007) identified a series of characteristics of LMS in education that will be the backbone of the ELS:

- each learner has access to individual lessons
- lessons are part of a standardized curriculum
- extend the difficulty in a consistent manner
- collect the results of the learner's performance
- provide lessons based on the learner's performance

In order to have a sustainable development process and make sure that the values of the ELS are propagated to the learner through the normative process of design, the ELS should incorporate an information system development methodology (Gasson, 1995).

Yaghini, Bourouni, and Amiri (2009) first analyzes whether the system approach is hard or soft. The proposed ELS identifies as a hard system with a specific and defined goal and a determined boundary. In addition, hard systems observe social phenomena as unchanging, predictable and repeatable problems. Thus, the methodology chosen is the Information Engineering Methodology (IEM) that, for this case, consists of three steps defined in 2.2.1, 2.2.2, 2.2.3.

### *2.2.1 Architecture Definition*

The higher level overview of the ELS is created using the Structure of a System proposed by (Aronson, Liang, & MacCarthy, 2005). Figure 16 outlines the inputs (elements that enter the ELS), processes (elements that transform inputs into outputs) and outputs (finished products). Furthermore, it is shown that the ELS implements the required feedback loop using the Dynamic Assessment methodology discussed previously.

### *2.2.2 Existing system analysis*

One of the standards to evaluate and develop the ELS is SCORM (Sharable Content Object Reference Model). It defines six requirements: availability, adaptability, economic, durability, interoperability and reusability (Shariat et al., 2014). Kasim and Khalid (2016) compared six learning management systems (Moodle, Sakai, ATutor, BlackBoard, SuccessFactors, SumTotal) by looking at the SCORM requirements but also at how effective they can be in an educational environment.

All systems have a good user interface and are easy to use. They are all flexible, and lecturers can adapt the courses in the software, which means they can adapt to the individual or organisation's needs (SCROM - Adaptability). All the systems are accessible, which means that the content is available from remote locations (SCROM - Availability). On the other hand, only four are based on the Cloud, which means that the other two are not taking advantage of cloud computing to optimise the costs (SCROM - Economic). Also, only three systems can integrate with other systems (SCROM - Interoperability). In addition, an important feature that is lacking from all the LMS systems, except SumTotal, is that they cannot identify talent and improve the learner's efficiency and effectiveness. It appears that all the systems were developed respecting the SCROM standard, but they are missing the durability and reusability requirements. Nevertheless, these requirements are content-related, and it depends on the organisation how they create it. For example, companies like SAP, Adobe, Oracle Corporation all make use of different LMS systems and adapt them to their needs (*Learning Management System (LMS) Market Global Opportunity Analysis and Industry Forecast (2019-2025)*, 2019).

### *2.2.3 Logical Design*

*Overview of Logical Design* (1999) defines logical design as a conceptual representation of the system that demonstrates the relationship amongst the objects. By creating first the logical design, the focus can stay on the information requirements without thinking about the implementation. Figure 17 from the Appendix presents the Activity Diagram of the ELS without any additional features presented in the next section. More specifically, it describes the learner's process to assimilate the information, practice, and when the ELS assesses it.

## 2.3 Development of the Gamification System

In order to support and motivate the learner that leads to an enhanced learning process and create engagement, the ELS will adopt a gamified approach (Caponetto, Earp, & Ott, 2014; Kapp, 2012).

Gamification is the process of deriving engaging elements from games and applying them to real-world activities (Chou, 2019). Implementing gamification can bring essential advantages for the learners. Giang (2013) shows that gamification elements improve the learning ability by 40%. Besides, gamified systems support intrinsic motivation, are available to a broad audience through mobile technology, directly support well-being and address a broad audience that recognises video gaming elements (Johnson et al., 2016).

Octalysys Framework can be used to implement gamified elements in a structured manner, developed by Chou (2019). The author argues that every game is fun because it appeals to a particular human drive which he defines as Core Drives. There are eight Core Drives in the framework that can either push us in an inspiring and empowering way or a manipulative and obsessive manner. The Core Drives are: Epic Meaning Calling, Development Accomplishment, Empowerment of Creativity Feedback, Ownership Possession, Social Influence Relatedness, Scarcity Impatience, Unpredictability Curiosity, Loss Avoidance.

In order to implement the Octalysis Framework, Chou (2019) proposes a Four-Phase Design (Figure 4) aiming to optimise all the Core Drives for each of the phases.

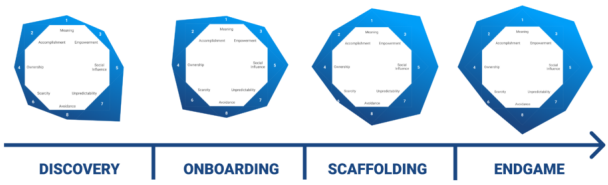


Figure 3: 4 Phase Octalysis

Before diving into each phase, it is worth mentioning that the purpose is to create a White Hat gamified system, aiming to make the learner feel powerful, fulfilled, and satisfied. It means that the ELS will mainly use Core Drives from the upper side of the hexagon (Core Drive 1, 2, 3) and the rest of the Core Drives will be used in a non-manipulative way, where it is imperative.

The chosen elements that will play a role in gamifying the ELS are avatars, badges, guided tutorials and roadmaps.

Moreover, all the chosen elements that lead to gamification are chosen from the Octalysis Framework. Such elements, used in an educational environment, support the cognitive tasks, reward suitable behaviour, and boost learners' motivation (Rabah, Cassidy, & Beauchemin, 2018).

The following sections will go through each phase and address the Core Drives to gamify the proposed ELS. Since a learner's motivation to use the ELS is constantly subjected to change, the proposed division is to follow the interaction and journey of the learner and constantly address their evolution.

### 2.3.1 Phase 1: Discovery

Contrary to other three-phased frameworks, Octalysis introduces a new phase that starts when people come across the product and ends when people sign up. Obviously, this component is very intertwined with marketing, but this topic can be avoided by looking at the motivation of the actions. The motivation can be analysed and adjusted to fit the Discovery phase by addressing the correct Core Drives.

**Core Drive 1: Epic Meaning and Calling**

This core is often in place in the core messages of companies or games. The plot of games often consists of saving the world that is about to be destroyed, enabling the player to engage in something bigger than themselves. Since the goal is to create a purpose greater than themselves, the propagating messages of the ELS should stress how impactful communities driven by education can be. Being part of the ELS helps the learner grow and paves the way towards developing an ecosystem guided by empirical data that should ultimately help future learners. Therefore, by joining the ELS, the learner becomes part of the change.

**Core Drive 5: Social Influence and Relatedness**

The ELS should be discoverable because herd behaviour influences children's choices regarding technology (Vedadi & Greer, 2021). As long as the learners become measurable more skilful than their old self, their peers will notice and want to experience the ELS.

### 2.3.2 Phase 2: Onboarding

The Onboarding phase is all about teaching the learners the ELS's purpose and how to use it. It starts as soon as the learner signs up and ends when the learner grasping the basic use of the ELS.

**Core Drive 4: Ownership and Possession**

The ELS will embed two essential elements to boost ownership during the account registration.

1. In order to create a feeling of control and ownership, the learner will first choose their interests. The learner will know that this data will generate a customised recommended curriculum.
2. The learner will customise their profile consisting of an avatar that will be the face during the interaction with other peers (Waltemate, Gall, Roth, Botsch, & Latoschik, 2018).

The presented steps also mitigate the issue presented in Phase 1, Core 5. By helping create its own experience, the ELS makes sure that the learner takes active decisions.

**Core Drive 4: Ownership and Possession**

After the signup phase, the learner will encounter the first lesson as a tutorial. Since one of the main features of the learning framework is keeping the learner in ZPD through constant feedback, the learner must learn how to receive and give it. The learner will encounter the video material and the quiz and receive feedback from the ELS. Making the learner feel intelligent and competent will boost the current core.

**Core Drive 2: Development and Accomplishment**

At the end of the tutorial, the learner will receive its first badge to boost the accomplishment feeling. The badging system thus is an essential element of the gamification process. Therefore, the ELS will hold a specific page where are all the badges will be showcased.

### 2.3.3 Phase 3: Scaffolding

Scaffolding starts when the learner finishes learning the essential tools of the system and receives its first badge. This phase represents the regular journey and activities within the ELS. More specifically, scaffolding happens while the learner uses the ELS to assess new information and acquire new skills.

**Core Drive 1: Epic Meaning and Calling**

As a skilful learner in specific categories, the ELS will ask for feedback for other learners. The learner will feel that it creates a more educated community by sharing its knowledge and contributing to the common goal.

**Core Drive 2: Development and Accomplishment**

Learners want to experience constant progress, and in order to ensure such an element, the ELS will implement a roadmap system that will ensure a constant feeling of progression. The roadmap will be created based on the assessed data during the Onboarding phase, but the learner can customise another one based on their likings. Moreover, the learner profile will highlight the completed categories and measure them using Miller's Pyramid discussed previously. At the same time, every time the learner completes a milestone, it will be accentuated by adding a new badge to the collection.

**Core Drive 3: Empowerment of Creativity and Feedback**

During the phase where the learners practice the learned knowledge, they can develop different solutions to the same problems. Here, the role of the peer is significant since one of the tasks is to recognise out of the box thinking and acknowledge it. By doing so, the learner nurtures the courage to be creative and practices how to receive feedback.

### 2.3.4 Endgame

This phase is dedicated to veteran users who completed the roadmap, which the ELS tries to retain. At this stage, the learners find out why they should stick and continue to provide feedback for others.

**Core Drive 1: Epic Meaning and Calling**

Even though the learner finished the roadmap, it can still be part of the feedback loop. Again, the learner can still be part of the learning process of others by continuously participating in the process.

**Core Drive 2: Development and Accomplishment**

The learner can start other lessons that did not represent an interest before but discover them later. Besides, games are constantly changing their content which will constantly create new content or change the content of existing courses. If the learner wants to stay up to date, it can come back and rewatch and practice the updated material.

# 3. METHODOLOGY

## 3.1 Design and Development

In the first phase of prototyping, it is essential to identify the non-functional requirements. For a better understanding, the requirements are defined as Agile user stories and showed in Table 3. (Lucassen, Dalpiaz, van der Werf, & Brinkkemper, 2016). Moreover, each one of the identified non-functional requirements translates as a functional requirement. According to Eckhardt, Vogelsang, and Fernández (2016), non-functional requirements differ from functional requirements by looking at how the system shall implement functionality in contrast to what the system shall implement.

A prototype is an approximate representation of the features that the future product, service, or system will contain (Otto & Wood, 2001). Otto and Wood (2001) indicated multiple prototype objectives, but due to the nature of the research and the time constraint, the study will focus on refinement. The process of refinement means gradually building the prototype, and therefore validate the requirements, which are already defined (Gordon & Bieman, 1995). Using the rapid prototyping ideology (Yan & Gu, 1996), which focuses on shortening the time of development, we will create a prototype that addresses function (Michaelraj, 2009), in a high-fidelity manner (Michaelraj, 2009) that showcases the interaction between the learner and the ELS.

We chose to use Adobe XD to build this prototype. The software enabled a fast and streamlined development process.

## 3.2 Technical Requirements

The current research will not build a functioning ELS but a high-fidelity prototype to help define the high-level technical requirements.

### *3.2.1 Backend*

The aim of the first iteration of the backend system is to create a sustainable and scalable design. Macero, Macero, and Anglin (2017) recommends building it as a monolith rather than splitting it into microservices from the beginning. Building it as a monolith enables a less demanding approach to deploy, orchestrate and test the system, and it also decreases the chances of a poor software design. The monolith approach of the backend system can be seen in Figure 5.

As for the tool used to develop the backend, we are interested in a framework that enables fast development, allows easy connectivity with databases and comes with a REST API solution. Therefore, the ELS shall use the Spring Boot features chosen based on other several advantages (Guntupally, Devarakonda, & Kehoe, 2018; Suryotrisongko, Jayanto, & Tjahyanto, 2017):

- provides a RESTful Web Service interface that offers built-in CRUD handling (Rodriguez, 2008)
- out-of-the-box features such as externalised configuration, profiling, logging, internationalisation, integration with JSON mapping libraries, and testing (*Core Features*, 2021)
- supports dependency injection (Yang, Tempero, & Melton, 2008)
- supports Aspect Object Programming (AOP) (Kumar, Kumar, & Iyyappana, 2016)
- provides the Data Layer through the Java Persistence API (JPA) (DeMichiel & Keith, 2006)

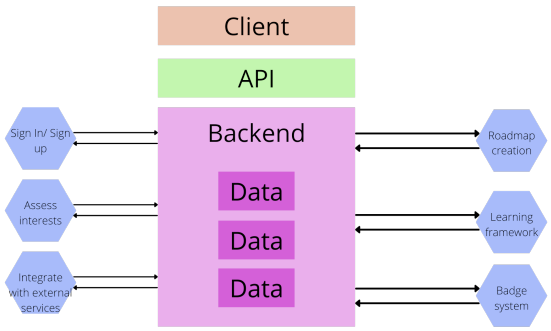


Figure 4: Backend architecture

### *3.2.2 Frontend*

In order to build the frontend, we looked for a tool that enhances productivity, streamlines maintenance, assures faster rendering and a strong community backs that. The chosen framework will be ReactJS. It is a free and open-source JavaScript library that enables developers to build web applications that dynamically update the data. It also comes with several other advantages (Paudyal, 2021):

- support for JSX, whose purpose is to write HTML structures inside the same file as the Javascript code (Gackenheimer, 2015)
- makes use of the Virtual DOM, which enables the declarative API of React (*Virtual DOM and Internals –*, 2022)
- heavily component based, which makes code reusable and easy to understand (Subramanian, 2019)
- provides a built-in state object (React Hooks) that mitigates the need for a third party state management solution (Bugl, 2019)

## 3.3 Prototype

The following subsection showcases the prototype. Due to space limitations, only the main functionalities will be shown in small resolution screenshots, in Apendix. The complete prototype can be seen here https://xd.adobe.com/view/495ea80f-c9b6-42d4-bbc3-619b4a772624-1c0d. The designs exported as PNG images can be seen at https://github.com/eduardm1/design-eSports-education.

## 3.4 Evaluation

Testing the prototype aims to acquire sufficient information about the current implementation of the requirements. According to (Otto & Wood, 2001), every prototype should answer a specific question which in this case is *How well are the functional requirements translated into non-functional requirements?*. In order to collect the data, we created an evaluation form using Google Forms. The participants were asked to use the ELS as a child, parent or both. After their journey ended, they came back to the form, and we asked for their opinion about specific functional requirements and, by association, about the equivalent non-functional requirement.

Table 2: List of non-functional and functional requirements

| Section | Non-functional requirements | Functional requirements | Evaluation |
|---|---|---|---|
| Section 2.3.1 | 1. As a learner, I understand that joining the ELS has a greater meaning | 1. Create landing page section that summarises the advantages<br>2. Create a section on the landing page that highlights the feedback component and how the ELS is pioneering eSports education. | 1. mean = 3.8 s.d. = 0.89<br>2. mean = 4 s.d.=0.75 |
| Section 2.3.1 | 2. As a learner, I understand the learning process of the ELS. | 1. Create a section on the landing page that shows the learning process. | 1. mean = 4.3 s.d = 0.66 |
| Section 2.3.1 | 3. As a learner, I want to share the ELS with my peers | 1. Create a section on the landing page that holds the share buttons | 1. mean = 3.2 s.d.=1.73 |
| Section 2.3.2 | 4. As a learner, I want my profile to be identified uniquely | 1. Let the learner create an avatar | 1. mean = 4.2 s.d. = 0.95 |
| Section 2.3.2 | 5. As a learner, I want to understand how the ELS works before using it. | 1. Create tutorial that showcases the ELS by learning about "feedback". | 1. mean = 4.1 s.d. = 0.8 |
| Section 2.3.2<br>Section 2.2 | 6. As a learner, I want a curriculum fit for my needs | 1. Assess interests of the learner. | 1. mean = 4 and s.d. = 0.86 |
| Section 2.3.2 | 7. As a parent, I want to join together with my child | 1. When the parent creates the account, send email to the child and "link" accounts. | 1. mean = 4,1 and s.d = 0.83 |
| Section 2.1<br>Section 2.2 | 8. As a learner, I want to learn about video gaming and eSports using an empirically researched methodology | 1. Implement 4CI/D | 1. mean = 4 s.d. = 0,68 |
| Section 2.3.3<br>Section 2.2 | 9. As a learner, I want to see my curriculum in a manner that keeps me engaged. | 1. Implement a roadmap based on the assessed interests | 1. mean = 4.3 and s.d. = 0.66 |
| Section 2.3.2 | 10. As a learner, I want to be rewarded for completed milestones | 1. Implement badge library<br>2. Show badge on the learner's profile | 1. mean = 4,3 and s.d. = 0.77 |
| Section 2.3.3 | 11. As a learner, I want to see my progress in a quantified manner | 1. Show Miller's Pyramid for every task | 1. mean = 3.8 s.d. = 0.7 |
| Section 2.3.3 | 12. As a parent, I want to track the progress of my child | 1. Make the profile of the child public to the parent | 1. mean = 4.5 s.d. = 0.66 |
| Section 2.3.3 | 13. As a parent, I want to track the hours spent gaming by my child | 1. When signing up, ask the learner for Battlenet , Steam and Riot IDs<br>2. Using the integrations, show the hours spent on the child's profile. | 2. mean = 4.4 s.d. = 0.76 |
| Section 2.3.4 | 14. As a learner that finished the curriculum, I want to still use the ELS | 1. Prompt the learner to discover new interests.<br>2. Show to the learner that it can still provide feedback. | 1. mean = 4.1 s.d = 0.7<br>mean = 2. 4 s.d. = 0.57 |

### 3.4.1 Participants

The evaluation form was distributed to one of the student teams within the University of Twente, Esports Team Twente. We collected fourteen answers, all coming from the students where 30,8% tested as parents, 15,4% tested as children, and 53,8% tested from both perspectives.

### 3.4.2 Instruments

We chose to create the form as a Likert questionnaire because the data can be gathered relatively quickly that provided a reliable estimate (Nemoto & Beglar, 2014). We organised the evaluation form following the Octalysis Framework structure (Discovery, Onboarding, Scaffolding and Endgame). By doing so, it was easier for the participant to follow the form alongside the prototype. The questions aimed to quantify the quality of the functional requirements.

Before distributing the evaluation form, the supervisor, dr. G.W.J. Bruinsma offered feedback about the quality of the questions that was implemented afterwards.

### 3.4.3 Results

The results will also follow the 4 Phase Octalysis Framework for ease of reading. The mean for every measured functional requirement is presented in Table 3 in the third column.

1. Discovery

   The users rated the Discovery phase with a mean of 3.8 and a standard deviation of 0.4. Here, the user identified the advantages of using the ELS, information about how this pioneers eSports education, the learning process and how to share the ELS with their peers. Table 4 shows the questions that were used during the evaluation of the Discovery phase.

Table 3: Discovery phase form questions.

| Questions |
|---|
| 1. The e-learning system gives me the impression that I will be part of an innovative community if I join. |
| 2. The e-learning system presents me with the advantages of using the system. |
| 3. The learning process of the system was made clear to me. |
| 4. It is clear to me how to share the platform on social media. |

2. Onboarding

   The Onboarding phase scored a mean of 4.1 and a standard deviation of 0.06. It is identified by the user in its journey through account creation, skill assessment, avatar creation and tutorial screens. Table 5 shows the questions that were used during the evaluation of the Onboarding phase.

3. Scaffolding

   The Scaffolding phase scored a mean of 4.25 and a standard deviation of 0.25. Here, the user identified the 4C/ID model and its components, the Miller's Pyramid, and the tools that show the child's progress

Table 4: Onboarding phase form questions.

| Questions |
|---|
| 1. It is clear that my interests count in defining my learning roadmap. |
| 2. Creating an avatar of my liking will create a more unique experience for myself. |
| 3. Joining the e-learning system with my child and sharing these experiences will create a stronger bond. |
| 4. Joining the e-learning system with my child and sharing these experiences will improve its learning experience. |
| 5. After completing the tutorial, it is clear how to use the system for my learning roadmap. |

and spent hours. Table 6 shows the questions that were used during the evaluation of the Scaffolding phase.

Table 5: Scaffolding phase form questions.

| Questions |
|---|
| 1. The learning framework enables me to acquire information efficiently. |
| 2. The roadmap provides a clear overview of the learning path. |
| 3. I enjoy it when the system rewards me with badges for completing milestones. |
| 4. The pyramid is a clear visualization to follow my progress. |
| 5. I find it is useful to see the progress of my child. |
| 6. I find it is useful to track the gamed hours of my child. |

4. Endgame

   With a mean of 4.09 and a standard deviation of 0.18, the Endgame phase measured the retention of the user. Table 7 shows the questions that were used to evaluate the Endgame phase.

Table 6: Endgame phase form questions.

| Questions |
|---|
| 1. Because I can still train new skills, I will continue using the e-learning system after completing the roadmap. |
| 2. Providing feedback to others helps me become more skillful, and therefore I will continue using the e-learning system after completing the first roadmap. |

# 4. DISCUSSION AND CONCLUSION

The current study focuses on creating the theoretical framework of a parent-child eSports e-learning system, prototyping the extracted requirements of such ELS and user testing it. This section explains the outcome of every subquestions and offers information about future research.

Firstly, the current study looked at the non-functional requirements of a possible ELS, which were extracted throughout the creation of the theoretical framework. Since the proposed ELS, at its core, is an LMS, the proposed learning framework incorporates the main identified characteristics of an LMS: standardised curriculum, individual lessons, and constant skills assessment. The learning framework aims to help the learner integrate the knowledge and skills in daily life. Therefore, the current study applied an instructional design approach, 4C/ID; thus, streamlining the learning process for both types of possible identified learners: children and parents. In order to increase the motivation and engagement levels, the ELS uses white hat gamified interactions designed through the Octalysis Framework. The theoretical creation of the framework resulted in fourteen non-functional requirements depicted in Table 3, which represent the answer to Q1.

Secondly, to prototype, the current research identified the functional requirements. Each non-functional requirement is translated into one or two functional requirements without knowing precisely if they fit. However, prototyping and evaluation reveal that out of eighteen functional requirements, only showing the share buttons on the landing page was not visible for every participant in the evaluation (a mean of 3.2). With a mean of 3.8, the ELS could present better the advantages of the system and the Miller Pyramid. The rest of the requirements scored a mean above 4.0, meaning that the current prototype could be used to test an actual population and answer Q2.

Thirdly, the current research analysed creating a high-level fidelity prototype within the time limit to validate the identified requirements. The result of it was an Adobe XD design presented in an earlier section that created the entire user journey and thus answered RQ3.

Fourthly, we obtained evidence that the users perceived the identified requirements positively. The Discovery phase showed a lower mean, which could be mitigated by making the share buttons a call to action and advantages more evident in a future prototype. Since they play such an essential role in Core Drives 1 and 5, an idea would be to create a specific page that shows the advantages and methodology they will follow and share them at the end. The other Octalysis phases all had a mean higher than 4, which until further testing, we can accept them as they are, thus answering to RQ4.

Future research should focus on testing the learning framework with real-life educational content and assess if the learners can improve their skills. To be more precise, future research could focus on measuring if every step of the 4C/ID implementation fulfils its scope. After it is known that the learning framework is doing what it is intended to do, further user testing could be done. More specifically, participants of such study should be actual parents and children that work together through the real-life educational content. Doing so can measure whether the learners can use the ELS for its intended purpose.

In conclusion, the current research proposes a new learning framework illustrated in a user-approved LMS design that implements gamified interactions. Even though users approve the design, the current research is the starting point of creating a parent-child eSports e-learning system to foster sustainable gaming for children. Research still has to be conducted to approve the learning framework and get the design approved by real-life users.

# References

Achab, S., Nicolier, M., Mauny, F., Monnin, J., Trojak, B., Vandel, P., ... Haffen, E. (2011). Massively multiplayer online role-playing games: comparing char-

acteristics of addict vs non-addict online recruited gamers in a french adult population. *BMC psychiatry*, *11*(1), 1–12.

Anderson, C. G., Tsaasan, A., Reitman, J., Lee, J. S., Wu, M., Steel, H., ... Steinkuehler, C. (2018). Understanding esports as a stem career ready curriculum in the wild. In *2018 10th international conference on virtual worlds and games for serious applications (vs-games)* (pp. 1–6).

Aronson, J. E., Liang, T.-P., & MacCarthy, R. V. (2005). *Decision support systems and intelligent systems* (Vol. 4). Pearson Prentice-Hall Upper Saddle River, NJ, USA:.

Bender, P. K., Kim, E.-L., & Gentile, D. A. (2020). Gaming disorder in children and adolescents: Risk factors and preventive approaches. *Current Addiction Reports*, 1–8.

Berking, P., & Gallagher, S. (2013). Choosing a learning management system. *Advanced Distributed Learning (ADL) Co-Laboratories*, *14*, 40–62.

Besombes, N. (2020, 02). *Esports Related Professions - Nico Besombes.* Retrieved from `https://medium.com/@nicolas.besombes/esports-professions-e402a1c3ab92`

Bingöl, U., & Çakir, Y. N. (2021). Impact of future expectations on career planning attitudes' of professional esports athletes. *Yönetim Bilimleri Dergisi*, *19*(39), 203–224.

Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child development*, *78*(1), 246–263.

Bonnaire, C., & Phan, O. (2017). Relationships between parental attitudes, family functioning and internet gaming disorder in adolescents attending school. *Psychiatry Research*, *255*, 104–110.

Boyan, A., & Sherry, J. L. (2011). The challenge in creating games for education: Aligning mental models with game models. *Child development perspectives*, *5*(2), 82–87.

Bugl, D. (2019). *Learn react hooks: Build and refactor modern react. js applications using hooks.* Packt Publishing Ltd.

Caponetto, I., Earp, J., & Ott, M. (2014). Gamification and education: A literature review. In *European conference on games based learning* (Vol. 1, p. 50).

Carrillo Vera, J. A., & Aguado Terrón, J. M. (2019). The esports ecosystem: Stakeholders and trends in a new show business. *Catalan Journal of Communication & Cultural Studies*, *11*(1), 3–22.

Cheung, C. S.-S., & Pomerantz, E. M. (2012). Why does parents' involvement enhance children's achievement? the role of parent-oriented motivation. *Journal of Educational Psychology*, *104*(3), 820.

Chou, Y.-k. (2019). *Actionable gamification: Beyond points, badges, and leaderboards.* Packt Publishing Ltd.

Chuang, T.-Y., & Chen, W.-F. (2007). Effect of computer-based video games on children: An experimental study. In *2007 first ieee international workshop on digital game and intelligent toy enhanced learning (digitel'07)* (pp. 114–118).

Cigdem, H., & Ozturk, M. (2016). Factors affecting students' behavioral intention to use lms at a turkish post-secondary vocational school. *International Review of Research in Open and Distributed Learning*, *17*(3), 276–295.

Clark, A. C., & Ernst, J. V. (2009). Gaming in technology education: the study of gaming can teach life skills for the twenty-first century that employers want... these include analytical thinking, team building, multitasking, and problem solving under duress. *The Technology Teacher*, *68*(5), 21–27.

*Core Features.* (2021). `https://docs.spring.io/spring-boot/docs/current/reference/html/features.htmlfeatures.json`.

Craik, K. (1943). The nature of exploration cambridge university press. *Cited in online encyclopaedia of human-computer interaction*.

DeMichiel, L., & Keith, M. (2006). Java persistence api. *JSR*, *220*.

Dindar, M., & Akbulut, Y. (2014). Motivational characteristics of turkish mmorpg players. *Computers in Human Behavior*, *33*, 119–125.

Eckhardt, J., Vogelsang, A., & Fernández, D. M. (2016). Are" non-functional" requirements really non-functional? an investigation of non-functional requirements in practice. In *Proceedings of the 38th international conference on software engineering* (pp. 832–842).

Ewoldsen, D. R., Eno, C. A., Okdie, B. M., Velez, J. A., Guadagno, R. E., & DeCoster, J. (2012). Effect of playing violent video games cooperatively or competitively on subsequent cooperative behavior. *Cyberpsychology, Behavior, and Social Networking*, *15*(5), 277–280.

Gackenheimer, C. (2015). Jsx fundamentals. In *Introduction to react* (pp. 43–64). Springer.

Gasson, S. (1995). „the role of methodologies in it-related organisational change". In *Proceedings of bcs specialist group on is methodologies, 3rd annual conference, the application of methodologies in industrial and business change, north east* (pp. 1–2).

Gentile, D. A., Bailey, K., Bavelier, D., Brockmyer, J. F., Cash, H., Coyne, S. M., ... others (2017). Internet gaming disorder in children and adolescents. *Pediatrics*, *140*(Supplement 2), S81–S85.

Gerber, S., & Scott, L. (2011). Gamers and gaming context: Relationships to critical thinking. *British Journal of Educational Technology*, *42*(5), 842–849.

Giang, V. (2013, 09). *'Gamification' Techniques Increase Your Employees' Ability To Learn By 40%.* Retrieved from `https://www.businessinsider.com/gamification-techniques-increase-your-employees-ability-to-learn-by-40-2013-9?international=truer=USIR=T`

Gordon, V. S., & Bieman, J. M. (1995). Rapid prototyping: lessons learned. *IEEE software*, *12*(1), 85–95.

Granic, I., Lobel, A., & Engels, R. C. (2014). The benefits of playing video games. *American psychologist*, *69*(1), 66.

Guney, Z. (2019). A sample design in programming with four-component instructional design (4c/id) model. *Malaysian Online Journal of Educational Technology*, *7*(4), 1–14.

Guntupally, K., Devarakonda, R., & Kehoe, K. (2018). Spring boot based rest api to improve data quality report generation for big scientific data: Arm data center example. In *2018 ieee international conference on big data (big data)* (pp. 5328–5329).

*The Internet2Project.* (2021, 12). Retrieved from `https://internet2.edu/`

Johnson, D., Deterding, S., Kuhn, K.-A., Staneva, A., Stoyanov, S., & Hides, L. (2016). Gamification for

health and wellbeing: A systematic review of the literature. *Internet interventions*, *6*, 89–106.

Kapp, K. M. (2012). *The gamification of learning and instruction: game-based methods and strategies for training and education.* John Wiley & Sons.

Kasim, N. N. M., & Khalid, F. (2016). Choosing the right learning management system (lms) for the higher education institution context: A systematic review. *International Journal of Emerging Technologies in Learning*, *11*(6).

Kim, Y. H., Nauright, J., & Suveatwatanakul, C. (2020). The rise of e-sports and potential for post-covid continued growth. *Sport in Society*, *23*(11), 1861–1871.

Kumar, M. A., Kumar, D. A., & Iyyappana, M. M. (2016). Applying separation of concern for developing softwares using aspect programming concepts. In *International conference on computation* (pp. 906–9014).

Lam, L. T., Peng, Z.-w., Mai, J.-c., & Jing, J. (2009). Factors associated with internet addiction among adolescents. *Cyberpsychology & behavior*, *12*(5), 551–555.

*Learning Management System (LMS) Market Global Opportunity Analysis and Industry Forecast (2019-2025)* (Tech. Rep.). (2019). Retrieved from `http://reports.weforum.org/future-of-jobs-2018/`

Leopold, T., Zahid, S., & Ratcheva, V. (2018). *The Future of Jobs Report 2018.* Retrieved from `http://reports.weforum.org/future-of-jobs-2018/`

Lin, J. M.-C., & Liu, S.-F. (2012). An investigation into parent-child collaboration in learning computer programming. *Journal of Educational Technology & Society*, *15*(1), 162–173.

Lopez-Fernandez, O., Williams, A. J., Griffiths, M. D., & Kuss, D. J. (2019). Female gaming, gaming addiction, and the role of women within gaming culture: A narrative literature review. *Frontiers in Psychiatry*, *10*, 454.

Lucassen, G., Dalpiaz, F., van der Werf, J. M. E., & Brinkkemper, S. (2016). Improving agile requirements: the quality user story framework and tool. *Requirements engineering*, *21*(3), 383–403.

Macero, M., Macero, & Anglin. (2017). *Learn microservices with spring boot.* Springer.

Michaelraj, A. (2009). *Taxonomy of physical prototypes: structure and validation.* Clemson University.

Miller, G. E. (1990). The assessment of clinical skills/competence/performance. *Academic medicine*, *65*(9), S63–7.

NCSA Sports. (2021, 07). *Esports Scholarships | How to Get an Esports Scholarship.* Retrieved from `https://www.ncsasports.org/college-esports-scholarships`

Nemoto, T., & Beglar, D. (2014). Likert-scale questionnaires. In *Jalt 2013 conference proceedings* (pp. 1–8).

Newzoo. (2021). *Global Games Market Report The VR Metaverse Edition* (Tech. Rep.). Retrieved from `https://newzoo.com/insights/trend-reports/newzoo-global-games-market-report-2021`

Otto, K., & Wood, K. (2001). Product design: Techniques in reverse engineering and new product design. *Prentice Hall*.

*Overview of logical design.* (1999). Retrieved from `https://docs.oracle.com/cd/A81042`$_0$`1/DOC/server.816/a76994/logical.htm`

Parshakov, P., & Zavertiaeva, M. (2018). Determinants of performance in esports: A country-level analysis. *International Journal of Sport Finance*, *13*(1), 34–51.

Paudyal, A. (2021). Developing video chat application with reactjs and webrtc.

Piko, B. F., Milin, R., O'Connor, R., & Sawyer, M. (2011). *Multidisciplinary approach to child and adolescent depression.* Hindawi.

Post, G., & Birt, J. (2020). Assessing esport candidacy for critical thinking education. In *Ascilite 2020: 37th international conference on innovation, practice and research in the use of educational technologies in tertiary education* (pp. 295–300).

Poznyak, D. V. (2008). *Inclusion of "gaming disorder" in ICD-11.* `https://www.who.int/news/item/14-09-2018-inclusion-of-gaming-disorder-in-icd-11`.

Prensky, M. R. (2012). *From digital natives to digital wisdom: Hopeful essays for 21st century learning.* Corwin Press.

Rabah, J., Cassidy, R., & Beauchemin, R. (2018). Gamification in education: Real benefits or edutainment. In *17th european conference on e-learning, athens, greece.*

Rodriguez, A. (2008). Restful web services: The basics. *IBM developerWorks*, *33*, 18.

Russoniello, C. V., O'Brien, K., & Parks, J. M. (2009). Eeg, hrv and psychological correlates while playing bejeweled ii: A randomized controlled study. *Annual review of cybertherapy and telemedicine*, *7*(1), 189–192.

Ryan, R. M., Rigby, C. S., & Przybylski, A. (2006). The motivational pull of video games: A self-determination theory approach. *Motivation and emotion*, *30*(4), 344–360.

Scholz, T. M., & Barlow. (2019). *esports is business.* Springer.

Shabani, K., Khatib, M., & Ebadi, S. (2010). Vygotsky's zone of proximal development: Instructional implications and teachers' professional development. *English language teaching*, *3*(4), 237–248.

Shapero, B. G., Black, S. K., Liu, R. T., Klugman, J., Bender, R. E., Abramson, L. Y., & Alloy, L. B. (2014). Stressful life events and depression symptoms: the effect of childhood emotional abuse on stress reactivity. *Journal of clinical psychology*, *70*(3), 209–223.

Shariat, Z., Hashemi, S. M., & Mohammadi, A. (2014). Researchand compare standards of e-learning management system: a survey. *International Journal of Information Technology and Computer Science*, *6*(2).

Smith, P. L., & Ragan, T. J. (2004). *Instructional design.* John Wiley & Sons.

Subramanian, V. (2019). React components. In *Pro mern stack* (pp. 41–60). Springer.

Suryotrisongko, H., Jayanto, D. P., & Tjahyanto, A. (2017). Design and development of backend application for public complaint systems using microservice spring boot. *Procedia Computer Science*, *124*, 736–743.

Torres, C. R. (2000). What counts as part of a game? a look at skills. *Journal of the Philosophy of Sport*, *27*(1), 81–92.

Uttal, D. H., Meadow, N. G., Tipton, E., Hand, L. L., Alden, A. R., Warren, C., & Newcombe, N. S. (2013). The malleability of spatial skills: a meta-analysis of training studies. *Psychological bulletin*, *139*(2), 352.

Van Merriënboer, J. J., Kirschner, P. A., & Kester, L. (2003). Taking the load off a learner's mind: Instructional design for complex learning. *Educational psychologist*, *38*(1), 5–13.

van Merriënboer, J. J. G. (2019). *The four-component instructional design model an overview of its main design principles*. School of Health Professions Education Faculty of Health, Medicine and Life Sciences.

Vedadi, A., & Greer, T. H. (2021). Revisiting how perceived uncertainty and herd behavior influence technology choice. *Journal of Organizational and End User Computing (JOEUC)*, *33*(6), 1–19.

*Virtual DOM and Internals –*. (2022). Retrieved from `https://reactjs.org/docs/faq-internals.html`

Vygotsky, L. S. (2012). *Thought and language*. MIT press.

Waltemate, T., Gall, D., Roth, D., Botsch, M., & Latoschik, M. E. (2018). The impact of avatar personalization and immersion on virtual body ownership, presence, and emotional response. *IEEE transactions on visualization and computer graphics*, *24*(4), 1643–1652.

Watson, W., & Watson, S. L. (2007). An argument for clarity: What are learning management systems, what are they not, and what should they become.

Wertsch, J. V. (1979). From social interaction to higher psychological processes. a clarification and application of vygotsky's theory. *Human development*, *22*(1), 1–22.

Wijman, T. (2021, 12). *The Games Market and Beyond in 2021: The Year in Numbers.* Retrieved from `https://newzoo.com/insights/articles/the-games-market-in-2021-the-year-in-numbers-esports-cloud-gaming/`

Wood, D., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of child psychology and psychiatry*, *17*(2), 89–100.

Wright, T., Blakely, D., & Boot, W. (2012). The effects of action video game play on vision and attention. *Video game play and consciousness*, 71–89.

Yaghini, M., Bourouni, A., & Amiri, R. H. (2009). A framework for selection of information systems development methodologies. *Comput. Inf. Sci.*, *2*(1), 3–11.

Yan, X., & Gu, P. (1996). A review of rapid prototyping technologies and systems. *Computer-aided design*, *28*(4), 307–318.

Yang, H. Y., Tempero, E., & Melton, H. (2008). An empirical study into use of dependency injection in java. In *19th australian conference on software engineering (aswec 2008)* (pp. 239–247).

Yen, J.-Y., Yeh, Y.-C., Wang, P.-W., Liu, T.-L., Chen, Y.-Y., & Ko, C.-H. (2018). Emotional regulation in young adults with internet gaming disorder. *International journal of environmental research and public health*, *15*(1), 30.

Zhao, M., & Hao, W. (2019). Challenges of gaming disorder: suggestions from a public health perspective. *General psychiatry*, *32*(3).

# APPENDIX

Table 7: Reflective questions

| | | |
|---|---|---|
| What: Explain your problem or point for improvement as specific as possible | How: Explain how your plan will lead to an improvement by going into as much details as possible | Really: Actively look for counterarguments and evidence |
| What would you like to improve, or is there a problem you would like to solve? | Provide a mechanistic explanation to make your assumptions explicit. I.e. how exactly does your plan lead to the intended result? More assumptions can be detected by asking 'how?' and 'why?'. | Can you think of counterexamples, or reasons why your plan may not work or may be counterproductive? |
| How did you determine this problem or point for improvement? | Map out the evidence for your assumptions. I.e. how do you know that your plan will lead to the intended result? What evidence supports your assumptions? | Can you think of alternative plans? How are those plans better or worse than the plan you propose? |
| How can you see progress, and can you measure it? | | |

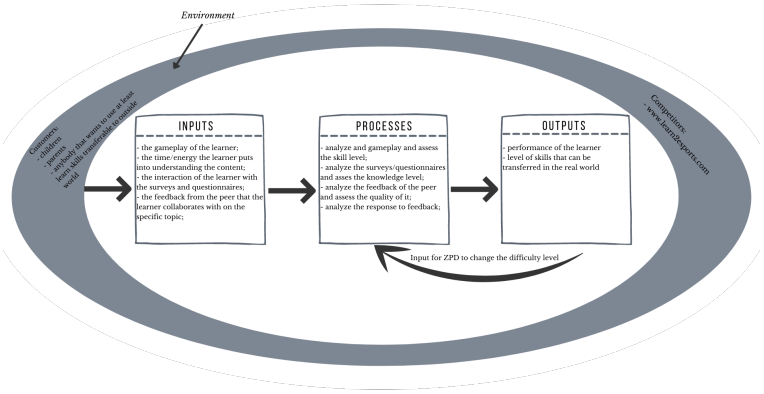


Figure 5: Structure of the ELS

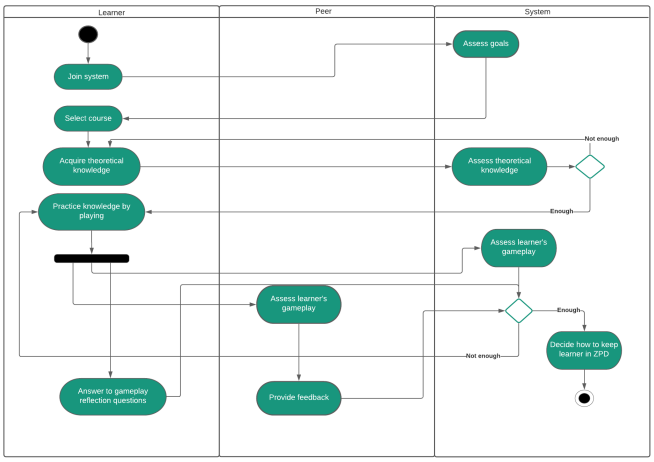


Figure 6: Activity Diagram


Figure 7: Landing page

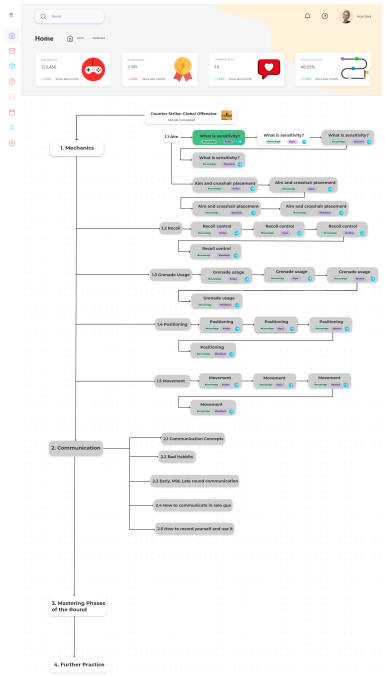


Figure 8: Learner's roadmap

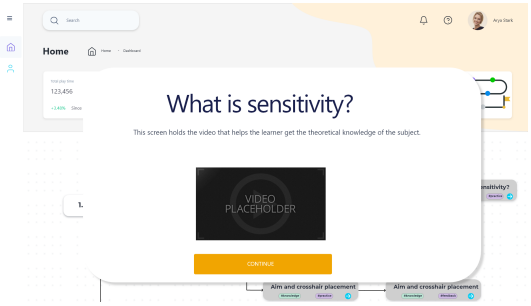


Figure 9: Knowledge step

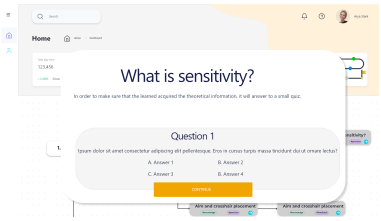


Figure 10: Quiz step

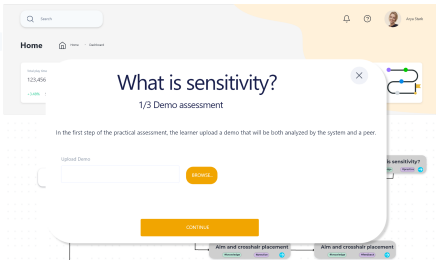


Figure 11: Demo assessment

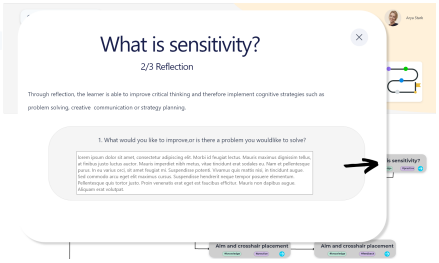


Figure 12: Reflection Step

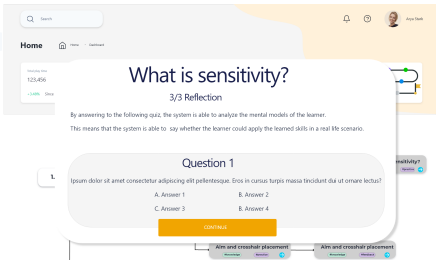


Figure 13: Mental Model Step