Improving a New Digital Content Creation Line of Study in Adult Education College

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The topic of the research is digitalization and digital competence frameworks and competence in the digitalized world and programming. Research methods in the thesis are the qualitative research, the review of literature and case study. Used methods in case study are interviews, questionnaire and observation. Research group in the case study are the new Digital Content Creation line of study students. The new Digital Content Creation line of study was designed according to the Digital Competence Framework 2.0 from European Commission. With the questionnaires, students evaluated their digital skills in the beginning of the studies, in the middle of the study year and at the end of the studies. Review of literature was made in researching digitalization and digital frameworks and competence in digitalization and programming. The goal of the action research process was to improve the Digital Content Creation line of study curriculum and programming teaching. According to interviews, the students think that their digital skills have improved very much during the study year. Students have gained good basics to begin to learn more about programming. As a conclusion according to the research and the case study, basic civic skills that everyone should master are determined. Determined skills are: understanding technology, digital tools, privacy and security, communicating through digital technologies, problem solving, updating digital skills, computational thinking, searching and filtering digital information and giving specific instructions.

Keywords: action research, digital content creation, digitalization, teaching programming, digital competence, digital framework, programming framework

Contents

1 Introduction

1.1 Research Goals and Questions

The goal of the research is to strengthen people's digital competence. Research begins by studying digitalization and digital competence frameworks. At first the research requires a definition of digitalization and the Fourth Industrial Revolution. Second task is to examine the change in working life requirements regarding digitalization. Third task is to find out people's general digital skills. The goal is to improve a new adult education college line of study that provides a wide perspective in to improving people's digital skills.

With the research, the goal is to find and study multiple international and national frameworks for digital competence. Find out the digital skills that everyone should master. Interest is also in the current need for programmers and the reasons for that. Is programming one of the digital skills that everyone should master?

The end result of the study is a new point of view to the current Digital Content Creation study program. Recommendations in how to generalize and improve teaching programming in general, at education that uses digital competence. How does this line of study relate to digital competence and what is the target level. How is it taken into account in other educations at the same grade and how does it support digital competence? Focus is in practical work. Goals and their relations to the models are discussed.

The goal is to find out competence in programming and the relations in competence and programming. Research what programming skills are needed in achieving certain levels of digital competence and what are the requirements at different levels of expertise.

Research Questions

1. What is digital competence?
    a. What is digital competence in programming?
    b. What programming skills are needed in achieving certain levels of digital competence?
2. How to strengthen peoples' digital competence?
    a. How to strengthen peoples' programming skills?
    b. How to teach programming in adult education digital competence curriculum?

1.2 Study Content

Answers to first research questions will be answered through the literature study. First research questions will be mostly answered through studying different competence frameworks.

Second research questions will be answered through the case study. Answers will be tied to adult education through the case study. The core of the case study is to describe the case and identify the key issues of the case. What have been taught to students and how the competence levels have changed. What competence levels have been achieved. Using the study of different competence and the case study to

determine that. What requirements in programming are at different levels of digital competence.

2 Digitalization

Our lives have digitalized, which requires people to understand digital technologies. The digital environments consist of our everyday life and how our society functions.

Personal computers came to the market over 30 years ago and digital web – the Internet was commercialized over 20 years ago. Digitalization of public services is at the European Union Digital Strategy. Its main objective is to develop the unification of Digital Market in Europe by 2020. The Ministry of Finance in Finland is developing an electrical channel which will guide all citizens to digital services and incoming register, the channel should be ready by 2020. In the future also voting in municipal elections and general election will be electrical. [1]

2.1 Defining Digitalization

Digitalization is defined in many ways and in many aspects. The term 'digitalization' is hard to define in just one sentence and in one aspect, there is no one right answer in to what digitalization signifies exactly. Digitalization has no unambiguous and well-established definition.

When looking at digital data, it can be more easily accessed, shared and duplicated infinitely. In digital form, information can be preserved in more stable format. [2]

Digitalization also means the introduction of digital technology in every aspect of society. Digitalization is defined as an overall factor in the transformation and

development of business and society – including how we act, think and experience. [2]

In working life digitalization might lead to loss of jobs. Evolutionary robotics and automation have traditionally reduced manual labor for humans, and the impact on employment in these areas can be significant. Digitalization also creates new work. Health care, schools and public services do not work without people, and some need to develop and maintain an ever-growing pool of equipment and electronic services. Experts cannot be replaced by machines. [2]

It is possible that the greatest impact of digitalization has yet to be seen. At its best, digitalization means a complete overhaul of an organization's operating methods. In plain language, this means thinking about how it would have originally been worthwhile to organize if modern technology had been in place. Extensive reforms require a great deal of commitment from both creators and managers, as they need a clear understanding of what the organization ultimately aspires to do and the opportunities that new technology offers to accomplish these tasks. Decision makers need the skill to see the potential of technology and courage to implement the change. [3]

Digitalization refers to the storage, transmission and processing of information in a computer-readable form, but it also refers more broadly to the process of economic and social change resulting from developments in information and communications technology (ICT). Digital platforms are also used in traditional business. [3]

2.2 The Fourth Industrial Revolution

The Fourth Industrial Revolution and the Digital Revolution, the Internet and combining technology in the physical, digital and biological field transforms the entire production, management and governance systems. The Digital Revolution is a new virtual world and interaction in real time. Cloud, Big Data Analytics and the In-

ternet of Things are an interconnected global system. Smart Cities, Smart Homes and renewable energy, such wind, solar and geothermal power are put to use. The goal is global digitalization. [4]

The future of the Fourth Industrial Revolution is in autonomous transport and advanced robotics, machine learning and artificial intelligence, advanced materials, genomics and biotechnology. The new ways of working and becoming more creative to keep up with the changes. Emotional intelligence is needed in the future. [5]

In the future, the Fourth Industrial Revolution can cause at work redundancy, rapid grow or a change in the skill sets. The new opportunities or massive dislocation of jobs are consequence of the Fourth Industrial Revolution. It is highly specific to the occupation, the region and industry in question and how the change is managed. [6]

Current breakthroughs come in a speed that has never seen before. The Fourth Industrial Revolution is evolving in an exponential speed. It is mixing in almost every branch and in every country. The unforeseen access to data, processing power and storing capacity are unlimited. The Fourth Industrial Revolution has potential. For example in fields such as robotics, artificial intelligence, the Internet of Things, 3D printing, biotechnology, nanotechnology, materials science, autonomous vehicles, quantum computing, and energy storage have huge potential. [7]

We can remotely make a payment with an app on the phone, buy a product or order a taxi. In the future, the communication cost will decrease and with technical innovation the supply chain will be more effective. [7]

Over 30 percent of the people globally uses social media in learning, connecting, and sharing information. There is an opportunity in social cohesion between different cultures, but also a risk in the spreading of extreme ideologies. [7]

The technologies that keep up the Fourth Industrial Revolution are impacting on businesses. Transparency as the customer participates through digital services

and social media. There are patterns of customer behaviour and collected data from it. Affects to how companies do marketing, delivering and designing services and products. Customer expectations are different and collaborative innovation is used. Customer service should be improved and the use of digital technology will bring more value to physical services and products. [7]

2.3 Digital Era in Working Life

The subject of digitalization in working life is very extensive and multithreaded. [8]

Finnish working life has changed significantly in the past decades. Finland, which used to live in agriculture, has transformed into a service society for employees. The workforce has become feminized and unemployment has become a permanent phenomenon. Demand for the workforce has resulted in displacing the working-age population inside the country and across borders. The level of education has increased and the work has been computerized. [9]

Automation substitutes for the workforce by the displacement of workers by machines could lead to increase the amount of work or worsen the capital returns to the workforce. [7]

Talent will be highlighted in the future working life and be the crucial component of production. The need for highly skilled workers has grown. Working life has split up into low-pay and high salary sections according to people's skills. Because of technology the need for middle class has decreased, which has lead to the increasing of income to stop and that further causing a sense of unfairness and dissatisfaction. [7]

The most likely in the future people will come across a variety of career paths and job descriptions in the course of working life. [10]

According to Web-tietopalvelu the skills needed in working life in the information society are listed at Table 2.1. [11]

Table 2.1: Digital skills needed in working life [11]

Device usage (devices and operating systems)
Information Management
Use of the Internet
Information retrieval
E-mail
Basics of word processing
Electronic services
Social media
Security basics
Specific applications in your field

Teachers and students should have more skills than workers in information society have, the skills are according to Table 2.2 mostly the same but there are more skills needed in presentation graphics, spreadsheet basics, image processing, ten finger system, e-learning, security and programming.[11]

Administration Staff has different skills set than workers in information society or teachers and students as you can see at Table 2.3. In addition, there are spreadsheet and financial applications, data management applications, decision-making applications and networking and web meetings. [11]

2.4 Digital Skills Needed in Digital Era

Digital skills needed today according to the Kansalaisopistojen liitto are listed on the Table Digital skills 2.4. There are 21 skills included in the Table. The use of devices listed in the Table refers to the ability to use modern devices such as computers, tablets and smartphones and other modern devices. Operating the operating system refers to the ability to use different operating systems, when using computers

Table 2.2: Teachers and students [11]

Device usage (devices and operating systems)
Information Management
Use of The Internet
Information retrieval
E-mail
Basics of word processing
Electronic services
Social media
Security basics
Programming basics
Ten finger system (digital writing skills)
The basics of presentation graphics
Spreadsheet basics
Basics of image processing
Basics of online work (distance learning and teleworking)
Teaching and learning applications, teaching technology, e-learning

Table 2.3: Working as administration staff [11]

Device usage (devices and operating systems)
Information Management
Use of the Internet
Information retrieval
E-mail
Basics of word processing
Electronic services
Social media
Security basics
Ten finger system (digital writing skills)
The basics of presentation graphics
Spreadsheet and financial applications
Data management applications, decision-making applications
Networking and web meetings

and laptops, smart phones and other mobile devices such as smart watches. Most common operating systems are, in computers Windows, macOS, Linux and Google Chrome OS, in mobile devices Android and iOS and in smart watches Tizen and watch OS. Using the Internet refers to the ability to use the Internet, such as using a browser and searching information with it. Most common browsers are Chrome, Mozilla, Internet Explorer and Opera. Using electronic services and services refers to using public services and taking part in community. Information management and retrieval refer to using storage space physically on computer and in cloud environments. Media literacy refers to accessing, critically evaluating, and creating or modifying media. Digital identity refers to managing digital identity, protecting one's reputation and producing the data through digital environments. Communication refers to interacting through digital technologies. Content sharing is to share digital content through digital technologies. Social media can be used in communication, interacting and sharing digital content. Email also refers to communication and collaboration through digital technologies. The basic knowledge of security is to protect devices and digital content with regular software updates and using devices safely. Producing content refers to digital content creation, such as creating and editing digital content in various formats, such as word processing. Programming refers in to planning and developing instructions to the computer to solve a problem or task. Netiquette refers to behavioural norms and knowledge using digital technologies. Copyright refers in to understanding licences and copyright in digital content. Ergonomics refers to behaving in a responsible, safe and ergonomic manner. Problem solving refers to solving technical problems in using digital environments. Adoption of new technologies refers in to using digital tools and technologies in creating expertise. [12]

DigComp the Digital CompetenceFramework 2.0 for citizens from European Commission, digital skills are included in the Table 2.5. Digital Competence Frame-

work has some same skills listed as Kansanopistojen liitto. The skills are more precisely defined in Digital Competence Framework, there are five competence areas and 21 competence seen at the Table 2.5. [13]

Competence areas are Information and data literacy, Communication and collaboration, Digital content creation, Safety and Problem solving. Information and data literacy has three competences. The competences are Browsing, searching, filtering data, Evaluating and Managing information and digital content. In Communication and collaboration area there are competences Interacting, Sharing, Engaging and Collaborating through digital technologies, Managing digital identity and Netiquette. In Digital content creation, area are competences for Developing, Integrating and Re-elaborating digital content, Copyright and licences, and Programming there. In safety area there are competences in Protecting devices, personal data and privacy, health and well-being and the environment. Problem solving area there are competences for Solving technical problems, Identifying needs and technical responses, Creatively using digital technologies and Identifying digital competence gaps. [13]

Digital skills have been taught and studied since information technology became more widespread in society, work and study. The present situation differs from the past in that today all citizens need digital skills, whereas in the past the basic citizen was able to cope with less digital skills. Digitization requires citizens to learn to succeed. All citizens need certain basic skills to function satisfactorily in the information society. While younger generations are fluent in the use of digital technology for entertainment and social media, there are benefits of learning concrete practical skills for working life. Digital literacy refers to the concrete practical skills that a citizen of the information society should have, using and applying various digital devices (PCs, laptops, tablets, smartphones) and Internet clouds, as well as various applications and programs for work, study, business, hobbies and free-time.

Table 2.4: Digital skills according to Kansanopistojen liitto [12]

The use of devices
Information management and retrieval
Using the Internet
Media literacy
Email
Basics of word processing
E-services and services
Social media
Basics of security
Programming
Producing content
Adaption of new technologies
Communication
Operating the operating system
Digital identity
Content sharing
Software update
Netiquette
Copyright
Ergonomics
Problem solving

Table 2.5: Digital skills according to the Digital Competence Framework 2.0 [13]

1. Information and data literacy
Browsing, searching and filtering data, information and digital content
Evaluating data, information and digital content
Managing data, information and digital content
2. Communication and collaboration
Interaction through digital technologies
Sharing through digital technologies
Engaging in citizenship through digital technologies
Collaborating through digital technologies
Netiquette
Managing digital identity
3. Digital content creation
Developing digital content
Integrating and re-elaborating digital content
Copyright and licenses
Programming
4. Safety
Protecting devices
Protecting personal data and privacy
Protecting health and well-being
Protecting the environment
5. Problem solving
Solving technical problems
Identifying needs and technical responses
Creatively using digital technologies
Identifying digital competence gaps

[11]

3 Digital Competence Frameworks

International and national frameworks for Digital Competence such as ePerusteet from Finnish National Agency for Education, DigComp The Digital Competence Framework 2.0 for citizens from European Commission, PIAAC International Adult Research from Jyväskylä University Finland and DiKATA-projects levels of digital skills from Snellman Summer University in Finland. [14]

According to Finnish National Agency for Educations ePerusteet framework, national principles for education, adult education is general education and the aim is to pay attention to changes in society and current matters. Global education contributes to creating conditions for equitable and sustainable development in line with the UN's development goals. [15]

According to DigComp 2.0, the key components of digital competence are Information and data literacy, Communication and collaboration, Digital content creation, Safety and Problem solving. In information and data literacy the key is to be able to search and find digital data. To know what data is needed and how and where to store the data and how to manage it. In Communication and collaboration the key is in how to use digital technologies in communication, interaction and collaboration. It is important to be aware of generational and cultural diversity. Participating in society, managing digital identity and the reputation in digital ser-

vices are important. Sharing data and co-operating through digital technologies. The digital content creation includes programming, to design and develop instructions for the computer to solve a problem or execute a certain task or a function. To create digital content in different formats and to edit or integrate digital content, for example video, audio and pictures. Safety includes protecting well-being, personal data, privacy, devices and the environment. To understand the risks in digital environment and the safety issues when sharing and using information in digital environments. Problem solving means identifying needs and to solve technical problems. To identify the need to improve one's skills and seek for more information. [13]

It is important to understand that digital competence doesn't signify only the use of devices, programs or services. It should be seen as a wider concept, which comprehends using information technology confidently and critically as an instrument in becoming employed, to learn, to self-educate and to participate in society. How to communicate, study, work and live in digitalized environment. What possibilities does digitalization bring and how to benefit from it so that sustainable well-being is fulfilled?

According to Program for the International Assessment of Adult Competencies (PIAAC) research from Jyväskylä University in Finland, the basic skills in data processing and management data literacy, numerics and problem solving skills that apply to information technology are important. According to OECD's study in 2013, over 600 000 Finnish people have a shortage in the digital skills. According to EU's statistics from 2015 to 2017 about 19 percent of Finnish (16 to 74 year old) had poor digital skills. [16] [17]

3.1 Levels of Expertise

According to Finnish Snellman Summer University DiKATA-project, there are three levels in digital skills. The levels are a novice user, end user and utility user. A novice user is someone who is not very familiar with smartphones, tablets or computers. An individual wants to acquire the basic skills required in the information society with regard to the use of equipment, security and communication. The aim is to equip the individual with the ability to use equipment safely, in digital technologies and with a critical attitude according to information found online. [14]

According to the Digital Criteria, the end-user is a person who aims to use information and communication technologies smoothly in work, study and leisure. A person's level of competence meets the needs of the information society and the world of work. The aim is to be proficient in collaborative work, be able to produce and edit information on appropriate platforms, understand both the technical and human aspects of data security and privacy, and be able to communicate and interact within their own work, study or leisure networks. [14]

The utility user has the ability to effectively and diversely use digital technology in different areas of life. In addition to technical knowledge, the aim is to acquire the skills to adopt new tools, operating models and practices in work, study and leisure. Time management, information retrieval and management, and copyrights are the core competencies of the user. In addition, the user is fluent in communicating and interacting across networks and masters the basics of information ergonomics. [14]

There are different levels of expertise, everyone does not have to be at the same level with their skills. In different professions different skills are needed and you can always proceed to the next level when needed.

Proficiency levels in The Digital Competence Framework 2.0 are foundation 1-2, intermediate 3-4, advanced 5-6 and highly specialized 7-8. Overall levels are foundation, intermediate, advanced and highly specialized. Granular levels are foundation

Main keywords that feature the proficiency levels								
4 overall levels	**Foundation**		**Intermediate**		**Advanced**		**Highly specialized**	
8 granular levels	1	2	3	4	5	6	7	8
Complexity of tasks	Simple task	Simple task	Well-defined and routine tasks, and straightforward problems	Tasks, and wee-defined and non-routine problems	Different tasks and problems	Most appropriate tasks	Resolve complex problems with limited solutions	Resolve complex problems with many interacting factors
Autonomy	With guidance	Autonomy and with guidance when needed	On my own	Independent and according to my needs	Guiding others	Able to adapt to others in a complex context	Integrate to contribute to the professional practice and to guide others	Propose new ideas and processes to the field
Cognitive domain	Remembering	Remembering	Understanding	Understanding	Applying	Evaluating	Creating	Creating

Figure 3.1: Digital competences' proficiency levels [13]

1, foundation 2, intermediate 3, intermediate 4, advanced 5, advanced 6, highly specialized 7 and highly specialized 8 as seen in the Figure 3.1. [13]

In foundation proficiency level 1 complexity of tasks is a simple task, autonomy is with guidance and the cognitive domain is remembering. In proficiency level 2 complexity of tasks is a simple task, autonomy is with guidance when needed and the cognitive domain is remembering. [13]

In intermediate proficiency level 3 complexity of tasks is well-defined and routine tasks and straightforward problems, autonomy is on my own and the cognitive domain is understanding. In level 4 complexity of tasks is well defined and non-routine problems, autonomy is independent and according to my needs and the cognitive domain is understanding. [13]

In advanced proficiency level 5 complexity of tasks is different tasks and problems, autonomy is guiding others and the cognitive domain is applying. In level 6 complexity of tasks is most appropriate tasks, autonomy able to adapt to others in a complex context and the cognitive domain is evaluating. [13]

In highly specialized proficiency level 7 complexity of tasks is to resolve complex problems with limited solutions, autonomy is to integrate or contribute to the professional practice and to guide others and the cognitive domain is creating. In level 8 complexity of tasks is to resolve complex problems with many interacting factors, autonomy is to propose new idea and process to the field and the cognitive domain is creating. [13]

The research and analysing for creating Digikomp carried out between 2015-2016. Digikomp 2.0 and publishing the model was in a year 2016. [18]

3.2 Teaching Programming

The K–12 Computer Science Framework is a model in teaching computer science and programming. The framework was developed for schools and organizations for teaching computer science. The framework enlightens what students should know and do as listed in the Figure 3.2. Computing education includes computer literacy, educational technology, digital citizenship, information technology, and computer science. Computer literacy refers to the use of programs and computers, such as productivity software. Educational technology refers to computer literacy used in school subjects. For example using a web-based application in collaboratively creating editing, and saving an essay online. Digital citizenship refers to the safe use of technology. Information technology refers to for example installing software. Computer science is the base for computer science. [19]

According to the K-12 Computer Science Framework in computer science education, teaching programming via visual programming to learn about variables, loops, conditional statements, functions and events. After that the students can apply their skills to create projects, games, apps and program robots. [19]

The model of motivated learning at Table 3.1 presents pre-task, during the task and post task variables that influence into students' motivation for learning. During

Core concepts
Computing systems
Networks and the Internet
Data and Analytics
Algorithms and Programming
Impacts of computing

Core practices
Fostering an Inclusive Computing Culture
Collaborating around computing
Recognizing and defining computational problems
Developing and using abstractions
Creating computational artifacts
Testing and refining computational artifacts
Communicating about computing

Figure 3.2: K–12-Computer-Science-Framework [19]

the task, the teacher, feedback and material are things that effect on students' motivation. Post task and pre-task students' expectations, goals and gained social support have an effect on students' motivation. [20]

Dedication and motivation are required by the students learning to program. Students' previous knowledge and skills have an effect on their motivation and insufficient skills or lack of motivation might lead to failure in the course. Measuring students' motivation level and background competence with questionnaires could reduce student failing programming studies. Asking some personal data, such as age, pre-university studies, and general knowledge of programming and computer science in questionnaires. With the help of questionnaires, difficulties could be prevented or recognized in time. There might be a need for pre-programming courses before the official programming courses to some students. [21]

In Finnish grounds of Basic Education Curriculum 2014 is defined how to teach computer science and programming to students. Getting to know the basic skills of

Table 3.1: Model of motivated learning [20]

Pretask	During task	Post task
Goals	Instructional variables	Attributions
	Teacher	
Expectations	Feedback	Goals
Self-efficacy	Materials	
Outcome	Equipment	Expectations
Values	Contextual variables	Affects
	Peers	Values
Affects	Environment	Needs
Needs	Personal variables	
Social support	Knowledge construction	Social support
	Skill acquisition	
	Self-regulation	
	Choice of activities	
	Effort	
	Persistence	

programming begins with step-by-step instructions, including testing. It encourages the student to develop instructions for use as computer programs in a graphical programming environment. To design and execute programs in a graphical programming environment. [22]

Since the Fall semester 2016, the new curriculum for basic education introduced a new skill to study and programming in Finnish schools. Coding is not a new subject in its own right, but it is studied by integrating programming with other subjects. As the world changes, the use and understanding about technology and digital tools is an essential civic skill that is to be promoted through the teaching of programming and information technology. The aim is for students to learn to use computer science in a wide range of subjects. [23]

In Finnish grounds of Basic Adult Education Curriculum 2017 is mentioned programming: train students to develop step-by-step instructions to computer programs in a graphical programming environment. To teach programming in a graphical programming environment and practice programmed actions, such as robotics and automation. [24]

The modern way to teach programming is to begin teaching young children with visual programming platforms and integrating computer science and programming teaching in curriculum from the beginning of studies on alimentary and preschool.

When teaching programming we should start with teaching imperative programming, cover variables, different data types and routines. After that functions, object oriented programming, decentralized systems and user interfaces.

When comparing programming teaching models to digital competence there are some similarities. Also in programming teaching models and in digital competence.

According to Linda Liukas and Juhani Mykkänen, programming is important and it should be brought to primary schools' curriculum. More and more people should learn how to program. Whether it is science, art, healthcare, information

Table 3.2: Reasons for teaching programming [25]

Students have a right to learn programming
Students want study more information and communication technologies
More IT experts are needed
We do not want to be left behind in development
Programming can save the national economy
Coding cannot be outsourced easily
It is important to understand programming, even if you never code yourself
Programming is motivational and develops mind
Teaching programming to everyone will also get females involved in programming
Finland has great teachers for the change to better

systems in society, software for business development, or maintenance, smartphones, the global computer network, electronic communications, or social media – in the background there is program code. In Finland in basic education there is information technology curriculum that includes the subdivisions of computer basics, device usage, and data management, word processing, spreadsheet, databases, graphics and internet. In practice, the components are merged in teaching other subjects. As seen at Table 3.2 there are many reasons for teaching programming. [25]

Good programmer features are desire and ability to learn new things, ambition, creativity and accuracy. According to Liukas and Mykkänen there are steps to follow in programming learning, as seen at Table 3.3. Liukas and Mykkänen have also conducted a framework for teaching programming as seen at Table 3.4. [25]

Computers are more and more essential and teaching programming is getting more popular. Computers are used in a large diversity of problem-solving domains [26]. The Scratch is a graphical block-based, easy to learn and popular programming language. Programming language Scratch was designed to teach programming to

Table 3.3: First steps in learning to program [25]

Learn how to give specific directions
Visual programming
Understanding the basics of a programming languages
Know how to interpret program code
Programming languages
Programming tools

Table 3.4: Programming teaching framework [25]

Programming vocabulary
Computational thinking
User interface
Problem solving
Programming languages
Programming tools

children. Big companies such Google and Intel sponsor Scratch. According to TIOBE Programming Community index, Scratch has ascended to the TIOBE index top 20 list. The index shows the popularity of programming languages and it is a useful tool in making a decision about what programming language should be learned. In April 2020 the most popular programming language is Java, JavaScript is in a seventh place and Scratch in a twentieth place on the popularity index. [27]

It does not matter what language is learned. In learning the concepts of programming languages, language concepts and features can be used in other languages, which do not directly support such constructs and features. Language concepts can be simulated in those other languages. If a programmer was familiar with a wide range of languages, it would be easier to choose a suitable language for a specific problem. Continuous learning is essential in software development. Learning a new programming language takes time and is difficult. Examining general programming language concepts might make the learning of new programming languages easier. The understanding about object-oriented programming will make learning of other languages with the same concept easier. At first learning one language, and then moving on to other languages with the same concepts. [26]

There are simple functional languages and more complex non-functional languages, like Java. In programming languages the data and control structures of the language, such as data types (long, short, char, byte, float, int, double, string, void, or Boolean), operators (Boolean, pointer, record, or array), statements (for, while, if or else), functions, parameters, variables, expressions, inheritance and language features (type checking) are used in defining data structures. Pointers are not included in Java, because of reliability problems. Java uses compile-time type checking in nearly all variables. Programming languages use form or the syntax of a language, such as special words, for example for, while, and class and statements or statement groups, forming in control constructs. In Java closing syntax there are brackets

used, so there are fewer reserved words, which leads to simplicity. Regular design in a programming language means fewer exceptions and makes the programming language easier to learn and understand. Java is widely used because the cost of the language implementation system is low, Java compiler systems are free. Imperative languages use variables and iterations and are fast. Functional languages' execution is not that efficient on current computers. Java is also popular because of the inheritance and object-oriented features. Java language is reliable. [26]

JavaScript is called a scripting language, all-though it is imperative language as well. Web scripting language JavaScript uses interpretation, this leads to execution being slower and often needing more space. HTML markup language belongs to the markup/programming hybrid languages' category. HTML is not a programming language and it is used in specifying the information used in layout of the Web documents. [26]

3.3 Programming and Digital Competences

Digital competence connects indirectly in teaching programming. Expertise in programming and scripting can help in developing tools, for example macros. In game industry, a creative digital content creator masters programming and scripting. In making digital music, the equipment is complicated and there is a need for skills outside of basic programming skills. Graphic designers use scripting when building scenes. In the media profession, scripting can help to automatize various phases of the workload.

According to study of the Teaching and learning strategies of programming, skills that can be improved with programming are problem-solving, computational thinking and creativity. [21]

The list of important skills is conducted from the different lists of digital competence mentioned in this Chapter earlier, seen on the Table 3.5.

Table 3.5: List of important skills

Device usage
Information management
Use of the Internet
Information retrieval
E-mail
Basics of word processing
Electronic services
Social media
Security basics
Programming
Producing digital content
Ten finger system
Basics of presentation graphics
Spreadsheet basics
Applications

4 Case Study: the Digital Content Creation Line of Study in Adult Education College

The DigComp 2.0 Digital Competence Framework supports learning in five competence areas and twenty-one competence. Especially good things that are conducted from the framework are improving citizens' digital competence in using digital technologies in a self-confident and safe manner for work, job search, learning, using online services, entertainment and participating in society. The framework supports skills that are needed in employment services, job search, teaching and studying. Students can develop digital competence for future needs. In Europa 40 percent of Europeans have no digital skills or inadequate digital skills. 42 percent of people who have no digital skills are unemployed. Framework supports the need for improving digital skills, students can make a plan on what skills they need to improve and focus in improving them. [13]

4.1 Research Methods

Research methods are qualitative research and case study. Research methods are interviews, questionnaire using purposeful sampling, review of literature, observations in class and a case study, which examines a phenomenon in its natural setting.

The plan is to perform a case study, observe the students in a classroom in the pilot period of the new Digital Content Creation line of study at adult education college. Interview students and employers during students' internship, and to find out the current digital skills needed in working life according to employers.

Qualitative research is to understand people's experiences, social practices and phenomenon. Qualitative research should be rigorous and credible. [28]

Assign questionnaires to students to determine how their digital skills are improving during studies. Research strategy used is Case study, an empirical inquiry. An in-depth research of a group to study the causes of underlying principles. Case study can be made when examining a phenomenon in its natural settings, in this case when working in a classroom with Digital Content Creation assignments. Interviews and learning results indicate what aspects should be improved.

Review of literature is done in researching digitalization. An action research is done, action research is a method of testing hypotheses in a real world environment.

Action research can be defined as a process that aims at change and improve things. Reflection is one of the starting points of action research. It seeks to gain insight into and develop new activities. Action research is an approach that is interested in how things should be. There is a strong requirement for action research integration into work and activities, pragmatism, systematic problem solving, combining theory and practice, and increasing theoretical understanding about the problem. As a strategy, it also means the interaction of practical and theoretical research. It is characterized by the simultaneous action and investigation and the achievement of immediate and practical benefits. In addition to exploration, the goal is to develop the activities simultaneously. [29]

Action research is meant to solve problems more than get information. The aim is to make a change for the future. Action research happens in practice and it is supported by the organization and it has a defined time and cost. [30]

Action research is associated with practical work and problems in recognizing and removing problems. Action research does not pursue primary in generalized results. In action research action, observation and design are continuously repeated in a cyclic process. With repeating the cycles in the action research, working is developed continuously. Inside the cycle the steps in design, action and observation are repeated and working is simultaneously developed continuously. [31]

In action research understanding and circumstances are put into perspective in practice. Action research is seeking equivalent or non-equivalent answers in between rhetoric categories and reality. In education theory, action research does not only seek the discoverable and noticeable facts but deeper meanings. It is important to accomplish concrete changes in education and in teaching practices. Interaction in a classroom with the student and the teacher affects students independent learning, asking questions and actively participating in teaching situations. [32]

In action research, a didactic research aspect can be used in studying the conditions prevailing in teaching and their effects. Teacher assessment divided into ongoing situational awareness during the teaching process assessment and post teaching assessment that takes place in relation to the classroom and school context and on the other hand in relation to the assessment of the collective level. Assessment after a teaching event can focus on students' achievements and / or the teacher's own activities. The assessment also includes an assessment of the teaching event by the students as well as a self-assessment. [33]

A didactic research aspect is used in action research. Didactic is an ongoing situational awareness during the teaching process assessment. Post teaching assessment is used in teacher assessment. Assessment takes place in the classroom. Assessments after a teaching event can focus on the teacher's own activities and students' achievements. The assessment also includes an assessment of the teaching event by the students as well as students' self-assessment. [33]

Research methods in the thesis are the qualitative research, the review of literature and case study, used methods are interviews, questionnaire and observation. Research group in the case study are the new Digital Content Creation line of study students. With the questionnaires, students evaluated their digital skills in the beginning of the studies, in the middle of the study year and at the end of the studies. Students were also interviewed informally three times during the study year and one time officially at the end of the study year. Review of literature was made in researching digitalization and digital frameworks and competence in digitalization and programming. The goal of the action research process was to improve the Digital Content Creation line of study curriculum and programming teaching. Action research is associated with practical work and in recognizing and removing problems. Action, observation and design are continuously repeated in a cyclic process so the working is developed continuously. In the action research of the new Digital Content Creation line of study, this means that teaching, observing and designing and improving teaching materials was repeated in a cyclic process to improve the line of study.

4.2 Case Description

Paasikivi-Opisto was founded in 1980 and is located in Turku, on the island of Kakskerta. Paasikivi-Opisto is a multidisciplinary adult education college specializing in visual culture and communication. Adult education college studies on Media and Art as well as the Finnish language and culture studies. Also, a Vocational College and study a basic level degree in Media and Visual Expression. Paasikivi-Opisto has a good set of values and strength in visual culture and communication, which gives a good basis designing a new line of study. Paasikivi-Opisto has a strong experience in teaching finish language and culture to immigrants and organizing TIEKE degree studies (Tietoyhteiskunnan kehittämiskeskus ry, Finnish Information Society

Development Centre).

The goal is to create a new Digital Content Creation line of study at adult education college, that will provide wider perspective focusing on understanding citizens' digital skills and developing them and in creative digital content creation. The point is to work in a multicultural group of students. Study line will use the DigComp 2.0 Framework in guiding the learning.

Focus group is multicultural. The Digital Content Creation study line is targeted to adults, to both immigrants and adults that speak Finnish as a native language. Focus group is all adults that need to improve their digital skills. Focus group is wide so the criteria of liberal adult education will be fulfilled. Added value will be in improving Finnish skills with native in language immersion. Studies last one full study year, but it is possible to study only the Fall semester or the Spring semester if needed. The curriculum must be planned so that it is possible to join the group for Spring semester or study the Fall semester only.

Creative work is increasing. It is believed that creative content creation will develop adaptability, adopting new skills and general social skills. Especially problem solving and collaboration skills are emphasized in project based learning.

The case will study the effectiveness and success of the study line. The purpose is to examine the average numbers or results from digital skills tests and student interviews. There is also a final exam in programming, to test the students' problem solving and programming skills in imperative programming.

4.3 Case Curriculum

The curriculum of the Digital Content Creation study line education is originated from DigComp 2.0 framework. Courses follow the competence areas and competence of the framework. The percentage of programming on the study line is 25 percent of the curriculum. Other courses are strongly related to programming or support

the learning of programming and other digital skills.

Course content will follow DigComp 2.0 Framework, so that digital content creation is emphasized more than other areas of the framework. Digital content creation is 50 percent, Communication and collaboration 20 percent, Information and data literacy is 10 percent, Problem solving is 20 percent and Safety is 10 percent of the study line curriculum. Competence of digital content creation will cover widely also other areas. Programming is included in digital content creation competence area, from the five areas of competence conducted from the framework.

In the curriculum of the Digital Content Creation, there are 18 credits per semester or all together 36 credit per study year, where one credit refers to one-week workload. Every day there are lectures and personal or group tasks to students between morning 9.30 to 14.05 afternoon. Working hours are 25 hours per study week. In adult education and especially at Community college it is important that the students have possibility to work during studies. It is planned that after study day it is possible to go to work an evening shift or to work on the weekends, that is why the days are so short. It is also planned that it would be possible to do all the assignments at the academy during the working hours. If the students want to study at home, the FOSS-programs are free and available to all during and after the studies. FOSS-programs are achievable despite the socio-economic situation, which would otherwise increase equality between students. At the academy there are high-performance personal computers for all the students and the programs used are installed in computers so that everyone has the chance to work with proper equipment. There is also possibility to lend other equipment for the courses, such as the digital camera and other camera equipment and graphics tablet.

Free and Open-Source Software (FOSS-programs) are used in Digital Content Creation line of study. The point is to use programs that are generally and free of charge available to all citizens.

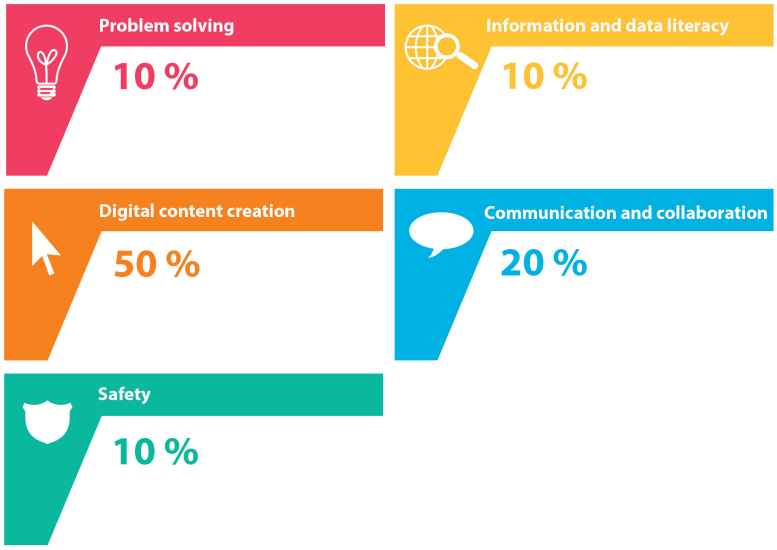

Figure 4.1: Course content areas emphasize percent [13]

Programming is one in twenty-one competences. The competences are listed in Chapter 2.4 at Table 2.5. In the Digital Content Creation curriculum, programming and programming related areas and competence are strongly represented. Safety (information security) and Problem solving areas and competence are strongly related to programming competence. The students have total of 18 credits at the Fall semester, which include 4.5 credits of Programming, 1.5 credits of Safety (Information security) and 3.5 credits of Digital skills. The area of digital skills includes competence in Problem solving, Usability, Project work, User interfaces, and other competence that support programming, and learning to program. Communication and collaboration area is 2 credits. Interacting and sharing through digital technologies is competence, which are highly used in programming. Information and data literacy is 1 credit area, which includes competence in Browsing, searching and filtering data, Information and digital content and Evaluating and managing digital content. From the Fall semesters 18 credits, 4.5 credits are programming and 8.5 credits are strongly related to, or support programming and learning to program as seen in the Figure 4.2.

The students have total of 18 credits at the Spring semester, which include 4.5 credits of programming, 1 credit of Safety (Information security) and 3 credits of Digital skills. Digital skills include Problem solving, Usability, Project work, User interfaces, and other competences that support programming and learning to program. Communication and collaboration area is 1 credit. Interacting and sharing through digital technologies are competences which are highly used in programming. Information and data literacy is 2 credits, which include Browsing, searching and filtering data, Information and digital content and Evaluating and managing digital content. From total of 18 credits, 4.5 credits are programming and 7 credits are strongly related or support programming or learning to program as seen in the Figure 4.3.

As it is seen in Figures 4.2 and 4.3 the courses have been divided under the main themes, that are Digital skills 3.5 credit, Safely using digital technologies 1.5 credits, Data literacy 1 credit, Visual content creation 3.5 credits, Programming 4.5 credits, Photography 1 credit, Communication 2 credits and Video filming 1 credit.

In at Table 4.1 are listed all the courses studied in the Fall semester 2019 and the credits gained from the courses.

At Table 4.2 are listed all the courses studied in the Spring semester 2020 and the study points gained from the courses. I will later explain in more detail all the courses that include programming or are strongly related to programming.

4.4 Course Implementation

In the beginning of the study year in the Fall semester the students did a test in which the students evaluated their own digital skills in a scale from 1 to 8 according to DigComp 2.0 Framework proficiency levels as seen in the Figure 3.1 in Chapter 3.1. The test was conducted from the Framework areas and competences so that all the areas and competences were covered in the test. Students also wrote their goals

Digital Content Creation line of study
Weekly curriculum fall semester 2019
Programming-driven content production and creative use of digital technologies

Digital skills 3.5 credits
Safely using digital technologies 1.5 credits
Information and data literacy 1 credit
Visual content creation 3.5 credits
Programming 4.5 credits
Photography 1 credit
Communication and collaboration 2 credits
Video filming and editing 1 credit

18 credits combined

Fall	Digital skills 3.5 credits	Safely using digital technologies, 1.5 credits	Information and data literacy, 1 credit	Visual content creation 3.5 credits	Programming 4.5 credits	Photography 1 credits	Communication and collaboration 2 credits	Video filming and editing 1 credit
Week 1	Digital skills, testing students digital skills, study Data literacy, Project work and learn the basics of Portfolio, 1 credit		Information retrieval, information and data literacy and writing techniques.					
Week 2		Information security, Netiquette, 1 credit						
Week 3		Copyrights, 0.5 credit						
Week 4					Programming 1, basics, 0.5 credits			
Week 5					Programming 2, 1 credit, binary			
Week 6					Visual programming 1, 1 credit			
Week 7	Problem solving 1, Lego Mindstorm, 1 credit							
Week 8								
Week 9						Photography 1, image processing, 1 credit		
Week 10				Graphic design 1, 1 credit				
Week 11			Project studies		Publishing platforms, blog platforms, wordpress, 1 credit			
Week 12	Usability and user interfaces, 0.5 credits						Communication and collaboration 1, 1 credit	
Week 13	Portfolio, 1 credit							
Week 14				Marketing, 0.5 credits			Social media 1, 0.5 credits	
Week 15				Vector graphics 1, 1 credit				
Week 16					Programming languages 1, Hello World, 1 credit			
Week 17							Media literacy, Youtube 0.5 credits	Video filming and editing 1 credit
Week 18				3D-modelling 1, 1 credit				

Figure 4.2: Weekly curriculum Fall 2019

Table 4.1: Courses Fall semester 2019

Course	credits
Digital skills 1	1
Data literacy 1	1
Information security 1	1
Copyright 1	0,5
Programming 1	0,5
Programming 2	1
Visual programming 1	1
Problem solving 1	1
Photography	1
Graphic design 1	1
Publishing platforms	1
Usability	0,5
Communication and collaboration 1	1
Portfolio 1	1
Marketing 1	0,5
Social media	0,5
Vector graphics 1	1
Programming languages 1	1
Video filming and editing 1	1
Media literacy 1	0,5
3D modelling 1	1

Digital Content Creation line of study
Weekly curriculum spring semester 2020
Programming-driven content production and creative use of digital technologies

Digital skills 3 credits
Safely using digital technologies 1 credits
Information and data literacy 2 credits
Visual content creation 4.5 credits
Programming 4.5 credits
Photography 1 credit
Communication and collaboration 1 credits
Video filming and editing 1 credit
18 credits combined

Spring	Digital skills 3 credits	Safely using digital technologies, 1 credit	Information and data literacy, 2 credits	Visual content creation, 4.5 credits	Programming, 4.5 credits	Photography, 1 credits	Communication and collaboration, 1 credit	Video filming and editing, 1 credit
Week 1		Information security and copyrights, 1 credit						
Week 2			Information retrieval, information and data literacy, and writing techniques. 0.5 credits					
Week 3	Problem solving 2, Lego Mindstorm, 1 credit							
Week 4					Visual programming 2, 1 credit			
Week 5					Programming 3, 1.5 credits			
Week 6								
Week 7				Graphic design 2, 1 credit				
Week 8				Pop-Up seminar exhibition, 1 credit				
Week 9				Marketing 2, 0.5 credits				
Week 10					Portfolio2, 2 credits			
Week 11							Communication and collaboration 2, 1 credit	
Week 12	Project studies, 2 credits							
Week 13								
Week 14			Media literacy 2 magazine project, 1.5 credits					
Week 15						Studio photography 1, image processing, 1 credit		
Week 16				Vector graphics 2, 1 credit				
Week 17				3D-modelling 2, 1 credit				
Week 18								Video filming and editing 2, 1 credit

Figure 4.3: Weekly curriculum Spring 2020

Table 4.2: Courses Spring semester 2020

Course	credits
Safely using digital technologies	1
Data literacy 2	0,5
Problem solving 2	1
Visual programming 2	1
Programming 3	1,5
Graphic design 2	1
Pop-Up seminar	1
Marketing 2	0,5
Portfolio 2	2
Communication and collaboration 2	1
Project studies	2
Media literacy project	1,5
Studio photography	1
Vector graphics 2	1
3D modelling 2	1
Video filming and editing 2	1

for the study year and in studying in the Digital Content Creation line of study and wrote down what digital skills they need to improve during the studies. After completing the test, the students were divided into three groups according to their level of digital skills and their personal goals for the studies. The results from the test were quite even, there were some students who stood out with their skills as intermediate and some highly specialized. Most of the students had intermediate digital skills. Groups were made at three levels intermediate, advanced and highly specialized. I will explain in more detail all the courses that include programming or are strongly related to programming.

Under the Digital skills main theme there were three courses. In the Digital skills course, the students practised their computer skills with basic Open Office programs Writer, Calc and Impress. Lectures were held in basic office productive tools, project work and building a portfolio. The Problem solving course covered Lego Mindstorm platform for building and programming Lego robots. Students made a project plan for Lego Mindstorm and EV3. They wrote down what kind of robot they want to build and what functions the robot has. In the usability course, the individual task was a user interface evaluation.

Under the main theme Information and data literacy, there was one course. In Data literacy course the informaticist from HUMAK (Humak University of Applied Sciences) library lectured about the information gathering process in general, Google-tricks and introduced the library to the students. Informatician lectured also about evaluating information, source criticism, privacy and fake information. Introduced the students to copyright licences by Creative Commons global non-profit organization. Information and the image search with CC licences.

Under the Safely using digital technologies the main theme there were two courses. In Information security course the themes discussed are security, cloud services, cyber crime and passwords. Students learned about the basic components

of security, how the Internet works, and the most common type of cyber security attacks. Students worked in teams and created a mind map from project work, they conducted the results from search results from Google and other search engines. Students explored their digital identity and made posters from the most important netiquette rules, with using data visualization. In the Copyright course, we used materials provided by Kopiosto, representative copyright organization in the Finnish creative industry. Kopiraittila is Kopiosto's inspirational and invigorating material for copyright learning and teaching.

Under the Programming main theme, there were four courses. Programming 1 course covered binary, ASCII code and introduced to pixels. Lecture in what programming is, where it is needed and how programming appears in everyday devices and activities. A brief introduction to programming, basic concepts and imperative programming, such Java language. Algorithms and basic data types, such string, boolean, int and double, condition statements and loops, methods, tables and classes in Java programming language. Codeacademy web based learning platform was used to learn about from the most common programming languages for example Java, Ruby, Python, HTML and JavaScript. Online compiler and editor jdoodle for 72 languages in executing code. Courses were so short that there was no time installing software and plugins and teach how to use complex editors. Programming languages 1 course was JavaScript and the platform used was Codeacademy. In the Programming 2 course Python programming language was discussed. Students used Codeacademy, Codecompat and Trinket. In the Visual programming course, the students made a game, a group work on the Scratch, a web based visual programming platform. Students made a project plan for the game project. Students' decided the roles for the group members and the content of the project together. Students made a game script, game graphics and sound effects. The target audience was studied and the name of the game decided. The Publishing platforms course covered the

basics of html and css. Students made as an individual work a traditional web page with Notepad++ program, as a group work the students explored different publishing platforms in groups. Students were introduced to blogging platforms, portfolio sites and publishing systems for creating websites.

In the Communication and collaboration course, forms of communication on different communication culture and communication channels were discussed. What is the role of communication, who should lead the company's communications, what is the difference between communication culture and communication channels in formal and informal communication and what about mass and target communications?

In Safely using digital technologies course topics covered are Google Digital Garage, the current state in information security and reversed image search. Students were guided in recognizing personal strengths for applying work and studies. In Data literacy 2 course topics covered were media literacy and recognizing reliable sources researching information. Problem solving 2 covered the Lego Mindstorm visual programming platform and assignments programming more complex visual programming programs. Visual programming 2 course covered visual programming through assignments done in the visual programming platform. Programming 3 students developed their web page from the Fall semester and added JavaScript to the website. Project studies content is defined individually per student. Opportunity to go for an internship or plan and execute an individual project. Goals are set individually per student.

4.5 Case Study Implementation

The aim of the case study is to improve the Digital Content Creation line of study. An action research was done simultaneously with the literature research. Literature study was made to increase theoretical understanding about digitalization and digital competence frameworks. After the case study, the case study was combined

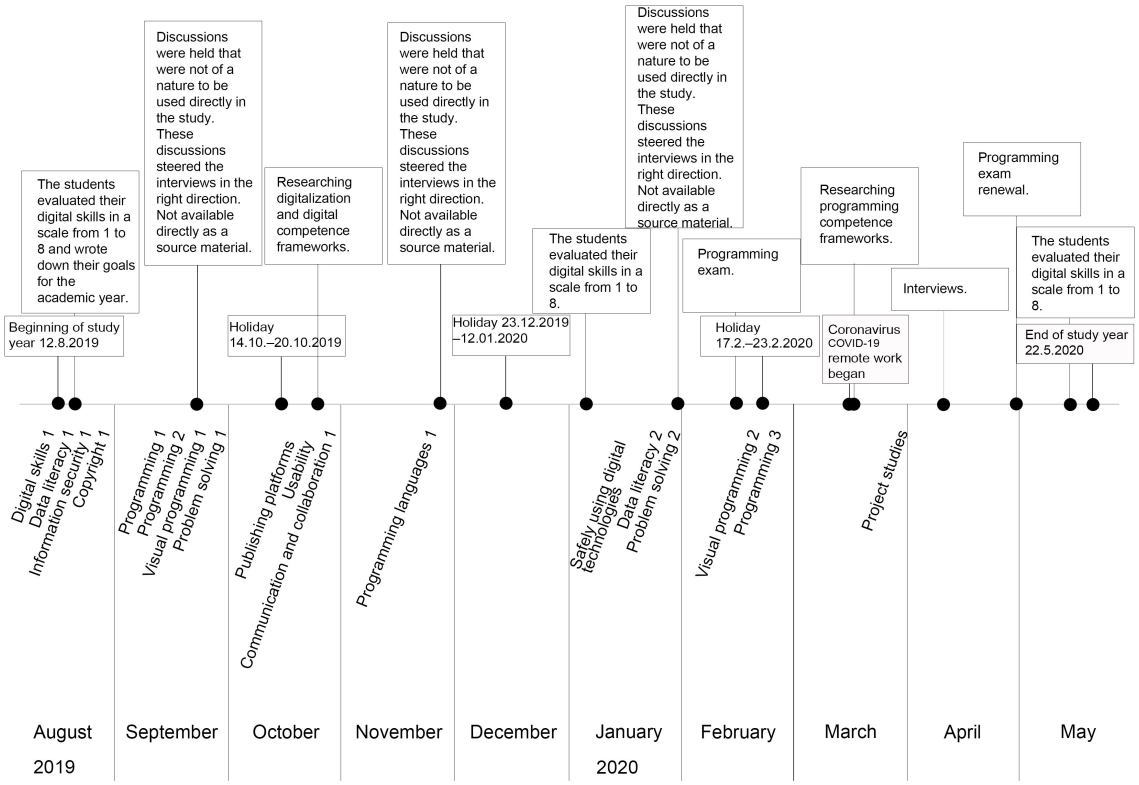

Figure 4.4: Action Research Timeline

to the theory. In the case study, the students work and activities were observed. Strategy was the interaction between case study and theoretical research. In practice get information by observation in action research. Solve possible problems and to accomplish concrete changes in the Digital Content Creation line of study and in teaching practices. In the case study, students' interaction in a classroom with other students or the teacher and the students' independent learning was observed. Also, students' activity, asking questions and actively participating in teaching situations was observed. Action research timeline seen in the Figure 4.4.

4.5.1 Observations

At the beginning of studies, the curriculum was reviewed together with the students and explained the content and goals of the study year.

Observations for the action research were made in the classroom during the teaching of the Digital Content Creation line of study courses and in students working with the assignments. After the teaching monitoring the students' achievements and learning. Assignments were returned in Google Classroom digital environment group assignment return slots, which made it easier to document the progress of the studies and comment on students returned assignments.

Most of the Digital Content Creation line of study courses that included programming or strongly programming related topics were at the beginning of the Fall semester in August to November. Writing the thesis theory began in October and continued to May. Observations were made during personal study plan discussions. These discussions steered the interviews held in the Spring in the right direction. Discussions are not directly available as a source material because the discussions were held in connection with HOPS (personal study plan), which is not a public discussion.

There were a possibility to select courses at the HUMAK (Humak University of Applied Sciences) and Open University of Turku. In Open University of Turku there are basic studies in Creative writing available at Paasikivi-Opisto, studies are worth 25 credits and last the whole study year.

4.5.2 Interviews

At the beginning of the Fall semester there were sixteen students all together, one student changed to other line of study at the beginning of the Fall semester. At the Spring semester two of the fifteen remaining students quit studies before the others. Twelve of the remaining thirteen students were interviewed at the end of the studies in Spring semester.

Students were asked at the beginning of the studies to write their goals for studies in the Digital Content Creation line of study. Evaluation of the knowledge at the

beginning of the Fall semester can be seen as background competence. Students' motivation is effected by student's life, work, study and leisure, so good planning is needed in integrating studies into everyday life. The personal study plan was based on the students' writings on their goals for the study year. Students wrote about their background and what was their level of expertise according to their digital skills. They wrote down the reasons for applying to the education. The discussions before the formal interviews are not of a nature to be used directly in the study. These discussions steered the interviews in the right direction, but are not available directly as a source material. Students were interviewed at the end of the Spring semester according to the improving of their digital and programming skills. Topics were the success of the programming teaching, the content of the course and course materials ans students' reaching their goals during the study year.

Interview Questions for Students

1. Do you think your digital skills have improved during the school year?
2. Estimate whether you have benefited from studying on the line of study considering the future employment, work-life or studies?
3. Do you think your programming skills have improved during the school year?
4. Evaluate the success of programming teaching.
5. Evaluate the content of programming teaching.
6. Evaluate programming teaching materials.
7. Do you think that you have achieved the goals you set for the study year in the Fall?

Interview Questions for Employers

Interview students' employers after their internship. Contact employers after students' internship and to find out how the internship went and was the employer pleased with the students' accomplishments during the internship. Introduce all the skill levels to the employers and ask: Were the students digital skills at adequate level for the assignments assigned during the internship?

4.5.3 Questionnaires

The DigComp Conceptual reference model was used as a frame in the digital skills self-evaluation questionnaires. Students were asked to evaluate their skills in a scale from 1-8. The proficiency levels are: 1-2 foundation, 3-4 intermediate, 5-6 advanced and 7-8 highly specialized. Digital Content Creation students were tested at the beginning of the first semester (16 answers), at the beginning of the second semester (15 answers) and at the end of the studies (12 answers). At the beginning of the Fall semester, the background knowledge of the students is determined as a self-evaluation of the background competence. In the middle of the study students performed the same test again, and at the end of the Spring semester at the end of the study year.

The questionnaire questions for students seen in the Figures. In the first Figure is listed digital skills questions in Communication and collaboration 4.5.

In second Figure there are listed digital skills questions in Information and data literacy 4.6.

In third Figure is listed digital skills questions in Security, Problem solving and Digital content production 4.7.

Digital skills

Communication and collaboration

Information and communication technologies and the use of digital technologies and services.

1. Interacting through digital technologies such as email, digital media, websites or applications.

2. Participation in society through public and private digital services.

3. Collaborate with digital technologies such as email, project tools like Google Drive and Skype.

Communication culture and interacting through digital technologies

Digital communication and digital identity.

4. Differences between formal and informal communication, understand the differences between informal and formal communication such as communicating at workplace versus communicating with friends.

5. Digital identity management, be aware of what content is uploaded to the internet and how difficult it is to completely remove information from the internet.

6. Netiquette, or Internet etiquette, how to behave on the Internet.

7. File sharing, such as email attachments and cloud services (Google Drive and Dropbox).

Communication environments and technologies

Use of digital communication channels.

8. Multichannel and social networks such as social media, email and online chat.

9. Communication technologies, tools and methods such as email, video conferencing (Skype) and project tools (Google Drive).

Presentations as communication situations

Presentations as communication situations. Use of digital tools in the presentations and use of document templates.

10. Visualization of presentations, such as images and charts in a PowerPoint presentation.

11. The content of the presentations, such as the core issues in the texts and the visualizations supporting the presentation (pictures and diagrams).

12. Document templates, filling in and document templates or make a new document according to the template.

Figure 4.5: Digital skills questions in Communication and collaboration

Information and data literacy

Information management and saving and sharing digital files.

13. Private and shared folders, know what to upload to a shared folder and what to a private folder such as Google Drive or shared versus personal network drive on school computers.

14. File naming conventions, know how to name files recognizably and, if necessary, not use ä, ö, å or other special characters.

15. File Types, recognizing the most common file types for text, image, audio, and video files.

16. Back up data, understand the purpose of backups, and regularly back up important files.

Information retrieval techniques

Information retrieval techniques and using digital information retrieval tools.

17. Keywords used in searches and how to use them (Google or other search engines).

Using different sources to search for information.

18. Using the Internet to search for information.

19. Using search engines to search for information, such as Google.

20. Using databases to retrieve information, databases are collections of files compiled for a specific purpose, usually compiled by the topic or field.

Critical data literacy and evaluating information. Filtering digital data.

21. Assessing the reliability of data.

22. Finding important and useful information.

Generating information and the importance of new information.

23. Combining different forms of media, such as combining image, audio, text, and video, by editing into a single

Publication of information.

24. Various publishing platforms and their utilization, such as creating websites, using ready-made blog templates or Youtube.

Data access rights.

25. Copyright, Concepts and Practices, understanding what copyright means and how material on the Internet may be used for one's own purposes.

26. Licensing and licensing practices, understanding the difference between open source (free) and chargeable programs.

Figure 4.6: Digital skills questions in Information and data literacy

Security

Security, risks and their identification.

27. User as a security risk, such as human errors behind the spread of computer viruses (email attachments and suspicious links on websites).

28. Technical factors as a security risk, such as understanding the importance of virus protection on computers and mobile devices'. Regularly updating devices software to reduce security risks.

29. Security breaches and characteristics, knowing how to identify a possible security breach and how to act in case it happens.

Protecting against security risks.

30. Creating a username and password how to generate a username and secure password.

31. Virus protection, understanding the importance of virus protection and know how to operate safely and reducing the risks of computer viruses.

32. Using external memory, such as a memory stick, external hard drive, and connecting devices to the computer to transfer files.

Rules and legislation.

33. Risks in using e-mail and the Internet, understanding security risks associated in processing personal data.

34. Data protection, the new data protection law.

35. Employee's rights and obligations in information work, finding out the practices in the workplace and at the place of study regarding the use of equipment, computers and the Internet.

36. Securing devices, such as virus protection, software updates, and using devices so that the device for example does not get wet or drop to the floor.

37. Protecting the environment, restoring discarded equipment to factory settings (deleting your personal data) and recycling properly.

38. Protecting privacy and personal information, handling personal information in correct manner.

Problem solving

Solving technical problems.

39. Understanding and solving problem situations in digital environments.

40. Solving technical problems.

41. Identifying needs and technical answers, knowing, for example, when the device should be taken for se ability to read instructions in the event of a problem.

Digital content production

Developing expertise and skills.

42. Learning skills, identifying the best practises in learning (for example, reading, writing, performing or list

43. Learning environments and platforms, such as electronic materials and learning environments (for e Google Classroom).

Project management.

44. Project work, the signifying of project work and working in a project team.

45. Use of project tools such as Trello, Google Drive, Google Hangouts, Skype and Dropbox.

Digital content production.

46. Creativity and innovation.

47. The image, audio, video and multimedia as data formats.

48. Assessing needs and identify, select, and use digital tools and technical solutions in solving needs. I when to use certain digital tool and where context, such as a word processor versus an image editor.

49. Creative the creative use of digital technologies.

50. Recognizing if digital skills need to be improved or updated.

51. Producing digital content, such as image, sound, video or text.

52. Editing, enhancing and merging digital content, such as image processing, editing or word processing.

53. Programming.

Figure 4.7: Digital skills questions in Security, Problem solving and Digital content production

5 Case Study: Results

Results of the case study are presented in this Chapter. The research nature is empirical, research methods are action research, interviews and questionnaires.

5.1 Observations

Observations for the action research were made in the classroom during the teaching of the Digital Content Creation study line courses and in students working with the assignments. After the teaching monitoring the students' achievements and learning.

Students' digital skills have improved. There were opinions in whether the assignments should be group work or individual work, if the tasks are too hard or too easy or if there is enough or not enough assignments. Students needed more study material and examples in Portfolio course. Lego Mindstorm and Visual programming course could be combined to one Visual programming course or there could be a Game course instead of the Visual programming course. More pictures and screen captures should be shown in the lectures and theory materials separately shared to the students to study. In the class schedule, lectures and practice lessons could place in separate lessons. More lectures in advanced special studies. Precise assignments and more explaining why the assignment is done.

In the Problem solving course observations made were in the challenges of the group work. There were three groups and one of the groups worked very well together, the other group was somewhat quieter and did not work together as good

as the first group. The third group did not work together at all, that group was the one where there were most absences and that lead to conflicts.

Programming languages 1 course was in a wrong place because all the other programming courses were at the beginning of the Fall semester. It was hard for the students return to the programming topic after the weeks of only visual courses. Programming courses' order was changed for the Spring semester. Programming feels to be separate from the visual courses. Some students have not learned or understood programming. Programming feels too hard for some students and according to some students it demands too much learning. Some students really want to learn to program, but they think that they have not learned. Programming courses could be developed, there could be more web design and designing web pages using currently used platforms.

5.2 Interview Answers from Students

1. Do you think your digital skills have improved during the school year?

Students think that their digital skills have improved very much, or they have updated their digital skills. Students have learned much about searching and filtering information. Learned to use programs and devices that are used in digital content creation. Learned about publishing to social media, image and video processing and 3D-modelling. Basic understanding in programming is gained and in searching information regarding programming and solving problems. Information security and mastering the basic skills according to the subject, that are needed in general or at work. Students are understanding the importance of searching information and updating their knowledge and skills. Seeing more digital possibilities at work. Learned a little of everything. More knowledge in what skills and abilities are possessed and in naming their skills. Students learned the basics in programming.

2. Estimate whether you have benefited from studying on the line of study considering the future employment, work-life or studies?

Students think that they have basic skills to cope in the digital world. Some students have become employed during studies. They want to keep up in development and current standards. Keeping skills updated. Knowledge in naming their skills have improved. Vocabulary in digitalization has improved. Knowing it is important to keep learning through life. It was easier to do preliminary assignments and prepare for entrance examination in this year than year before, when applying to study at university. Students are getting small projects in digital content creation in collaboration with internship contacts or a prior working place. Basic knowledge in programming is useful in applying to study engineering. Applying to work in a field that requires digital skills. The learned know-how is possibly useful in future studies. Knowledge has grown and interest in practising skills further at home. Knowledge has deepened and courage in practise work has grown. Knowledge in what are the most interesting areas in the digital content creation field and proceed to gain more information about those.

3. Do you think your programming skills have improved during the school year?

Before the studies, the students had very little or no programming knowledge or skills. Programming skills have improved during the Fall semester. Programming seems to be hard and not very interesting subject to many of the students. Programming is demanding and it takes a lot of time and effort in achieving a level of expertise where programming could really be used. Understanding programming and logic's have clearly improved, but programming skills are not excellent. Understanding in programming has improved and visual programming feels relatively easy. Knowledge in understanding the structure in programming and knowing what

information to search. Most of the students did not now how to program before the studies and have learned the basics during the studies. Some would like to learn more. Some have learned very little and still need continuous guidance in doing the assignments. Programming skills should be used daily or weekly to keep the knowledge good and to know how to program. Students have gained good basics to begin to learn more about programming. Students should focus more and practise more programming to learn more.

4. Evaluate the success of programming teaching.

Programming felt very difficult for many students and in their opinion they could have needed more guidance. More personal guidance and explaining the program while programming the assignments could help understand better. Some students do not know how programming should be taught, maybe to go through the same steps with different programming languages. First Visual programming, then Lego Mindstroms and last the programming languages. Simple tasks in visual programming were good, one command taught at a time. Teaching was successful, but there should have been more time. We moved too quickly from one programming language to another. Students gave some improvement successions. Some students thought that teaching multiple programming languages in the Fall semester was too much, it would be better to focus in only one language. Instructions in assignments could be better. Assignments should be made easier. More going through smaller parts of code together, one language at a time. Different languages with different syntax are confusing. Programming Hello Wold and one command at a time and seeing how it works and what happens. It would have been rewarding according to some students to program a Scratch game with visual programming tools in a few month period or a real project with real or imaginary client would be motivating. Project assignment could be larger and more extensive, with code refactoring and developing or there

could be several small programming projects.

5. Evaluate the content of programming teaching.

All the programming courses should have been one after the other, no other courses in between. Teaching general programming basics first, after that visual programming and then programming languages. In the programming courses, teach languages and then Lego Mindstorms and then visual programming. Assignments were good. It is better to resolve the assignments by oneself. Traditional programming assignments were the best. More time is needed to focus on one programming language and fewer languages to learn. Simple Hello World programs more. Codeacademy web based learning environment was good. HTML, CSS and JavaScript are the most important languages to digital content creation professional.

6. Evaluate programming teaching materials.

Good materials for adult education college. Mainly tutorials, more printed instructions and tables are needed. Good materials. More example programs needed. All commands and areas of the programming language should be shown in examples. Theory and assignments follow each other. More precise instructions and compact materials needed. It was good that assignments were seen through together at the end. Discussion about the assignments and all the possible solutions were good. Instructions were good, but the programming commands should be seen through together more precisely.

7. Do you think that you have achieved the goals you set for the study year in the Fall?

Goals have been mostly achieved. Students were not expecting to learn so much. Students learned to download programs to the computer and install scanners and

printers to the computer. Good education in updating skills, for those who are already in working-life. Google analytic could have been more precisely seen through. Social media was good. Goals in learning to film video footage and editing are full filled. Basic understanding in programming is gained. The Main goal is to get a job or get to study at university further more. Searching information and building a website was learned. Studying builds routine to life and at the same time you learn. Students know better what's is possible to do. Students have learned more programming, drawing, vector graphics and 3D-modelling. Learned more Finnish language, both writing and speaking. Goals have been mainly achieved.

Interview Answers from Employers

Resulting from the Corona-virus COVID-19 the agreed internships in Project studies course were cancelled at the hands of employers, so the employer interviews were cancelled.

5.3 Questionnaires

Digital Content Creation students were tested at the beginning of the first semester (16 answers), at the beginning of the second semester (15 answers) and at the end of the studies (12 answers). In the beginning of the Fall semester, the background knowledge of the students is determined as a self-evaluation of the background competence. In the middle of the studies, students performed the same test again, and at the end of the Spring semester in the end of the study year. The students were asked to evaluate their own knowledge according to 8 Proficiency levels in The Digital Competence Framework 2.0. 1-2 being foundation, 3-4 intermediate, 5-6 advanced and 7-8 highly specialized user. More precise definition seen in Chapter 3.1 Levels of expertise.

Programming knowledge is more advanced at the end of the studies, than it

was in the middle and at the beginning of studies. 16.7 percents of the students are at the end of studies at 5 advanced proficiency level. At the beginning of the studies, the percentage was 6.3 percent. At the end of the studies, 33.3 percent of the students were at 2 foundation proficiency level. At the beginning of the studies, the percentage was 12.5 percent. At the end of the studies, 50 percent of the students were at 1 foundation proficiency level. At the beginning of the studies, the percentage was 75 percent. Students have better foundation in programming knowledge and are able to guide others. Programming knowledge has grown to be at better at level at the end of the Spring semester than at the beginning of the Fall semester. It is interesting to see that some students evaluated their programming skills to be better in the middle of the studies than at the end of the studies in the Spring semester. The result is easily explained with the curriculum, all the programming courses at Spring semester were in the beginning, so at the end the self-confidence in one's skills might not be so high, resulting in lower evaluations of the skill level. Other explaining factor is that the students' self-evaluation is affected with the growing knowledge during the study year. Levels of expertise self-evaluated by the students seen in the Figure 5.1.

Students' problem solving skills were, regarding their own evaluation, in the beginning of the study year in the Fall semester compared with at the end of the Spring semester more highly specialized. Programming knowledge has grown to be at better level at the end of the Spring semester than at the beginning of the Fall semester. 25 percent of the students were at the end of studies at Spring at 5 advanced level, solving different tasks and problems, guiding others and applying information. At the beginning of the studies, the percentage was 43.8 percent. 33.3 percent of the students evaluated their skills to be 6 advanced level at the end of the study year. In 6 Advanced level students perform most appropriate assignments, are able to adapt others in a complex context and evaluating. At the beginning of the

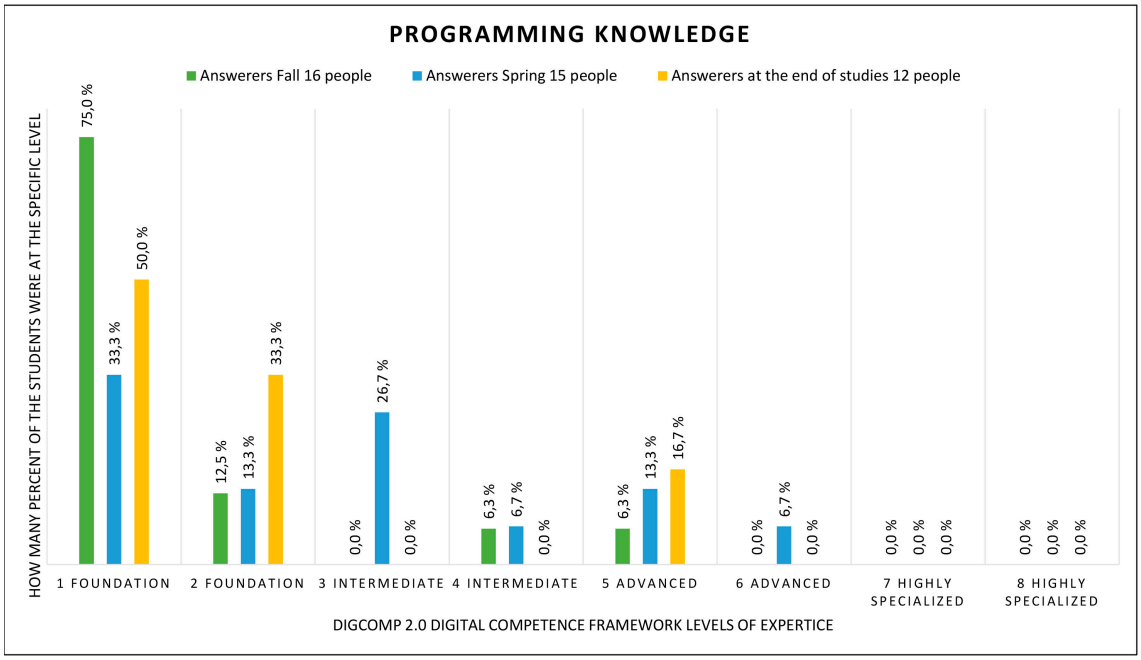

Figure 5.1: Programming knowledge compare Fall semester versus Spring semester

studies at Fall, the percentage was 18.8 percent. 25 percent of the students were at 7 Highly specialized level at the end of the study year. In the beginning, there were only 12.5 percent of the students. At highly specialized level students can resolve complex problems with limited solutions, integrate to contribute to the professional practice and to guide others. Percent of the levels seen in the Figure 5.2.

Project tools knowledge regarding students self-evaluation, seen in the Table 5.3. At the beginning of the Fall semester 18.8 percent of the students evaluated their skills to be 1 foundation as seen in the Figure 5.3, at the end of the studies' percentage was 0 percent. At the end of the studies, 25 percent of the students evaluated their skills to be at level 5 advanced. At the beginning of the studies, that percentage was also 25 percent. 33.3 percent of the students evaluated their skills to be at 6 advanced level at the end of the studies. At the beginning of studies, that percentage was 25 percent. 6 level means the ability to do most appropriate assignments, able to adapt others in a complex context and evaluating. 16.7 percent of the students evaluated their skills to be at 8 highly specialized level at the end

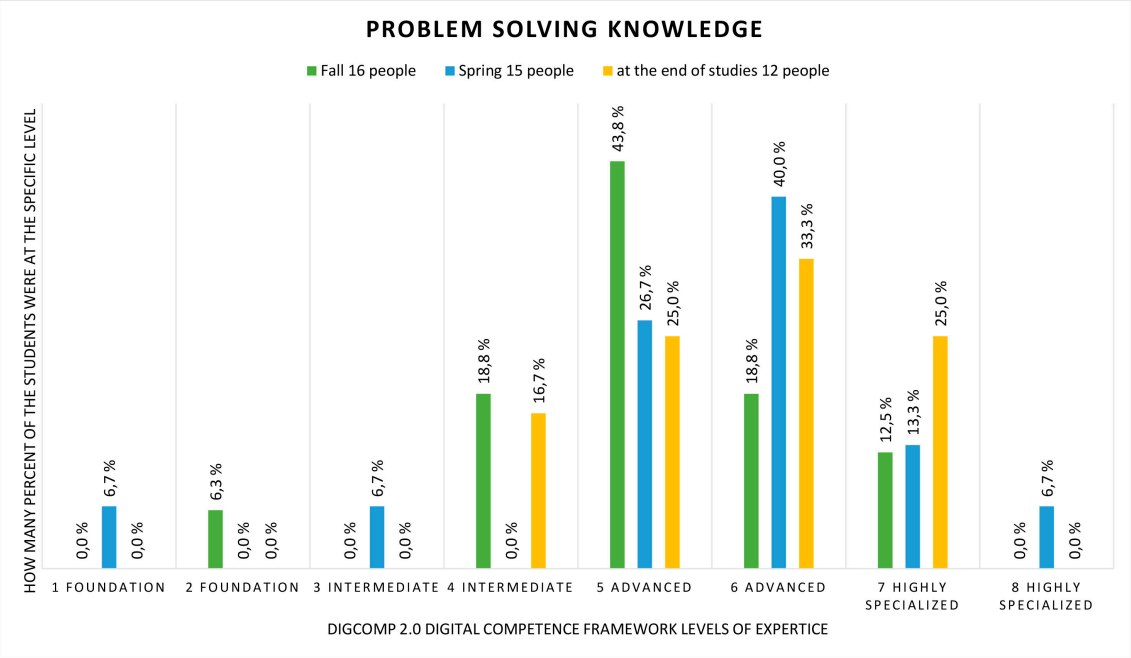

Figure 5.2: Problem solving knowledge compare Fall semester versus Spring semester

of the studies. At the beginning of the studies, that percentage was 12.5 percent. 8 highly specialized level, means resolving complex problems with many interacting factors, propose new ideas and processes to the field and creating.

At the beginning of the Fall semester 25 percent of the students' security knowledge was 3 intermediate level. At the end of the Spring semester, the percentage was 0 percent. At the beginning of the Fall semester 25 percent of the students were at 5 advanced level as seen in the Figure 5.4. At the end of the Spring semester, 25 percent of the students were at the same level. At the end of the studies, competence level for the most of the students were at 6 advanced level, 33.3 percent of the students. In advanced 6 level students can do most appropriate tasks, are able to adapt to others in a complex context and evaluating. 25 percent of the students were at the end of the studies at level 8 highly specialized.

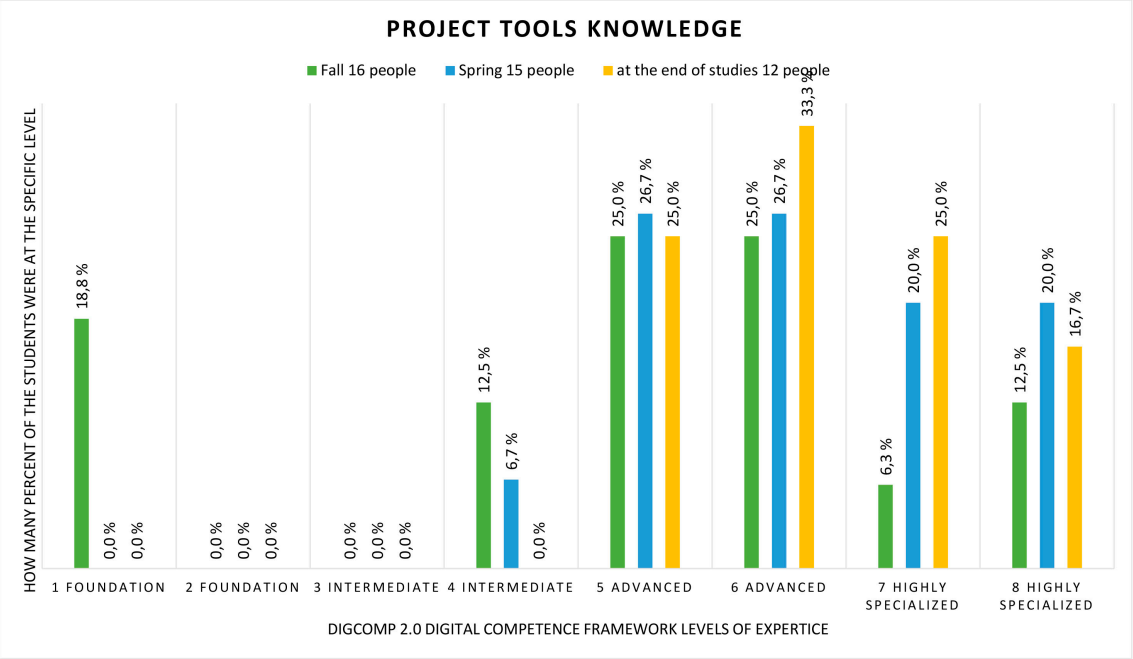

Figure 5.3: Project tools' knowledge compare Fall semester versus Spring semester

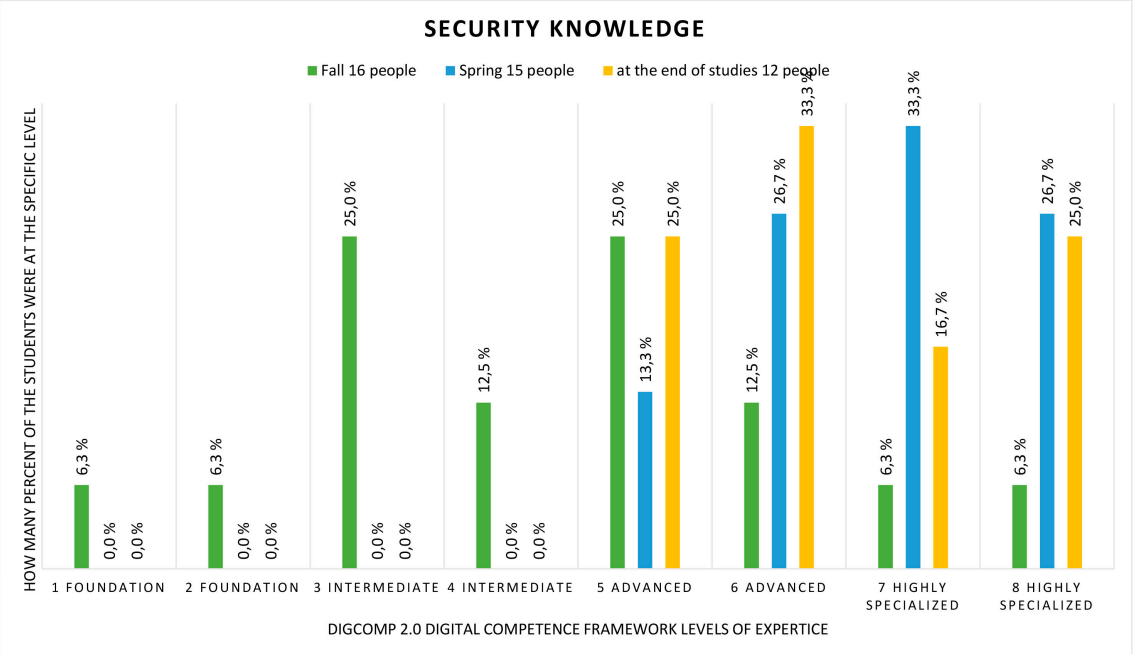

Figure 5.4: Security knowledge compare Fall semester versus Spring semester

6 Discussion

The goal of the research is to strengthen people's digital competence and to improve a new adult education college line of study, which provides a wide perspective in to improving people's digital skills.

The original curriculum, which was planned for the whole study year was improved during the study year. The original plan was that the courses at Fall semester would be the same at Spring semester, only more advanced content in the Spring than Fall semester. During teaching at Fall semester the curriculum had to be changed according to students' feedback and teachers' observations.

Software technology today is interested in large-scale software and yet the paradigm of software development has shifted to faster-producing software. Speed and lack of time have brought agile methods and web software design. Web Software Technology, studies how web applications should be developed, has also emerged from the roots of Software Technology. In the digital era, fundamental skills are web design or at least the ability to use publishing platforms. In the digital era and digitalized world everyone should master digital publishing platforms. Digital platforms are used in working life and in traditional business. Producing and editing information on appropriate platforms, understanding technology and digital tools are essential civic skills. Understanding the both human and technical aspects of privacy and data security, and use devices and programs safely belong also to the essential civic skills. Being able to interact and communicate through digital

technologies and to plan and develop instructions or to solve a problem or task are also essential civic skills. The new ways of working are web meetings and digital platforms, which enable working together in different locations and remote work.

In programming and problem solving courses were taught the basics. The goal is more in the students being able to perform solutions to everyday problems, not so much in large programming projects. At Adult education college, where students are updating their skills and learning more basic skills, the skill level does not have to be at the same level as in education where the goal is to graduate in to a profession.

6.1 Improving Digital Skills

In general the students are more successful in their digital skills after studying one study year the Digital Content Creation line of study, than before the studies. Students think that their digital skills have improved very much during the study year. Some students have updated their digital skills to the current skill level needed in the digital era. Students think that they have basic skills to cope in the digital world. Also, knowledge in naming their skills have improved. As seen in the Digital skills level evaluation tests students digital skills were improved, especially in project tools, security, problem solving and programming knowledge. Regarding students self-evaluation their skills have grown from the foundation and intermediate levels to advanced and highly specialized levels.

6.2 Improving Programming Skills

The conclusion of programming being one of the basic digital skills, required from all citizens, seems difficult to justify. When analysing the effectiveness of the teaching methods and the level of expertise in the programming courses of the curriculum, it seems that the level of expertise in the programming is the introductory level.

Teaching computer programming is a fast-changing area. A fundamental skill for everyone is computational thinking, which means creating solutions to problems by using computer techniques. [21]

The curriculum describes the practical implementation of the courses and the order in which the topics are tough. At first in teaching programming it is easy to begin with determining the background competence of the students and study basic digital skills, such as project work and basic computer skills. Learning to search and filter digital information in digital platforms. Information security and general issues related to digital security are basic skills, that prepare for working with computers and programming. First programming courses will began with programming and computer history and basic concepts. Introduction to computer languages, binary and ASCII code. With the help of visual programming platforms Scratch and Lego Mindstorm students are trained to develop instructions to the computer in a graphical programming environment. Focus is in imperative programming and teaching variables, different data types and routines. With Lego Mindstorm platform problem solving skills are improved with designing structures with visual programming platform and performing tasks with the robot. After these introductory courses it is easier to become familiar with programming languages and learn more about variables, loops, conditional statements, functions and events. Learning to program languages and their syntax. Writing first simple programs (Hello World). According to Liukas and Mykkänen [25] first steps learning to program are learning to give specific directions, visual programming, understanding the basics of programming languages, knowing how to interpret program code, programming languages and programming tools. Also, computational thinking, problem solving and creativity are mentioned in several sources. In a study of Teaching and learning strategies for programming and DigComp The Digital Competence Framework 2.0 creativity is mentioned [13]. In DigComp Creatively using digital technologies is in problem

solving competence area.

6.3 Answers to Research Questions

1. What is digital competence?

Digital competence is competence to cope in the digital era and in the digitalized world. Core practises in Computer Science Framework are fostering an inclusive computing culture, collaborating around computing, recognizing and defining computational problems, developing and using abstractions, creating computational artefacts and communicating about computing [19]. According to Itkonen, digitalization refers to the digital storage, transmission and processing of information in a computer-readable form [3]. The ability to use equipment safely, in digital technologies [14].

According to DigComp The Digital CompetenceFramework 2.0 for citizens from European Commission, the key components of digital competence are Information and data literacy, Communication and collaboration, Digital content creation, Safety and Problem solving. Being able to search and find digital data and storing, filtering and managing digital data. Using digital technologies in communication and collaboration. Be able to manage digital identity and interact through digital channels. Creating digital content, solving problems, creating and editing digital content in different formats, understanding the importance of security and privacy in digital environments. [13]

List of important skills conducted from the different lists of digital competence are device usage, information management, use of the Internet, information retrieval, e-mail, the basics of word processing, electronic services, social media, security basics, programming, producing digital content, ten finger system, the basics of presentation graphics, spreadsheet basics and Applications.

Digital competence doesn't signify only the use of devices, programs or services. It should be seen as a wider concept, which comprehends using information technology confidently and critically as an instrument in becoming employed, to learn, to self-educate and to participate in society. It covers all fields, communicating, studying, working and living in digitalized world.

a. What is digital competence in programming?

Digital competence in programming according to K-12 Computer Science Framework are learning variables, loops, conditional statements, functions and events [19]. According to Finnish grounds of Basic Education Curriculum 2014 [22] the basics of programming begins with step-by-step instructions, including testing. Encouraging the student to develop instructions to use in visual programming environment, design and execute programs in visual programming environment. The understanding about technology and digital tools is an essential civic skill. In Finnish grounds of Basic Adult Education Curriculum 2017 is mentioned practising programmed actions, such as automation and robotics [24]. Competence in programming is achieving a certain level of competence in programming knowledge and skills. Programming skills needed in achieving the basic level of knowledge in programming are programming vocabulary, computational thinking, user interfaces, problem solving, programming languages and tools.

b. What programming skills are needed in achieving certain levels of digital competence?

There are different levels of expertise in digital competence. In the DigComp Digital Competence Framework 2.0 has eight proficiency levels: 1-2 foundation, 3-4 intermediate, 5-6 advanced and 7-8 highly specialized user [13]. In DiKATA-project three levels are listed in digital skills, a novice user, end user and utility user [34].

In DigComp the levels complexity are simple task, simple task with guidance, well-defined and routine tasks, well-defined and non-routine tasks, different tasks and problems, most appropriate tasks, complex problems with limited solutions and complex problems with many interacting factors. Java, JavaScript and Scratch are according to TIOBE Programming Community index [27] among twenty the most popular programming languages in a year 2020. The index is a useful tool in making a decision in what programming languages to learn. Language concepts can be simulated to other languages, even though they are not directly supporting same constructs and features according to Sebesta [26]. Recommendation is to first learn one language, and then move on to other languages with the same concepts. Learning data types, operators, statements, functions, parameters, variables, expressions, inheritance and language features like object-oriented features are more professional level skills. Level of competence must meet the needs of the information society and the world of work [14]. In different professions different skills are needed and you can always proceed to the next level when needed.

2. How to strengthen peoples' digital competence?

Peoples' digital competence can be strengthened with actively updating digital skills at the same time as technology is developing. Learning new skills and updating learned knowledge to the present-day level will strengthen digital competence. Digital competence can be strengthened with the help of DigComp Digital Competence Framework 2.0, digital competence areas and competence. Computational thinking seems to play a central role in strengthening digital competence [25].

a. How to strengthen peoples' programming skills?

Programming seems to be unfamiliar subject to many people. The conclusion of programming being one of the basic digital skills, required from all citizens, seems

difficult to justify. To strengthen peoples' programming skills, the basics of problem solving and programming must be first introduced for people. In the Digital content creation line of study, programming skills were strengthened with providing Problem solving, Visual programming and Programming courses to students. In these courses, the students learned the basics in problem solving and programming and got better understanding and knowledge according to the subjects. Problem-solving, computational thinking and creativity can be improved with programming.

Good programmer features are desire and ability to learn new things, ambition, creativity and accuracy [25]. Also, computational thinking, problem solving and creativity are mentioned in several sources. Dedication and motivation are required in learning to program. Previous knowledge and skills effect on motivation, and insufficient background skills or lack of motivation might lead to failure [21].

b. How to teach programming in adult education digital competence curriculum?

In teaching programming we should start with teaching visual programming and move on to teaching imperative programming. Cover the basics of programming, such variables, different data types and routines. Next proceed to functions, object oriented programming, decentralized systems and user interfaces. According to Sebesta [26] learning the concepts of programming languages and features in one programming language can be used in other languages, even though they do not support such construct and features. According to Liukas and Mykkänen first steps in learning to program are to learn how to give specific directions, visual programming, understanding the basics of programming languages, knowing how to interpret program code, programming languages and programming tools [25].

According to interviews, the students think that their digital skills have improved very much during the study year. Students have gained good basics to

begin to learn more about programming. Knowledge in understanding the structure of programming and knowing what information to search has grown. Knowledge that it is important to keep learning through life. According to the Digital skills, level evaluation tests the students' digital skills were improved, especially in project tools, security, problem solving and programming knowledge competence. Students experienced beneficial to learn all the possibilities digital content creation has.

7 Conclusions

Research methods used are qualitative research and case study. Used research methods are the interviews, questionnaires and review of literature. In the case study students' were observed in the new Digital Content Creation line of study. Interviews and questionnaires were made to collect information from the students. In qualitative research students experience, phenomenon and social phenomenon are understood. With the questionnaires, students evaluated their digital skills in the beginning of the studies, in the middle of the study year and at the end of the studies. Case study was made when examining working in a classroom. Review of literature was made in researching digitalization and digital frameworks and competence in digitalization and programming. The goal of the Action research process was to improve the Digital Content Creation line of study curriculum and programming teaching.

In the interviews results that came up were that, the students think that their digital skills have improved very much during the study year. Students think that they have basic skills to cope in the digital world. Also, knowledge in naming their skills have improved. Knowledge in understanding the structure programming and knowing what information to search has grown. Knowledge that it is important to keep learning through life. According to the Digital skills, level evaluation tests the students' digital skills were improved, especially in project tools, security, problem solving and programming knowledge competence. Students experienced beneficial

to learn all the possibilities digital content creation has. Students have gained good basics to begin to learn more about programming.

In the background research, the term 'digitalization' was defined first, then digital skills needed in the digitalized era, and for last programming competence and teaching. Digital frameworks and programming frameworks, competence areas and competence were emphasized in the thesis.

According to the research and case study, civic skills in programming are understood technology, digital tools, privacy and security, communicating through digital technologies, problem solving, updating digital skills, computational thinking, searching and filtering digital information and giving specific instructions.

Professional skills are large programming projects, functions, object oriented programming, decentralized systems and user interfaces. Learning the concepts of programming languages and features in one programming language can be used in other languages. Learning data types, operators, statements, functions, parameters, variables, expressions, inheritance and language features like object-oriented features are more professional level skills. Fundamental skills are web design or at least the ability to use publishing platforms.

Skills that are in between professional skills the basic civic skills, are digital publishing platforms, giving specific instructions, visual programming, understanding the basics of programming languages, knowing how to interpret program code, programming languages and programming tools. Also, the basics of programming like variables, different data types and routines, programming vocabulary, user interfaces, programming languages and tools.

As a future development, better background competence questionnaires or competence profiles for students' could be planned. Background competence questionnaires will help in preventing students' failure in programming courses. To see the need for pre-programming courses to lower the risk to failure resulting from insuffi-

cient background knowledge. Recognizing in time the possible upcoming problems in students learning or motivation, would help to prevent failure. Students age, pre-university studies, and general knowledge of computer science and programming the affect to the students' motivation ability to learn to program. The students' competence profile in programming would reveal the level of knowledge in computational thinking, which has a strong influence on the success of programming courses.

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Appendix A Appendix

Digital skills

Content of the Digital skills course were to test students Digital skills, study Data literacy, Project work and learn the basics of Portfolio. At the beginning of the Fall semester, the student takes a test to determine one's starting level in digital skills. After completing the course, the student masters' the basic computer skills, has set personal goals for the development of digital skills that need more improving and knows the basics of project work and building a portfolio. After the course, the student masters all basic computer skills.

Data literacy 1

Data literacy 1 course covers information retrieval, information and data literacy, and writing techniques. After completing the course, the student knows how to search digital information and how to filter the retrieved information and is able to write clear and understandable text. The demonstration of learned skills is that the student writes a brief add text or desktop publishing text.

Information security

Information security course covers general security issues related to digital security. Students are exploring the Internet and exploring one's own digital identity. After completing the course, the student can use the computer safely, understand what

netiquette and digital identity signifies. The demonstration of learned skills is that the student gives a presentation related to information security and digitalization.

Copyright

Copyright course reviews a general overview of copyright and presents how to act in digital environment and with digital content. After completing the course, the student understands what copyright means and can apply it in practice. The student is able to find materials that can be used and modified freely (Creative Commons licences). The demonstration of learned skills is that the student gives a presentation to the subject of copyright.

Programming 1

Programming 1 course goes through what programming is and teaches the basics of imperative programming. Getting acquainted with history and basic programming concepts. After completing the course, the students understand the basics of programming and know the basic programming concepts in imperative programming. The student understands the basics of programming.

Programming 2

Programming 2 course covers computer language, binary and ASCII code. After completing the course, the student knows what binaries and the ASCII code are. The student understands what are binary and ASCII code and how to form them.

Visual programming 1

Visual programming 1 course covers various visual programming platforms and programming. Students perform visual programming tasks. After completing the course, the student learns more about programming and develops problem solving

capabilities in visual programming. The student is able to solve visual programming tasks.

Problem solving 1

Problem solving 1 course introduces you to the Lego Mindstorm platform and introduces you to programming through visual programming and construction. After completing the course, the student can perceive and design structures and make simple visual programming programs. The demonstration of learned skills is that the students build a Lego robot in project groups and write a program with the visual programming platform to perform a task with the robot.

Publishing platforms 1

Publishing platforms 1 course covers various publishing and blogging platforms. Students choose the right platform for their portfolio and get to know the platform. After completing the course, the student knows what publishing platforms exist and understand the purpose for which different publishing platforms can be used. The student knows what publishing platforms are and is able to choose a suitable publishing platform for one's portfolio.

Usability

The usability course introduces usability and user interfaces. After completing the course, the student understands the basics of user interfaces and usability. The student is able to evaluate the usability of the user interface and to make a design of a simple user interface considering usability from the customers' point of view.

Communication and collaboration 1

Communication and collaboration 1 course explores digital communication culture and different communication channels. After completing the course, the student understands what is meant by digital communication knows how to use various digital communication channels. The student understands the communication culture and is able to communicate on digital communication channels. Students write an assignment on digital communication.

Portfolio 1

Portfolio 1 course goes through constructing a work portfolio. Exploring different platforms and ways to make one's own portfolio. After completing the course, the student knows what a portfolio is and makes a plan and builds a digital portfolio such as an website.

Programming languages 1

Programming languages 1 teaches the basis of different programming languages and to code the first simple program (Hello World). After completing the course, the student knows what programming languages are and have become familiar with many languages and their syntax. The Student is able to write a simple program.

Safely using digital technologies

Safely using digital technologies course covers computer literacy, project work, security and copyright. After completing the course, the student knows how to use the computer well, project work practices, roles and responsibilities. Understand the importance of information security and copyright. The student is able to use the computer well and has a deep understanding about project work practices and understands the importance of information security and copyright.

Data literacy 2

Data literacy 2 course covers information retrieval, information and data literacy, and writing techniques. After completing the course, the student can search for information, filter the information they find and are able to write clear and understandable text. Students are able to write good text in their own portfolio and find freely available material.

Problem solving 2

Problem solving 2 course uses the Lego Mindstorm visual programming platform and construction. After completing the course, the student can perceive and design structures and program complex visual programming programs. The student builds a Lego robot and programs it to perform complex functions.

Visual programming 2

Visual programming 2 course teaches visual programming through assignments done in the visual programming platform. After completing the course, the student learns more about programming and develops problem solving capabilities in visual programming. The student is able to solve visual programming assignments.

Programming 3

Programming 3 course covers the most common programming languages and assignments are programming small programs. After completing the course, the student understands the basics of programming and can write simple programs in imperative programming.

Pop-Up seminar

Pop-Up seminar exhibition, lecture and workshop activities. The place changes every year. The aim is to learn how to work collaboratively in a project. Presence and active participation.

Portfolio 2

Portfolio 2 course introduces students to preliminary assignments and entrance examinations. Exercises and group work. Feedback and evaluation of the assignments prepare the students for the preliminary assignments and entrance examinations. The purpose of portfolio work is to compile your work of the study year into a portfolio. The focus of the course is on the student's own work while the teacher acts as a tutor. The aim is to prepare for the entrance examinations with the help of exercises and to make possible preliminary assignments. In Portfolio Work, the goal is to create and publish a professional portfolio on a platform of your choice. The student is able to make a professional portfolio.

Communication and collaboration 2

Communication and collaboration 2 course explores communication culture and communication channels. After completing the course, the student can use various digital communication channels, understands appropriate communication in different situations, knows what kind of digital content can be published on social media and services and is able to use media services for digital content production. The student understands communication culture and is able to communicate in various digital communication channels.

Project studies

Project studies content is defined individually per student. Opportunity to go for an internship or plan and execute individual project. Goals are set individually per student.

Media literacy 2

Media literacy 2 project is a magazine co-produced by Media and Art Students. The magazine is done as a group work, where the special expertise of the different study lines are highlighted. The goal is to learn editorial work. The aim is for the student to recognize the features of a good image reportage and to be able to implement one's own reportage. The aim of the course is also to familiarizing with layout work. Presence and active participation.