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Having an attitude toward technology

Rethinking PATT studies from a theoretical perspective to study students' attitudes toward technology

Johan Svenningsson

LINKÖPING UNIVERSITY

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Abstract

Attitudes are complex and consist of emotions, beliefs, and behavior. The overall aim of this thesis is to contribute to a theoretically anchored understanding of attitudes toward technology by exploring the three components of attitudes: affective, cognitive, and behavioral among 12-15-year-old students in Sweden.

This thesis includes three research papers (I, II, III) and one book chapter (Paper IV) that are based on data from two studies. Data (student interviews N=6 and survey N=173) from the first study was used in Papers I, II and IV, and data (student survey N=485) from the second study were used in Paper III.

In Paper I, an existing attitude survey (PATT) is validated for use in a Swedish context. In Paper II, an instrument to quantify students' perceptions of technology and technology education is developed This instrument is used to study the cognitive component of attitudes and is named the Mitcham Score. In Paper III, the methods developed in Paper I and II are used to study the relationships among the affective, cognitive, and behavioral components of attitudes. In Paper IV, students' perceptions of technology are discussed as a starting point for teachers, when planning and teaching technology.

The methods developed throughout the thesis prove useful to research the different components of attitudes. The Mitcham Score can give insights into students' perception of technology as well as be used as a construct of the cognitive component of attitudes. The PATT survey categories called Boredom and Interest measure students' feelings (affect), while the category called Career was seen as assessing the behavioral component. The affective component, Interest, was related to both the cognitive component and the behavioral component. A high Mitcham Score, or in other words a broad perception of technology, seems to be a key concept for girls to consider technological careers.

Keywords: Attitudes, Technology Education, PATT, Mitcham Score

Sammanfattning

Attityder är komplexa och kan påverkas av olika faktorer, såsom känslor, övertygelser och beteenden. Det övergripande syftet med denna avhandling är att bidra till en teoretiskt förankrad förståelse av attityder till teknik genom att utforska de tre komponenterna av attityder: affektiva, kognitiva och beteendemässiga, bland 12–15-åriga elever i Sverige.

Avhandlingen innehåller tre artiklar (Paper I, II, III) och ett bokkapitel (Paper IV) som är baserade på data från två studier. Data (elevintervjuer N=6 och enkät N=173) från den första studien användes i Paper I, II och IV, och data (elevenkät N=485) från den andra studien användes i Paper III.

I Paper I valideras en befintlig attitydenkät (PATT) för användning i en svensk kontext. I paper II utvecklas ett instrument för att kvantifiera elevers uppfattningar om teknik och teknikundervisning, detta instrument utvecklades för att kunna studera den kognitiva komponenten av attityder och kallas Mitcham Score. Paper III utgår från de metoder som utvecklats i Paper I och II för att studera sambanden mellan de affektiva, kognitiva och beteendemässiga komponenterna av attityder. I Studie IV diskuteras elevers uppfattningar om teknik som en utgångspunkt för lärare, för att planera och undervisa teknik.

De metoder som utvecklats i avhandlingen visar sig vara användbara för att undersöka de olika komponenterna av attityder. Mitcham Score kan ge insikter i elevernas uppfattning om teknik samt användas för att bedöma den kognitiva komponenten av attityder. Den använda PATT-enkätens kategorier som kallas Tråkighet och Intresse mäter tydligt elevernas affektiva komponent medan kategorin som kallas Karriärssträvan mäter den beteendemässiga komponenten. Den affektiva komponenten, Intresse, relaterade till både den kognitiva och den beteendemässiga komponenten. Mitcham Score, eller med andra ord hur bred elevers uppfattning om teknik är, verkar vara en nyckelfaktor för att flickor ska överväga en karriär inom teknik.

Nyckelord: Attityder, Teknikundervisning, PATT, Mitcham Score

Acknowledgments

This thesis has accompanied me for a long time. My attitude toward it has changed back and forth, from positive feelings, all the way to a giving-up attitude. Even though I have been close to giving up on writing, people surrounding me have often been more encouraging and have had stronger beliefs in finishing it than myself.

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Linköping 26 February 2024
Johan Svenningsson

List of Papers

I. Svenningsson, J., Hultén, M., & Hallström, J. (2018). Understanding attitude measurement: Exploring meaning and use of the PATT short questionnaire. *International Journal of Technology and Design Education, 28*, 67-83.

II. Svenningsson, J. (2020). The Mitcham Score: quantifying students' descriptions of technology. *International Journal of Technology and Design Education, 30*, 995-1014.

III. Svenningsson, J., Höst, G., Hultén, M., & Hallström, J. (2022). Students' attitudes toward technology: exploring the relationship among affective, cognitive and behavioral components of the attitude construct. *International Journal of Technology and Design Education, 32*, 1531-1551.

IV. Svenningsson, J. (2019). Carl Mitcham: Descriptions of technology. In *Reflections on technology for educational practitioners: Philosophers of Technology Inspiring Technology Education,* (pp. 13-24). Brill.

(Due to copyright regulations, in this thesis, Paper IV is published in an earlier manuscript version)

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Chapter 1

Introduction

Having an attitude can mean a variety of things, depending on who you ask and in what context. The term attitude is often used mechanistically. For example, saying, “Drop that attitude!” to a teenage daughter expresses that negative or grouchy behavior is undesirable, but the expression is very general. It would become more interesting to ask why or toward what that attitude is directed and possibly easier for the teenager to handle (the real-life daughter used in this example has grown from a child to a teenager during the writing of this thesis). Therefore, when researching attitudes, it is important to consider what the attitude is directed toward, in the case of this study toward technology.

Attitudes have been the object of research for a very long time (Aiken, 2002). Although attitudes have been defined in multiple ways historically, it has become common to see attitudes as composed of three components: affective, cognitive, and behavioral (Eagly & Chaiken, 1993). This is also the approach taken in this thesis. The affective component is a person’s positive or negative feelings or emotions toward an attitudinal object. The cognitive aspect has to do with a person’s beliefs, prior experience, or knowledge about an attitudinal object, while the behavioral aspect refers to a person’s actions or intention to act in a certain way in relation to that attitudinal object (Aiken, 2002).

To return to the example above: My teenage daughter has during the past few years been an active vegetarian. At first, I saw it as a typical teenage rebellion, based strictly on emotions - to be against meat. However, when I started asking questions about it, her motives were clearly not based only on emotions but also on knowledge. She explained that learning about the climate impacts of the meat industry, as well as the questionable ways in which the animals are treated, provided reasons for her action. It becomes clear that the cognitive component of attitudes coexists with the affective (like caring about the welfare of the animals), which in this case leads to a behavior.

In a technology education context, knowing about students’ affective and cognitive attitudes can facilitate teachers’ understanding of students’

behavior, and lead to more effective teaching (Ankiewicz, 2018). Many countries aim to foster future engineers and employees for technology-related jobs through compulsory technology education. Attitudes toward technology play an important role in students' career choices (Ardies, et al., 2013). Those who do not want to work in technology-intensive jobs still must be able to participate as a democratic citizen, by making choices based on knowledge in and about technology. To enable this, it is important that schools provide opportunities for students to gain knowledge about technology and how to use it.

Attitudes are an integral part of the technology subject in the Swedish national curriculum and have been for many decades (Skolverket, 2022; 2011; 1996). In 2011, the Swedish school inspectorate investigated students' attitudes toward technology. The results showed a decrease in perceived interest in technology throughout school years 5 to 9 (ages 11-15), and more so among girls than boys (Skolinspektionen, 2014). In a Belgian study, similar results were presented over a two-year period (Ardies et al., 2014).

Attitude studies were in a way a starting point for technology education research, following the emergence of technology education as a school subject. In the mid-1980s the Pupils' Attitudes Toward Technology (PATT) questionnaire was developed in the Netherlands (PATT-NL) by Raat and de Vries (1986). The first PATT studies aimed to investigate secondary school students' attitudes and their concepts of technology, to develop technology education as a school subject (de Klerk Wolters, 1989). The original PATT-NL questionnaire was used in several other countries, (e.g., in Sweden by Riis & Augustsson, 1991). The questionnaire, mainly used in Europe, was further developed for the USA (Bame & Dugger, 1989), PATT-USA. The PATT-USA questionnaire was later used by Ardies et al. (2013) as a basis to develop a shorter questionnaire, named the Pupils' Attitudes Toward Technology-Short Questionnaire (PATT-SQ). It is important to stress that although the initial PATT-NL was based on traditional attitude theory, in the various later iterations of the PATT surveys the notion of attitude theory has vanished, placing a stronger focus on a more general conception of attitudes in relation to the development of technology education. Thus, the types of questions that have been posed have changed gradually,

although anchored in more loose attitude constructs (Ankiewicz, 2018; Ardies, et al., 2013). However, improving the theoretical foundation of surveys on attitudes toward technology could lead to a better understanding of students' attitudes, something that this thesis intends to contribute to.

Aim and Research Questions

The overall aim of this thesis is to contribute to a theoretically anchored understanding of attitudes toward technology by exploring the three components of attitudes: affective, cognitive, and behavioral among 12-15-year-old students in Sweden.

The research questions for this thesis are:

- How can PATT-SQ be better developed and adapted to research the affective and behavioral components of attitudes? (Papers I and III)
- How can students' perception of technology be better studied and developed as a cognitive component of attitudes? (Papers II and IV)
- What is the nature of, and what are the relationships between the cognitive, affective, and behavioral components of attitude, and how do they contribute to a better understanding of students' attitudes toward technology? (Paper III)

Disposition of the thesis

This thesis is based on four papers, three peer-reviewed articles published in a top-tier journal in the field with an impact factor of 2,177 in 2022, and one peer-reviewed book chapter by invitation, that together lead toward a model to examine and study attitudes.

The papers in this thesis deal with the different components of attitudes (affective, cognitive, and behavior), see Fig. 1. Throughout the thesis, the three components of attitudes are used and discussed as separate components, and in paper III all three components are surveyed and the relations between them are analyzed.

In the theoretical framework, the three attitudinal components are further explained together with a model of how technology can be

manifested. This model is further on used as an analysis method to extract students' perceptions of technology, which is used to demonstrate the cognitive component.

In the methods section, the instruments used to extract students' affect, cognition, and behavior toward technology are presented together with the methods used for analysis.

The method section is followed by a summary of the included papers, that are used to discuss the research questions.

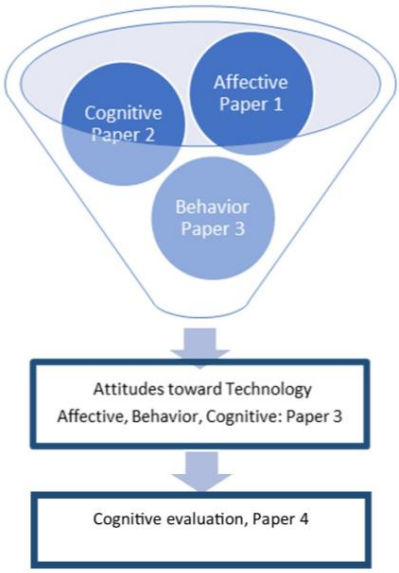

Fig 1. Illustration of how the included papers explore the respective attitude components and how they lead toward researching the three components of attitudes in paper III and a cognitive approach for teaching evaluating technology education in paper IV.

Chapter 2

Background and Previous Research

In this chapter, I will discuss the concept of technology and the context of Swedish technology education followed by a review of relevant research on how attitudes toward technology have been studied.

The Concept of Technology

As this is a study of students' attitudes toward technology, a thorough review of what is meant by technology is needed. The philosophical research community has struggled to reach a consensus on a definition of technology (Dusek, 2006). Schatzberg (2018) explains that during the three-thousand-year evolution of the concept of technology, tensions have frequently arisen between different definitions due to social differences between learned scholars and "lowly" technicians. As a result, today three principal meanings of technology have crystallized: technology as the industrial arts, which relates to the designed world; technology as applied science; and technology as technique.

In the history and philosophy of technology, it is mainly the first meaning that has gained prominence. Traditionally there are two branches of the philosophy of technology: engineering philosophy of technology and humanities philosophy of technology (Mitcham, 1985). Mitcham (1994) presents a framework of technology that bridges the gap between the two branches, combining the engineering aspect and the human aspect. This framework will be used throughout this thesis.

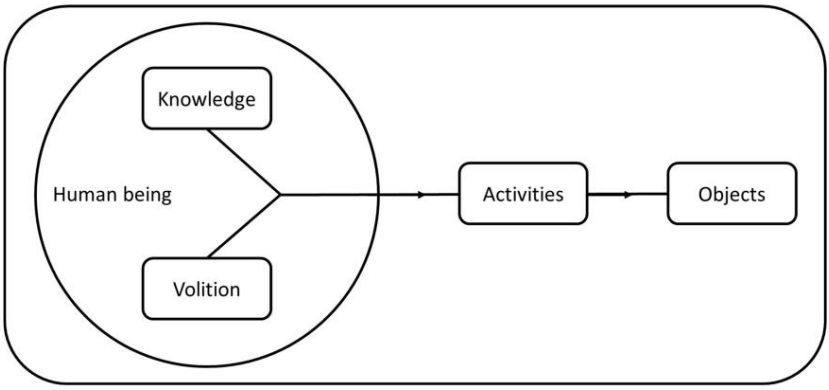

Fig 2. The four manifested modes of technology, adapted from Mitcham (1994 p. 160)

In Mitcham's (1994) model, technology is defined as technological *knowledge* and *volition* within human beings, leading to the development, creation, and use (*activities*) of technological *objects* (see Fig. 2). In the following I will elaborate on this definition.

We can start by considering technology as hardware or *artifacts (technological objects)*. Dusek (2006) discusses technology as hardware that is used as technology by humans, thus arguing that an abandoned tractor sitting deep in the forest is not technology since it does not function as technology. A technological object thus must be *used, repaired,* or *maintained* or be a part of a *technological system* to be accounted for as technology. Artifacts can also be seen as digital ones (Hallström, 2024) that must be used, repaired, and maintained. These types of actions, involving technological objects, are referred to as *technological activities* (Mitcham, 1994). Further, to use technology there must be some *technological knowledge* involved, for instance how the artifact is used or produced. Mitcham (1994) contrasts technological knowledge (of technological objects or artifacts) with knowledge of nature (of natural objects). Traditionally in philosophy, knowledge is defined as justified true beliefs (de Vries, 2016; Mitcham, 1994). True beliefs are however not always as applicable when it comes to technological knowledge. Instead, technological knowledge can be seen as more normative in character. A technological object or a specific

material for instance is considered as being good or bad to use for a specific task (de Vries, 2016).

Many definitions of technological knowledge rely on Ryle's (1945) concepts of knowing how and knowing that. Knowing how is often referred to as tacit knowledge, or simply how something is done (Norström, 2014). Knowing that, meanwhile, refers to theoretical knowledge that may be based on literature. Mitcham (1994) describes technological knowledge in terms of *sensorimotor skills*, *technical maxims*, *descriptive laws,* and *technological theories*. Sensorimotor skills are similar to traditional know-how and are acquired through a trial-and-error process or master-apprentice learning. In everyday language, we might call this, skills. Technical maxims can be for example recipes or instructions for how to perform a certain task. Descriptive laws are akin to scientific laws and can be a series of tests leading to applicable generalizations when for instance building a bridge. Technological theories are closely linked to applied science and are based on all the above knowledge types, but they can be formulated as technological theories.

As mentioned above, technological objects require a user in order to be seen as technology at all. The user possesses certain knowledge about how to use the technological object but might also decline to do so. Therefore, in order for technology to be used (manufactured, maintained, or repaired) there is a fourth aspect in need of consideration. Mitcham (1994) calls this fourth aspect *volition*. This aspect combined with knowledge comprises the human aspect of technology. Volition could mean our will to produce, maintain, repair, or use (activity) an object.

Mitcham's model applies to the everyday user of technology, as well as to an engineer developing new products, and will serve as the definition of technology throughout this thesis.

The Swedish Concept of Teknik

In the Swedish language, *teknik* is normally used as a translation of the English word technology (for a more comprehensive survey of the etymology of *teknik* see Hultén, 2013a). However, *teknik* also has another meaning, which is closer to the English word *technique* or *skill*,

to which it is also etymologically related (Schatzberg, 2018). When studying Swedish students' perceptions of technology, this other meaning can create confusion for students. For example, a student could see *teknik* as something that has to do with soccer i.e. techniques or skills used when playing soccer. Thus, when studying students' perceptions of technology, it is important that they understand the meaning of the word. That said, the concept of skill is somewhat related to what Mitcham (1994) calls activity (see Fig. 2). However, there are important differences. Take the activity of soccer, for example. Soccer clearly requires knowledge of how to play and also the will to play (volition). Playing soccer is also an activity that involves engagement with an object. However, the will in this case is not to be considered comparable to the will in the Mitcham sense of the concept, because the use of the ball does not engage technological problem-solving. Challenges related to language have also been noted in other countries, such as South Africa (Van Rensburg et al., 1999).

To conclude, surveying students' attitudes toward technology can pose challenges depending on the language used in the survey, and this is important to bear in mind when designing a survey and evaluating its results. Another contextual factor to be aware of is whether and how children are taught technology in school. This will be discussed in the next section.

Technology Education in Sweden

Technology is part of the curriculum in many countries (Nordlöf et al., 2022; Jones, 2009; de Vries & Mottier, 2006). However, it is taught in slightly different ways across the world. One major difference is between countries that teach technology as a separate subject, such as Sweden, and those that teach it as part of science, such as South Africa (Ankiewicz, 2021); as a topic within several school subjects (e.g. Arts and crafts, Science, Mathematics) like Norway (Bungum, 2006); or as part of the subject of crafts (separate from art), as in Finland (Autio et al., 2015; Metsärinne & Kallio, 2015). The way technology is taught will of course influence how students perceive technology, and therefore Swedish compulsory (primary and lower secondary school) technology will be described.

Technology as a school subject is relatively young when compared with many other school subjects in Sweden (Hultén, 2013a; Lövheim 2010; Elgström & Riis, 1990). Nonetheless, technological content has been part of the curriculum since at least the 19th century, although initially as part of other subjects such as science (Hultén, 2013b). In Sweden, technology as a school subject was born out of the great reformation of the primary and secondary school system in the post-World War II period (Hultén, 2013a). As secondary education was extended, the need to reorganize secondary education became apparent, especially in relation to the practical and vocational subjects which were highly specialized at that time. In the process of transforming this field into one of general importance for children, the concept of technology was important, and in the 1960s, the idea of a general technology subject, relevant to all children, was born (Hultén, 2013a). At first, it was not deemed important enough to be compulsory, but politicians later argued that all children should receive technology education (Lövheim, 2013), and in 1980 it became compulsory as part of the new curriculum. However, at the same time, it lost its status as a single subject, as it had been taught in the previous curriculum, and was integrated into science, where technology was supposed to enhance the practical relevance of science (Elgström & Riis, 1990).

A decade later when the curriculum was revised again, Technology again became a subject in its own right, separate from the science subjects (Carlgren, 2013; Lövheim, 2013). This presented an opportunity to redefine the subject of technology and clarify that technology was not merely applied science, to anchor the subject in "an epistemology of one's own" (Lövheim, 2010, p. 535). The relationship between technology, humans, and nature became more visible (Lövheim, 2013). The result was the technology syllabus of 1994 (Skolverket, 1996). Even though the science subjects and technology have their separate syllabuses the four school subjects (Biology, Chemistry, Physics, and Technology) shared their dedicated teaching hours – 800 hours shared between the subjects throughout compulsory school (Bjurulf, 2011). Since 2018, 200 teaching hours have been dedicated to Technology. The establishment of a school subject dedicated to general knowledge of technology can also be seen in several other countries as well (Jones et al., 2013).

The above review shows that despite being relatively young, technology has been a school subject in its own right for several decades now. Although what is taught in the classroom, is not always the same as specified in the curriculum (Dow, 2006; Hagberg & Hultén, 2005) some form of technology has been taught in Swedish compulsory schools for a long time, which most likely has had some effect on students' attitudes toward technology.

Surveys to Measure Student's Attitudes Toward Technology

The survey of *pupils' attitudes toward technology* (PATT) has a long history in technology education research. The first version, PATT-Netherlands (PATT-NL), was developed by Raat and de Vries (1986) in the 1980s. They intended to explore students' (ages 13-15) attitudes toward and perceptions of technology when entering technology education (Kőycű & De Vries, 2016). In the PATT-NL questionnaire, students' attitudes toward the technological field are surveyed from a range of perspectives, such as their career aspirations in technology, and interest in technology and technology education. In 1986, the first PATT workshop was held in Eindhoven, gathering participants from all over the world to discuss the first results from the pilot studies regarding pupils' attitudes toward technology. In the report from the workshop, one learns for example students thought that skills from technology education "will also come in handy when you design and make a bookshelf at home, when you are repairing your bike or moped, or a piece of electrical equipment or a leaking tap at home" (Raat, 1986, pp. 9-10). Of course, a lot has changed since then.

The example of making your bookshelf may seem outdated, but it is interesting to consider the context in which the PATT-NL questionnaire was developed – the 1980s. One must remember that during this time, technology, as a school subject was uncommon or in its infancy in many countries. The items in the PATT-NL questionnaire were extracted from interviews and open-ended questions answered by students (de Klerk Wolters, 1989). The items were created to be timeless (Ardies, 2015), and in a way they are, there is no specific technology mentioned that can be placed in a certain time period. In another way, the manner in which

some questions are posed might be seen as outdated, which I will come back to when describing my study.

In the 1990s the PATT-NL was revalidated and modified in the USA (Ankiewicz, 2019a) to produce the PATT-USA. This led to a shorter questionnaire, compressed into one double-sided paper, and with updated survey items.

The PATT-USA survey was also further developed into questionnaires suitable for children aged 12 and younger, PATT-ELEM (for elementary school) by Holter (2016). A similar instrument was also developed by Papadopoulos (2021) called PATT-G4, focusing on fourth-graders in the USA.

The survey used in the USA (PATT-USA) was reused and updated in Belgium (by Ardies, et al., 2013) and in Oman (by Candela et al., 2021). In the Omani context, the questionnaire was validated and translated into Arabic, but one of their conclusions was that the questions were too many. In Belgium, the full survey was shortened but still contains the same attitudinal factors to be studied (Ardies, et al., 2013). This shortened questionnaire (PATT-SQ) contains 24 attitudinal items.

As stated in the introduction, PATT surveys are based on the idea of attitudes as a construct, but there is a lack of connection to theory when analyzing and discussing results. How the attitude construct has been conceived of, has been more or less from one PATT survey to another. The PATT survey is often discussed as measuring students' attitudes toward technology, even though it is only the affective component that is in clear focus (see Ankiewicz 2019b). However, the construct used in this thesis can be used to describe the items of previous studies.

The traditional PATT-questionnaires consist of a main section that aims to investigate the affective component of attitudes (Tzeng & Yu, 2023; Ankiewicz 2019a; Ardies et al., 2013). The questionnaire, traditionally, also has a part concerned with the cognitive component of attitudes, consisting of a so-called concept scale, where respondents are presented with a list of items and asked to choose which are technology and which are not (dichotomous). Finally, also relating to the cognitive component, both PATT-NL and PATT-USA have an essay part, where respondents are asked to describe what they think technology is in writing, or for younger students (ages 10-12) in drawings (Ankiewicz,

2018). The essay-part and the concept scale were not included in the PATT-SQ questionnaire. A recently published systematic review of research on attitudes toward technology (23 articles) concluded that the cognitive and behavioral components need more exploration and proposed to also research environmental effects (e.g., how education is delivered in the classroom) (Tzeng & Yu, 2023). I will discuss the cognitive part of the PATT-questionnaires more thoroughly in a later section.

Results from Attitudes Toward Technology Surveys

The first results from studies based on the PATT-NL questionnaire showed, for example, that girls found technology less interesting and less important than boys did (Boser et al., 1998). Using PATT-SQ, Ardies et al. (2015) researched the factors influencing students' interest and career ambitions regarding technology. To have a positive attitude toward a career in technology, you should, for instance, be a boy, have technical toys at home, have a father who works with technology, and have a mother who does. For a higher interest in technology, a student should be a boy, and again have a father who works with technology and a mother who does not. This shows that gender-related aspects correlate to students' attitudes in several ways, both the gender of the student and the occupation of their mothers and fathers. Ardies' (2015) PATT-SQ studies used the assumption of equal understanding and perception of technology among boys and girls, which means that all students were studied equally.

Regarding differences in attitudes depending on age, attitude studies show that younger students generally have more positive attitudes toward technology than older students (Ardies et al., 2014; Papadopoulos, 2021; Purković et al., 2021; Skolinspektionen, 2014;).

The character of technology instruction can also affect attitudes. Ardies et al. (2014) showed positive effects on students' interest in technology with increased hands-on activities in technology classrooms, especially for boys. These results were further strengthened by a later study by Ardies et al. (2015) which also concluded that investigative work in technology classrooms had a positive effect on students' career aspirations (for boys and girls). In a study with 10–12-year-old students,

the effects of an intervention were measured using PATT-SQ as pre- and post-tests (before intervention, directly after intervention, and 21 days after intervention). The intervention was a visit to a high-tech truck where students experienced "diverse interactions with high-tech material and exhibits, focusing on how technology can contribute to solving problems in industry and society" (Boeve-de Pauw et al., 2022., p. 825). Results from that study showed an increase in positive attitudes toward technology among participating students directly after the intervention. Three weeks later the positive attitudes had decreased but were still more positive than in the pre-test (Boeve-de Pauw et al., 2022).

Autio et al. (2015) used parts of the PATT-NL questionnaire to compare students' attitudes toward technology in different countries (Finland, Estonia, and Iceland). They concluded that Icelandic girls and boys have more equally comparable attitudes toward technology than the students in the compared countries. In general, boys were more interested in technology and technological careers than girls in all the countries studied. In all three countries, students generally showed no difference in technological understanding based on gender and saw technology as a phenomenon for both boys and girls.

Students' Perceptions of Technology

Students' perceptions of technology can be seen as a part of the cognitive component of attitudes (de Klerk Wolters, 1989) and thereby a possibly important part of students' attitudes toward technology. For instance, PATT studies in England revealed that students found it difficult to complete the PATT questionnaire since they felt they had no clear perception of technology (Orgee, 1986). Students' perceptions of technology have been studied both through PATT studies and as individual studies. Perceptions of technology have mainly been studied through quantifiable questionnaires, but also through more open written responses, by drawings or picture support, and via interviews.

Luckay and Collier-Reed (2014) have pointed to difficulties in surveying and quantifying students' technological literacy, a difficulty that is transferrable when focusing on students' perceptions of technology. The different PATT surveys have often included a concept

scale to determine students' perceptions of technology (Ankiewicz, 2019a).

However, these concept scales have been difficult to interpret for students as well as to analyze by researchers. One explanation for this is that the scale derives from an expert perspective (Luckay & Collier-Reed, 2014). Another approach to investigating students' perception of technology in PATT questionnaires has been the inclusion of an essay-type question (Ankiewicz, 2019a; Bame & Dugger, 1989). There are some minor variations between studies, but it usually consists of a question such as: "What, in your opinion, is technology?" (e.g. DiGironimo, 2011, p. 1344). In some PATT-studies, the essay-type question has been analyzed according to predefined themes (e.g. (Dudziak & Szydlowski, 1987) or more empirical-driven themes (e.g., Rennie & Jarvis, 1995).

Rennie and Jarvis (1995) also presented a way to quantify students' answers by scoring the responses according to the number of themes included in the essay answer (0-3 points) indicating the breadth of a student's understanding of the concept of technology. There has been no single standard way to analyze the broadness of students' descriptions of technology, but *products* or *objects* are reoccurring and commonly used as themes in such analyses (e.g., Burns, 1992; DiGironimo, 2011; Dudziak & Szydlowski, 1987; Liou, 2015; Rennie, 1987; Rennie & Jarvis, 1995). Another commonly occurring theme is process-oriented technology (e.g., Burns, 1992; Dudziak & Szydlowski, 1987; Rennie, 1987; Rennie & Jarvis, 1995). In some studies, the historical role of technology has been used as a theme (e.g., DiGironimo, 2011; Liou, 2015; Rennie & Jarvis, 1995) and sometimes technology as science-based (e.g., Liou, 2015; Rennie & Jarvis, 1995). In some studies, human being is present as a theme, for example, technology as learning, affective, or its harms and benefits (e.g., Burns, 1992; DiGironimo, 2011; Rennie & Jarvis, 1995).

In the first Swedish PATT (Riis & Augustsson, 1991), the original PATT constructs of attitudes (career, interest, etc.) were elaborated into two other concepts from a selection of items in the survey. These two concepts were a concrete and an abstract view of technology. A concrete view was narrow and artifact-focused, while the abstract view went beyond the artifact and placed technology in a wider context.

A similar approach was taken by Papadopoulos (2021) in using PATT-G4 to analyze students' descriptions of technology, which were categorized as abstract, concrete, and/or conceptual.

Another approach used specifically with younger students (aged 9-12) is to use interviews with picture support to reveal perceptions of technology, as in Su and Ding (2022) and Solomonidou and Tassios (2007). Both of these studies used a phenomenographic approach to analyze the interviews inductively to create themes from students' answers. Lind et al. (2023) studied perceptions of technology among even younger students (aged 8) through a series of classroom activities. They used a deductive approach to analyze these activities using Mitcham's (1994) model of technology as technological objects, activities, knowledge, and volition. A similar deductive approach was taken by Blom and Abrie (2021) where Mitcham's four manifestations were used to analyze data from students' written descriptions of technology, using the Mitcham Score (Svenningsson, 2020).

Results from Students' Perceptions of Technology

The Swedish PATT study concluded that the major factor influencing the more desirable abstract, broader view of technology was socioeconomic background. In other words, the responses of students with a higher socioeconomic status reflected a more complex and abstract view of technology (Riis & Augustsson, 1991). An analysis of PATT essay answers from students in South Wales students found that girls tended to have a less broad definition of technology than boys did (Hendley et al.,1996). Studies show that students often describe technology as technological objects, and more specifically as modern electrical objects (de Vries, 2006; Garmire & Pearson, 2006; Järvinen & Rasinen, 2015; Kőycű & de Vries, 2016; Riis & Augustsson, 1991).

Even though studies suggest that most students have quite a narrow conception of technology, there are exceptions. Using Mitcham's (1994) model Lind et al. (2023) revealed that younger students were able to develop and broaden their perception of technology during four different classroom activities where discussions were encouraged.

Understanding Attitudes in Technology

As stated earlier, the tradition of surveying students' attitudes toward technology has for the most part not been anchored explicitly in attitude theory. As also stated earlier, the most frequently used and established instruments, the PATT questionnaires, have had their focus on the affective part. As a result, research into attitudes toward technology has focused on students' affect (positive or negative feelings) toward technology based on gender, age, other background variables, and changes in attitudes. Studying several attitudinal components lets us further understand attitudes toward technology and theorize how these relate to behavior.

There are a couple of studies that discern and study the affective, cognitive, and behavioral components of attitudes. In a Finnish study, an alternative questionnaire to PATT was developed to survey: "(1) pupils' knowledge about technology, (2) pupils' attitudes toward technology, and (3) pupils' activity know-how of technology", (Järvinen & Rasinen, 2015, p. 67). Even though their survey covers all three components of attitudes, they did not anchor the survey in attitude theory, and they did not perform any correlation studies on the relationship between the different components.

Approaching a more theoretically grounded study of students' attitudes toward technology, Rupnik and Avsec (2019) used technological literacy theory to develop a questionnaire that they implemented together with the PATT-SQ on Slovenian students (aged 11-14) – thus having them answer two questionnaires. They found a significant negative relationship between career aspirations in technology and technological literacy, where students pursuing a technological career were less capable in the technological literacy part of the questionnaire. On the other hand, interest had a positive relationship with technological literacy. They also found a significant relationship between students' boredom with technology and their technological literacy (bored students were less technologically literate).

On a theoretical level, based on previous attitude studies, Ankiewicz (2019b) noticed a highly relevant resemblance between Mitcham's (in Fig. 2) philosophical framework and the three-component model of attitudes where the affective, cognitive, and behavioral component

correspond to volition, knowledge, and activities respectively. Ankiewicz (2019b) created a superimposition of the two models and analyzed different instruments used to study attitude according to the superimposition. A conclusion from the study was that attitudes were researched based on one, two, or three components of attitudes, but they did not investigate the relationship between the different components.

Summary

In conclusion from the topics presented above, a few patterns are observable in previous research. Surveys used to study attitudes toward technology, for instance, have evolved over the years from a lengthy questionnaire to a shortened and simplified version. The affective component has been the dominant component of the questionnaire. Although surveys have sometimes included a cognitive element, this has changed over time and there appears to be no established format. Also, the PATT surveys have neglected the behavioral component (Ankiewicz, 2019a). Finally, the research has often lacked attempts to theoretically anchor the PATT questionnaires to attitude theory (cf. Potvin & Hasni, 2014). The superimposition of Mitcham's (1994) framework and the three components of attitudes, thereby connecting attitude theory with results, facilitate ways to discuss, understand, and analyze students' attitudes toward technology.

The results concerning students' attitudes and perceptions regarding technology tell us that gender has been and still is an influencing factor, with boys generally having more positive attitudes toward technology. Generally, studies also show a decrease in interest and positive attitudes over time through compulsory school (younger students being more positive than older students). Also, there are reasons to believe that there are still gender biases in the way the questions are posed in the PATT questionnaires. Ardies (2015) is clear about using the assumption of equal understanding and perception of technology for boys and girls, which means that all students are studied as equal and compared as equal. This commonly analyzed gender comparison of students' attitudes and interests is in need of further understanding.

Chapter 3

Theoretical Framework

In this chapter, the theoretical approach for the thesis will be presented and discussed. The theoretical framework has three components. The first is attitude theory, which will be presented first in this section. Secondly, as this study is concerned with attitudes toward technology, a theoretical framework for the concept of technology is needed, which will be based on Mitcham's (1994) framework, described earlier in this thesis. Lastly, a composite framework, merging the two previously mentioned, is presented. The composite framework has been developed by Ankiewicz (2019b) and enables a more elaborate analysis of students' attitudes toward technology and can also be used to anchor the PATT questionnaire in attitude theory.

Attitudes

An attitude is an evaluation of a psychological object, represented in dimensions such as good versus bad, pleasant versus unpleasant, or likable versus dislikeable (Ajzen 2001; Eagly & Chaiken, 1993). Attitudes can traditionally be seen as having three components: *affective*, *cognitive,* and *behavioral* (Ankiewicz, 2018; Eagly & Chaiken, 1993) also called the *tripartite model* (Breckler, 1984) or *Traditional approach* (Ankiewicz, 2018). The affective component is a person's feelings or emotions toward an object. The cognitive aspect has to do with a person's conception, belief, prior experience, or knowledge about an object. Finally, the behavioral aspect constitutes a person's actions or intention to act in a certain way in relation to an object (Aiken, 2002). This traditional approach has been used in research on attitudes toward technology (Ankiewicz, 2018).

Even though it is commonly accepted as an attitudinal model, the focus in attitudinal research is and has been on the affective component (Breckler, 1984), and this includes research on attitudes toward technology (Ankiewicz, 2018). The tripartite model has been tested for other attitude objects, with mixed empirical support; therefore, the

model needs testing in a technology context. Breckler (1984) concludes that all three components can be distinguishable through research and notes the importance of addressing attitudes as comprised of all three components. By researching all components one can also distinguish relationships among them (Breckler, 1984).

However, attitude theories are normally not only theories about what an attitude is but also how it relates to human behavior and the choices we make (Aiken, 2002). An attitude toward, for example, a topic (like technology) is based on a person's beliefs and feelings about that topic, and those influence their behavior. A person's beliefs and feelings can, on the other hand, be weakened or strengthened and even replaced, which can lead to a change in attitude (Fishbein & Ajzen, 1975). When an attitude toward a new object is formed, it happens automatically, when we learn how this new object is associated with other known attitudinal objects (which we already have an attitude toward it).

The theory of planned behavior (TPB) (Ajzen & Fishbein, 1980) is applicable when trying to predict and study behavior, which is often the case in attitude studies. TBP proposes that cognitive and affective components of attitudes partly determine behavioral intention. Behavioral intention is seen as an immediate motivational factor for behavior itself. Behavioral intention is viewed as an outcome of affect and cognition. The stronger the (behavioral) intention is, the more likely a person is to behave according to it (Fishbein & Ajzen, 2010). The importance of these three sub-concepts for predicting and influencing behavior differs between populations and objects of interest. If we assume that two persons have the same positive feelings and beliefs toward an object, then we still do not know if they will carry out the same behavior, since individual factors such as actual control may differ between individuals. For instance, if you intend to become a pro athlete but lack the necessary skills or financial resources (Fishbein & Ajzen, 2010), then your actual control is affected which in turn affects behavior. Behavior itself is difficult to predict from surveys or interviews, mainly because of the actual control factor. Therefore, the approach used to study behavior in this thesis is focused on intention toward a behavior (*behavioral intention*).

Merging the Concept of Technology with Attitudes

Technology is a broad concept, and different students associate the word with different things. These associated things (for example, computers, mobile phones, etc.) can be seen as different stimuli for a concept (Fishbein & Ajzen, 1975). When lacking knowledge about a new concept (such as technology), we associate this new concept with our existing attitudes toward similar concepts (perhaps science, or commercials where technology is mentioned). However, the stimuli for different concepts can be replaced upon learning more about the concept and lead to a change in attitude.

As stated earlier, Mitcham's (1994) framework for technological knowledge is used in this thesis (see Fig. 2).

In this thesis, the intention is to integrate the theory of attitudes with the philosophy of technology. Ankiewicz (2019b) presents a model for this purpose merging Mitcham's typology (Fig. 2) with the three-component model of attitudes (see Fig. 3). The volitional aspect of technology could, in fact, be someone's feelings or emotions about a technological activity or object, equating to the affective component of attitudes. The knowledge aspect represents a person's cognitive component. Ankiewicz (2019b) also concludes previous attitude studies that the cognitive component influences the affective component, rather than the other way around. However, a positive feeling toward an object often leads to a will to learn more (Hidi & Renninger, 2006), thus a mutual effect can be accounted for.

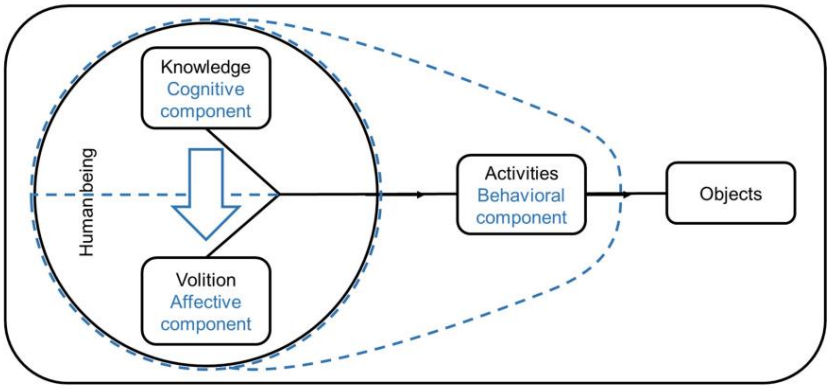

Fig 3. The four manifested modes of technology (in black) together with the three-component model of attitudes (in blue), adapted from Ankiewicz (2019b p. 337)

This model suggests that the affective component of a person's attitude toward technology together with the cognitive component leads to a behavior, i.e., to use, create, or choose a career involving technological objects. Throughout this thesis, behavior is studied according to TBP (Fishbein & Ajzen, 2010) where behavioral intention is evaluated through survey statements, rather than studying actual behavior.

Chapter 4

Methods

The merged superposition of attitudes with Mitcham's manifestations of technology acts as a model for the theoretical frame of the thesis (Fig. 4). Paper I covers the affective and behavioral components. In Paper II, the cognitive component is studied. In Paper III, the theory of planned behavior, TPB (Ajzen & Fishbein 1980) is implemented to study behavior through behavioral intention and its interactions with the affective and cognitive components. In Paper IV, the cognitive component (the Mitcham Score) and Mitcham's (1994) manifestations of technology are discussed and presented as a didactic tool for teachers in their planning and teaching of technology.

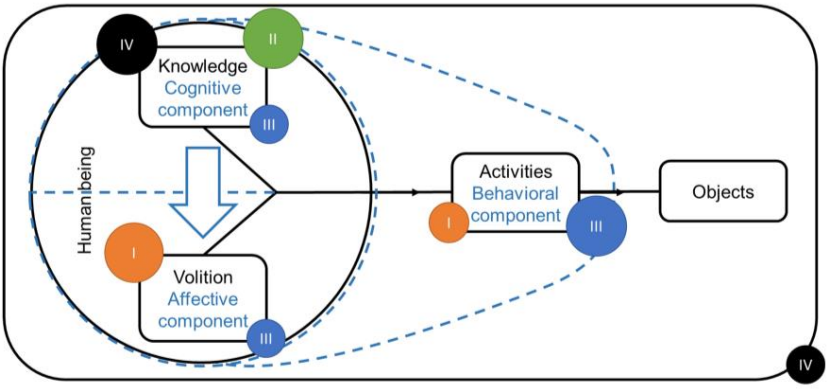

Fig 4. Structure of the included papers within the four manifested modes of technology together with the three-component model of attitudes, adapted from Ankiewicz (2019 p. 337).

The instruments used in this thesis are the Pupils' Attitudes Toward Technology- Short Questionnaire (PATT-SQ, Ardies et al., 2013) and the Mitcham Score analysis method (Svenningsson, 2020). Both instruments are developed, tested, and used throughout this thesis. The instruments together are called PATT-SQ-SE.

Design of the Studies

This thesis consists of data collected from two main studies. The first study took the form of a pilot study to explore, extend, test, validate, and develop the attitude questionnaire for a Swedish context. In the second study, the questionnaire developed in the first study was used on a larger sample of respondents.

Study 1

Adjustment and Development of an Existing Attitude Survey

In study one, the focus was firstly to test, adapt, and develop an existing survey (PATT-SQ by Ardies et al., 2013); and secondly to reintroduce the essay part from PATT-NL/PATT-USA (Ankiewicz, 2019a; Bame & Dugger, 1989) and develop a method to analyze and quantify it. The integration of these two methods will be called PATT-SQ-SE (see Fig. 5).

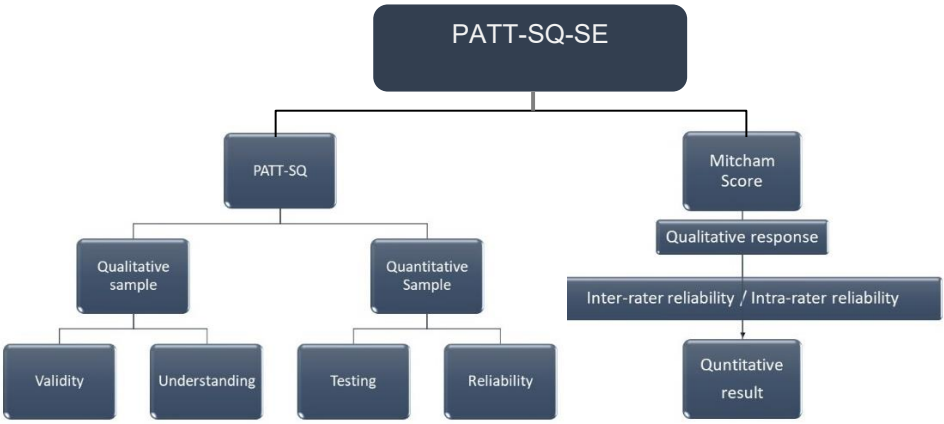

Fig 5. Overview of the process of developing and validating the method for surveying students' attitudes toward technology, PATT-SQ-SE.

Quantitative data collection was carried out using a translated (English to Swedish) version of PATT-SQ (quantitative sample in Fig. 5) (see Appendix 1 for the used Swedish survey). In addition, qualitative data collection was carried out via the abovementioned essay part with the addition of two open-ended questions regarding participants' perception

of technology and technology education (Mitcham Score in Fig. 5). (N=173, 169 valid respondents ages 13-16). A method for analyzing the written responses to these questions was developed through a deductive approach using Mitcham's (Fig. 2) manifestations of technology as a foundation. The developed method was named the Mitcham Score where respondents received 0-4 points depending on how many aspects of technology (from Mitcham's 1994 framework) are described.

To further understand students' responses to the survey items, qualitative data collection was carried out through interviews (N=6 aged 15), using questions based on their survey answers (qualitative sample in Fig. 5).

The data gathered from study 1 were used in Papers I, II, and IV. In Paper I, PATT-SQ data were used together with the qualitative interview data. In Paper II, the participants' responses to the open-ended questions were used to develop a method to quantify responses. In Paper IV, a smaller sample of students' (N=32, from the same school) open-ended questions were used.

Study 2

Using the Adapted Attitude Survey on a Representative Student Group

In study 2, the adapted and developed PATT-SQ-SE survey from study 1 (Papers I and II) was used on a broader group of students. A total of 485 students completed the online survey (of which 483 were valid responses and 472 valid responses including Mitcham Score). For the written responses used in the Mitcham Score analysis, all students who had written anything regarding the two questions about technology OR technology education were considered valid. The distribution of responses to the survey was 272 in grade 7 and 211 in grade 9 (243 girls and 240 boys).

Surveying Attitudes

Since attitudes and interests are theoretical constructs and not observable directly (Lovelace & Brickman, 2013), surveying them requires methods that extract this information more indirectly, for

example, a person's interest. Therefore, the researcher needs to use questions or statements that are based on indicators of, for example, interest. This can be done through in-depth interviews or surveys.

The main instrument used to research attitudes toward technology in this thesis was the PATT-SQ survey (Ardies et al., 2013). The PATT-USA survey consisted of a main part (Bame & Dugger, 1989), made up of 58 statements (reduced to 24 in the shortened PATT-SQ) that were considered suitable for assessing the affective component of students' attitudes (Ankiewicz et al., 2001; Van Rensburg et al., 1999). This meant that the student's emotional engagement with technology and technology education was surveyed. The PATT-SQ survey consists of 24 items, with responses scored on a five-point Likert scale. The respondent indicates how far he or she agrees with a statement (strongly agree, agree, neither agree nor disagree, disagree, strongly disagree). To analyze the data, the items are grouped into categories (Lovelace & Brickman, 2013). These categories were predefined and validated by Ardies et al. (2013). Each category contains several statements that are formulated in similar ways aiming to extract a student's beliefs about their attitudes.

The survey used for this thesis consists of six different categories intended to research students' attitudes, with a total of 24 items (item 27 is analyzed in both the *Consequences* and the *Interest* categories) that are presented in a randomized order to the respondents:

1 Career *– Respondents' career aspirations in technology*
17. I will probably choose a job in technology
39. I would enjoy a job in technology
45. I would like a career in technology later on
63. Working in technology would be interesting

2 Gender *– Gender patterns in technology*
30. Boys are able to do practical things better than girls
41. Boys know more about technology than girls do
47. Boys are more capable of doing technological jobs than girls

3 Consequences *– Consequences and importance of technology*
20. Technology makes everything work better
25. Technology is very important in life
31. Everyone needs technology
27. Technology lessons are important

4 Interest *–Interest in technology and technology education*
32. I would rather not have technology lessons at school
27. Technology lessons are important
34. If there was a school club about technology, I would certainly join it
46. I am not interested in technology
50. There should be more education about technology
52. I enjoy repairing things at home

5 Difficulties *– Perceived difficulty in the technology subject*
21. You have to be smart to study technology
26. Technology is only for smart people
43. To study technology you have to be talented
49. You can study technology only when you are good at both mathematics and science

6 Boredom *– Perceived boredom with technology*
33. I do not understand why anyone would want a job in technology
57. Most jobs in technology are boring
58. I think machines are boring
64. A technological hobby is boring
(Ardies et al., 2013. p. 18)

There were some issues in the PATT-USA survey from 1989 that needed updates. Throughout the work on this thesis, it has been important to stay close to the original survey to be able to compare results from other studies. Even though the survey used in the present study (PATT-SQ) was developed and tested in 2013, the items in the survey were the same ones as in PATT-USA from 1989. As a result, there was a need for translation, testing, and evaluation of the survey for the Swedish context, to check that the items were up to date and could be understood as intended. The numbering of the statements above reflects the numbering used in PATT-USA (Bame & Dugger, 1989).

Surveying Different Attitude Components

Since attitudes can be seen in terms of the three components; *affective*, *cognitive,* and *behavioral* (Eagly & Chaiken, 1993), the theoretical framework for this thesis was used to analyze the methods used.

Surveying the Affective Component

To measure the affective component of students' attitudes toward technology, the most recent version of the developed PATT-SQ was used (see Ardies et al., 2013).

The affective component has been considered to be in focus in the PATT questionnaires. In this thesis, the categories that trigger a student's emotions toward technology either positively or negatively are used as affective indicators. Therefore, the categories of *Interest* and *Boredom* were used as indicators of these positive or negative feelings:

> ***4 Interest*** *–Interest in technology and technology education*
> *32. I would rather not have technology lessons at school*
> *27. Technology lessons are important*
> *34. If there was a school club about technology I would certainly join it*
> *46. I am not interested in technology*
> *50. There should be more education about technology*
> *52. I enjoy repairing things at home*
> (Ardies et al., 2013. p. 18)

The statements in PATT-SQ regarding interest focus on the will to gain more knowledge, especially through school technology. A high mean score on the interest scale should, therefore, indicate a well-developed individual interest in technology education, as presented by Hidi and Renninger (2006). Thereby a low mean score in the interest category indicates that the student does not perceive him or herself as having a well-developed individual interest. To further connect the interest items with theory, items 46 and 52 can be deleted since they have to do with out-of-school experiences. Without these two items, the object of interest (Krapp & Prenzel, 2011) is narrowed down to students' well-developed individual interest in technology education, rather than what their

definition of interest refers to or if they connect repairing things at home with technology education.

One item required a new translation: item 34, "If there was a school club about technology, I would certainly join it" (Ardies et al., 2013; Bame & Dugger, 1989). Sweden does not have a tradition of school clubs and therefore this item was changed to something that Swedish students could relate to. In Sweden there is something called *students' choice* whereby the student can choose a subject or activity of their own; this can be seen as an extracurricular activity. The item was thus translated to "If technology was available as a student choice subject, I would certainly choose it".

> ***6 Boredom** – Perceived boredom with technology*
> *33. I do not understand why anyone would want a job in technology*
> *57. Most jobs in technology are boring*
> *58. I think machines are boring*
> *64. A technological hobby is boring*
> (Ardies et al., 2013. p. 18)

The *Boredom* category aims to survey to what extent students are bored with technology, mainly in an out-of-school context. The different items in this category indicate the degree of students' feelings of engagement with technology.

Surveying the Cognitive Component

The early versions of the PATT questionnaire (e.g., Bame & Dugger, 1989) included two main parts: one surveying the affective component and one surveying the cognitive component through 31 statements to which respondents could answer "agree", "disagree" or "don't know". A difficulty experienced with this part of the survey was how to interpret the answers. For example, "I think technology has little to do with our energy problem" (Bame & Dugger, 1989, p 152) is difficult to interpret what agreement with this means. Therefore, the background part of the PATT questionnaire became interesting. This third part acted as an introduction with student characteristics and an essay-type question

about technology (Bame & Dugger, 1989: "Please give a short description of what you think technology is". Since perceptions of an object are seen as a part of the cognitive component of attitudes (Fishbein, & Ajzen, 1975), this could be one approach to studying the cognitive component.

In this thesis, two questions were used to generate data to assess students' perception of technology as one part of the cognitive foundation for an attitude. The questions used for this purpose are:

> *Describe what you consider to be technology (not the school subject technology)* and
>
> *If you were to describe the school subject technology for anyone who has not studied it in school themselves, how would you describe it?*

Most students have at least some experience in technology education; the second question does not exclude students who are uncertain of what technology is.

Surveying the Behavioral Component

Even though the affective component has been considered to be in focus in the PATT-questionnaires, Summers and Abd-El-Khalick (2018) present an attitude survey in science education positioning the Career category as a construct that affects an intention directly (whilst the other constructs affect intention indirectly). An intention is closely linked with an actual behavior:

> ***1 Career** – Respondents' career aspirations in technology*
> *17. I will probably choose a job in technology*
> *39. I would enjoy a job in technology*
> *45. I would like a career in technology later on*
> *63. Working in technology would be interesting*
> (Ardies et al., 2013. p. 18)

The different items in the Career category are formulated in such a way that a high mean score suggests that the respondent's intention is to

pursue a technological career (*Behavioral Intention*). As mentioned in the theoretical framework chapter, the stronger an intention is, the more likely a student is to behave according to it (Fishbein & Ajzen, 2010).

Data Collection

Data for the studies in this thesis were collected on three different occasions. Papers I, II, and IV all include the same respondents (see Table 1).

Table 1. Number of respondents in the different studies and data collections.

	Paper I	Paper II	Paper III	Paper IV
PATT-SQ	173	173	485	32 (of the 173)
The Mitcham Score			483	
Interviews	6			

The respondents for Paper I were selected through first-person contact with regional schoolteachers. The aim of this sample was to collect data from a variety of different school types and 2-3 school classes from each school. The first three collections were done in person by visiting three different schools to distribute the survey and to be able to answer questions and get input from students. As a test, the fourth school was asked to complete a digital version of the survey online. A teacher at one of the schools selected the six interviewees.

For Paper II, the same respondents were used, but only their qualitative descriptions of technology and technology education.

For Paper IV, 32 students from two natural science profile classes, within the sample of 173 were chosen.

For Paper III, a new sample was selected. To find schools for this study a sample of 30 (out of 1750[1]) schools was randomly selected (Invitation to participate, Appendix 3). The intention was to select a representative sample of schools to establish the status of Swedish students' attitudes

[1] All schools' in Sweden including 9th school year, retrieved from https://www.skolverket.se/skolutveckling/statistik

toward technology. After several reminders and phone calls, seven schools responded and six of them agreed to participate. One of the participating schools failed to follow the instructions for data collection and only students from grades 6 and 8 participated (instructions were to collect from grades 7 and 9). The sample of schools was therefore reduced to five schools. For each school, all students in grade 7 (ages 12-13) and grade 9 (ages 14-15) were asked to participate, amounting to approximately 100 respondents from each school. Since the data collected could no longer be seen as representative of the country, the analysis for Paper III focuses on the relationship between the attitudinal components.

Data Analysis

In this section, the methods used to analyze the different attitudinal components will be presented, followed by the methods used to analyze the components together as a student's attitude toward technology.

Affective and Behavioral Components

The affective and behavioral components (behavioral intent) are both parts of the PATT-SQ questionnaire. The main use of the data from the questionnaire is different types of mean score analysis to see how attitudinal components and background factors influence each other.

Cognitive Component

A deductive approach was used to classify and quantify the answers concerning students' descriptions of technology. As a theoretical and deductive base, Mitcham's (1994) four ways of describing technology are used (*objects-activities-knowledge-volition)*.

The respondents' descriptions of technology and/or technology education were analyzed and scored 1 point for each of the four manifestations of technology (total score 0-4 points and named "the Mitcham score"). To score in the object category, the respondents had to have written that technology relates to man-made objects. In the activities category, respondents mentioned the process of making or

using technological objects. To score in the knowledge category, the respondent needed to refer to technology as something that requires knowledge, "how-to/know-how". The final category, volition, includes respondents who express technology as a human will to consciously improve or control technology or to the consequences of technology. Typical examples of the Mitcham score are:

1 point - "Computers, cell phones, and tablets"
placed in the category *Objects*

2 (1+1) points - "I'm thinking of electronics and building things"
placed in the categories *Objects* and *Activities"*

3 (1+1+1) points - "How things work and how to fix them"
placed in the categories *Objects*, *Activities*, and *Knowledge*

4 (1+1+1+1) points - "Facts about electricity, technical gadgets, how they are manufactured, how they can become more environmentally friendly, the evolution of technology, how things are built, etc.".
placed in the categories *Objects, Activities, Knowledge,* and *Volition*.

The method of analysis produces two types of data: firstly, the abovementioned "Mitcham Score" which represents how broad a student's perception of technology and technology education is (ranging from 0-4 points); and secondly, which aspects of technology students managed to articulate in their responses.

To create more equal group sizes of students, the Mitcham Score results in Paper III were sorted into three groups Low (0-1 points, narrow perception of technology), Medium (2 points), and High (3-4 points, broad view of technology).

Attitude Analysis

The mean score analyses of attitudes were conducted primarily in Paper III. The analysis followed three steps to study the relationships between affect, cognition, behavior, and respondents' background factors.

Step 1: The different attitude scale means were divided into the three different cognitive groups of The Mitcham Score. This was to check whether there were differences between attitude mean scores depending

on how broadly the students described technology and technology education.

Step 2: One-way analysis of variance (ANOVA) was done to analyze the significance of relationships between the Mitcham Score (cognitive component) and the affective and behavioral components. To be able to perform this analysis the respondents were divided into boys and girls. Gender was a moderating variable (cf. Elias et al. 2012).

Step 3: Multinomial logistic regression analysis (Field 2009) was performed to investigate how variables (predictor variables) affected the likelihood of a respondent belonging to a specific group (dependent variable). The dependent variable was set to be the behavioral component (career intention) and the respondents were divided into three (equal-sized) groups depending on their career intention mean score. The affective components Boredom and Interest were used as predictor variables, as well as the respondent's age and gender. To be able to incorporate the cognitive component (the Mitcham Score), the analysis was performed separately for the three different Mitcham Score groups (Low, Medium, High).

Validity and Reliability

Validity and reliability have been tested and improved throughout this project.

Validity

To test the validity of the studies in this thesis, the attitude constructs are tested based on input from the interviewees as well as from the first study data collection, where I was able to distribute some of the surveys in person.

One change in the survey was made prior to the first analysis. To more closely link the *Interest* category to interest theory, the category was reduced to four items (from six). The items that refer to interest in technology education were used in the analysis, while the two more general statements (items 46 and 52) were removed. Therefore, the category *Interest* was renamed "Interest in technology education".

The interview data were collected through semi-structured interviews, to allow the respondents to speak more freely about the different topics with the survey as the basis for the questions (e.g., the Likert scale, Career, Interest, and Gender). The intention was to extract more information from the respondents than the survey did (Robson, 2011). By the sequential exploratory design, the interviews aimed to enable understanding and interpretation of how and why the respondents answered the way they did.

The interviewees (six 14-year-olds, three boys, and three girls) were chosen by their teacher who was instructed to choose a variety of students with differing levels of knowledge and interest in the subject of technology.

The participants completed the PATT-SQ survey three weeks prior to the interview. Since all six students belonged to the same school class and had the same technology teacher, the natural variations between schools could be excluded.

Each interview lasted for approximately 15 minutes and was audio-recorded and transcribed. The qualitative data analysis software program MAXQDA was used to label and sort student answers according to the PATT-SQ survey categories (e.g., *Career*, *Interest*, *Gender*). The aim was to detect underlying thoughts about *career*, *interest*, and *gender* issues, without the questions being specifically directed toward these topics. The interviews led to no obvious validity issues regarding the parts of the survey used in this thesis. However, I was able to get some valuable input on the Gender items in the survey.

The Gender items were outdated which was noted by several respondents early in the data collection for study 1 (items 30, 41, 47). To keep the possibility of comparing data with previous studies, these three items were retained. However, three new items were also added to research the effect of how the item is posed. They are the same items, but with the genders swapped around. These items were:

Girls are able to do practical things better than boys
Girls know more about technology than boys do
Girls are more capable of doing technological jobs than boys

The respondents in the individual interviews all reasoned in the same way about these items, saying that it depends on the individual rather than their gender.

Regarding the validity of the Mitcham Score, one must acknowledge that it does not capture the whole concept, since it is only based on an individual's written response to two questions. The scoring is also dichotomous, and each aspect mentioned is worth the same scoring; there is no hierarchy. However, the score does give us a glimpse of what a student thinks of when hearing the word technology.

Reliability

The reliability of the studies has been controlled by statistical methods and based on prior research. The PATT-SQ has been tested regarding its internal reliability calculating Cronbach's alpha (α) for each category, in both studies 1 and 2 (see Table 2.). A guideline by Lovelace and Brickman (2013) suggests that Cronbach α-value > 0.70 is acceptable. the Boredom category in Table 2, for study 1, received an α-value below 0.70, the Cronbach's a-level is sensitive when using few items (10 or less), therefore the inter-item correlation was analyzed. The inter-item correlations should range between .2 and .4 (Briggs & Cheek, 1986). The inter-item correlation mean in this case was acceptable (.3) and the category is reliable.

Table 2. Internal reliability in Study 1 and Study 2 (Cronbach's α)

Category	N respondents Study1/Study2	Cronbach's α Study1/Study2	N items
Career (Behavioral component)	169/483	.91/.89	4
Boredom (Affective component)	168/483	.63/.70	4
Interest in technology education (Affective component)	166/483	.79/.78	4

For the Mitcham Score, which was a new analysis method, reliability was tested in intra-rater reliability as well as inter-rater reliability. For the intra-rater reliability, a researcher and teacher of technology education were asked to perform a classification using a template. She was given a random sample of 15 student descriptions of technology and technology education three weeks apart. The analysis of the classification resulted in a Kappa value of .893 (Cohen's Kappa, $p < .001$), where a Kappa above .8 is considered an almost perfect agreement (Viera and Garrett 2005). This indicates that the classification method of student descriptions is reliable over time.

In studies 1 and 2, more than 600 descriptions from students were analyzed according to the classification method. If one is to use the method it is important that several researchers can agree on how to assess a student's Mitcham Score, that is inter-rater reliability. Three researchers used a template for the assessment (Appendix 2, in Swedish, as an Appendix in Paper 2, in English) of a random sample of 15 descriptions (from study 1) and 34 descriptions (from study 2). In both cases, Krippendorff's alpha and percentage agreement were calculated (Table 3.). Krippendorff's alpha simultaneously measures different raters to determine the method's reproducibility. This type of study aims to achieve an alpha value above .667 (Krippendorff, 2004). Rare findings increase the sensitivity in inter-rater agreement. When there are rare findings, a low alpha does not have to mean low agreement (Viera & Garrett, 2005). All three researchers were well acquainted with the philosophical framework that the Mitcham Score is based upon, which is why percentage agreement can serve as a good benchmark (McHugh 2012).

Table 3. Inter-rater reliability between three researchers, presented with Krippendorff's alpha percentage agreement, from study 1 and 2

	Krippendorff's Alpha		Percentage agreement	
Aspect	Study 1	Study 2	Study 1	Study 2
No definition	.560	.798	.87	.94
Objects	.294	.845	.60	.94
Activities	.819	.756	.87	.82
Knowledge	.778	.843	.87	.91
Volition	.060	.320	.67	.94

In study 1, the agreement was lower for the rare aspects Volition, and that it was rare to not mention Objects as an aspect. For study 2, the classification template was discussed prior to the assessment which led to a greater agreement. Overall, the three researchers reached an acceptable level of agreement, and the classification of students' Mitcham Score is considered reliable. This means that any one of these researchers can use the template for the classification of the over 600 descriptions and reach similar enough results in this qualitative analysis.

Method Discussion

Digital vs. Paper Survey

As mentioned, the first data collection (three of four schools in the first data collection) was carried out in person via a paper version of the survey. This gave valuable insights for future use of the survey, especially regarding the gender items. The digital version, however, made the data collection easier to import into SPSS. Another positive experience with the digital version was that students wrote more extended answers in the open-ended sections of the survey. The digital version makes it possible to make a question mandatory and thereby avoid missing data. Optional questions can also be implemented. In this case, for example, the question about the respondent's gender was made optional, meaning that leaving this item unanswered would not prevent the student from proceeding with the rest of the survey.

Ethical Considerations

The study adheres to the ethical principles for research in the humanities and social sciences published by the Swedish Research Council (2017).

All participating students were informed about the study, its intended use, and their right to choose to participate or not. They were informed either in person when receiving the survey, by their teacher, and/or through an introduction letter in the survey. The data collected through the anonymous survey and the interviews were not of sensitive character, and no personal data was collected. The choice to participate was made, first by the students' teacher, and then by the students themselves. All respondents participated anonymously and all students who started the survey completed the whole survey. The interviewees at the time of the audio-recorded interviews were 14 years old. The rules for video recording (Swedish Research Council, 2017) were applied even though the interviews were only audio recorded. As such, both the participants and their legal guardians approved their participation in the interview. To protect personal data (according to GDPR) the interviews were transcribed with fictitious names, and audio recordings were transferred to a USB drive, which was stored in a locked cabinet and will be kept for 10 years after this thesis is published.

If change anything about the survey, I would consider including more response options for the question about the respondent's gender. As described earlier, the respondents could either choose between 'boy' and 'girl' or not to answer the question at all.

Likert Scale

The PATT-survey uses a five-point Likert scale. To be able to compare results with other similar studies, the same scale was used in the studies for this thesis. A problem observed in previous studies has been that girls in general are more likely to select the middle option (3) when using a five-point Likert scale (Burns, 1992; de Klerk Wolters, 1989; Rennie, 1987). This merits consideration when comparing the mean scores of boys and girls.

Chapter 5

Summary of Papers

The first paper (Paper I) aimed to identify and evaluate a method for researching students' personal engagement with (attitudes toward) technology. The second paper (Paper II) aimed to develop and test a method for classifying respondents' qualitative data (descriptions of technology) by converting it to quantitative data. In Paper III, the two methods from Papers I and II were merged and used on a new sample of students. In the final paper (Paper IV), the method from Paper II was used as an evaluation tool for a single school class. This was followed by a discussion on what to do with the results after the evaluation and how to use them when planning classroom activities.

Paper I: Understanding attitude measurement: exploring meaning and use of the PATT short questionnaire.

The purpose of this study was to increase knowledge about measuring Swedish students´ attitudes toward technology using the PATT short questionnaire (PATT-SQ, by Ardies et al. 2013). The questionnaire used for the study consists of 24 statements which students respond to on a five-point Likert scale. These 24 statements survey students' attitudes within six different categories.

1 Career—Career aspirations in technology (4 items)
2 Gender—Gender patterns in technology (3 items)
3 Consequences—Consequences and importance of technology (4 items)
4 Interest—Interest in technology and technology education (6 items)
5 Difficulties—Perceived difficulty in the technology subject (4 items)
6 Boredom—Perceived boredom with technology (4 items)

The focus of the study was to validate the survey for use in a Swedish context (in grades 6-9, ages 12-15). Based on previous research issues, gender differences in answers to statements, as discussed by Burns (1992), de Klerk Wolters (1989), and Rennie (1987), and non-neutrally expressed statements (in the Gender category) as discussed by Van Rensburg et al. (1999), as well as possible misinterpretation of the term 'technology' (cf. Mitcham & Schatzberg, 2009) were observed in the study. The most frequently studied topics within attitudes have been gender and career aspirations (Potvin & Hasni, 2014). These two categories were therefore studied in-depth, as well as the interest category since it can be seen as both a field by itself and a construct within attitudes. The research questions for this study were:

- How can student interpretations and the meaning of their answers in the PATT-SQ questionnaire be understood?
- What can the result tell us about students' career aspirations, interest, and gender issues in technology?

To answer these questions, some updates were made to the survey. For example, the three statements relating to gender were originally expressed in a non-neutral way, e.g.: "Boys are able to do practical things better than girls". These statements were still used but the opposite statement was formulated and used as well, e.g.: "Girls are able to do practical things better than boys". With the (three) new statements, the questionnaire consisted of 27 items.

The study consisted of a quantitative data collection using the PATT-SQ survey (N=173, 169 valid respondents ages 13-16) and a qualitative data collection through interviews (N=6 aged 15) based on the interviewees' survey answers. The quantitative data were analyzed with the following aims:

- measure internal reliability within the six included categories following the guidelines by Lovelace and Brickman (2013) using Cronbach´s alpha (α) and inter-item correlation mean (Briggs & Cheek, 1986) when applicable.
- explore how the respondents´ gender affects their attitudes (Interest, Career and Gender), using t-tests (Cohen, 1988) and how the middle option in the five-point Likert scale is used (Burns, 1992; de Klerk Wolters 1989; Rennie 1987)
- explore different methods to use the Gender category.

The qualitative data were analyzed and compared with the answers in the survey to:

- control the validity of the survey.
- gain an understanding of how the items and survey were interpreted by respondents.

The results of the analysis led to the conclusion that internal reliability is acceptable in all six categories. This means that the different statements in each category are related (statistically) and thus can be used as a category to compare mean values. The interviews with students do not point to any validity problems with the questionnaire. The

students seemed to understand most of the questions in the intended way and how to position their answers on a Likert scale. The differences between boys and girls in terms of using the middle option showed some differences, though not as large as observed in other studies (Burns 1992; de Klerk Wolters 1989; Rennie 1987). When comparing the mean values of boys and girls using t-tests, the effect based on gender was moderate when it comes to Career aspirations (boys were more positive), while a small effect was observed for Interest in school technology (boys were more positive).

In the Gender category, differences were observed depending on how the item was phrased. In general, students empowered their own gender. Thus, if the statement was formulated as "Boys are more able…", boys generally would agree more with this than girls would (the student's gender has a large effect on the mean score). Likewise, if the statement was formulated as "Girls are more able…" girls generally would agree more with this than boys would (in this example the student's gender has a small effect on the mean score). As a category, this complicates using the mean scores. The interviews revealed that the respondents tended to use the same Likert-option for all six items in the Gender category; for example, they either totally agreed (5) or totally disagreed (1) with all statements, or in some cases used the middle option (3) for all statements. Further analysis led to the result that 41.7% of all participants selected the same option for all six statements. Therefore, the Gender category was considered unreliable, despite having high internal reliability, it lacked validity.

The six statements in the Interest category had high internal reliability. If only including the items concerning interest in technology education, however, this results in a higher internal reliability. To maintain the existing strong connection between the results from the Interest category (PATT-SQ) and the well-developed individual interest (Hidi & Renninger, 2006), this category can advantageously be reduced to four items. The category becomes an indication of how well-developed the student's individual interest in technology education is.

Paper II: The Mitcham Score: quantifying students´ descriptions of technology

The purpose of this study was to develop a method for analyzing, classifying, and quantifying students' descriptions of technology. The research questions for this paper were:

- What aspects of technology are covered in students' descriptions of technology?
- How can the aspects found be implemented in attitude studies?

Student descriptions of technology were gathered via the same data collection as in the first study (N=173).
Two open-ended questions were inserted at the beginning of PATT-SQ:

a. *Describe what you consider to be technology (not the school subject technology)? and*
b. *If you were to describe the school subject technology for anyone who has not studied it in school themselves, how would you describe it?*

The first question has previously been used in PATT-studies (but not further analyzed). The second question was constructed with the intention of being a more concrete way to elicit students' perception of technology, by asking them to describe the school subject technology, of which they are assumed to have some experience.

In this study, a deductive approach was used to classify and quantify students' answers to the questions above. Mitcham's (1994) four ways of describing technology were used (*objects-activities-knowledge-volition)* as the deductive base for categorizing the aspects of technology that students mentioned in their descriptions. For this, a classification guide was developed and used. Students received 1 point for each of the four aspects considered to be mentioned in their answers. If none of the four aspects was mentioned in either of their answers to the two questions, this was regarded as *no definition*, and their answers received 0 points.

This process will produce two types of results. First, there is a result indicating which aspects are mentioned by students in their answers to the two questions. Second, there is a result that is the sum of the points

received for an individual student (0-4 points). This sum is named the Mitcham Score and is an indication of the broadness of a student's description of technology.

The classification guide was tested by controlling intra- and inter-reliability. The reliability of the classification was very high regarding intra-rater reliability. This means that the classification is reliable when the same person performs the classification according to the guide. In terms of inter-rater reliability, the results were mixed. Inter-rater reliability means the degree of agreement among different observers (three in this case) regarding the classification. High reliability was reached for the technological aspects *activities, knowledge,* and for *no definition*. For the aspects *volition* and *objects,* it was more difficult to reach a consensus. In this study, the disagreement between the three researchers regarding *objects* in 4 out of 6 instances stemmed from descriptions of technology as "things or stuff", for *volition, the* use of the word "invention" was classified as volition by one researcher, and not by the other two; this accounted for 3 out of 5 differences.

The classification of the 164 valid respondent descriptions (164/173 students provided a written response to any of the two questions) showed that 79.9% described technology as related to technological *objects*, 49.4% mentioned *activities*, 44.5% referred to *knowledge,* and 4.9% to *volition*. When presented as Mitcham Score (the sum of the aspects mentioned in a student's description), the most common score indicated that the student mentioned two aspects of technology (69, 42.1% in Table 4.)

Table 4. Mitcham Score distribution

Mitcham Score	Frequency	Valid percentage
0	24	14.6
1	32	19.5
2	69	42.1
3	33	20.1
4	6	3.7
Total	164	100

The developed method can be used in several ways. The main intention for developing the method was to be able to use it in PATT-surveys and to run new types of analyses of students' attitudes. This was implemented in the study presented in Paper III.

Paper III: Students' attitudes toward technology: exploring the relationship among affective, cognitive and behavioral components of the attitude construct

In this study, the methods developed in Paper I (PATT-SQ-SE) and in Paper II (The Mitcham Score) were explored and used together on a new and larger sample. By scrutinizing the different categories in the survey as *affective*, *cognitive,* and *behavioral* components of attitudes it was possible to analyze the relationships among attitude components. The Mitcham Score was considered as part of a student's cognitive component, the categories regarding interest and boredom as part of the affective component, and the career category as part of the behavioral component, or behavioral intention (Ajzen & Fishbein, 1980). The research question for this study was:

- What are the relationships, if any, among the affective, cognitive, and behavioral components of students' attitudes toward technology and how does this relationship relate to gender?

To approach this question, a model by Ankiewicz (2019b) was used (see Fig. 6). In this model, the traditional attitude framework is superimposed onto Mitcham's four dimensions of technology, on which the Mitcham score is based.

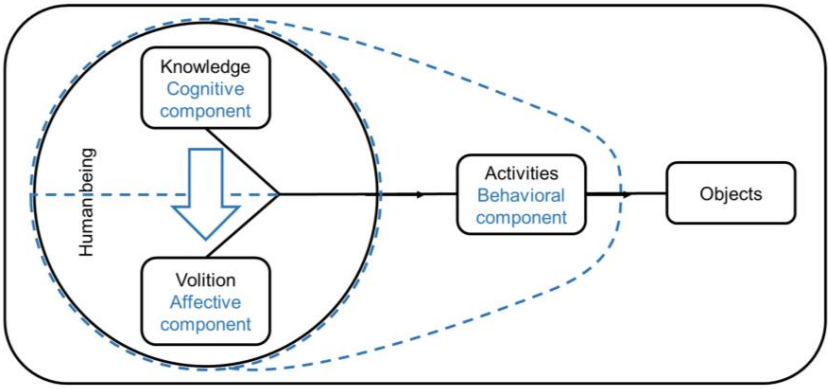

Fig. 6 Superimposition of the traditional approach to attitudes (in blue) upon Mitcham's philosophical framework of technology (in black), adapted from Ankiewicz (2019b p. 337)

The data for the study were collected digitally from five different schools, where all students in grades 7 and 9 were asked to participate in the study. The survey was distributed by the class teacher. In total, 485 students completed the online survey (483 valid responses, 472 valid responses including Mitcham Score). The distribution of responses to the survey was 272 in grade 7 and 211 in grade 9 (243 girls and 240 boys).

As in Papers I and II, reliability and validity were controlled. For the PATT-SQ-SE part internal reliability was controlled and deemed acceptable for the used categories, *Boredom*, *Interest,* and *Career*.

For the Mitcham Score, inter-rater reliability was tested by having three of the authors use the classification guide (in Paper II) on 34 random written responses. As recommended in Paper II, some examples of *Volition* and *Objects* were discussed and agreed on beforehand. The inter-rater reliability was considered as high.

All 472 written responses were analyzed using the classification guide, where every student received a Mitcham Score of 0-4. The Mitcham Score was then divided into three different groups; *Low* (Mitcham Score 0-1, 31.4%), *Medium* (Mitcham Score 2, 39.4%), and *High* (Mitcham Score 3-4, 29.3%) which led to a more even distribution of students.

To study the relationships among the affective, cognitive, and behavioral components, we first present the mean score for the affective and behavioral components within the different Mitcham Score groups, as seen in Table 5. The results presented in Table 5 indicate that there were gender differences in terms of attitude scores and Mitcham Score. Boys were in general more positive toward a career in technology, more interested in and less bored with technology. Girls in general received a higher Mitcham Score than boys. There were also indications that students with a higher Mitcham Score were in general more positive about a career in technology, more interested, and less bored with technology, especially for the girls in the study.

Table 5. Mean scores in measured attitude scales, based on students' Mitcham Score (low 0-1, med 2, high 3-4); the highest mean scores are in bold

		Career aspirations		Interest		Boredom	
		Girl	Boy	Girl	Boy	Girl	Boy
Low	Mean	2.35	3.43	2.68	3.29	3.31	3.41
	N	50	97	50	97	50	97
	Std. Deviation	.85	1.03	.81	.98	.84	.79
Med	Mean	2.91	**3.65**	3.09	3.67	**3.41**	3.93
	N	94	93	94	93	94	93
	Std. Deviation	.97	1.08	.97	1.05	.85	.84
High	Mean	**3.00**	3.51	**3.13**	**3.78**	**3.41**	**4.04**
	N	92	46	92	46	92	46
	Std. Deviation	1.03	.96	.78	.83	.80	.44

To determine whether the indications in mean scores indicated in Table 5. were connected statistically to the Mitcham Score, one-way

analysis of variance (ANOVA) was conducted for boys and girls separately.

The results showed that interest and Mitcham Score had a positive effect on each other (small effect size $\eta^2 = .04$ for girls and $\eta^2 = .05$ for boys). For girls, career aspiration and Mitcham Score had a positive effect (medium effect size $\eta^2 = .06$) on each other. The ANOVA analysis made it possible to study how the cognitive component (the Mitcham Score) the affective components (*Interest* and *Boredom*) and behavioral intentions (*Career*) affect each other respectively.

To further understand how the three attitudinal components were connected, a multinomial logistic regression (Field, 2009) was conducted. This analysis was done by separating students into different Career groups, (one group with a mean score from Low=1-2.33, one Medium=2.34-3.66, and one High=3.67-5). The analysis investigated to what extent respondents' behavioral attitude component (Career) is affected by their affective attitude components (Interest and Boredom), gender, and age, and whether these interactions depend on the cognitive attitude component (the Mitcham Score). To observe the cognitive component, three separate multinomial logistic regression analyses were done, one for each Mitcham Score group (0-1=Low, 2=Med, 3-4=High).

From the multinomial regression analysis, the results implied that students who were bored with technology had an increased risk of belonging to a lower career group when their Mitcham Score was medium or high. A higher interest in technology decreased the risk of belonging to one of the lower career groups, independently of the student's Mitcham Score. A girl with a low Mitcham Score had an increased risk of being in one of the lower career groups, although this risk was eliminated for girls that had a medium or high Mitcham Score. There were no significant differences between girls and boys in career aspirations when they had a high Mitcham score.

The results from both the ANOVA and the regression analysis indicated that the affective component, interest, was a key factor for both boys and girls. Interest was related to both the cognitive component and the behavioral component. The other affective component, boredom, was related positively to the behavioral intention if the student's

cognitive component, in terms of their conception of technology, was well developed.

The cognitive component was a key factor for girls' behavioral intent. A broad view of technology eliminated gender differences in career aspirations. Both of the affective components measured were positively related to career intentions and Mitcham Score. Based on empirical data, the model in Fig. 6 was elaborated the results were visualized in the model in Fig. 7.

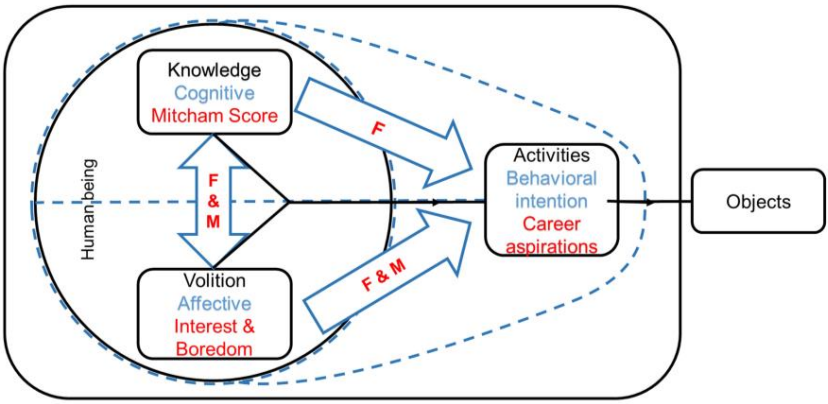

Fig 7. Empirically based model of attitudinal profile in technology; attitude components in blue, Mitcham's (1994) framework of technology in black, and the aspects examined in this study in red. Relations between attitudinal components for girls = F, boys = M.

Paper IV: Carl Mitcham – Descriptions of Technology

Studies show that when asked what they consider to be technology, most people describe various kinds of technological objects, with the most commonly mentioned types being electronic objects such as cell phones or computers (Burns, 1992; de Vries, 2006; Garmire & Pearson, 2006; DiGironimo, 2011; Kőycű & de Vries, 2016;). This study sought to compare Mitcham's (1994) broad description of technology with students' descriptions of technology. The intention was to get a greater picture of what students consider technology to be and how to use this in the everyday technology classroom. In this paper, Carl Mitcham's (1994) framework is in focus. In contrast to this, Nia and de Vries (2016) studied the ITEA's Standard for Technological Literacy based on Mitcham's framework, which revealed a lack of discussion regarding technological knowledge and proposed clarifications of content's know-how and knowing that.

The data used in this study derive from Paper II and consist of two classes that were extracted from that dataset. The two classes belonged to grade 7 (age 13) and grade 8 (age 14) respectively, with a total of 16 respondents from each class. Both belonged to a science profile program. Besides the two Mitcham Score questions, i.e.:

a. *Describe what you consider to be technology (not the school subject technology)? and*

b. *If you were to describe the school subject technology for anyone who has not studied it in school themselves, how would you describe it?*

students also answered a third question where they were asked to describe their best memory from a technology class.

The analysis of students' descriptions produced two different types of data: firstly, a Mitcham Score ranging from 0-4 points and indicating the broadness of a student's description of technology and technology education; and secondly, the student's variety of aspects of technology is used to describe technology and technology education.

This analysis is proposed as a screening tool for teachers to test class awareness of different aspects of technology. The results from the class screening in this study suggest that these students had a broader perception of technology in general than other samples. Therefore, it can be an advantage to use this foundation to build upon to further develop students' awareness of technology toward different types of technological knowledge, activities, and objects.

To accomplish this, it is suggested that the teacher actively plan in-class activities with a variety of materials and tasks that encourage students to test and re-test, followed by evaluation for the development of different types of knowledge.

Chapter 6

Discussion

The overall aim of this thesis was to contribute to a theoretically anchored understanding of attitudes toward technology by exploring the three components of attitudes: affect, cognition, and behavior toward technology for 12-to 15-year-old students in Sweden. Two main studies have been used to explore, develop, and test methods for surveying attitudes and connect them to attitude theory. In this chapter, I will use the results from the included papers to discuss the research questions for this thesis.

How can PATT-SQ be better developed and adapted to research the affective and behavioral components of attitudes? (Papers I and III)

The affective part of attitudes has been the main focus throughout the history of Pupils' Attitudes Toward Technology studies, mainly because the PATT main part that has most frequently been used is considered to measure the affective part of students' attitudes (Tzeng & Yu, 2023; Ankiewicz, 2019a; Ardies et al., 2013). However, as argued in Paper III, out of the six categories in PATT-SQ, only *Boredom* and *Interest (Interest in technology education)* clearly measure students' feelings (affect). Further, the *Career* category was seen as assessing the intention to choose a technological career and therefore related to the behavioral component (behavioral intent, Fishbein & Ajzen, 2010).
The remaining categories (*Consequences, Difficulties,* and *Gender*) showed problems in relation to measuring the affective part of attitudes (cf. with items in Summers & Abd-El-Khalick 2018, p. 186). The items in the three categories related to the affective and behavioral component in this study are generally posed as "I am", positioning the respondent to make a statement based on him or herself. Meanwhile, the other categories, *Consequences*, *Difficulties,* and *Gender*, contain items posed as "One can", potentially moving the respondent away from him or herself (human being). This manner of phrasing elicits an indication of respondents' generalized ideas or beliefs about a concept, which are

considered part of the cognitive component rather than the affective component (Aiken, 2001; Fishbein & Ajzen, 1975). Items in the *Consequences* category seem to survey students' general beliefs about technology and the importance of technology, as well as in the *Diffculties* category where the items are formulated to indicate general beliefs about technology.

The *Gender* category triggered gender awareness, meaning that students in general stated that there were no differences between genders regarding technological capacity. In fact, 41.7% of the survey respondents selected the same option for all six statements regarding gender. The Gender items could instead be interpreted as measuring a student's beliefs about girls' and boys' capacity in technology, which in that case should be part of the cognitive component of attitudes.

To conclude, the categories *Boredom* and *Interest in technology education* can be used to study the affective component of students' attitudes. Conversely, the categories *Consequences, Difficulties,* and *Gender* rather survey students' beliefs about technology and thereby are more closely linked to the cognitive component of attitudes (Summers & Abd-El-Khalick, 2018). The items in the *Career* category survey the respondents' intentions regarding future choices and thereby can be seen as related to behavioral intent (Summers & Abd-El-Khalick, 2018; Fishbein & Ajzen, 2010). This suggests that the PATT-SQ could be further shortened by using only the three categories of items related to affect and behavior. The reduction of items leads to a survey of affect and behavioral intent consisting of 14 items (cf. Ardies et al., 2013 with 24 items).

How can students' perception of technology be better studied and developed as a cognitive component of attitudes? (Paper II and IV)

Various methods have been used to analyze the essay part of PATT studies, as well as to analyze students' descriptions of technology. In this thesis, Mitcham's philosophical framework was used to quantify students' qualitative descriptions of technology and technology education. By using Mitcham's framework to analyze students' descriptions it was possible to determine which aspects of technology

were most commonly perceived among students, as well as which combinations of aspects.

The classification guide constructed in Paper II is considered reliable to use for the classification, but there are some concerns regarding individual interpretations. The classification guide needs to be discussed prior to the scoring process to reach an agreement, especially regarding technology as objects and volition. Since its inception, other researchers have also used the method. Blom and Abrie (2021) used the Mitcham Score to analyze South African students' (aged 15-16) descriptions of technology. They produced similar results as in Paper II and Paper III regarding the Mitcham Score distribution and an acceptable inter-rater agreement (82%) compared with the study in Paper III (82-94%).

The Mitcham Score can give insights into students' perception of technology as well as be used as a construct of the cognitive component of attitudes. In Paper IV the Mitcham Score is elaborated as a tool for teachers to analyze and develop students' perceptions of technology as part of their teaching. A suggestion from that paper was that the analysis can serve as a screening method to help teachers understand how students perceive technology and based on the results, plan teaching activities intended to broaden students' perceptions of technology.

Since Paper IV was published, Lind et al. (2023) have also used the Mitcham Score to classify student discussions (aged 9) during four actual classroom activities organized under the theme "What is technology?". In these activities, students were asked to take photographs of technology and then discuss their photos in groups. The first activity took place in the classroom, which resulted in many photos of modern electrical objects. In the second activity, the students were requested to exclude electrical objects, which led to a broader representation of technological objects. The third photo opportunity took place outdoors. In the final activity, the students took photos of technological details on a bike. The researchers concluded that the students developed broader conceptions of technology as a result of participation in the four teaching activities. Thus, discussion in combination with activities that enable the development of student awareness of the different aspects of technology, could be very fruitful.

What is the nature of, and what are the relationships between the cognitive, affective, and behavioral components of attitude, and how do they contribute to a better understanding of students' attitudes toward technology? (Paper III)

To be able to better understand and potentially affect students' attitudes toward technology, there is a need to research the relations between the different components of an attitude toward technology (Breckler, 1984). In study 2 (Paper III) for this thesis the analysis of the survey data diverged from Ardies (2015) PATT-SQ studies. The Mitcham Score was implemented as an indicator of the cognitive component and the *Career* category was reinterpreted as behavioral intent. Another difference was regarding the analysis. Ardies (2015) uses an assumption of equal understanding of the concept and perception of technology among students, or that they have a "correct" (p. 21) interpretation of technology. Using that assumption, students were also studied equally as one group, comparing boys' vs girls' attitudes (affect). This type of comparison of boys' and girls' attitudes is a commonly used approach (Potvin & Hasni, 2014). However, the results of the Mitcham Score analysis can be used to observe student perceptions of technology and show that girls in general have a broader view of technology (Paper III). In the analysis in Paper III, boys and girls were separated and analyzed as separate cases as well as in a group, which led to other types of results.

For this thesis, the constructs used to study the relationship between the components of attitudes are *Interest* and *Boredom* (affect), *The Mitcham Score* (cognition), and *Career aspirations* (behavioral intent). Together they form the survey named PATT-SQ-SE.

Ankiewicz's (2019b) model shown in Fig. 3 can be used to illustrate and discuss results. In Fig. 8 the results from ANOVA and multinomial logistic regression analysis have been interpreted and placed within the model.

A conclusion from analyzing the relationships between the affective, cognitive, and behavioral components of attitudes in this thesis is that there are differences in these relationships depending on the student's gender. The main difference is observed in the cognitive component, where girls in general received a higher Mitcham Score meaning that they described technology and technology education in a broader sense.

Also, the higher the Mitcham score, the more likely girls were to consider choosing a career path within technology.

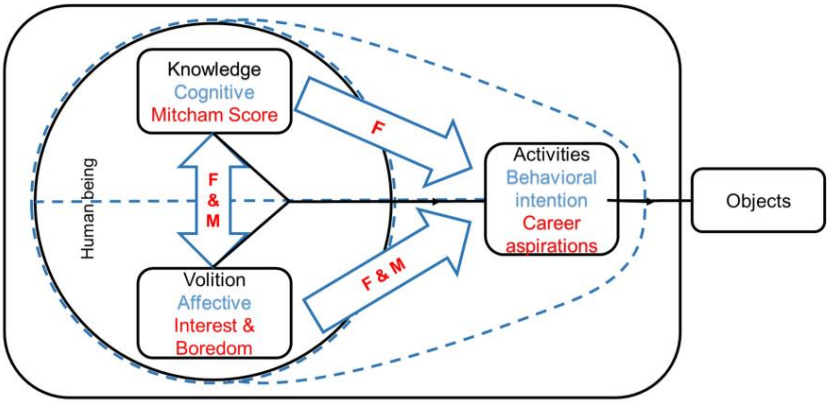

Fig 8. Results from Paper III illustrated in the model by Ankiewicz (2019b)

The model by Ankiewicz (2019b) can also be used in several ways to display attitudes. Fig. 9 shows the results from a study by Rupnik and Avsec (2019).

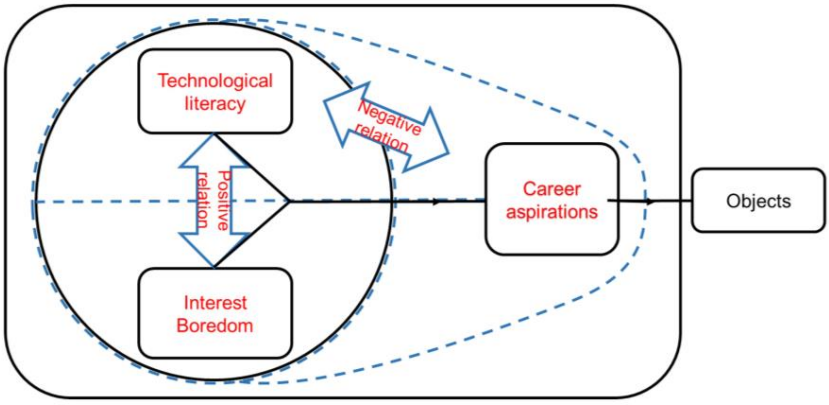

Fig 9. Results from Rupnik and Avsec (2019) illustrated in the model by Ankiewicz (2019b)

Their study researched the relationship between technological literacy and interest, boredom, and career aspirations among students in

Slovenia using the PATT-SQ survey. Their intention was of course not for their results to be placed within this model, but it can give us a quick recapitulation of their results in order to compare and discuss them with those from Paper III.

Rupnik and Avsec (2019) observed a negative relationship between career aspirations and technological literacy among the participating students. They also observed a positive relationship between interest and technological literacy, as well as the fact that students scoring lower on boredom were more technologically literate. The relationships described by Rupnik and Avsec (2019) are similar to the results reported in Paper III (cf. Fig. 9). They use a different method to examine the knowledge aspect (*Cognition*). The major difference in results between the two studies concerns the relationship between the cognitive component and behavioral intent. In Paper III, a positive relationship was observed for girls between cognition and behavioral intent, while Rupnik and Avsec (2019) observe a negative relationship between the two components. This may be an effect of studying the attitudes of a whole group. Since the relationship between the cognitive and behavioral components in boys is not observable while it is for girls, this may affect the observed relationship.

To conclude, using ANOVA on boys and girls separately helps to observe the general differences in attitudinal profiles toward technology, based on gender. The analysis in Paper III displayed the relationship between *Career aspirations* and *Cognition* (the Mitcham Score) for girls and no statistical relationship for boys. The multinomial logistic regression analysis reinforced that result, and gender had no effect on career aspirations among students with a high Mitcham Score.

Conclusions

Throughout this thesis, several methods have been developed and tested. Mitcham's (1994) framework has been shown as a powerful tool to use in several different ways. In this thesis it has been used to analyze students' perception of technology and as a foundation to discuss attitudes through the model by Ankiewicz (2019b).

The Mitcham Score has been shown to be useful by e.g. Blom and Abrie (2021). One must however acknowledge that the method only gives

us a glimpse of students' perceptions of technology and represents only one aspect of the cognitive component of attitudes. To reach an even more comprehensive view of students' attitudes toward technology further ways of using the *Gender, Consequences,* and *Difficulties* categories in PATT-SQ could be elaborated to broaden the cognitive component. One of the main results of this thesis is the separate attitudinal profiles for girls and boys. The Mitcham Score, or in other words the broadness of students' perceptions of technology, seems to be a key concept for girls to consider technological careers. To determine whether this relationship is an isolated one, it would be interesting to develop the behavioral component to survey other behaviors than career aspirations.

Mitcham's (1994) framework for analysis has been used by Lind et al. (2023) to analyze the progression of younger students' (aged 9) perceptions of technology through education. Since students' perceptions of technology affect their career aspirations, a purposeful approach to develop perceptions of technology is desirable. This can be accomplished i.e., by teachers, through emphasis on discussions connected to activities in school as proposed by Lind et al. (2023). It can also take place in the teacher's planning stage as proposed in Paper IV. Using Mitcham's (1994) framework can facilitate teachers' work to enable students of different ages to develop and broaden their perceptions of technology through different aspects.

Chapter 7

Svensk sammanfattning

I det här kapitlet sammanfattas avhandlingen på svenska.

Introduktion

Den här avhandlingen handlar om attityder, hur man kan mäta och förstå mer av dem. Mer specifikt attityder till teknik och teknikundervisning. Även om attityder har definierats på flera olika sätt historiskt, så är det ett vanligt sätt att se på attityder som en sammansättning av tre komponenter: affektiva, kognitiva och beteendemässiga (Eagly & Chaiken, 1993). Det är också den ansatsen som används genom den här avhandlingen.

I en teknikdidaktisk kontext kan kunskap om elevers affektiva och kognitiva attityder underlätta lärares förståelse av elevers beteende och leda till mer effektiv undervisning (Ankiewicz, 2018). En annan aspekt är att många länder strävar efter att hitta sina framtida ingenjörer och arbetskraft i teknikrelaterade arbeten genom teknikundervisning. Attityder till teknik har visat sig spela en viktig roll för just elevers framtida yrkesval (Ardies, et al., 2013).

Attityder är även en del av teknikämnets kursplan i teknik (Skolverket, 2022) och har varit det i flera decennier (Skolverket, 2011; 1996). Under 2011 undersökte Skolinspektionen elevers attityder till teknik. Resultatet visade på en minskning av det upplevda intresset för teknik under skolår fem till nio (11–15 år), bland flickor minskade det upplevda intresset mer än hos pojkar (Skolinspektionen, 2014). I en belgisk studie presenterades liknande resultat gällande intresse under en tvåårsperiod (Ardies et al., 2014).

Att studera attityder var på sätt och vis en utgångspunkt för den teknikdidaktiska forskningen, under teknikämnets framväxt som grundskoleämne. I mitten av 1980-talet utvecklades en enkät för att mäta elevers attityder till teknik (Pupils' Attitudes Toward Technology, PATT-NL) i Nederländerna av Raat och de Vries (1986). Deras avsikt var att undersöka elevers (åldrar 13–15) attityder till och uppfattningar om

teknik när de tar del av teknikundervinsing, men även att höja teknikämnets status och utveckla läroplanerna i teknik. Den ursprungliga PATT-NL-enkäten användes i flera andra länder (bland annat i Sverige av Riis & Augustsson, 1991). Enkäten vidareutvecklades i USA (Bame & Dugger, 1989), PATT-USA. PATT-USA-enkäten användes sedan som grund för att utveckla en kortare enkät av Ardies et al. (2013) kallad Pupils' Attitudes Toward Technology-Short Questionnaire (PATT-SQ).

Även om den ursprungliga PATT-NL baserades på traditionell attitydteori, har attitydteorierna delvis suddats ut i de olika senare versionerna av PATT-studierna. Där har fokus varit på en mer allmän uppfattning om attityder i förhållande till utveckling av teknikundervisning (Ankiewicz, 2018; Ardies, et al., 2013). Att förbättra den teoretiska grunden för enkäter om attityder till teknik skulle kunna leda till en bättre förståelse för elevers attityder, något som jag genom den här avhandlingen vill bidra till.

Syfte

I den här avhandling är det övergripande syftet att bidra till en teoretiskt förankrad förståelse av attityder till teknik och teknikundervisning genom att utforska de tre attitydkomponenterna; affekt, kognition och beteende gentemot teknik för 12–15-åriga elever i Sverige.

Avhandlingen baseras på två studier, där den första studien fokuserar på att testa och utveckla metoder för att studera attityder till teknik och använda dessa i en klassrumsmiljö (resultat presenterade i Paper I, II och IV). Den andra studien tillämpar dessa metoder tillsammans med ett teoretiskt ramverk genom en ny större datainsamling (Paper III).

Bakgrund och tidigare forskning

Avhandlingen behandlar attityder till teknik och teknikundervisning. Nedan följer en kort genomgång om hur teknik som begrepp behandlas i avhandlingen, följt av tidigare forskning om elevers attityder till teknik och hur elever ser på begreppet teknik.

Begreppet teknik

Eftersom den här avhandlingen handlar om elevers attityder till teknik behövs en genomgång av vad som menas med teknik. Traditionellt finns det två grenar inom teknikfilosofin: ingenjörsfilosofi och humanistisk teknikfilosofi (Mitcham, 1985). Genom att kombinera den mänskliga aspekten med den ingenjörsmässiga aspekten skapade Mitcham (1994) ett ramverk som överbryggar dessa två grenar, och därmed ett synsätt från både ingenjörs- och humanistisk filosofi. Ramverket används genomgående i avhandlingen, på flera sätt.

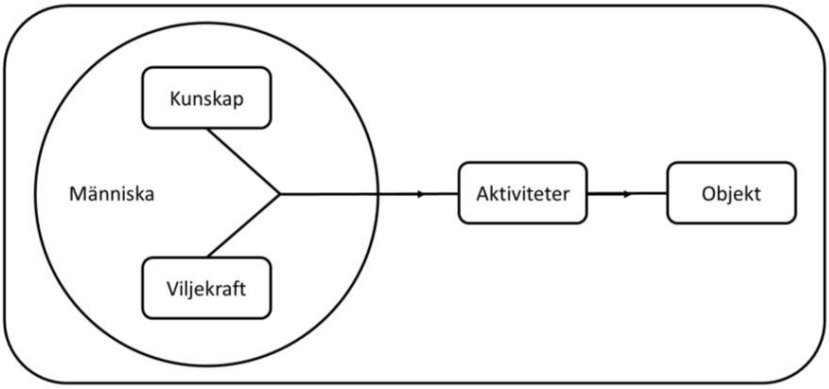

Fig 10. Bild över de fyra aspekterna av teknik, översatt till svenska och anpassad utifrån Mitcham (1994 p. 160)

Kortfattat kan Mitchams (1994) modell beskrivas som att teknik manifesterar sig som teknisk *kunskap* och *viljekraft* hos en människa som leder till *aktiviteter* som utveckling, skapande, tillverkning och användning av nya tekniska *objekt* (se Fig. 10).

Tekniska objekt behöver enligt Mitcham (1994) en (mänsklig) användare för att överhuvudtaget ses som teknik. Användaren har sin kunskap för att använda det tekniska objektet men kan också välja att inte göra det. För att teknik ska kunna användas (tillverkas, underhållas eller repareras) behövs också en viljekraft.

Mitchams beskrivning av teknik är tillämpbar på både den vanliga användaren av teknik, såväl som en på ingenjör som utvecklar nya produkter, och kommer, som tidigare nämnts, att användas för att beskriva teknik genom hela avhandlingen.

Teknik eller teknik?

I svenska språket används ordet teknik normalt som en översättning av det engelska ordet *technology*. Men teknik har också en annan betydelse, närmare besläktad med det engelska ordet *technique* eller *skill* (Schatzberg, 2018).

När vi studerar uppfattningar om teknik kan denna andra betydelse skapa förvirring hos elever. En elev kan till exempel se teknik som något som har med fotboll att göra (fotbollsteknik). För svenska elever kan det alltså helt enkelt betyda teknik eller färdigheter som används när man spelar fotboll. När man kartlägger elevernas föreställningar om teknik är det därför viktigt att de förstår vilken av dessa betydelser (teknik eller teknik som i färdigheter) de tillfrågas om. Tekniska färdigheter är relaterat till Mitchams (1994) aspekter av teknik som färdigheter för att genomföra en teknisk aktivitet (se Fig. 10). Det finns dock viktiga skillnader. Ta till exempel aktiviteten fotboll. Fotboll kräver helt klart kunskap om hur man spelar, och en viljekraft att spela. Och att spela fotboll är på många sätt en aktivitet som kräver tekniska objekt (boll och skor exempelvis). Det en elev syftar till i en kontext som fotbollsteknik handlar dock snarare om färdigheter inom fotboll, kopplat till motoriska färdigheter, än tekniska kunskaper och färdigheter.

Attityder till teknik och teknikundervisning

De första resultaten från studier baserade på PATT-NL-frågeformuläret visade bland annat att flickor tyckte att teknik var mindre intressant och mindre viktigt än vad pojkar tyckte (Boser et al., 1998). Med den uppdaterade och förkortade PATT-SQ undersökte Ardies et al. (2015) vilka faktorer som påverkar elevernas intresse och karriärambitioner inom teknik. För att få en positiv inställning till en karriär inom teknik bör du till exempel vara en pojke, ha tekniska leksaker hemma, ha en pappa som jobbar med teknik och inte ha en mamma som jobbar med teknik. För ett högre intresse bör en elev vara en pojke, och återigen ha en pappa som arbetar med teknik och inte ha en mamma som arbetar med teknik. Det innebär att genusaspekter korrelerar med elevers attityder på flera sätt, både elevens kön och mammans och pappans yrke.

När det gäller attitydförändringar beroende på ålder, visar attitydstudier att yngre elever i allmänhet har mer positiva attityder till

teknik än äldre elever (Ardies et al., 2014; Papadopoulos, 2021; Purković et al., 2021; Skolinspektionen, 2014;).

Teknikundervisningens karaktär kan också påverka attityder. Ardies et al. (2014) visade positiva effekter på elevers intresse för teknik efter praktiska aktiviteter i teknikundervisningen, särskilt för pojkar. I en studie med 10–12-åriga elever mättes effekten av en intervention med PATT-SQ som för- och eftertest (direkt efter intervention respektive 21 dagar efter intervention). Interventionen var ett besök i en högteknologisk lastbil där eleverna fick interagera med olika tekniska material och utställningar, med fokus på hur teknik kan bidra till att lösa problem inom industri och samhälle (Boeve-de Pauw et al., 2022). Resultat från den studien visade deltagarna hade mer positiva attityder till teknik efter interventionen. Tre veckor senare hade de positiva attityderna minskat men var fortfarande mer positiva än de var i förtestet.

Autio et al. (2015) jämförde elevers attityder till teknik med hjälp av delar av PATT-NL-enkäten i olika länder (Finland, Estland och Island). Deras studie visade att isländska flickor och pojkar hade mer jämlika attityder till teknik, än vad eleverna i de jämförda länderna hade. Generellt var pojkar mer intresserade av teknik och tekniska yrken än flickor i samtliga länder.

Sammanfattningsvis kan vi se att attityder till teknik hos elever generellt blir mindre positiva desto äldre de blir. Studier visar också att flickor generellt är mindre positiva och har ett lägre intresse för teknik och teknikundervisning än pojkar. Det visar sig dock att det går att förändra attityder till teknik och teknikundervisning genom exempelvis interventioner.

Elevers syn på teknik

Studier visar att elever ofta beskriver teknik som tekniska objekt, och mer specifikt som moderna elektriska objekt (de Vries, 2006; Garmire & Pearson, 2006; Järvinen & Rasinen, 2015; Kőycű & de Vries, 2016; Riis & Augustsson, 1991). En svensk studie kom fram till att den viktigaste faktorn som påverkade bredden av hur elever såg på teknik var den socioekonomiska bakgrunden. Resultaten visade att elever med hög socioekonomisk status, återspeglade en mer komplex och abstrakt syn

på teknik (Riis & Augustsson, 1991). I en analys av svar på PATT-uppsatser från elever i södra Wales tenderade flickor att ha en mindre bred definition av teknik än pojkar (Hendley et al., 1996).

Även om de flesta elever visar upp ganska snäva uppfattningar om teknik finns det undantag. Med hjälp av Mitchams (1994) manifestationer av teknik visade Lind et al. (2023) att yngre elever kunde utveckla och bredda sin uppfattning om teknik under fyra klassrumsaktiviteter där diskussioner om teknik uppmuntrades.

Teori

Attityder

En attityd innebär en utvärdering av ett psykologiskt objekt, representerat i dimensioner som bra kontra dåligt, trevligt kontra obehagligt, eller sympatiskt kontra osympatiskt (Ajzen 2001; Eagly & Chaiken, 1993). Attityder ses traditionellt genom tre komponenter: *affektiv, kognitiv* och *beteendemässig* (Ankiewicz, 2018; Eagly & Chaiken, 1993).

Den affektiva komponenten är en persons känslor eller känslor gentemot ett objekt. Den kognitiva aspekten har att göra med en persons uppfattning, tro, tidigare erfarenhet eller kunskap om ett objekt. Slutligen är de beteendemässiga aspekterna en persons handlingar eller avsikt att agera på ett visst sätt (Aiken, 2002). Det här traditionella tillvägagångssättet har ofta använts inom forskning av attityder till teknik (Ankiewicz, 2018).

Även om det är en allmänt accepterad attitydmodell har det varit vanligt att fokus i attitydforskning hamnat främst inom den affektiva komponenten (Breckler, 1984), likaså i forskning om elevers attityder till teknik (Ankiewicz, 2018). Den traditionella modellen av tre komponenter har testats för andra ämnen, med blandat empiriskt stöd, därför är modellen i behov av att testas för en teknikkontext (Breckler, 1984).

Breckler (1984) drar slutsatsen att alla tre komponenterna kan särskiljas och noterar vikten av att hantera attityder genom att inkludera samtliga tre komponenter. Genom att undersöka alla komponenter kan man också urskilja relationer mellan de tre.

Attitydteorier är dock normalt inte bara teorier om vad en attityd är, utan också hur den relaterar till mänskligt beteende och de val vi gör (Aiken, 2002). En attityd till exempelvis ett skolämne (som teknik) baseras på en persons övertygelser och känslor om det ämnet och de har en inverkan på beteendet. En persons övertygelser och känslor kan å andra sidan försvagas eller stärkas eller till och med ersättas, vilket kan leda till en attitydförändring (Fishbein & Ajzen, 1975).

Attitydforskning syftar ofta till att försöka förutsäga och studera beteenden, då är teorin om planerat beteende användbar (Theory of Planned Behavior, TPB) (Ajzen och Fishbein, 1980). TBP förklaras som att de kognitiva och affektiva komponenterna i attityder delvis styr en persons intention att följa ett beteende. Intentionen ses som en omedelbar motivationsfaktor för själva beteendet. Desto starkare intentionen är, desto mer sannolikt är det att bete sig i enlighet med den (Fishbein & Ajzen, 2010).

Ett faktiskt beteende är svårt att förutsäga genom undersökningar eller intervjuer, framför allt mer långsiktiga beteenden som val av yrken. Därför studeras beteende i denna avhandling genom intentioner mot ett beteende, beteendeintention (*behavioral intention*).

Kombinera begreppet teknik med attityder

Om man nämner ordet "teknik" associerar olika elever ordet till olika saker, det är ett brett begrepp. Dessa associerade saker (till exempel dator, mobiltelefoner etc.) ses som olika stimuli för ett koncept (Fishbein & Ajzen, 1975). När vi saknar kunskap om ett nytt begrepp (till exempel teknik) associerar vi detta nya begrepp med attityder till liknande begrepp (det kan exempelvis vara naturvetenvetenskap eller reklamfilmer där teknik nämns). Stimuli för olika begrepp kan dock bytas ut när man lär sig mer om konceptet och när det byts ut kan det leda till en förändring av attityd.

I denna avhandling integreras attitydteorin med teknikfilosofi. Ankiewicz (2019b) presenterar en modell för detta och slår samman Mitchams modell (Fig. 10) med traditionella attitydmodellen med tre komponenter av attityder (se Fig. 11). Aspekten viljekraft gentemot teknik kan i själva verket vara någons känslor eller känslor kopplat till en teknisk aktivitet eller ett objekt, det vill säga den affektiva komponenten

av attityder. Kunskapsaspekten representerar en persons kognitiva bas. Ankiewicz (2019b) drar också slutsatsen att den kognitiva komponenten påverkar den affektiva komponenten, snarare än tvärtom.

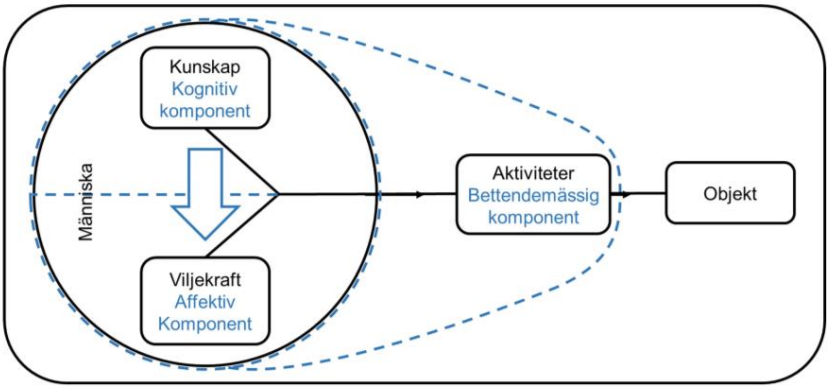

Fig 11. Bild över de fyra aspekterna av teknik (i svart) tillsammans med de tre attitydkomponenterna (i blått), översatt till svenska och anpassad utifrån Ankiewicz (2019b p. 337)

Modellen innebär att den affektiva komponenten av en persons attityd till teknik tillsammans med hans eller hennes kognitiva komponent leder till ett beteende att använda, skapa eller välja en karriär som involverar tekniska objekt. Genom hela denna avhandling studeras beteende enligt TBP (Fishbein & Ajzen, 2010) där beteendeintention närmas genom enkätundersökningar, snarare än att studera ett faktiskt beteende.

Metoder

Den sammanslagna modellen som kombinerar attityder med Mitchams aspekter av teknik agerar modell för avhandlingens teoretiska ram (Fig. 11). Paper I behandlar de affektiva och beteendemässiga komponenterna av attityder. I Paper II studeras den kognitiva komponenten. I Paper III, tillämpas teorin om planerat beteende, TPB (Ajzen & Fishbein 1980) för att studera beteendeintention och dess interaktioner med de affektiva och kognitiva komponenterna. I Paper IV diskuteras den kognitiva komponenten (Mitcham Score) och Mitchams (1994) aspekter av teknik.

Dessa presenteras som ett didaktiskt verktyg för lärares planering och undervisning av teknik.

De instrument som används i denna avhandling är Pupils' Attitudes Toward Technology- Short Questionnaire (PATT-SQ, Ardies et al., 2013) och analysmetoden Mitcham Score (Svenningsson, 2020). Båda instrumenten utvecklas, testas och används genom avhandlingen. Instrumenten tillsammans kallas PATT-SQ-SE.

Data till avhandlingen har samlats in genom två studier. Data från den första studien används för att testa och utveckla metoder för att studera attityder. Data från den andra studien används för att skapa en teoretiskt förankrad bild över relationerna mellan de olika attitydkomponenterna.

PATT-SQ

Huvudinstrumentet för att undersöka elevers attityder till teknik i denna avhandling är PATT-SQ-enkäten (Ardies et al., 2013). PATT-USA-enkäten bestod av en huvuddel (Bame & Dugger, 1989) som omfattade 58 påståenden (dessa är reducerade till 24 påståenden i den förkortade PATT-SQ) som ansågs lämpliga för att bedöma en elevs affektiva komponent (Ankiewicz et al., 2001; Van Rensburg et al., 1999). Detta innebar att elevernas affektiva komponent kopplat till teknik och teknikundervisning kunde kartläggas. PATT-SQ-enkäten består av 24 påståenden som eleven svarar på, via en femgradig Likert-skala. Respondenten väljer själv hur väl han eller hon håller med om ett påstående (Håller med, Håller delvis med, Är osäker, håller inte med, Håller knappast med, Håller inte alls med). För att analysera data grupperas påståendena i flera kategorier (Lovelace & Brickman, 2013). Dessa kategorier definierades och validerades av Ardies et al. (2013). När påståendena grupperats kan sedan medelvärden användas för att genomföra medelvärdesanalyser. Varje kategori innehåller flera olika påståenden som är formulerade på ett liknande sätt för att extrahera en elevs attityder.

Enkäten består av sex olika kategorier (teknik*intresse, karriärsambitioner* inom teknik*,* teknik är *viktigt,* teknik är *tråkigt,* teknik är *svårt* samt *könsskillnader* inom teknik) som syftar till att

undersöka elevers attityder. Påståendena presenteras i en slumpmässig ordning för respondenterna (se Appendix 1).

För att testa, utveckla och validera enkäten genomfördes en kvantitativ datainsamling genom av en översatt (engelska till svenska) version av PATT-SQ (N=173, 169 giltiga respondenter i åldrarna 13–16 år. För att ytterligare förstå elevernas svar på enkätfrågorna gjordes även en kvalitativ datainsamling genom intervjuer (N=6 år 15), med frågor baserade på deras enkätsvar.

The Mitcham Score

De första versionerna av PATT-enkäten (t.ex. Bame & Dugger, 1989) innehöll två huvuddelar. En affektiv del, och en med avsikt att kartlägga den kognitiva komponenten genom 31 påståenden som respondenterna kunde svara "håller med", "håller inte med" och "vet inte" på. En svårighet som upplevdes med den delen av enkäten var hur man skulle tolka svaren. Till exempel, "Jag tror att teknik inte har så mycket med energiproblem att göra " (fritt översatt från Bame & Dugger, 1989, s 152) är svårt att tolka, vad ett medhållande om detta innebär. PATT-enkäten innehöll även en tredje del. Den tredje delen bestod av en introduktion med bakgrundsinformation om respondenten och en uppsatsfråga om teknik (Bame & Dugger, 1989). Respondenterna ombads att: "Ge en kort beskrivning av vad du anser att teknik är". Eftersom hur synen av ett objekt ses som en del av den kognitiva komponenten av attityder (Fishbein, & Ajzen, 1975), kan detta vara ett sätt för att studera just den kognitiva komponenten.

I den här avhandlingen utökades den frågan till två frågor som tillsammans skulle generera data för att bedöma elevers beskrivningar av teknik som en del av en elevs kognitiva komponent. De frågor som användes var:

> *Beskriv vad du anser att Teknik är (inte teknikämnet)?* och
>
> *Om du skulle beskriva skolämnet teknik för någon som inte haft det i skolan, hur skulle du beskriva det då?*

De flesta studenter borde åtminstone ha viss erfarenhet av teknikundervisning, den andra frågan utesluter därför inte elever som känner att de inte vet vad teknik är.

Svaren på dessa två frågor analyseras tillsammans och ges 1 poäng för varje enskild av de fyra aspekterna i Mitchams (1994) ramverk som identifieras (se Fig. 10) utifrån en framtagen bedömningsmall (se Appendix 2). På det här sättet kan varje elevs kvalitativa fritextsvar kvantifieras och få en poäng mellan 0–4 beroende av hur många aspekter som inkluderas i de båda svaren på frågorna ovan.

PATT-SQ-SE

Till studie 2 slogs de två utvecklade metoderna ovan samman till PATT-SQ + the Mitcham Score → PATT-SQ-SE. Till den här studien samlades nya data in. Ambitionen för datainsamlingen var ett representativt urval av skolor (mail skickades till 30st av ca: 1750, se Appendix 3). Efter flera påminnelser landade det i enbart 6 skolor (varav en skola inte följde instruktionerna). Därför fokuseras analyserna i studie 2 i stället på att undersöka relationerna mellan de olika attitydkomponenterna.

För att studera den **affektiva komponenten** används de två kategorierna i PATT-SQ som berör elevens *teknikintresse* (intresse för teknikundervisning) och om eleven upplever teknik som något *tråkigt*.

Karriärsambitioner identifierades som den **beteendemässiga komponenten** utifrån TPB-teorin. Påståendena i den här kategorin är formulerade som val kopplat till en vilja att arbeta med teknik i framtiden. Därmed ses det som beteendeintention (Fishbein & Ajzen, 2010), där ett högt medelvärde indikerar en intention att vilja arbeta med teknik.

Som **kognitiv komponent** av elevens attityd till teknik används the Mitcham Score, som ger ett kvantitativt värde från 0–4 utifrån hur brett eleven beskriver teknik och teknikundervisning.

Etiska överväganden

Alla deltagande elever informerades om studien, dess användning och deras rätt att välja att delta eller inte. De informerades antingen när de fick enkäten, av sin lärare och/eller genom ett introduktionsbrev i enkäten. De uppgifter som samlades in genom den anonyma enkäten och intervjuerna var inte av känslig karaktär och inga personuppgifter samlades in. De intervjuade var vid tiden för de ljudinspelade intervjuerna 14 år. Riktlinjerna för videoinspelning (Vetenskapsrådet, 2017) tillämpades trots att intervjuerna bara spelades in med ljud. Det innebar att både deltagande elever och deras vårdnadshavare godkänt deras deltagande i intervjun. För att skydda personuppgifter (enligt GDPR) transkriberades intervjuerna med fiktiva namn och ljudinspelningar överfördes till ett USB-minne.

Resultat Studie 1

Utifrån data i Studie 1 skrevs Paper I, II (och även Paper IV), som alla på ett eller annat sätt handlar om att testa och utveckla metoder kopplat till attityder. Här nedan följer en kort sammanfattning av resultaten av metodutvecklingen i Paper I och II.

Kopplat till enkäten PATT-SQ som användes i Paper 1, kunde slutsatsen att de olika kategorierna anses uppnå kriterierna för intern reliabilitet, att påståendena inom en kategori hänger samman. Utifrån de genomförda intervjuerna kunde även validiteten av enkäten anses god, då samtliga intervjuades muntliga svar stämde bra överens med vad de besvarat i enkäten.

Den metod som kallas the Mitcham Score utvecklades för att analysera och kvantifiera elevers fritextsvar. För poängen (0–1 för varje aspekt av teknik) varje elev får på sina beskrivningar av teknik, skulle anses ha hög reliabilitet genomfördes två analyser. Den första analysen gjordes för att undersöka om bedömningen utifrån den framtagna bedömningsmallen (Appendix 2) var beständig över tid, intra-bedömarreliabilitet. För detta ombads en kollega använda bedömningsmallen på 15 slumpmässigt utvalda elevsvar två gånger med tre veckor mellan tillfällena. Bedömningen de båda gångerna var i stort sett identisk (95% lika). Den andra analysen gjordes för att se om flera forskare som utgick från bedömningsmallen gjorde liknande

bedömningar, inter-bedömarreliabilitet. I den analysen nådde aspekterna *Aktiviteter* och *Kunskap* upp till kriterierna för hög reliabilitet, men inte för aspekterna *Objekt* och *Viljekraft*. Därför föreslås att en diskussion av exempel (utöver de i bedömningsmallen) innan faktiskt bedömning genomförs.

Resultat Studie 2

Till studie 2 kombineras alltså metoderna i Paper I och Paper II för att studera samtliga tre attitydkomponenter och relationerna dem emellan. Rekommendationerna från studie 1 hanterades också, exempelvis diskussionen av bedömningen av fritextsvaren för the Mitcham Score, vilket ledde till en hög inter-bedömarreliabilitet.

Den affektiva delen av attityder har varit huvudfokus genom hela historien om elevers attityder till teknik och teknikundervisning, främst för att den PATT-huvuddel som oftast har använts ansetts mäta just den affektiva delen av elevers attityder (Ankiewicz, 2019a; Ardies et al.,; Tzeng & Yu, 2023). Men, efter genomgång av de olika påståendena i de sex kategorierna dras slutsatsen i den här avhandlingen att det bara är kategorierna *tråkigt* och *intresse* (intresse för teknikundervisning) som tydligt mäter elevernas känslor (affektiv komponent). Vidare sågs karriärkategorin i PATT-SQ som intentionen att vilja välja en teknisk *karriär*, och därför relaterad till den beteendemässiga komponenten (Fishbein & Ajzen, 2010).

Kategorierna *viktigt, svårt* samt *könsskillnader* inom teknik kartlägger snarare elevers föreställningar om teknik och är därmed närmare kopplade till den kognitiva komponenten av attityder (Summers & Abd-El-Khalick, 2018). Detta innebär att PATT-SQ kan förkortas ytterligare genom att endast använda de tre kategorierna av kategorier som berör den affektiva och beteendemässiga komponenten av attityder.

Den genomförda indelningen av attitydkomponenterna i PATT-SQ-SE gör det möjligt att undersöka relationerna mellan de olika komponenterna. Resultatet av de statiska analyserna av de olika komponenterna synliggörs via pilarna i Fig. 12.

Resultaten från både variansanalys (ANOVA) och regressionsanalys indikerade att intresse som affektiv komponent var en nyckelfaktor för

både flickor och pojkar. *Intresse* relaterade nämligen till både den kognitiva komponenten (the Mitcham Score) och den beteendemässiga komponenten (*karriärssträvan*).

Även den undersökta affektiva komponenten *tråkigt* relaterade positivt med karriärssträvan och Mitcham Score.

Den kognitiva komponenten (the Mitcham Score) var en nyckelfaktor för flickors beteendemässiga komponent (*Karriärssträvan*). Högt Mitcham Score och därmed en bred syn på teknik tog helt bort skillnaderna mellan flickors och pojkars *karriärssträvan*.

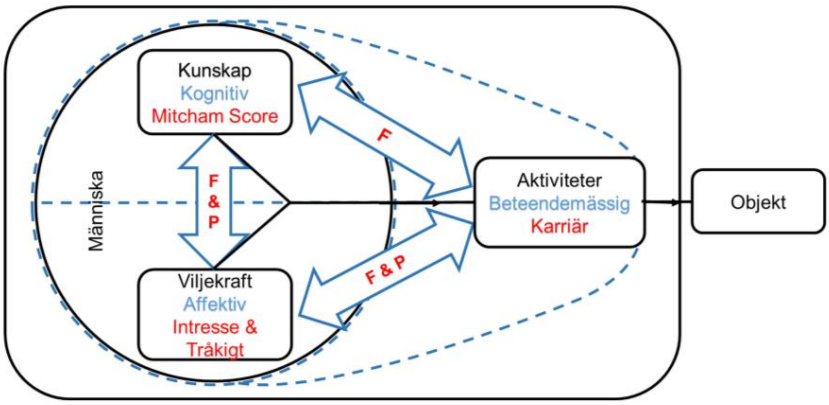

Fig 12. Modell över elevers attityder till teknik. Mitchams (1994) aspekter av teknik i svart, attitydkomponenter i blått och de studerade kategorierna i rött. Relationerna mellan komponenterna synliggörs med pilar där flickor = F, pojkar = P.

Diskussion

Genom den här avhandlingen har metoder utvecklats och testats. Mitchams (1994) ramverk har visat sig vara ett kraftfullt verktyg att använda på flera olika sätt. I denna uppsats har det använts för att analysera elevers uppfattning om teknik och som underlag för att diskutera attityder genom modellen av Ankiewicz (2019b).

Mitcham Score har visat sin användbarhet av till exempel Blom och Abrie (2021). Metoden ger oss dock bara en inblick i elevers uppfattningar om teknik och bara en aspekt av deras kognitiva attityder.

Ett av de viktigaste resultaten i denna avhandling är de separata attitydprofilerna för flickor respektive pojkar. Mitcham Score, eller med andra ord bredden i hur teknik uppfattas, verkar vara en nyckelfaktor för att flickor ska överväga karriärer inom tekniska områden. För att se om den relationen är en isolerad relation skulle det vara intressant att utveckla beteendekomponenten till att kartlägga andra beteenden än *karriärsträvan*.

Mitchams (1994) ramverk har även använts av Lind et al. (2023) för att analysera förändring av hur yngre elever (9 år) uppfattar och diskuterar de olika aspekterna av teknik när de har teknikundervisning. Eftersom elevers uppfattning om teknik påverkar karriärambitioner (främst för flickor) är ett målmedvetet tillvägagångssätt för att utveckla just uppfattningar om teknik önskvärt. Detta kan göras genom diskussioner som förankras i teknikaktiviteter i skolan som föreslås av Lind et al. (2023). Det kan också ske i lärarens planeringsfas som föreslås i Paper IV. Genom att använda Mitchams (1994) ramverk kan man underlätta lärares arbete med att ge elever i olika åldrar möjlighet att uppfatta teknik ur olika aspekter.

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Den här enkäten innehåller frågor och påstående om skolan och teknik. Enkäten har tidigare använts i många länder. På de flesta frågor skall du bara kryssa i lämplig ruta, på andra vill jag att du skriver ett kortfattat svar.

Avsikten med undersökningen är att få veta vad elever i Sverige tycker om teknikämnet och teknik utanför skolan. Ditt deltagande är frivilligt och du kan när som helst välja att avbryta. Dina svar kommer enbart att användas i forskningssyfte. Informationen från enkäterna kan hjälpa att göra skolans teknikundervisning bättre.

Det finns inga rätta eller felaktiga svar, därför är det viktigt att du svarar så som du själv känner.

Om det är något du undrar över är det bara att fråga.

Dina svar kommer att vara till stor hjälp.

Vänliga hälsningar

Johan Svenningsson, Linköpings universitet

Så här fyller du i pappersenkäten
Nedan ser du hur du markerar ett svarsalternativ, och hur du avmarkerar ett redan gjort val.

☒ Korrekt markerat svarsalternativ

☒ Inkorrekt markerat svarsalternativ, krysset ska vara mitt i rutan

☒ Inkorrekt markerat svarsalternativ, krysset är alltför kraftigt

☒ Ångrat val, svarsalternativet räknas inte som markerat

1. Jag är en

☐ Flicka
☐ Pojke

2. Min skola heter

3. Jag går i årskurs

☐ 6
☐ 7
☐ 8
☐ 9

4. Kryssa i de yrken nedan som du anser kräver teknisk kunskap

☐ Arkitekt
☐ Dataprogrammerare
☐ Designer
☐ Elektriker
☐ Industriarbetare
☐ Ingenjör
☐ Produktutvecklare
☐ Sjuksköterska
☐ Snickare
☐ Stadsplanerare

5. Beskriv vad du anser att teknik är (inte teknikämnet)

6. Om du skulle beskriva skolämnet teknik för någon som inte haft det i skolan, hur skulle du beskriva det då?

7. Vilka ämnen i skolan tycker du är mest intressanta (markera 1-5 ämnen)

- ☐ Bild
- ☐ Biologi
- ☐ Engelska
- ☐ Fysik
- ☐ Geografi
- ☐ Hem och konsumentkunskap
- ☐ Historia
- ☐ Idrott och hälsa
- ☐ Kemi
- ☐ Matematik
- ☐ Moderna språk (spanska, franska osv)
- ☐ Musik
- ☐ Religion
- ☐ Samhällskunskap
- ☐ Slöjd
- ☐ Svenska
- ☐ Teknik

8. Vilka ämnen i skolan tycker du är minst intressanta (markera 1-5 ämnen)

- ☐ Bild
- ☐ Biologi
- ☐ Engelska
- ☐ Fysik
- ☐ Geografi
- ☐ Hem och konsumentkunskap
- ☐ Historia
- ☐ Idrott och hälsa
- ☐ Kemi
- ☐ Matematik
- ☐ Moderna språk (spanska, franska osv)
- ☐ Musik
- ☐ Religion
- ☐ Samhällskunskap
- ☐ Slöjd
- ☐ Svenska
- ☐ Teknik

9. Jag kommer troligen välja ett yrke inom teknik (som har med teknik att göra)

Jag håller med	Jag håller delvis med	Jag är osäker	Jag håller knappast med	Jag håller inte alls med
☐	☐	☐	☐	☐

10. Flickor är bättre på praktiska saker än pojkar

Jag håller med	Jag håller delvis med	Jag är osäker	Jag håller knappast med	Jag håller inte alls med
☐	☐	☐	☐	☐

11. Alla människor behöver teknik

Jag håller med	Jag håller delvis med	Jag är osäker	Jag håller knappast med	Jag håller inte alls med
☐	☐	☐	☐	☐

12. Jag förstår inte varför någon skulle vilja jobba med teknik

Jag håller med	Jag håller delvis med	Jag är osäker	Jag håller knappast med	Jag håller inte alls med
☐	☐	☐	☐	☐

13. Om jag fick välja, då skulle jag välja bort tekniklektioner i skolan

Jag håller med	Jag håller delvis med	Jag är osäker	Jag håller knappast med	Jag håller inte alls med
☐	☐	☐	☐	☐

14. Om teknik fanns som elevens val i skolan så skulle jag välja det

Jag håller med	Jag håller delvis med	Jag är osäker	Jag håller knappast med	Jag håller inte alls med
☐	☐	☐	☐	☐

15. Pojkar är bättre än flickor på tekniska yrken

Jag håller med	Jag håller delvis med	Jag är osäker	Jag håller knappast med	Jag håller inte alls med
☐	☐	☐	☐	☐

16. Jag skulle tycka om att ha ett jobb inom teknik

Jag håller med	Jag håller delvis med	Jag är osäker	Jag håller knappast med	Jag håller inte alls med
☐	☐	☐	☐	☐

17. Flickor vet mer om teknik än pojkar

Jag håller med	Jag håller delvis med	Jag är osäker	Jag håller knappast med	Jag håller inte alls med
☐	☐	☐	☐	☐

18. Man behöver talang för att studera teknik

Jag håller med	Jag håller delvis med	Jag är osäker	Jag håller knappast med	Jag håller inte alls med
☐	☐	☐	☐	☐

19. Jag vill göra karriär inom teknik i framtiden

Jag håller med	Jag håller delvis med	Jag är osäker	Jag håller knappast med	Jag håller inte alls med
☐	☐	☐	☐	☐

20. Jag är inte intresserad av teknik

Jag håller med	Jag håller delvis med	Jag är osäker	Jag håller knappast med	Jag håller inte alls med
☐	☐	☐	☐	☐

21. Man måste vara duktig i både naturvetenskap och matematik för att studera teknik

Jag håller med	Jag håller delvis med	Jag är osäker	Jag håller knappast med	Jag håller inte alls med
☐	☐	☐	☐	☐

22. Flickor är bättre än pojkar på tekniska yrken

Jag håller med	Jag håller delvis med	Jag är osäker	Jag håller knappast med	Jag håller inte alls med
☐	☐	☐	☐	☐

23. Det borde vara mer teknikundervisning i skolan

Jag håller med	Jag håller delvis med	Jag är osäker	Jag håller knappast med	Jag håller inte alls med
☐	☐	☐	☐	☐

24. Jag tycker om att reparera och fixa trasiga prylar hemma

Jag håller med	Jag håller delvis med	Jag är osäker	Jag håller knappast med	Jag håller inte alls med
☐	☐	☐	☐	☐

25. De flesta teknikyrken är tråkiga

Jag håller med	Jag håller delvis med	Jag är osäker	Jag håller knappast med	Jag håller inte alls med
☐	☐	☐	☐	☐

26. Jag tycker apparater är tråkiga

Jag håller med	Jag håller delvis med	Jag är osäker	Jag håller knappast med	Jag håller inte alls med
☐	☐	☐	☐	☐

27. Pojkar är bättre på praktiska saker än flickor

Jag håller med	Jag håller delvis med	Jag är osäker	Jag håller knappast med	Jag håller inte alls med
☐	☐	☐	☐	☐

28. Att arbeta med teknik skulle vara intressant

Jag håller med	Jag håller delvis med	Jag är osäker	Jag håller knappast med	Jag håller inte alls med
☐	☐	☐	☐	☐

29. Tekniska fritidsintressen är tråkiga

Jag håller med	Jag håller delvis med	Jag är osäker	Jag håller knappast med	Jag håller inte alls med
☐	☐	☐	☐	☐

30. Tekniklektionerna i skolan är viktiga

Jag håller med	Jag håller delvis med	Jag är osäker	Jag håller knappast med	Jag håller inte alls med
☐	☐	☐	☐	☐

31. Teknik är bara för begåvade människor

Jag håller med	Jag håller delvis med	Jag är osäker	Jag håller knappast med	Jag håller inte alls med
☐	☐	☐	☐	☐

32. Teknik får allt att fungera bättre

Jag håller med	Jag håller delvis med	Jag är osäker	Jag håller knappast med	Jag håller inte alls med
☐	☐	☐	☐	☐

33. Man måste vara smart för att studera tekniska ämnen

Jag håller med	Jag håller delvis med	Jag är osäker	Jag håller knappast med	Jag håller inte alls med
☐	☐	☐	☐	☐

34. Pojkar vet mer om teknik än flickor

Jag håller med	Jag håller delvis med	Jag är osäker	Jag håller knappast med	Jag håller inte alls med
☐	☐	☐	☐	☐

35. Teknik är viktigt i livet

Jag håller med	Jag håller delvis med	Jag är osäker	Jag håller knappast med	Jag håller inte alls med
☐	☐	☐	☐	☐

36. Vilket är ditt bästa minne från en tekniklektion?

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Den här undersökningen syftar till att se hur lika lärare bedömer elevers beskrivningar av teknik och teknikämnet, utifrån fyra bestämda kategorier. Av 170 elevsvar har 15 slumpats fram och används i den här enkäten. Dessa 15 vill jag att du försöker placera in i de olika kategorierna utifrån beskrivningen nedan.

I din bedömningen vill jag att du placerar in varje elevsvar inom en, flera eller ingen av kategorierna:

Teknik som: **Objekt** - **Kunskap** - **Aktiviteter** - **Vilja/drivkraft**

I bedömningen utgår ni från att: **Kunskap om teknik** tillsammans med **den mänskliga drivkraften att skapa förändra och förbättra** leder till **utveckling, tillverkning och användning** av nya **tekniska objekt och apparater.**

Genom att analysera elevens svar kan vi sedan placera in detta i noll till fyra av dessa kategorier. Det finns inte någon hierarki bland kategorierna.

De ord i elevers beskrivningar av teknik i exemplen nedan som påverkar vilken kategori de hamnar inom är färg- och fetmarkerade.

I första hand används svar på "a= teknik är", men om "b= teknikundervisning är" innebär att de täcker in fler kategorier tas denna med i bedömningen också.

5 exempel på elevsvar och tolkningar:

1

a "Teknik är teknik"

b "Tråkigt"

Passar inte i någon kategori. Att enbart nämna teknik gör inte att eleven hamnar i någon kategori, inte heller om eleven syftar på teknik som "bra fotbollsteknik".

2

a "Datorer, mobiler och surfplattor"

b "Vet inte"

passar i kategorin Tekniskt objekt/apparater

3

a "Uppfinningar."

b "Att man får uppfinna och bygga"

passar i kategorierna Tekniskt objekt/apparater, samt Aktiviteter När både a och b vägs samman.

4

a "Hur saker funkar och hur man fixar dom."

b "Det är roligt man får lära sig mycket"

passar i kategorierna Tekniskt objekt/apparater, Aktiviteter samt Kunskap

---

5

a "Fakta om elektricitet, tekniska prylar, hur dom tillverkas, hur dom kan göras miljövänligare, evolutionen inom teknik, hur saker byggs etc.(finns massor med saker inom teknik)

b "Samma"

passar i kategorierna Tekniskt objekt/apparater, Aktiviteter, Kunskap samt Vilja/drivkraft

Skriv gärna ut den här sidan och använd som stöd när du ska bedöma elevernas svar

LINKÖPINGS UNIVERSITET

INSTITUTIONEN FÖR SAMHÄLLS- OCH VÄLFÄRDSSTUDIER / TekNaD

2016-02-18

Nationell undersökning
-Teknikundervisning

Hej,

Vid avdelningen för teknikens och naturvetenskapernas didaktik (TekNaD) vid Linköpings universitet bedrivs ett forskningsprojekt kring elevers syn på teknik och teknikundervisning och hur denna syn påverkas av olika undervisningsfaktorer. För att studera detta planeras just nu en nationell enkät med elever och lärare i grundskolans årskurs 7-9. Elever får svara på flervalsfrågor om deras intresse för och attityder till teknik medan lärare får svara på frågor om undervisningens förutsättningar.

Genom ett slumpmässigt urval bland Sveriges ca: 1750 skolor med årskurs 7-9 är er skola 1 av 30 utvalda skolor,

Deltagande i studien är viktigt då urvalet baseras på flera olika bakgrundsvariabler. Elevenkäten är testad i flera klasser tidigare och tar ca 15-20 minuter att genomföra. Med fördel genomförs enkäten digitalt med surfplatta eller dator, vår erfarenhet är att elever skriver mer på fritextfrågor då.

För att få ett brett material ska en klass per årskurs 7, 8 och 9 genomföra enkäten, dock ej profilklasser med inriktning mot teknik eller naturvetenskap. Samt alla lärare som undervisar dessa klasser i teknik. De medverkande klasserna behöver inte ha påbörjat sin teknikundervisning för att delta.

Vi vill påpeka att resultat och deltagande skolor sker anonymt i all resultatkommunikation, men för att kunna koppla elever med lärare och möjliggöra uppföljningsstudier kommer skolors namn att samlas in, men kommer inte att användas utanför forskningsgruppen eller redovisas offentligt.

Undersökningen planeras under våren och genomförs under hösten 2016, där vi hoppas på möjligheten att ni kan delta för att vi ska få reda på mer om elevers syn på teknik. Om ni vill veta mer om studien eller enkäten besvara till mail nedan. Vi önskar svar **om deltagande** och **möjligheter till digitalt deltagande** så snart som möjligt.

Johan Svenningsson
projektledare och doktorand inom teknikens didaktik

Magnus Hultén
Biträdande professor, Forskningsledare naturvetenskapernas didaktik

Jonas Hallström
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Papers

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