JÖNKÖPING UNIVERSITY
School of Engineering

Does esports participation help in developing computer literacy skills?

This final thesis has been carried out at the School of Engineering at Jönköping University within Informatics. The authors are responsible for the presented opinions, conclusions and results.

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Abstract

In this paper, we have focused on possible connections between Esports, more narrowly League of Legends, and increased Computer Literacy Skills.

The purpose of this study was to research Esports and Computer Literacy skills and analyse the possible link and how it might overall help one's day-to-day life, job prospects and more by using Esports as a tool for learning Computer Literacy Skills.

This study is guided by the theoretical perspective of transfer of learning. Using a cross-sectional observational study, we have come up with a 10-exercise test which analyses the computer literacy skills (CLS) of Esports players and Non-Esports individuals. Data were collected from 20 participants through observations to gauge participants' performance, supplemented by a post-test survey to gather additional insights.

Results between the two groups were similar, with a slight edge towards the Esports players group which has shown greater efficiency at completing the test overall and each individual task. Overall, our results show that people who enjoy these titles do tend to be more efficient at completing daily computer duties. However, both groups possess capable computer literacy skills in order to handle the ever-evolving digital world.

Further research is mandatory to explore the causal relationship between League of Legends and computer literacy skills, as well as to identify strategies for incorporating Esports in educational settings regarding computer literacy skills.

Keywords: Computer Literacy Skills, Computer Competence, Esports, Finals Thesis Work, League of Legends, Informatics, Cross-Sectional Observational Study.

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1. Introduction

When considering Esports or gaming more broadly one might initially associate these activities with relaxation and leisure. However, research has shown that Esports can serve a more utilitarian purpose beyond mere entertainment (Guo et al., 2022, Leung & Chu, 2023, Boonwang et al., 2022). Pluss et al. (2019) called Esports the chess of the 21st century, calling it the perfect field for individuals interested in evaluating and enhancing human expertise. As our world becomes increasingly digitised (Terras, 2011), the need for computer literacy skills is likewise growing. In light of these trends it is worth exploring whether Esports might offer means of developing such skills. Specifically, we aim to analyse the computer literacy capabilities of individuals who regularly engage in Esports and those who do not. If we find that Esports regulars demonstrate greater proficiency in this area, we will investigate why this is the case and how this knowledge can be applied to promote skill development.

Informatics is the study of the structure, behaviour, and interactions of natural and engineered computational systems. (University of Edinburgh, 2010). It has become part of our lives in multiple ways. We interact with it daily. Notably, informatics is now included in the curricula of many schools at both the upper-secondary and university levels. In some countries, such as Sweden, information systems have become essential components of their infrastructure. There is also a trend towards information moving from physical to digital. There are now ebooks, e-journals, e-documents and e-catalogues and they are rapidly becoming the norm (Oseghale, 2023). One key branch of Informatics is Computer Literacy.

Computer literacy is defined as the knowledge and ability to use computers and related technology efficiently, with skill levels ranging from elementary use to computer programming and advanced problem-solving (Indeed, 2023). Specifically, the term "Computer Literacy Skills" (CLS) refers to a person's ability to utilise a computer efficiently in order to achieve their goals as quickly as possible. Additionally, it implies knowledge of crucial tasks such as device maintenance and problem-solving to ensure effective and hassle-free task completion.

Esports, short for electronic sports, is a form of competition using video games. (Hamari & Sjöblom, 2017). The topic of our project is Esports within Informatics, and how it can be potentially used to help develop CLS in any individual.

In order to achieve consistent results and reduce variables we decided to narrow down our scope and only focus on one Esports title. Our Esport of choice for this study is League of Legends (LoL). It is the most popular Esports title there is (Horbiński & Zagata, 2023). It has one of the largest player bases in Esports. It gathered around 100-120 million players according to Aurenty (2021). We wanted to focus on the

biggest Esport there is in order to facilitate the search for fitting participants for our study.

We researched how beneficial Esports could be for CLS. Our goal was to see if there is any connection between Esports players and enhanced computer literacy.

For almost twenty years, researchers have been exploring how playing video games can help improve cognitive (Kowal et al., 2018), motor (Saha et al., 2022), and sensory-motor skills (Toth et al., 2021). However, very little research has focused on the computer skills that are developed as a result of the rapidly growing world of esports, where video games are played competitively. This study offers an understanding of the impact of Esports on individuals, highlighting the potential for improved proficiency in computer literacy skills.

1.1 Problem statement

Some people might struggle with the increased needs for CLS and thus lag behind. It is important that everyone is familiar with Computers and is able to use them every day to their advantage (Gupta, 2006). In this context, examining the potential benefits of Esports for developing CLS is an important undertaking.

CLS can bring many benefits to one's life such as helping with easy day to day tasks, increased job potential by having the necessary skills to qualify for a higher position or removing the burden of struggling with computer issues. Moreover, multiple scholarly investigations demonstrate a positive correlation between elevated levels of digital literacy and increased proficiency in discerning fake news and misleading content online (Sirlin et al. 2021; Muda et al. 2021; Flintham et al. 2018). Consequently, the acquisition of digital literacy can empower individuals to develop a discerning approach towards online content consumption, thereby fostering constructive impacts on social and political behaviours (Guriev et al. 2020; Levy 2021; Zhuravskaya et al. 2020; Iyengar et al. 2019).

To conclude, it is evident that CLS is critical to thrive in today's society. However, there is research pointing towards the need for CLS-learning tools, and how currently there are not enough of them (Tomczyk et al., 2022, Oseghale, 2023). We want to investigate Esports as such a tool in order to potentially help develop CLS in people. Right now, there remains a lack of research on the potential transfer of learning from popular Esports games, such as LoL to the development of CLS. This gap hinders the understanding of how Esports can potentially impact individuals' CLS.

Previously there have been studies which have shown that Esports, beyond its relaxing or enjoyable attributes, can benefit the Esports player cognitively (Kowal et al., 2018) and with their sensory-motor skills (Toth et al., 2021).

We are looking to research if Esports could also be beneficial for people struggling with CLS. This way they could enjoy a fun, leisurely and social activity (Zaib Abbasi et al., 2023) that can also impact their lives positively.

1.2   Purpose and research questions

Due to the problem stated before, it is evident that we need to conduct a study that analyses the potential link between CLS capabilities and Esports.

There is a clear link between Esports and the acquisition of 21st-century skills (Zhong et al., 2022). Our purpose is to ascertain whether CLS is one of them. We must also research whether there is a skill discrepancy between people who do not play Esports and people who do.

[RQ1] How do Esports players and Non-Esports people differ in Computer Literacy Skills if at all?

It is important we understand the potential link between CLS and Esports. Both topics are quite broad, so we require a thorough analysis to see if they are correlated in any matter.

[RQ2] How can playing Esports improve one's Computer Literacy Skills if at all?

1.3   Scope and delimitations

The primary focus of our research is to investigate if Esports players perform differently from Non-Esports people regarding CLS. To achieve results, we utilised a mixed-method approach, involving a test on CLS and a survey to achieve numerical data. However, it is essential to note that our study has delimitations.

This research is limited to League of Legends players for the Esports players group. The study will only cover data on participants aged between 20-27 years old, therefore, the findings may not be generalised to individuals outside this age range. The study was conducted over a period of 15 weeks. Furthermore, the study utilised a mixed approach, combining qualitative observations and quantitative data from a post-test survey and not any other research methodology.

1.4   Disposition

The report initiates by addressing the research gap that our research aims to fill in Chapter 1. In Chapter 2, the theoretical framework is presented with theories that support and create a foundation for our study. The theoretical framework is a guiding structure in relation to Chapter 1, with theories addressing the research gap for our study. Following in Chapter 3, we provide a description of the methods and procedures that we employed during our study, including approaches to data collection, analysis, and considerations for the validity and reliability of our research.

Chapter 4 of this study addresses the results that have been discovered and an analysis of the results. In Chapter 5, we discuss the results along with a detailed discussion of the methods we used. Lastly, in Chapter 6, the study is summarised and scrutinises the scientific and practical implications of our findings. Possibilities of further research that arise from our research are also employed.

2   Theoretical framework

There have been many studies done on Esports in the context of Business, Sports Science, Cognitive Science, Law, Media Studies, Sociology and even, minimally, in Informatics (Reitman et al., 2019).

In Informatics, studies have been conducted with the goal to collect large amounts of data about an Esports player or team performance. One representative Esports study within Informatics is Low-Kam et al., (2013), where they analysed team performance by extracting several performance metrics to observe patterns and disruptions within it.

The focus of our framework is to initially prove the extensive research of the benefits of Esports and to further emphasise the need for a study of Computer Literacy benefits within Esports. The second part of our framework looks at the literature on League of Legends and points out the gap. The third part focuses on the need for learning tools within CLS, thus implying the importance of researching the topic of our paper. Finally, we looked at the transfer of learning. This would prove the potential of using Esports to transfer learning towards CLS.

2.1 Benefits of Esports

When it comes to the benefits of playing Esports, one of the earliest studies looked at differences in cognitive abilities between people who play video games and those who do not (Kowal et al., 2018). The paper found faster cognitive task switching and processing speeds in those who are video game players. These findings indicate that video games can improve individuals' cognitive abilities, which may transfer to other fields, such as CLS. Video games have demonstrated the potential to enhance certain abilities that could ultimately contribute to an enhanced CLS. These abilities include accelerated decision-making and heightened speed in visual search.

Furthermore, Saha et al. (2022) looked at video games to improve fine motor and memory skills. It has shown positive results and even mentioned that this skill could transfer to scholastic performances. The findings from Saha et al. (2022) with individuals having improved fine motor skills, involved coordination and precise movements on a computer, which is being used when executing tasks on a computer. These abilities are connected with CLS when navigating interfaces and making use of keyboard shortcuts. Therefore, developing fine motor skills from video games could lead to higher performance on computer literacy tasks.

Additionally, Toth et al. (2021) proved that expertise within Esports increases sensory-motor skills. This finding indicates that engagement in Esports where abilities related to coordinated and precise movements can develop sensory-motor skills. The improved sensory-motor skills could potentially improve individuals' abilities and

performance related to CLS. Coordinated and precise movements are important when navigating interfaces and clicking on specific elements. Lastly, on that note, Toth et al. (2023) reveal positive target acquisition improvements in both groups of Esports players and Non-Esports people by just following a 10 minute training regime across a few days. In relation to the previous study by Toth et al. (2021), improved target acquisition may lead to improved CLS. Target acquisition, which can be related to computer literacy by navigating on a computer, clicking on specific elements and interacting with a user interface.

Page et al. (2017) proved that 'active video games' or AVG improve physical balance. This is an important discovery especially for people with Cerebral Palsy. The paper also found that there is a benefit for them using active video games. The conclusion was that these video games can be useful tools to aid in motor skill improvement.

Moreover, the systematic review made by (Zhong et al., 2022) provides ample evidence that Esports lead to the acquisition of 21st-century skills such as communication, collaboration, career skills, creativity, information literacy and many more. Due to the strategic and team-based nature of Esports, it is no surprise that they do help with enhancing problem-solving and communication skills (Lie et al., 2022).

Studies such as Lisk et al. (2012) and Lu et al. (2014) relieved the transferability of leadership skills, while Mysirlaki & Paraskeva (2020) pointed to betterment in life and career skills.

Notwithstanding the foregoing, Esports is a highly beneficial activity for its user. The skills identified as being enhanced by it are similar to skills required to excel at computer literacy.

2.2 Computer Literacy Skills

When addressing Computer Literacy Skills, we are alluding to the fundamental proficiencies that an individual must possess to competently manage and effectively utilise a computer system for the attainment of their objectives.

Updates

Updates pertain to a user's capacity to maintain the currency of their computer software. A pivotal characteristic of software updates involves the mitigation of vulnerabilities and the enhancement of program security. Consequently, this translates into heightened resistance against intrusion attempts by exploits and viruses, thereby bolstering the resilience of the device and minimising potential irreparable consequences. "Software updates reduce the opportunity for exploitation. [..] preventive mechanisms like updates can influence the probability of being compromised by Advanced Persistent Threats." (Tizio et al., 2023).

Split-screen

Acquiring the competence and familiarity with the utilisation of split-screen functionality on a computer has been substantiated as crucial for developing higher-order thinking skills (Deslauriers et al., 2019; Stonebraker, 2015). It has also been shown to support diverse learner needs well (Thomas & Gosling, 2009).

Word Processors

Office productivity applications, such as word processors, spreadsheets, and presentation software are indispensable tools of modern society (Lee et al., 2021). They are present and required by school institutions and workplaces worldwide. We thus consider it a vital computer literacy skill.

Image editing

Working with images is a common computer task, as evidenced by the widespread use of image editing software (Zeng et al., 2020) and the increasing amount of digital images being created and shared on platforms such as Instagram and beyond. Individuals possessing rudimentary computer literacy should demonstrate the capacity to proficiently engage with images.

Software installation

Installing applications onto a computer is the core design of modern operating systems. In spite of that, people might still struggle to perform this task on a day-to-day basis (Tomczyk et al., 2022). Any user with CLS must be able to complete this task effortlessly.

Searching information online - "Googling"

Gupta (2006) mentions how an individual uses web browsers and search engines to obtain the required information. The main search engine used for this endeavour is Google. Searching information on Google has become so common-place that it now has its own, frequently-used verb: Googling.

Troubleshooting and Resolving Computer Issues

Computers, as complex machines, are susceptible to errors and malfunctions that can impede their functionality. It is crucial that users are able to promptly address and resolve any errors or malfunctions that may arise to minimise disruption to their work or daily activities (Webb, 2010).

Uploading files

The act of uploading files to online platforms has attained ubiquity and assumes paramount significance within the contemporary digital milieu. Its significance has been further accentuated by the emergence of cloud computing, a paradigm that facilitates the immediate accessibility of computing resources as and when required. "Cloud Computing is considered nowadays as the future of ICT systems leveraging new methodologies for developing, providing and consuming services." (Menychtas et al., 2011). It also is used or plans to be used by an increasing amount of companies and organisations each year (Erturk, 2017, Haris et al., 2022)

Switching Keyboard Language

"More than 2 billion mobile users worldwide type in multiple languages on the soft keyboard." (Gothe et al., 2020). For some, switching keyboard languages could be an everyday task. A user with CLS is one which can make that change in seconds, by merely using keyboard shortcut commands.

2.3 League of Legends

For this paper, we have chosen League of Legends (LoL) as the main Esports video game. This was done due to the fact that it is the largest Esport. Focusing on one Esport helps us narrow down the scope of our research. Choosing League of Legends aided in searching for fitting participants.

The vast majority of League of Legends studies have been conducted from the perspective of behaviour, more specifically the aspect of toxic behaviour within League of Legends (Mora-Cantallops & Sicilia, 2018). Another part of League of Legends studies is about predicting win-loss scenarios, often using AI or Machine Learning (Jung & Kim, 2022, Shen, 2022, Hitar-Garcia et al., 2022). There is one study that looks at the interpretation of spatial situations in League of Legends of players and people who do not play. The paper concludes that the LoL players have a greater spatial awareness (Horbiński & Zagata, 2023).

As previously demonstrated, even though the game is popular, it is still underexplored scientifically, and there are many areas that need further research (Mora-Cantallops & Sicilia, 2018). This study aids in adding a new perspective to League of Legends research. Researching LoL and CLS in tandem can benefit both League of Legends, which needs more perspectives, and CLS, which is in demand for learning tools.

2.4 The CLS Education Demand

Digitization is rapidly expanding globally, necessitating a greater breadth of knowledge in the field in order to thrive and succeed in society (Terras, 2011). Digital technologies have the potential to significantly mitigate poverty and inequality through facilitating access to economic opportunities (Jack and Suri, 2014, Chun and

Tang, 2018, Hjort and Tian, 2021). A primary obstacle in addressing the digital divide, however, pertains to the insufficient levels of digital literacy. (Dimaggio et al., 2004, Zillien and Hargittai, 2009, Rains and Tsetsi, 2017, Hargittai and Micheli, 2019). Oseghale (2023) has discussed the issue of the lack of training on using and finding e-resources. By e-resources, he means all the information available on the internet. While certain individuals may adapt to the increasing demand for CLS, others may encounter difficulties (Tomczyk et al., 2022). Consequently, it becomes imperative to establish sufficient resources and tools to aid those who may face challenges in this regard.

2.5 Transfer of Learning

Transfer of learning refers to the application of knowledge, skills and experiences obtained in one context resulting in enhancing performance in a different context (Perkins & Salomon, 1992). This learning theory suggests that learning is profoundly connected to the specific context in which it occurs (Lave, 1988).

Perkins and Salomon (1992) also mention the various ways transfer of learning can occur, with near- versus far-transfer. Near-transfer means the transfer of knowledge, skills and experiences between two very similar contexts, "as for instance when students taking an exam face a mix of problems of the same kinds that they have practised separately in their homework" (p.4). On the other hand, far-transfer is when the transfer between the contexts is more distinct and dissimilar from each other. Perkins and Salomon (1992) express a far-transfer "For instance, a chess player might apply basic strategic principles such as taking control of the centre to investment practices, politics, or military campaigns" (p.4).

3   Method and implementation

Cross-sectional observational study

To investigate our research questions, we employed a cross-sectional observational study. The cross-sectional observational study allowed us to assess the relationship between computer literacy skills and Esports participation. By applying this, we could simultaneously measure the outcome in relation to the exposures of the participants (Setia, 2016; Kesmodel, 2018). This was the most suitable research design for our purpose and the reason we did not choose to employ a case-control study, which has its focus on selecting participants based on their outcome status which would be the participants' computer literacy skills (Schlesselman, 1982). A cross-sectional study is also more time-efficient than a cohort study where you observe your participants over a period of time (Setia, 2016; Mann, 2003).

Participants

For our study, we recruited 20 participants to take part in computer literacy tasks. Determining the required sample size to create a sufficient understanding that is yet not explored and researched can be characterised as illogical (Saunders et al., 2017). Therefore, we did not set up a specific number of participants to recruit but instead set an estimated sample size of 15-30 participants to meet our study's aim which is preferable (Sim et al., 2018). Participant recruitment predominantly involved through various social media platforms, where individuals were invited to partake in our study following a concise introduction regarding our research, mentioning we conducted tests on CLS. Additionally, some of the participants were approached in person at Jönköping University. The participant selection was obtained through a combination of purposive and convenience sampling methods. In the process of finding participants, our first step was to use a convenience sampling method. The selection of the participants was based on their accessibility, availability and their own motivation to participate in our research (Etikan, 2016). Our criteria among these individuals were individuals in the age range of 20 to 30 years. As Etikan (2016) mentioned, convenience sampling is an easy method to gather participants fast and easily, which suited our research with a limited timeframe of 15 weeks. The second step in our participation selection was to apply a purposive sampling method which is indicated in the subsequent categorization of the participants, who were selected based on their engagement and relation to Esports. Etikan (2016) explains the purposive sampling method as a selection of individuals with experience and knowledge within a phenomenon, in this case, Esports. This combination of convenience and purposive sampling methods gathered participants into two

distinctive groups: Esports players and non-Esports people within the age range of 20-30 years old.

The number of participants taking the test at the same time varied throughout the different testing days which lasted for 14 days. The maximum number of participants at the same time was 4. This made it possible for us as observers to follow along and take notes during the tests and also to save time related to our 15-week research period. To limit variables as much as possible during the test, we had identical PC stations positioned in a quiet testing area. To prevent participants from conversing with one to another and potentially interfering with the results, they were prohibited from doing so (Rosenbaum, 2010). This approach allowed us to collect accurate and easily-extractable data with participants working independently.

Mixed approach

The methodology utilised was a combination of qualitative and quantitative approaches in an inductive way, as the study focused on testing participants' computer literacy skills. We gathered data through observations made during the testing process while taking notes of their actions, as well as numerical data obtained from participants from a survey, contributing to our research and findings (Tashakkori & Creswell, 2007). With our inductive approach, we used the observations to create general conclusions to find patterns and differences in CLS between the two groups (Thomas, 2006). For now, there is no existing theory on Esports and CLS together, therefore we used an inductive approach instead of a deductive one. In order to address our initial research question, which examines potential differences in CLS between Esports players and Non-Esports people, the mixed approach was most suitable in our case. By combining these methods, we aimed to provide a comprehensive understanding of both their task performance through observations and also the participants' perspective through a survey. As Tashakkori & Creswell (2007) mention, the methodology is considered mixed when having two types of data collection procedures, two types of data and two types of data analysis. In our study, we employed both observations and a survey as data collection methods. These methods yielded both textual and numerical data. Furthermore, during the data analysis, we utilised a combination of thematic analysis with statistical analysis to find qualitative themes and statistical analysis to examine quantitative patterns. By embracing this mixed-methods design, we aimed to enhance the depth of our research findings.

The study was conducted at the Jönkoping Esports Center, utilising teams and Esports players from the university's Esports association - JUSTICE. The centre was used due to the extensive infrastructure it presents: multiple, identical computers and quiet, isolated rooms. This venue allowed us to set up a consistent environment, thus

helping with removing inconsistencies. The players and board members within JUSTICE are a suitable sample for the Esports-players group since they are long-time, experienced players. The Non-Esports group consisted of other university students. To ensure consistency in the results, our study applied a dual approach to adapt to the participant's preferences. Four identical PC stations were set up as the primary testing environment. Additionally, participants were given the option to bring their own computers, enabling them to use the operating system they are most familiar with. This approach aimed to enhance participant convenience and comfort during the test.

The test

Participants underwent testing on their Computer Literacy knowledge, as well as their CLS. The study involved tasks designed to evaluate participants' abilities to manage general computer-based tasks (see Appendix A for the test). When developing the tasks, we used guidelines from The Bebras International Contest on Informatics and Computer Literacy (Dagienė & Futschek, 2008). The mandatory criteria they have for their Informatics and Computer Literacy tests are:

- The task should be solvable within 3 minutes

- The problem statement should be easy to understand for the participant

- The task should be present on a single screen

- The task should be solvable on the PC without any physical tools

When developing our tasks we used these criteria for creating good tasks (Dagienė & Futschek, 2008).

The tasks presented to the participants were as follows:

1. **Check if the computer has any pending updates.** This is a key skill because in order to ensure the security and sound functioning of any computer, it must be up to date.

2. **Check if the keyboard is in the Swedish layout.** Keyboard layouts affect the positioning of certain characters and the key combination done to reach them. For example, on the English American keyboard to type out "?" you would need to hold SHIFT and the key adjacent to the right SHIFT. In order to type out that same character in the Swedish layout, you would need to hold SHIFT and the key next to "0" within the keyboard's number keys. Since a lot of people use dual keyboards on a regular basis (Gothe et al., 2020), this task is meant to test the participants on how efficiently they can identify and use the keyboard.

3. **Download a specific image of a car and save it to the desktop, then crop the image until you cannot see the back wheels of the car and save it.** This exercise tests their ability to work with images and media.

4. **Forcibly end an application which is installed on the computer.** Computer applications sometimes must be closed forcibly, either due to them freezing or simply not closing without the use of force.

5. **Take a screenshot of the desktop and send it to us via email.** Taking screenshots has become commonplace so it is important that users know how to do it. Moreover, it is just as important that they know how to work with that screenshot, such as sending it via email to someone.

6. **Upload the image to Google Drive.** Here we wanted to observe the user's ability to work with the uploading function and the drag & drop feature, which have now become commonplace.

7. **Create a Google Docs document and write a title in Times New Roman Bold 13pt font and make the title centred.** Having the capability to create a document and styling it is critical for formal and academic work.

8. **Split two applications or windows into a split-screen.** Oftentimes we use our computers to multi-task. Here we are observing how our participants go about setting up a multitasking environment.

9. **Install the application Teamspeak 3 on the computer.** With this exercise, we have given our participants an app they do not have installed on their computers and we observe how they go about getting the app.

10. **Explain with text how you would close a program that is not responsive.** This and question number 11 are theoretical questions. Participants were instructed to write out the answer instead of performing it. They were also allowed to "cheat" if they did not know the answer. This is based on the definition of computer literacy, where one part is how an individual uses web browsers and search engines to obtain the required information (Gupta, 2006).

11. **Provide an explanation of the issues that can arise from having 100% disk usage with text.** This is a more difficult question which we did not expect the average user to know. The concept of the exercise was to see how our participants search for and solve an issue that they are not familiar with. This exercise is meant to observe any skill differences in using and finding online resources. The secondary use of this exercise is to test the troubleshooting ability of our participants.

Upon completion of the tasks, participants were asked to fill out a survey providing feedback on their experience during the test. The survey aimed to gather information on various aspects. We collected their age, gender and the difficulty of the test on a scale from 1-10. The survey was done with Google Forms which we connected to a Google Sheets document where we could summarise the results (see Appendix B for the survey).

3.1   Data collection

Given the first research question "How do Esports players and Non-Esports people differ in Computer Literacy Skills if at all?". We observed our participants from behind while they did the test and at the same time took notes of their actions.

During the study, meticulous observations were made regarding the participants' behaviour while engaging in the assigned tasks. These observations encompassed several key aspects, including the participants' initiation time, which was recorded to ascertain the duration required to complete the test. Additionally, close attention was paid to the participants' manual actions, specifically their utilisation of keyboard shortcuts, and their mouse movements were analysed in detail.

Furthermore, the participants' confidence levels during the test were carefully noted and evaluated. This encompassed their ability to accurately identify the precise locations to click and execute these actions promptly, as opposed to engaging in aimless navigation in search of desired elements. The efficiency of their navigation was assessed, considering whether they adeptly switched between tabs and applications to swiftly reach their intended destinations or employed a sequential approach to progress through the tasks.

Moreover, the researchers took into account whether the participants relied on external resources, such as utilising search engines like Google, to assist them in accomplishing the assigned tasks. In cases where participants resorted to online searches, the effectiveness and expediency of their information retrieval process were scrutinised. Specifically, the researchers examined whether participants efficiently located the desired answers, demonstrating a rapid and targeted search process, or whether they engaged in prolonged searching, displaying a more wandering approach until discovering the required information.

By meticulously documenting and analysing these various behavioural factors, this study aimed to gain insights into participants' strategies, efficiency, and self-reliance when navigating and utilising online resources during task completion. Such observations and analyses contribute to a comprehensive understanding of individuals' proficiency in online information retrieval and their overall digital competencies.

The notes also enabled us to track and document our observations which ensures that the data collected is comprehensive and consistent through all tests, regarding both groups of Esports players and Non-Esports people (Mullhall, 2003). The notes consisted of how they managed to finish every task since most tasks had many different ways to be completed, for example with shortcuts.

As mentioned before, at the end of the study we asked our participants to complete the survey which included a query about how difficult the test was on a scale from 1 to 10. This is one of the quantitative aspects, we tracked and analysed the data using Google Forms and spreadsheets.

3.2 Data analysis

The data from our test consists primarily of observations of the participants. We have used a mixed approach to analyse the data in terms of data analysis. First, the observational data consisted of detailed observations of participants' actions and problem-solving strategies during the test. These observations were categorised and analysed using a qualitative approach. With this, we sought to identify patterns that emerge from the observations, allowing us to get a deeper understanding of the participants' actions, decision-making progress and results.

Together with this qualitative approach, we also analysed the data we gained from the survey the participants finished when done with the test. With this numerical data, we conducted a quantitative analysis to hypothetically identify if their subjective perception aligns with their actions and strategies. Additionally, a quantitative analysis was conducted for the participant's task performance regarding metrics such as test completion time and task completion accuracy.

Lastly, when analysing the qualitative and quantitative data, we sought to identify the potential transfer of learning from playing LoL to CLS. This was done by analysing the results and decision-making processes of the two groups. As researchers, we reviewed our notes from the observations and aimed to identify patterns and themes of the participants.

3.3 Validity and reliability

Validity and reliability considerations were applied in our research to ensure consistency and accuracy of the data contained.

To ensure validity, we developed the CLS test based on existing research and procedures recurrent when using a computer. Some tasks were developed from previous research on problems and common computer tasks and the others we developed from testing (Dagienė & Futschek, 2008). We used our computers for educational and recreational purposes and documented what different actions we took during so. The most common ones together with previous research formed our CLS

test. By drawing on established concepts and measures, we addressed ensuring the content validity of our CLS test.

Regarding the reliability of the data collection, we ensured to repeat the same procedure for every test occasion. We provided a clear and concise introduction to all participants to ensure consistency and with the aim to establish an understanding of the study's purpose. By doing so, we intended to reduce participant bias without their behaviour and performance being affected by our study's goals. During the observations, we as observers followed a protocol based on our documentation for consistency and to avoid potential observer bias in relation to our personal expectations. The documentation included the participant's actions and procedures at every task. When all tasks were finished, the participants were asked to fill out the survey provided with their subjective perception of how difficult the test was.

3.4   Considerations

In consideration of the test and the results, we had to take into account the participant's prior skills and usage of an operative system. Some individuals may feel more at ease with Windows and some with macOS and we had to take this into consideration during the test. Different operating systems have different commands and shortcuts, which may significantly impact participants' knowledge and actions during the test. In general, a vast majority of Esports players use Windows as their operating system (Alsop, 2023). Among our participants, all of the Esports players were Windows users.

Conversely, for individuals not engaged in Esports or gaming, macOS is relatively more common in contrast to Esports players (Taylor, 2023). Therefore, the skills in computer literacy may vary depending on past experiences with a specific operating system. As a consequence, we let the participants choose which operating system they would use based on their prior knowledge and experiences. We also have tried to create the tasks as neutral as possible so that they can be completed successfully on any operating system. During our tests, 3 users used computers with macOS.

The testing area we used did not have any computers with macOS and the participants who preferred to use a Mac operating system device had to use their own computers. We made sure that our test is similarly done on both operating systems and we also made sure both the Windows machines and the macOS machines were prepared for the test as similar as possible. Even with the different operating systems, all participants were in the same location with the same variables to try and minimise inconsistencies

Another consideration we had to take into account was that the two different groups of participants could hypothetically believe they were in a competition and a stressful situation could arise. To prevent this, we did not mention the comparative group

before the testing. This was done to make a more calm environment for the participants and to minimise any risk of performance anxiety or stress.

Lastly, it should be noted that during our tests and surveys, we never requested the participant's real name or any personal information apart from gender and age. Instead, every participant had a computer number which was included in the survey. The computer number was what we used when taking notes while observing so that we as researchers could connect our documentation with the surveys from the participants. Before the tests, all participants were informed that all their actions and answers will be submitted anonymously. This was done to maintain a calm test without stress and also by respecting their privacy with an ethical concern in mind.

4 Results

Overall, results show that Esports players completed the test faster on average. They also rated the test as being easier compared to the Non-Esports people. Esports players had a greater understanding of computer issues and troubleshooting.

4.1 Esports Players Results

The Esports players picked for this study have on average played League of Legends for a period longer than 3 years. Notably, 100% of them were male and from ages 20-27.

PARTICIPANT	GENDER	TIME TO COMPLETE
Participant 1	MALE	9
Participant 2	MALE	9
Participant 3	MALE	9
Participant 4	MALE	8
Participant 5	MALE	8
Participant 6	MALE	8
Participant 7	MALE	8
Participant 8	MALE	6
Participant 9	MALE	9.8
Participant 10	MALE	8
Participant 11	MALE	8
Participant 12	MALE	8

Table 1 - Esports Player Statistics

On average, the participants completed the test within approximately 8.8 minutes, with notable variations in individual performance. Notably, the fastest recorded completion time was an impressive 6 minutes. The participants universally perceived the test as facile, encountering minimal difficulties throughout its administration. According to the post-test survey results, the participants assigned an average difficulty rating of 2.3 out of 10 to the test. Moreover, a noteworthy observation was made regarding their tendency to consult Google for assistance when encountering unfamiliar information, showcasing both their resourcefulness and proficiency in utilising online search engines.

Exercise 1

The participants have managed to quickly identify whether the computer has pending updates. Usually, when there is an update pending on the Windows 10 operating system there is an icon in the taskbar that signals that. Most Esports players have used this technique to identify whether the computer has an update or not.

Exercise 2

For exercise number 2 most have checked the taskbar for the language icon. Some have opted to use the Windows search option and go into the language menu to check.

Exercise 3

For this task, 84% of the participants used the crop tool within Windows, with 16% using MS Paint. One participant used an MS Paint tool which allowed them to specifically select what to cut.

Exercise 4

In order to forcibly end the application installed on the computer, most people used the task manager. Notably, 16% of which used a less common but faster 3-key shortcut to open task manager.

Exercise 5

For taking a screenshot there was a mix of people using the snipping tool (40%) and also the print screen button on the keyboard (60%).

Exercise 6

In order to upload the image to the cloud-based service Google Drive, all users used buttons with one participant using the drag-and-drop technique.

Exercise 7

For this exercise everyone completed the task swiftly and easily. Some completed this task in a split screen view out of their own initiative.

Exercise 8

Most managed to grab one window and push it against a side of the screen, activating the split screen menu. One participant did not know how to set up a split screen environment, so they used Google and then used the newly learned shortcut (Windows key plus side arrow) to achieve a split screen. Another one already knew this shortcut from habit and used it for this test.

Exercise 9

For the exercise where we make the users install Teamspeak 3, everybody did it without a problem.

Exercise 10 & 11

Regarding the final two questions that necessitated written responses, the outcomes demonstrated an even distribution of results. Half of the participants, accounting for 50% of the total sample, opted to consult Google as they composed their answers. Conversely, the remaining participants relied solely on their own knowledge to articulate their responses. It is worth noting that the Esports players exhibited a notable advantage in terms of both efficiency and speed when it came to finding answers. They demonstrated a preference for selecting and copying text rather than engaging in prolonged search efforts or composing their answers in writing.

4.2 Non-Esports People Results

The study encompassed a sample of young individuals ranging in age from 21 to 26 years, characterised by an equal distribution between genders. Notably, the respondents, on average, perceived the study to be more challenging. This perception was reflected in the post-test survey results, where participants assigned an average difficulty rating of 3.1 out of 10 to the test. They also finished the survey in 12.6 minutes on average.

PARTICIPANT	GENDER	TIME TO COMPLETE
Participant 1	MALE	13
Participant 2	MALE	12
Participant 3	FEMALE	12
Participant 4	MALE	13.5
Participant 5	MALE	12.8
Participant 6	FEMALE	12.5
Participant 7	FEMALE	11.9
Participant 8	FEMALE	13.9

Table 2 - Non-Esports People Statistics

Generally, 25% of participants used gesture controls to switch between screens during the test. It is worth mentioning that they were performing it on macOS. We have seen a low amount of keyboard shortcuts used. We saw in specific one participant that was

generally feeling a bit lost during the entire test, taking quite a long time and being unsure of what to do at times.

Exercise 1

Most participants used the Windows 10 search feature to write "updates" or "Windows updates" and then click on the first result that would be the correct page. They then saw the update list and the download button and they knew that the computer was indeed pending updates.

Exercise 2

For this exercise, most have been easily able to check the language, with 25% having to use Google to find an answer. Another 25% resorted to accessing Google.com and pressed the keyboard icon next to the search bar and checked to see what keyboard was on there.

Exercise 3

Here we saw one participant struggle a lot to be able to complete the task and had to search on Google several times before being able to complete it. Everyone else completed the task in a similar timeframe.

Exercise 4

This exercise brought some confusion among the participant groups. They were expecting the application to be somewhere within the taskbar and took some time to search for it.

Exercise 5

In this exercise the results varied. One participant used the drag-and-drop feature for sending the image via email. One participant took a screenshot of the desktop and pasted it into the mail. Another one used the snipping tool to take a screenshot. And another one generally struggled to screenshot the desktop.

Exercise 6

The 6th exercise saw 37% of the participants use the drag-and-drop feature to upload the image to the drive.

Exercise 7

This exercise was successfully completed by all participants. There was little to no significant difference between this group and the Esports group with this task.

Exercise 8

On exercise 8, most people used the aforementioned technique of grabbing one of the app windows and dragging it to one side of the screen. One participant manually set up a split screen by resizing the windows individually. One person used Google to search for an answer to solve the task.

Exercise 9

All people have gone through the right steps in order to download the application. However, it has taken significantly longer for this group as opposed to the other group.

Exercise 10

The majority have written the answer using their current knowledge with the rest using Google to find the answer.

Exercise 11

Here, 75% of the people wrote the answer from memory while the rest used Google to write their answer.

4.3 Data Analysis

In the introduction, "Computer Literacy Skills" are defined as an individual's ability to utilise a computer efficiently in order to achieve their goals as quickly as possible. It is important to acknowledge that computer literacy skills encompass a spectrum of proficiency levels, ranging from limited familiarity with basic computer tasks to adeptness in promptly executing them. According to Brookshear and Brylow (2019), efficiency refers to the ability to perform useful work while minimising waste of time, energy, and other resources. It involves making the best use of available resources to achieve desired results within a reasonable timeframe.

Both groups demonstrated a commendable comprehension of computer skills, as evidenced by the successful completion of all assigned tasks. However, a notable trend emerged, indicating that the Esports players exhibited a higher degree of efficiency in their execution. In general, the participants, particularly the Esports players, displayed a heightened level of efficiency in completing the assigned tasks. This could be attributed to their dexterity in navigating the computer interface, evident in their familiarity with the locations of various elements and their ability to swiftly identify and select relevant options. Furthermore, the Esports players exhibited a greater proficiency in utilising intricate shortcuts, such as employing CTRL+Shift+Esc to access the task manager or employing the combination of the Windows Key and the Side Arrow keys to enable split-screen functionality. These

additional shortcuts contributed to their overall efficiency and expedited task completion.

Furthermore, our observations revealed that the Esports players exhibited greater efficiency in utilising Google as a resource. Even when encountering challenges during the tasks, they adeptly leveraged Google to swiftly acquire the necessary knowledge on-the-fly. This adaptability and rapid learning contributed to their overall efficiency, as reflected in the notably low average time taken to complete the tasks, despite the majority of them relying on Google for one or more specific aspects.

The data shows consistent engagement in Esports adds more intricate knowledge about everyday computer tasks. The Esports players demonstrated a heightened proficiency in approaching CLS, employing strategies that maximise efficiency and time-saving. Their adeptness in navigating computer systems, utilising shortcuts, and leveraging online resources allowed them to accomplish tasks with greater speed and effectiveness compared to other participants.

5 Discussion

This chapter aims to discuss the results of the study in relation to previously performed studies. We also discuss our observations and findings in relation to the purpose and research questions. Furthermore, we look at the implications and limitations of our research.

5.1 Result discussion

The main purpose of our study was to analyse CLS differences between participants who engage in Esports activity regularly and participants who do not.

How do Esports players and Non-Esports people differ in CLS if at all?

As previously mentioned in the results section, the group of Esports players finished the test in an average time of 8.8 minutes while the Non-Esports participants finished the test in an average time of 12.6 minutes. For both groups, all tasks were completed successfully and the difference between them was the time of completion and their perception of the difficulty of the test. To answer our first research question, Esports players differ in CLS versus Non-Esports individuals regarding the time of completion but not in completion success rate since everybody completed every task. This can be recognized from previous research by Kowal et al. (2018) where a significant difference in the time of test completion was found, meanwhile differences in terms of accuracy of completion were not found.

Our secondary motivation for conducting this study was to examine Esports and if it had any capability of bettering one's CLS.

How can playing Esports improve one's CLS if at all?

While observing the execution of the tasks, we could identify the group of Esports players using more keyboard shortcuts to complete tasks in a shorter time. Just to name a few, they used CTRL+Shift+ESC to open the task manager, Windows key + Side arrow to set up a split screen and also Windows key + Shift + S to screenshot using the snipping tool. In relation to a previous study by Saha et al. (2022) where Esports had a significant impact on fine motor and memory skills, keyboard shortcuts are one ability coming along with these improved skills. Potentially, the Esports players have improved their fine motor and memory skills by playing LoL which could be the reason for their heavier usage of keyboard shortcuts.

Another contributing factor to the Esports players' faster task completion was their adeptness in manoeuvring the computer interface. Their familiarity with the layout, menus, and functions enabled them to navigate the interface swiftly and accurately, minimising the time required to locate and access the necessary tools or features. This proficiency in interface navigation further enhanced their overall efficiency in

completing the tasks. Previous research by Saha et al. (2022) shows improved fine motor and memory skills and Toth et al. (2021, 2023) indicate improved sensory-motor and target acquisition skills by playing games. These three abilities can potentially indicate higher skills in using and handling an interface, which the Esports players managed to do faster than the Non-Esports people. In relation to the faster completion time, a potential component can be the Esports group's cognitive ability, which according to Kowal et al. (2018) is improved by playing video games. Their findings indicate that cognitive task switching and processing speeds are faster for individuals playing video games. In relation to CLS, this can lead to faster decision-making and visual search speed which would help someone to complete the test of computer literacy tasks we provided to our participants.

The observed expedited accomplishment of tasks within the realm of Esports participants is in accordance with the theoretical construct of transfer of learning, as elucidated by Perkins and Salomon in their seminal work in 1992. In this case, the Esports players' experience and expertise in gaming, which often requires quick thinking, dexterity, and problem-solving, may have facilitated the transfer of those skills to computer literacy tasks. Consequently, their proficiency in gaming may have contributed to their efficiency in completing computer-based tasks.

Additionally, it is noteworthy that the previous studies highlighting improvements associated with Esports further support the notion of transfer of learning. These studies provide evidence of the positive impact of Esports engagement on cognitive abilities, such as attention, memory, and decision-making. The skills honed through Esports participation could potentially transfer to computer literacy tasks, leading to improved performance and efficiency.

The concept of transfer of learning, supported by previous research, helps explain why the Esports players exhibited faster task completion in our study. It highlights the potential for skills acquired in one domain, such as gaming, to positively influence performance in related domains, such as computer literacy.

Overall, the only distinguishing factor between the two groups was the time of completion, with the Esports group demonstrating faster times. However, we identified adequate elementary skills in both groups with comparable success rates. Both groups are able to complete essential computer tasks and have a satisfactory level of CLS which is more than sufficient for daily use. Where Esports players excel is at efficiency. They are able to complete any given task faster, either by using fewer resources or by faster navigation.

5.2   Method discussion

A cross-sectional observational study was employed with the purpose of analysing the CLS of Esports players and Non-Esports individuals. This choice of method

established us to investigate differences between the groups during the test. The goal was to recognise the impact of Esports on CLS. On the other hand, the cross-sectional observational study we employed limited our inferences and thus this research is a foundation for further research. Regardless, with a sample size of 20 participants, we have succeeded in answering our research questions.

How do Esports players and Non-Esports people differ in CLS if at all?

The answer to this research question was possible through the data collected from the tests with computer literacy tasks. This includes observations during the tests of how the participants managed to fulfil the different tasks as well as the time spent on the completion of the test. With documented observations, we were able to see differences between the two groups and successfully answer our research question.

For the second research question:

How can playing Esports improve one's CLS if at all?

The answer to this research question was formed with guidance from previous research together with our findings. When considering the duration of the participants' test performances, it became evident that the Esports players exhibited a notably faster completion time compared to their Non-Esports counterparts. The previous research that has been developed with regards to the impact of Esports supported our findings, with Esports players finishing faster where abilities related to CLS have been improved.

5.3   Limitations

The study was conducted in Jönköping, Sweden with a majority of participants being of Swedish descent. A case can be made for people that are not of Swedish descent. Moreover, our study could have had different results if it was done outside of continental Europe or in any other region. It is unknown if the heritage affects the validity of our results.

While our sample size has been adequate for a mostly observational study, there is a possibility of this research providing different results if the sample size is increased significantly.

Another limitation of our study is the unequal group sizes between the Esports players and the Non-Esports individuals. The Esports group consisted of 12 participants meanwhile, the Non-Esports group only had 8 participants. This is due to the difficulty of recruiting test participants and the short time frame. The difference between the group sizes can possibly create implications for the data we obtained from the groups. Having one smaller group can potentially lead to data being less generalised and more based on the individuals partaking in our test instead. In

addition to this, generalizability regarding our sample size is a limitation of our study we have to consider. The sample size of our two different groups, will possibly not be enough to represent the two different groups of Esports players and Non-Esports individuals. In conclusion, our results will possibly not represent the broader population and are more of an indication.

A limitation we have to enlighten is the participants' computer experience prior to the study which is not accounted for in this study. In our participant selection process, we have prioritised acquiring participants of a similar background. In our case, all of our participants are undergraduate university students. Due to the given time frame however, we had to dismiss the enquiry of previous experience of our participants. Their computer experience is therefore an unmeasured factor which can potentially influence the results.

On top of that, some participants used their own computers to ensure familiarity with the operating system. Although the test was made to be performed the same on any operating system, there could be some influence in the multiple types used during the study

It is also crucial to note that while our study provides insights into the potential transfer or learning from Esports to CLS, it does not definitively determine causality. The findings from our results should be interpreted as exploratory, highlighting patterns.

6 Conclusions and further research

6.1 Conclusions

From a comprehensive standpoint, Esports was shown to be beneficial beyond its obvious relaxing and entertaining capabilities. It helps not only cognitively, but also physically. This study was meant to study the potential link between playing Esports and having an augmented level of Computer Literacy Skills (CLS). CLS has never been more required. With the increasing digitization of the world, it is important that everyone is able to reach a bare-minimum level of knowledge (Gupta, 2006). We theorised that Esports could potentially facilitate the learning of these skills. Throughout our study, we have found that people who enjoy these titles do tend to be more efficient at completing daily computer duties.

More research could be done on the topic that analyses how exactly and creates a guideline, making Esports a CLS-learning tool.

With this paper, we have aimed to answer the question of Esports and its potential connection to CLS. While we saw more efficiency in the group of people who play Esports, we could conclude that both groups possessed adequate CLS in order to successfully carry out essential tasks of everyday life.

6.1.1 Practical implications

The findings from this study have practical implications for the learning of computer literacy. With Esports players being more efficient during the tasks, educators can incorporate Esports-related activities into computer literacy education and programs. Another practical implication is the importance of leveraging the popularity of Esports to create tailored educational opportunities which align with the interests of the target audience.

6.1.2 Scientific implication

This research contributes to the scientific understanding of the relationship between Esports participation and CLS. The findings close a gap in the literature by analysing and contrasting the CLS of Esports players and non-Esports people. The results shed light on the potential advantages of using Esports as a framework for skill development by offering evidence of the relationship between Esports participation and computer literacy in terms of efficiency.

6.2 Further research

Future research can continue to extensively test Esports in different environments and look to further find if Esports can be beneficial in other areas than the already documented ones. There should also be more research focusing on all the major Esports titles and looking for a possible connection between those and CLS. One

measure we left out when delimiting our research was not to take the participants' prior computer knowledge and experience as a metric. Further research can examine the differences between individuals based on their prior computer experience.

In our study, all participants were 20 years old or older and used a computer daily for studies or entertainment. Further research can be done on younger individuals where a computer is not as necessary or common for studies as it is at the University level.

As noted before in the limitations, future research is needed to establish a greater causal link between LoL and CLS performance. This could be conducted by following participants over an extended period of time and by involving more participants, with our study as the body. Lastly, additional research is required to ascertain the strategic measures that can be employed to effectively integrate Esports-based interventions into educational environments.

7   References

Alsop, T. (2023). *Steam users operating systems used 2023*, *Statista*. Available at: https://www.statista.com/statistics/265033/proportion-of-operating-systems-used-on-the-online-gaming-platform-steam/.

Aurenty , A.D. (2021). *What are the most played esports in the world?*, *BBVA.CH*. Available at: https://www.bbva.ch/en/news/what-are-the-most-played-esports-in-the-world/.

Boonwang, T., Namwaing, P., Srisaphonphusitti, L., Chainarong, A., Kaewwong, S., Kaewwong, T., Duangsawang, N., Sawunyavisuth, B., Ngamjarus, C., Sawanyawisuth, K., & Khamsai, S. (2022). Esports may improve cognitive skills in soccer players: A systematic review. 27. 1-6. 10.14456/apst.2022.44.

Brookshear, J. G., & Brylow, D. (2019). Computer Science: An Overview (14th ed.). Pearson.

Chun, N. & Tang, H. (2018). 'Do information and communication technologies empower female workers?':, *ADB Economics Working Paper Series* [Preprint]. doi:10.22617/wps189352-2.

Dagienė, V. & Futschek, G. (2008). 'Bebras International Contest on informatics and computer literacy: Criteria for good tasks', *Lecture Notes in Computer Science*, pp. 19–30. doi:10.1007/978-3-540-69924-8_2.

Deslauriers, L., McCarty, L. S., Miller, K., Callaghan, K., & Kestin, G. (2019). Measuring actual learning versus feeling of learning in response to being actively engaged in the classroom. *Proceedings of the National Academy of Sciences*, *116*(39), 19251–19257. https://doi.org/10.1073/pnas.1821936116

Dimaggio, P., Harittai, E., Celeste, C., & Shafer, S. (2020). Excerpts from "digital inequality: From unequal access to differentiated use." *Inequality in the United States: A Reader*, 98–113. https://doi.org/10.4324/9781003071709-13

Emre, B., Güllep, B., Şenel, G. H., & Liman Kaban, A. (2022). Investigation of video game players' informal learning experiences and their influence on learning English as a foreign language. *Handbook of Research on Teacher and Student Perspectives on the Digital Turn in Education*, 190–212. https://doi.org/10.4018/978-1-6684-4446-7.ch010

Erturk, E. (2017). An Incremental Model for Cloud Adoption: Based on a Study of Regional Organizations. TEM Journal, 6(4), 868–876. https://doi.org/10.18421/TEM64-29

Etikan, I. (2016). 'Comparison of convenience sampling and purposive sampling', *American Journal of Theoretical and Applied Statistics*, 5(1), p. 1. doi:10.11648/j.ajtas.20160501.11.

Fletcher, B., Gowers, R., & Saeed, S. (2020). The effects of esports school tournaments on positive behavioural change. *Serious Games*, 219–229. https://doi.org/10.1007/978-3-030-61814-8_17

Flintham, M., Karner, C., Bachour, K., Creswick, H., Gupta, N., & Moran, S. (2018). Falling for fake news. *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. https://doi.org/10.1145/3173574.3173950

Gothe, S.V. *et al.* (2020) 'Language detection engine for multilingual texting on mobile devices', *2020 IEEE 14th International Conference on Semantic Computing (ICSC)* [Preprint]. doi:10.1109/icsc.2020.00057.

Guo, Z., Cahalane, M., & Carbonie, A. (2022). Online gaming with a purpose: Exploring positive personal development achieved through Esports Play. *Behaviour & Information Technology*, 1–23. https://doi.org/10.1080/0144929x.2022.2154266

Gupta, G.K. (2006). 'Computer literacy', *ACM SIGCSE Bulletin*, 38(2), pp. 115–119. doi:10.1145/1138403.1138446.

Guriev, S., Melnikov, N., & Zhuravskaya, E. (2020). '3G internet and confidence in government', *The Quarterly Journal of Economics*, 136(4), pp. 2533–2613. doi:10.1093/qje/qjaa040.

Hamari, J., & Sjöblom, M. (2017). What is esports and why do people watch it? *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2686182

Haris, R. M., Khan, K. M., & Nhlabatsi, A. (2022). Live migration of virtual machine memory content in networked systems: A review. *Computer Networks*, *209*, 108898. https://doi.org/10.1016/j.comnet.2022.108898

Hargittai, E., & Micheli, M. (2019). 'Internet skills and why they matter', *Society and the Internet*, pp. 109–124. doi:10.1093/oso/9780198843498.003.0007.

Hitar-Garcia, J.-A., Moran-Fernandez, L., & Bolon-Canedo, V. (2022). Machine learning methods for predicting league of legends game outcome. *IEEE Transactions on Games*, 1–1. https://doi.org/10.1109/tg.2022.3153086

Horbiński, T., & Zagata, K. (2023). 'The cognitive skills in interpretation of spatial situations in the League of Legends Game', *Simulation & Gaming*, p. 104687812311656. doi:10.1177/10468781231165616.

Hjort, J., & Tian, L. (2021). 'The economic impact of internet connectivity in developing countries', *SSRN Electronic Journal* [Preprint]. doi:10.2139/ssrn.3964618.

Indeed Editorial Team (2023). *Improving your computer literacy: What you need to know*, *Indeed*. Available at: https://www.indeed.com/career-advice/career-development/how-to-become-computer-literate.

Iyengar, S., Lelkes, Y., Levendusky, M., Malhotra, N., & Westwood, S. J. (2019). The origins and consequences of affective polarization in the United States. *Annual Review of Political Science*, *22*(1), 129–146. https://doi.org/10.1146/annurev-polisci-051117-073034

Jack, W., & Suri, T. (2014). *Risk sharing and transactions costs: Evidence from Kenya's Mobile Money Revolution*, *American Economic Review*. Available at: https://www.aeaweb.org/articles?id=10.1257%2Faer.104.1.183

Jung, C., & Kim, H. K. (2022). Win prediction from the Snowball Effect Perspectives. *2022 IEEE Games, Entertainment, Media Conference (GEM)*. https://doi.org/10.1109/gem56474.2022.10017891

Kesmodel, U. S. (2018). Cross-sectional studies - what are they good for? *Acta Obstetricia et Gynecologica Scandinavica*, *97*(4), 388–393. https://doi.org/10.1111/aogs.13331

Kowal, M., Toth,A., Exton, C., & Cambell, M. (2018) Different cognitive abilities displayed by action video gamers and non-gamers, Computers in Human Behavior. Volume 88, 255-262. https://doi.org/10.1016/j.chb.2018.07.010.

Lave, J. (1988). *Cognition in practice: Mind, mathematics and culture in everyday life*. Cambridge: Cambridge University Press.

Leung, K.-M., & Chu, W. (2023). "Esports participation among Hong Kong middle-aged and older adults: A qualitative study," Human Behavior and Emerging Technologies, 2023, pp. 1–11. Available at: https://doi.org/10.1155/2023/6798748.

Lee, H.-N., Ashok, V., & Ramakrishnan, I. (2021). Bringing things closer: Enhancing low-vision interaction experience with office productivity applications. *Proceedings of the ACM on Human-Computer Interaction*, *5*(EICS), 1–18. https://doi.org/10.1145/3457144

Levy, R. (2021). 'Social Media, news consumption, and polarization: Evidence from a field experiment', *American Economic Review*, 111(3), pp. 831–870. doi:10.1257/aer.20191777.

Lie, A., Stephen, A., Supit, L. R., Achmad, S., & Sutoyo, R. (2022). Using strategy video games to improve problem solving and communication skills: A systematic literature review. *2022 4th International Conference on Cybernetics and Intelligent System (ICORIS)*. https://doi.org/10.1109/icoris56080.2022.10031539

Lisk, T.C., Kaplancali, U.T. & Riggio, R.E. (2011). "Leadership in multiplayer online gaming environments," *Simulation & Gaming*, 43(1), pp. 133–149. Available at: https://doi.org/10.1177/1046878110391975.

Low-Kam, C., Raissi, C., Kaytoue, M., & Pei, J. (2013). Mining statistically significant sequential patterns. *2013 IEEE 13th International Conference on Data Mining*. https://doi.org/10.1109/icdm.2013.124

Lu, L., Shen, C., & Williams, D. (2014). "Friending your way up the ladder: Connecting massive multiplayer online game behaviors with offline leadership," *Computers in Human Behavior*, 35, pp. 54–60. Available at: https://doi.org/10.1016/j.chb.2014.02.013.

Mann, C. J. (2003). Observational research methods. research design II: Cohort, Cross Sectional, and case-control studies. *Emergency Medicine Journal*, *20*(1), 54–60. https://doi.org/10.1136/emj.20.1.54

Menychtas, Andreas & Kyriazis, Dimosthenis & Gogouvitis, Spyridon & Oberle, Karsten & Voith, Thomas & Gallizo, Georgina & Berger, Sören & Oliveros, Eduardo & Boniface, Michael. (2011). A Cloud Platform for Real-time Interactive Applications.. 397-403. 10.13140/2.1.3330.0486.

Mora-Cantallops, M., & Sicilia, M.-Á. (2018). MOBA games: A literature review. *Entertainment Computing*, *26*, 128–138. https://doi.org/10.1016/j.entcom.2018.02.005

Muda, R., Pennycook, G., Pieńkosz, D., & Bialek, M. (2021). *People Are Worse at Detecting Fake News in Their Foreign Language*. https://doi.org/10.31219/osf.io/p8su6

Mulhall, A. (2003). In the field: Notes on observation in Qualitative Research. *Journal of Advanced Nursing*, *41*(3), 306–313. https://doi.org/10.1046/j.1365-2648.2003.02514.x

Mysirlaki, S., & Paraskeva, F. (2020). "Emotional intelligence and transformational leadership in virtual teams: Lessons from mmogs," *Leadership & Organization Development Journal*, 41(4), pp. 551–566. Available at: https://doi.org/10.1108/lodj-01-2019-0035.

Oseghale, O. (2023). Digital Information Literacy Skills and use of electronic resources by humanities graduate students at Kenneth Dike Library, University of ibadan, Nigeria. *Digital Library Perspectives*, *39*(2), 181–204. https://doi.org/10.1108/dlp-09-2022-0071

Page, Z. E., Barrington, S., Edwards, J., & Barnett, L. M. (2017). Do active video games benefit the motor skill development of non-typically developing children and adolescents: A systematic review. *Journal of Science and Medicine in Sport*, *20*(12), 1087–1100. https://doi.org/10.1016/j.jsams.2017.05.001

Perkins, D., & Salomon, G. (1992). Transfer Of Learning.

Pluss, M. A., Bennett, K. J., Novak, A. R., Panchuk, D., Coutts, A. J., & Fransen, J. (2019). Esports: The chess of the 21st century. *Frontiers in Psychology*, *10*. https://doi.org/10.3389/fpsyg.2019.00156

Rains, S.A., & Tsetsi, E. (2016). 'Social Support and digital inequality: Does internet use magnify or mitigate traditional inequities in support availability?', *Communication Monographs*, 84(1), pp. 54–74. doi:10.1080/03637751.2016.1228252.

Reitman, J. G., Anderson-Coto, M. J., Wu, M., Lee, J. S., & Steinkuehler, C. (2020). Esports Research: A Literature Review. Games and Culture, 15(1), 32–50. https://doi.org/10.1177/1555412019840892

Rosenbaum, P.R. (2020). *Design of observational studies*. Springer International Publishing.

Saha, S., Basu, S., Majumder, K., & Chakravarty, D. (2022). Motion sensor-based Android game to improve fine motor and working memory skills of children. *Lecture Notes in Networks and Systems*, 263–275. https://doi.org/10.1007/978-981-19-0105-8_26

Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., Burroughs, H., & Jinks, C. (2017). Saturation in qualitative research: Exploring its conceptualization and Operationalization.Quality & Quantity, 52(4), 1893–1907. https://doi.org/10.1007/s11135-017-0574-8

Sajjacholapunt, P., & Joy, M. (2016). SRECMATs - an intelligent tutoring system to deliver online materials for student revision. *Proceedings of the 8th International Conference on Computer Supported Education*. https://doi.org/10.5220/0005783800670074

Schlesselman, J. J. (1982). *Case control studies: Design, conduct, analysis*. Oxford Univ. Press.

Setia, M. S. (2016). Methodology series module 3: Cross-sectional studies. *Indian Journal of Dermatology*, *61*(3), 261. https://doi.org/10.4103/0019-5154.182410

Sim, J., Saunders, B., Waterfield, J., & Kingstone, T. (2018). Can sample size in qualitative research be determined a priori? *International Journal of Social Research Methodology*, *21*(5), 619–634. https://doi.org/10.1080/13645579.2018.1454643

Sirlin, N., Epstein, Z., Arechar, A. A., & Rand, D. G. (2021). *Digital Literacy Is Associated with More Discerning Accuracy Judgments but Not Sharing Intentions*. https://doi.org/10.31234/osf.io/7rb2m

Stonebraker, I. (2015). Specialized tutorials for specialized resources: Using interactive guide on the side tutorials for special libraries reference and instruction. *Public Services Quarterly*, *11*(3), 232–236. https://doi.org/10.1080/15228959.2015.1060145

Shen, Q. (2022). A machine learning approach to predict the result of League of Legends. *2022 International Conference on Machine Learning and Knowledge Engineering (MLKE)*. https://doi.org/10.1109/mlke55170.2022.00013

Tashakkori, A., & Creswell, J. W. (2007). Editorial: The New Era of mixed methods. *Journal of Mixed Methods Research*, *1*(1), 3–7. https://doi.org/10.1177/2345678906293042

Taylor, P. (2023) *Global market share held by operating systems for desktop PCs, from January 2013 to January 2023*, *Statista*. Available at: https://www.statista.com/statistics/218089/global-market-share-of-windows-7/.

Terras, M. (2011). The Rise of Digitization. 10.1007/978-94-6091-299-3_1.

Thomas, D. R. (2006). A general inductive approach for analyzing Qualitative Evaluation Data. *American Journal of Evaluation*, *27*(2), 237–246. https://doi.org/10.1177/1098214005283748

Tizio, G.D., Armellini, M. and Massacci, F. (2023) 'Software updates strategies: A quantitative evaluation against advanced persistent threats', *IEEE Transactions on Software Engineering*, 49(3), pp. 1359–1373. doi:10.1109/tse.2022.3176674.

Thomas, J., & Gosling, C. (2009). An evaluation of the use of "Guides at the side" web-based learning activities to equip students in health sciences and nursing with Information Literacy Skills. *New Review of Academic Librarianship*, *15*(2), 173–186. https://doi.org/10.1080/13614530903240486

Toth, A., Ramsbottom, N., Constantin, C., Milliet, A., & Cambell, M. (2021). The effect of expertise, training and neurostimulation on sensory-motor skill in Esports, Computers in Human Behavior. Volume 121. https://doi.org/10.1016/j.chb.2021.106782.

Tomczyk, Ł., Fedeli, L., Włoch, A., Limone, P., Frania, M., Guarini, P., Szyszka, M., Mascia, M. L., & Falkowska, J. (2022). Digital competences of pre-service teachers in Italy and Poland. *Technology, Knowledge and Learning*, *28*(2), 651–681. https://doi.org/10.1007/s10758-022-09626-6

Toth, A.J., Hojaji, F. & Campbell, M.J. (2023). "Exploring the mechanisms of Target Acquisition Performance in Esports: The role of component kinematic phases on a first person shooter motor skill.," *Computers in Human Behavior*, 139, p. 107554. Available at: https://doi.org/10.1016/j.chb.2022.107554.

University of Edinburgh (2010). *What is Informatics - University of Edinburgh*, *University of Edinburgh Informatics*. Available at: https://www.ed.ac.uk/files/atoms/files/what20is20Informatics.pdf

Webb, D.C. (2010). 'Troubleshooting assessment: An authentic problem solving activity for it education', *Procedia - Social and Behavioral Sciences*, 9, pp. 903–907. doi:10.1016/j.sbspro.2010.12.256.

Zaib Abbasi, A., Alqahtani, N., Tsiotsou, R. H., Rehman, U., & Hooi Ting, D. (2023). Esports as playful consumption experiences: Examining the antecedents and consequences of game engagement. *Telematics and Informatics*, *77*, 101937. https://doi.org/10.1016/j.tele.2023.101937

Zeng, H., Cai, J., Li, L., Cao, Z., & Zhang, L. (2020). Learning image-adaptive 3D lookup tables for high performance photo enhancement in real-time. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 1–1. https://doi.org/10.1109/tpami.2020.3026740

Zhong, Y., Guo, K., Su, J., & Chu, S. (2022). The impact of Esports participation on the development of 21st century skills in youth: A systematic review. Computers & Education. 191. 10.1016/j.compedu.2022.104640

Zaib Abbasi, A., Alqahtani, N., Tsiotsou, R. H., Rehman, U., & Hooi Ting, D. (2023a). Esports as playful consumption experiences: Examining the antecedents and consequences of game engagement. *Telematics and Informatics*, *77*, 101937. https://doi.org/10.1016/j.tele.2023.101937

Zillien, N., & Hargittai, E. (2009). 'Digital distinction: Status-specific types of internet usage', *Social Science Quarterly*, 90(2), pp. 274–291. doi:10.1111/j.1540-6237.2009.00617.x.

Zhuravskaya, E., Petrova, M. & Enikolopov, R. (2020). 'Political effects of the internet and Social Media', *Annual Review of Economics*, 12(1), pp. 415–438. doi:10.1146/annurev-economics-081919-050239.

8   Appendixes

<div align="center">

Appendix A

The Computer Literacy Skills Test

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Computer Literacy Skills Test

Please tick the box whenever you have completed a task. For the last 2 tasks, please write. Contact one of the supervisors for any issues or questions.

- ☐ Check if the computer has any pending updates.
- ☐ Check if the keyboard is in the Swedish layout
- ☐ Click on this link below and save that picture to the desktop. Crop the photo until you cannot see the back wheels and save it.
- ☐ Forcibly end the G Hub app
- ☐ Take a screenshot of the desktop and send it to me via email (bodnarescu.gabriel2@gmail.com) with the subject "PC1"
- ☐ Upload the car image to the drive
- ☐ Create a new word document and write a title in Times New Roman Bold 13pt font centered
- ☐ Split two applications in a split-screen
- ☐ Install the application Teamspeak 3 on the computer

Explain how you'd close a program that is not responsive:

Find out what problems does having disk usage 100% cause and write it here:

When you're done make sure to alert the supervisors. Thank you!

Figure 1.

Thesis Survey

Beskrivning av formulär

PC Number *

Kort svarstext

Age *

Kort svarstext

Gender *

○ Male

○ Female

○ Annat …

How easy/difficult were the tests today *

	1	2	3	4	5	6	7	8	9	10	
Super easy	○	○	○	○	○	○	○	○	○	○	Super difficult

Figure 2.