UNIVERSITY OF TURKU

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TIIVISTELMÄ

Tämän väitöskirjan tavoitteena oli tarkastella, kuinka yksilön oppimismotivaatio kehittyy ajan myötä ja miten se on yhteydessä erilaisiin oppimistuloksiin. Oppimismotivaatiota tarkasteltiin tavoiteorientaatioiden ja kiinnostuksen käsitteiden kautta. Aiemmissa tutkimuksissa on huomattu, että opiskelijoiden erilaisilla tavoilla asettaa tavoitteita oppimistilanteissa, sekä sillä, millaista kiinnostusta he osoittavat oppimistilannetta kohtaan, on yhteys oppimistuloksiin kouluympäristössä ja koulutuksessa opitun asian siirtovaikukseen työelämäkontekstissa.

Tavoiteorientaatiot määriteltiin tässä tutkimuksessa yksilön vakiintuneiksi taipumuksiksi ja mieltymyksiksi valita tietynlaisia tavoitteita saavutustilanteissa. Tavoiteorientaatiot määriteltiin kolmen orientaation mallin mukaan, joka muodostuu oppimisorientaatiosta, suoritusorientaatiosta, sekä suoritus-välttämisorientaatiosta. Oppimisorientoitunut opiskelija pyrkii valitsemaan tavoitteita, joiden avulla hän pyrkii lisäämään tietoaan, parantamaan taitojaan tai hallitsemaan jonkin asian. Suoritusorientaatio taas viittaa tilanteisiin, joissa opiskelijan tavoitteena on näyttää kompetenssinsa toisia kohtaan. Suoritus-välttämisorientaation omaava taas yrittää välttää näyttämästä omaa epäpätevyyttään muille. Kiinnostus taas määriteltiin tässä tutkimuksessa perustuen teoreettiseen jakoon tunneperäisestä, lyhytaikaisesta ja muuttuvasta tiettyyn tilanteeseen liittyvästä kiinnostuksesta sekä pysyvämmästä, tietoon ja arvostukseen perustuvasta henkilökohtaisesta kiinnostuksesta. Kiinnostuksen kehittymistä tarkasteltiin neliportaisen kiinnostuksen kehittymismallin avulla. Tämä malli erottelee kiinnostuksen kehittymisen seuraaviin kehitysvaiheisiin: herännyt tilannekohtainen kiinnostus, ylläpidetty tilannekohtainen kiinnostus, orastava henkilökohtainen kiinnostus sekä syventynyt henkilökohtainen kiinnostus.

Väitöskirjan yleisen tason tavoitteisiin pyrittiin vastamaan seuraavien tutkimuskysymysten kautta: 1) Miten tavoiteorientaatiot ovat yhteydessä opitun asian siirtovaikukseen, ja mikä vaikutus koulutusohjelman pituudella tai siirtovaikutuksen mittausviiveellä on tähän yhteyteen? 2) Miten oppilaiden alakohtainen kiinnostus luonnontieteitä ja matematiikkaa kohtaan muodostuu ja kehittyy tutkivan oppimisen kontekstissa? 3) Miten oppilaiden kiinnostus biologiaa ja matematiikkaa kohtaan on yhteydessä oppimistuloksiin ja miten ne ennustavat toisiaan kouluvuoden aikana? Näihin kysymyksiin haettiin vastauksia kolmen empiirisen tutkimuksen avulla: Ensimmäisessä osatutkimuksessa tarkasteltiin aikuisopiskeli-

joiden tavoiteorientaatiota ja oppimisen siirtovaikutusta työelämä- ja korkeakoulukontekstissa. Menetelmänä käytettiin meta-analyysia, jossa kohteena oli 17 empiiristä tutkimusta viimeisen 30 vuoden ajalta. Tavoitteena oli selkeyttää, miten kolme erilaista tavoiteorientaatiota on yhteydessä opitun siirtovaikutukseen sekä onko koulutuksen pituudella tai opitun asian mittausajankohdalla vaikutusta siirtovaikutukseen. Toisessa osatutkimuksessa kohteena oli 18 7. -luokkalaista, jotka oli valittu koeryhmään. Tämä koeryhmä opiskeli paperittomassa, mobiililaitteilla tuetussa ympäristössä tavoitteenaan opiskella luonnontieteitä ja matematiikkaa tutkivan oppimisen periaatteiden mukaisesti. Tämän osatutkimuksen tavoitteena oli tutkia, miten oppilaiden kiinnostus luonnontieteitä ja matematiikkaa kohtaan kehittyy lukuvuoden aikana sekä mitkä seikat vaikuttavat heidän kiinnostuksensa muodostumiseen ja kehittymiseen. Kolmannessa osatutkimuksessa keskityttiin tutkimaan kiinnostuksen kehittymisen dynamiikkaa ja oppimistuloksia (N=104) luonnontieteiden oppimisen kontekstissa. Tämän osatutkimuksen tavoitteena oli testata empiirisesti kolmea mahdollista hypoteesia, siitä ennustaako kiinnostus oppimistuloksia, ennustavatko oppimistulokset kiinnostusta, vai vaikuttavatko ne toisiinsa vastavuoroisesti.

Empiiristen tutkimusten tulokset osoittivat, että vain oppimisorientaatiolla on positiivinen korrelaatio koulutuksessa opitun siirtovaikutukseen. Suoritusorientaatio ei korreloinut ollenkaan, ja suoritus-välttämisorientaatio korreloi negatiivisesti koulutuksessa opitun siirtovaikutuksen kanssa. Koulutuksen pituudella tai siirtovaikutuksen mittausajankohdalla ei ollut vaikutusta korrelaatioihin. Nämä tulokset osoittavat, että oppimisorientoituneet koulutukseen osallistuvat ovat kiinnostuneempia tietonsa ja taitojensa lisääntymisestä, ja ovat siten avoimempia käyttämään myös koulutuksen sisältöjä parantaakseen omia ammatillisia taitojaan. Kiinnostuksen käsitteeseen liittyvät tutkimukset osoittivat, että oppilaiden kiinnostus matematiikkaa ja luonnontieteitä kohtaan vaihteli lukuvuoden aikana, ja se liittyi myös heidän saamiinsa arvosanoihin. Kiinnostus ennusti oppilaiden arvosanoja matematiikassa ja biologiassa syyslukukauden aikana, mutta kevätlukukauden aikana arvosanat ennustivat oppiainekohtaista kiinnostusta lukuvuoden lopussa. Nämä tulokset näyttäisivät viittaavan siihen, että osalla oppilaista arvosanat vaikuttivat heidän kokemaansa kiinnostukseen ja näin ollen normatiivisella arvioinnilla saattaa olla negatiivinen vaikutus kiinnostuksen kehittymiseen. Tämä on linjassa aiemman tutkimuksen kanssa, jossa oppimisorientaation ja kiinnostuksen on havaittu laskevan juuri siirryttäessä alakoulusta yläkouluun.

AVAINSANAT: motivaatio, tavoiteorientaatio, kiinnostus, oppimistulokset, oppimisen siirtovaikutus, organisaatiokoulutus, tutkiva oppiminen, mobiilioppiminen

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ABSTRACT

The aim of this dissertation was to examine how individual's motivational aspects, more precisely achievement goal orientations and interest, develop over time and relate to different types of learning outcomes. The different ways in which learners' set goals in achievement situations and how interested they are in the task or topic have been found to relate to their learning outcomes in school context, and transfer of training to workplaces in organizational training context. Achievement goal orientations were defined as established tendencies and preferences for an individual to choose certain types of goals in achievement situations. They were conceptualized in a trichotomous model that consisted of mastery, performance-approach, and performance-avoidance orientations. Mastery-orientation refers to individual's tendency to choose the type of goals which aim to increase one's knowledge, improve a skill, or master a task. Performance-approach orientation, then, refers to situations in which the individual concentrates on displaying competence in relation to others, and performance-avoidance oriented individual would try to avoid displaying incompetence to others. Interest was conceptualized based on the theoretical division between the more emotion-based, short-lived, fluctuating and situation-specific situational interest, and the more stable, cognition- and value-based individual interest. The developmental framework in which these were examined was the four-phase model of interest development. It separates four different developmental stages of interest, namely triggered situational, maintained situational, emerging individual, and well-established individual interest.

The aim of this dissertation was to examine how individual's motivational aspects, more precisely achievement goal orientations and interest, develop over time and relate to different types of learning outcomes. The general research questions were: 1) How do achievement goal orientations relate to transfer of learning and are these relationships affected by the length of the training program or by the time lag between the end of training and measurement time? 2) How students' domain specific interest in science and mathematics is generated and develops in an inquiry-based mobile learning environment? 3) How students' interest in biology and in mathematics are connected to learning and interest and learning predict each other over the course of a school year.

Three empirical studies addressed these questions: Study I looked at adult learners' achievement goal orientations and transfer of training in organizational and

higher education context. It consisted of a meta-analysis of 17 empirical studies conducted over time span of 30 years. The aim was to clarify how the three different achievement goal orientations related to training transfer and whether this relation was affected by the length of the training program or how long after its completion training transfer was measured. Study II concentrated on 18 experimental group students who had been allocated to a paperless classroom project which aimed to utilize a mobile learning environment along with inquiry learning approach in science and mathematics education. The focus was to investigate how their interest in science and mathematics developed during the school year and what factors were influencing their interest generation and development. Study III explored the dynamics of interest development and learning outcomes, this time with students that received regular classroom teaching in science (N=104). The aim was to empirically test three possible hypotheses on the interaction between interest and learning: whether interest predicts learning outcomes, learning outcomes predict learning, or that they influence each other reciprocally.

The results from the empirical studies showed that only mastery goal orientation had a positive correlation with training transfer. Performance-approach did not correlate and performance-avoidance orientation had a small negative correlation with training transfer. All of these relationships were unaffected by either the length of training or the time lag between transfer measures. These findings indicate that trainees with a mastery goal orientation that are more concerned about improving their knowledge and skills are more open to productive use of training content to improve their practices beyond the context of the training. Findings from the interest development studies showed in Study II that the introduction of a new approach in the classroom may trigger an inverse novelty effect if the 'new' is not meeting the expectations. Study III found that the students' interest in mathematics and science subjects varied throughout the school year and that this variation extended to their grades in these subjects. Interest predicted students' grades in mathematics and biology during the autumn semester, but in spring semester the relationship shifted so that grades were the predictor of subject interest at the end of the school year. This seemed to indicate that parts of the students were going through a transitional phase in their study motivation and their interest may have been affected by the normative evaluation of their learning. This is in line with previous research which has found that the transitioning from primary to secondary school is especially critical time in the development of students mastery-orientation and interest towards studying.

KEYWORDS**:** motivation, achievement goal orientations, interest, learning outcomes, transfer of training, organizational training, inquiry learning, mobile lear

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grateful that I've had the opportunity to have such expert researchers as my pre-examiners.

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Contents

List of Original Publications

This doctoral dissertation is based on the following three studies, referred to in the text by their Roman numerals:

Study I Laine, E., & Gegenfurtner A. (2013). Stability or change? Effects of time lag and training length on achievement goal orientations and transfer of training. *International Journal of Educational Research 61*(1):71-79. doi: 10.1016/j.ijer.2013.03.014

Study II Laine, E., Veermans, M., Lahti, A., & Veermans, K. (2017). Generation of student interest in an inquiry-based mobile learning environment. *Frontline Learning Research 5*(4):42-60. doi: 10.14786/flr.v5i4.306

Study III Laine, E., Veermans, M., Gegenfurtner, A., & Veermans, K. (2019). Individual interest and the learning of biology and mathematics in secondary school science education. *A revised version submitted after recommendation of major modifications.*

1 Introduction

Intrinsic motivation is commonly seen as a desirable state in any learning situation, and most people would probably describe features related to intrinsic motivation when asked to define motivation. It is associated with a person's inner drive towards a goal and spending effort to master a skill or acquire certain knowledge even in the case of occasional setbacks (Ryan & Deci, 2000). Someone who is intrinsically motivated is usually seen as being largely unaffected by negative aspects in the surrounding environment and keep on engaging with the topic even without receiving support. An extrinsically motivated person, on the contrary, is seen to engage the task or learning situation because it leads to something beneficial, a reward, a favorable judgment from someone else, improvement in social status, and so forth. The same dichotomy also applies when we think about motivation in educational contexts. The high achieving students are usually thought to be those who are immersed in the study topic, and who spend additional time and effort in order to understand the study materials. However, there is a discrepancy between what is viewed as an optimally motivated learner and the demands of the school system. In many cases school systems are built around the paradigm of extrinsic and systemized evaluation where the learner's acquired skills and knowledge are thought to be measured objectively through tests, final projects, or other demonstrations (Ames, 1992). This may also apply in the field of organizational training although participation in training courses is usually less mandated compared to compulsory school contexts. Yet it might be that the employee participating in a course is mainly motivated by extrinsic incentives, such as impressing a supervisor, getting into a higher position in the work community, or getting a raise. Even though these types of goals can be seen beneficial from a learners' point of view, there can be negative consequences of them through overemphasizing the performative side of learning. In the achievement motivation literature in its most basic form the goals that people set for themselves in competence-related settings are divided into two categories. Performance goals refer to situations in which a person concentrates on displaying competence in relation to others, and mastery goals refer to situations where the aim is to increase one's knowledge, improve a skill, or master a task (Nicholls, 1984; Dweck, 1986; Dweck & Leggett, 1988; Ames, 1992). Achievement goals have over the

years been studied in various educational context, including young children (Dweck, 1986; Lepola & Hannula-Sormunen, 2018), lower and upper secondary school students (Vansteenkiste et al., 2010; Tuominen-Soini, Salmela-Aro & Niemivirta, 2011; Lee, Hayes, Seitz, DiStefano & O'Connor, 2015), higher education (VandeWalle, Cron & Slocum, 2001; Stull, Hegarty & Mayer, 2009), and wide range of organizational training, such as truck driving (Bell & Ford, 2007), sales (Wilson, Strutton & Farris, 2002), and customer service (Chiaburu, Van Dam & Hutchins, 2010).

School education is in large parts oriented towards normatively evaluated learning outcomes and the support for mastery is often surpassed by more short-term requirements of the curriculum. Students are usually required by law to go to school until their late adolescence and schools need to produce quantifiable and comparable data on their students' learning. Many times the evaluation of learning outcomes relies strongly on measurable factors, such as standardized test scores. However, research literature has already for the past decades shown that learning should not be viewed solely as memorizing the given material; for example emotions and processing of success or failure are also important in the learning process (Muis & Edwards, 2009). Normative evaluation is not as such a bad thing but also other ways to evaluate students' development could be used. Learning is not only about how much knowledge a learner possesses, but also how that knowledge is qualitatively organized and structured so that it can be applied in different contexts later on (Pintrich, 1988).

Two topical issues in the current day educational discussion are 21st century skills and lifelong learning. Both of these approaches rely on the idea of an intrinsically motivated, highly self-regulated learner who can and will transfer, apply and update his or her skills and knowledge without the structures that are provided during the school education. Therefore, one of the key factors for education in schools is how to instill a positive attitude and interest towards learning that will carry on long into adult life in the learner. How could learners' willingness for self-regulated learning be fostered so that it would yield long-term benefits for both themselves and the society at large? This also has implications to educational practices in schools. How should school structures be modified so that they enable these aspects to be implemented in teaching?

One answer to this question could be found from the different ways the learner's interest development and positive experiences of competence could be supported. Interest has been found to relate to successful learning and although research results on direct links to learning have been heterogeneous the indirect and mediating effects are well-documented. These effects have been found across different contexts, such as narrative writing (Albin, Benton, & Khramtsova, 1996), psychology studies (Harackiewicz, Durik, Barron, Linnenbrink & Tauer, 2008), learning statistics (Hay,

Callingham & Carmichael, 2015), and reading science texts (Ainley, Hidi & Berndorff, 2002). In addition, interest has been theorized to be based on positive feeling-related valence as opposed to purely value-related valence (Wigfield & Cambria, 2010). This conceptualization links individual interest with mastery goals which are also connected to positive valence of one's competence and seen to increase the chance of successful training transfer (Pugh & Bergin, 2006). Looking from the perspective of education, interest could be one crucial factor that links learning performance to the learner's striving towards gaining mastery. This means that although normative methods of evaluation, such as grades, are still needed, generating and supporting learner's developing interest towards the topic might offer chances for deeper changes in the learner's engagement in the long run.

The aim of this dissertation had two main focuses. Firstly, the aim was to examine how different achievement goal orientations relate to training transfer in organizational training and higher education context. In the second part of the dissertation the focus shifted from adult learners to adolescents and specifically how their interest to learn science and mathematics develops during their first year of secondary school. The focus of the first sub-study was on adult learners' achievement goal orientations and transfer of training in organizational and higher education context. It consists of a meta-analysis of 17 empirical studies conducted over time span of 30 years. The aim was to clarify how three different achievement goal orientations, namely mastery, performance-approach, and performance-avoidance orientations relate to training transfer and whether this relation is affected by the length of the training program or how long after its completion training transfer is measured. Findings from this first Study indicated the need to study students' learning motivation when it is still developing and forming in school context. Therefore, the second and third sub-studies were conducted in secondary school contexts where students were followed throughout their first year of secondary education. The focus of these studies was shifted from goal orientations to students' interest development because interest has been found to be connected to students' goal setting (Renninger & Hidi, 2011). The second sub-study focused on 18 experimental group students who had been allocated to a paperless classroom project, which aimed to utilize a mobile learning environment along with inquiry learning approach in science and mathematics education. The focus was to investigate how their interest developed during the school year and what factors were influencing their interest generation and development. In order to see how the new learning environment was affecting their interest, each experimental group's student received a propensity score matched counterpart from a peer who was studying in ordinary classroom environments. In the sub-study three the aim was to explore the dynamics of interest development and learning outcomes during the first year of the secondary school, The aim was especially to see how students' interest, measured at

three time points during the school year, predicted their grades and did these in turn predict their interest. The aim was to empirically test three possible hypotheses on whether interest predicts learning outcomes, learning outcomes predict learning, or that they influence each other reciprocally. The time periods when individuals transition from one educational system to another have been found to be especially crucial in the development of interest and motivational orientations (Krapp & Prenzel, 2011; Tuominen-Soini et al., 2011; Glynn, Bryan, Brickman & Armstrong, 2015).

In the following paragraphs, the main concepts of the thesis are introduced together with a grounding of methodological solutions (Chapters 1 and 2). The designs of the sub-studies and methods are described in chapter 3, and the overview of the empirical studies is provided in chapter 4. Finally, the discussion of the entire thesis is presented in chapter 5.

2 Achievement Goal Orientations

In their book Locke & Latham (1990) conducted a profound review on all the research that had at that time been conducted in the goal setting literature. The incentive for them to concentrate particularly on goal setting had started decades back with the simple question "Does goal setting work, that is, does it affect task performance?". Since receiving a positive answer to that question, research on goal setting, and achievement motivation in general, has expanded, differentiated and taken new paths. This development implicitly follows the underlying ethos of Locke and Latham's work, where the work of different researchers from different directions and different questions is gradually accumulated to form a better picture of the research field. This has included what Locke & Latham (1990) call *lateral integration* as well as *vertical integration*. In lateral integration the aim has been to connect goal setting to similar level concepts, such as self-efficacy, feedback, participation, incentives, and in the case of this study, interest. Vertical integration, then, aims to connect goals to broader theoretical concepts, such as personality or values. The underlying motive for this dissertation has followed both of these forms of integration by trying to draw theoretical and empirical connections between goal orientations and individual interest, in both workplace and school education contexts.

2.1 Goal theory

The term 'goal' has been widely used in the field of motivational research in the past, and it has been firmly incorporated in the psychological research of human behavior. It is hard, if not almost impossible to imagine an individual performing an action without any kind of a goal. Goals form the basic direction of our behavior and precede the actions we choose to take in a given situation. Yet, to come up with a strict definition of goal has proven to be more difficult than one would anticipate. In their extensive review on the semantic, historical and philosophical aspects of the goal construct, Elliot and Fryer offer the following definition: "A goal is a cognitive representation of a future object that the organism is committed to approach or avoid." In other words, goal is something that has its focus on an object in the future, guides behavior, is internally represented and is either approached or avoided by an

individual (Elliot & Fryer, 2008). Achievement goals, then, can be defined as a particular set of goals – those which involve competence (Dweck, 1986), and achievement behavior in general is the kind of behavior where the individual aims to develop or express his or her ability or avoid expressing the lack of it (Nicholls, 1984). Thus the roots of achievement goals lie in the individual cognitive processes, and the choosing of the achievement goals one is to pursue depends on whether or not one thinks those goals will potentially enhance competence and ability. Achievement goal orientations by definition are more established tendencies and preferences for an individual to choose certain types of goals. These stabilized preferences can be seen to originate from the person's repeated interactions with the contextual affordances of similar achievement situations (Gegenfurtner & Hagenauer, 2013).

Early achievement motivation research became interested in seeking answers to such questions as 'Is the learner able to demonstrate one's competence in a learning situation?' and 'Is the learner's demonstration of competence displayed by intrapersonal or normative standards?'. Its theoretical foundations were based on social cognitive approach which concentrates to look for explanations for a person's actions in a given situation from the person's cognitive factors rather than extrinsic ones. The research concentrated on certain momentary psychological mediators of behavior, and also assigned a great importance on the interpretive processes that take place in the process of affect generation and behavior mediation (Dweck & Leggett, 1988). In other words, how a learner interprets his or her level of competence in the situation, the demands and difficulty of the task, and what consequences these interpretations then have for their performance in the task. Already by the late 1980's research had focused especially on what kind of goals learners set for themselves (Dweck & Legget, 1988). The establishment, maintenance, and attainment of personally valued goals were seen as important factors in a person's path to successive learning results. By generating either an adaptive or a maladaptive motivational pattern the learner would work towards achieving those personally valued goals, or on the contrary fail to set and strive for such goals although those would be within one's reach. Especially with children the differences would be manifested when meeting obstacles or challenges in the task. Those children with a maladaptive pattern would suffer drawbacks in their cognitive performance whereas children with adaptive patterns would not suffer from such and their performance could even be made easier by the increased challenge (Dweck, 1986).

Learners would also differ in terms of what kind of a theory they would have about intelligence. If they would view intelligence as something fixed, a trait-like quality that is more or less unchanged then they would direct towards expressing this trait to themselves and others. If the learner would view intelligence as something malleable, something that can be developed, then he or she would orient towards increasing this quality. These two theories of intelligence would produce different

outcomes in terms of what kind of goals the learner will set and pursue in learning situations. With a fixed theory of intelligence, the learner would choose what were called performance goals, and with a malleable theory learning goals. With performance goals the learner would be concerned with his or her level of ability, whereas with a learning goal the reason to choose certain goals would be focused on investing effort in order to achieve progress and mastery (Dweck, 1986). The term 'performance goal' has been used frequently enough in the research literature so that its linguistic form can be used as it is. However, previous research literature has also referred to 'learning goals' as 'mastery goals' and 'task goals' although the conceptualization of these goals has been more or less the same. For the sake of clarity, in this study these goals will be referred to as mastery goals.

2.2 Models of achievement goal orientations

Previous research literature has developed different models to conceptualize different types of goals. The basic division has been made between mastery and performance-goals and in addition most models have either implicitly or explicitly made a difference between approach and avoidance-dimensions in the goal constructs (Elliot & Harackiewicz, 1996). In the following section three different approaches to goal orientations are presented and their relationship to learning and other motivational variables are discussed.

The trichotomous model

The trichotomous model of achievement goal orientations separates three distinct types of goal orientations that a person might have in an achievement setting. Studies such as Elliot and Harackiewicz (1996) and Midgley, Kaplan, Middleton and Maehr et al. (1998) began building on the foundations of the previous theory that divided goals into two categories along the mastery-performance division (Nicholls, 1984; Dweck, 1986; Dweck & Leggett, 1988; Ames, 1992). In the trichotomous model, mastery goals were always thought to be grounded on learner's positive intrapersonal judgments of his or her competence. This meant that mastery goals were seen to always elicit an approach orientation whereas performance goals could generate either approach or avoidance orientations. An approach orientation has its basis in a person's self-regulation when positive outcomes are expected from the situation. The approach forms of regulation often elicit responses in the learner that help him or her to perceive the situation as a positive opportunity to engage with the task in an optimal way. Avoidance orientation correspondingly is based on self-regulation that negative outcomes are expected. It is seen to elicit self-protective processes that hinder or inhibit optimal task engagement. Such processes might be for example

feeling threatened, sensitivity to information that hints towards failure, or anxiety about self-image instead of concentrating on the task. (Elliot & Harackiewicz, 1996).

In this model the second dimension, along approach-avoidance dimension, is related to competence and how the individual views it. If the person is mostly concerned of displaying his or her competence in relation to others, then the motivation behind his or her achievement strivings are seen as normative, in other words, performance oriented. If, on the other hand he or she views the achievement situation as a chance to improve competence, motivation behind achievement strivings is viewed as intrapersonal and mastery oriented. When this dimension is combined with the approach-avoidance dimension three different sets of achievement goals are formed. These three sets are mastery goals, performance-approach goals and performance-avoidance goals. In this model mastery oriented goals were seen to always lead to positive outcomes in the person's motivation regardless of the perceived competence level. However with performance oriented goals high perceived competence in the task would lead to positive outcomes in motivation whereas with low perceived competence the outcomes would be negative. These two different outcomes in motivation were called performance-approach and performance-avoidance orientations (Elliot & Harackiewicz, 1996). In theoretical literature mastery goals are mostly viewed to be based only on positive intrapersonal reactions (Dweck, 1986; Niemivirta, Pulkka, Tapola & Tuominen, 2019), although some researchers have also proposed that mastery goals can be avoidance-oriented (see e.g. Elliot & McGregor, 2001). Because of the positive intrapersonal reactions a person is likely to strive to learn more even though the task is challenging and even if a failure to accomplish the task should occur (Dweck, 1986). A mastery-oriented individual is seen to be task-oriented, aim for gaining knowledge or increasing skills, and his or her emphasis is on getting better and developing oneself.

The second set of goals in this model are called performance goals. These differ from mastery goals so that performance goals are normatively driven which means that the learner is concerned of demonstrating competence to others or trying to avoid showing lack of competence. These goals are divided into two categories, namely performance-approach and performance-avoidance goals. Performance-approach goals are a result of self-regulatory processes which are based on positive expectations of the outcomes of the task. Performance-avoidance goals, then, are the results of similar processes which are based on negative expectations of the outcomes. The individual with a performance goal is concerned how success or failure in the task might look in the eyes of someone else, be it a teacher, supervisor, classmates, co-workers, parent or spouse (Dweck & Leggett, 1988). The motive behind the individual's engagement in the task can have a more instrumental value than with a mastery goal orientation. This means that the learner's interest lies in

extrinsic rewards or cues of one's competence, such as getting a good grade, outperforming others, or getting a raise in salary for instance.

The 2 x 2 and 3 x 2 frameworks of achievement goals

The 2 x 2 achievement goal framework differs from the trichotomous model in that it adds fourth type of goals to the model, namely mastery-avoidance goals. Elliot and McGregor (2001) separate two dimensions of a goal structure based on how competence is defined and valenced in an achievement setting. According to this framework a person may define competence in an achievement setting in either absolute, intrapersonal, or normative standards. In absolute standard a person is concerned of understanding the topic at hand or mastering a task. An intrapersonal standard is applied when the person evaluates if he or she has improved in performance or gained in skills or knowledge during the task. The normative standard then, is applied when one compares his or her performance in the task to other peoples' performances. If a person views his or her competence in an achievement situation to be positively valenced, in other words finds the possible outcomes of the task desirable, then his or her behavior will be directed by anticipation of success. If, however, the situation is valenced negatively, that is the focus is on undesirable outcomes, then his or her behavior in the situation is driven by the expectancy of failure (Elliot, 1999; Elliot, 2001). These two fundamentally different ways to view the situation also cause different motivational outcomes; motivation to either approach or avoid the achievement situation. An approach motivation would lead to positive outcomes if effective and at worst only to the absence of positive outcomes if ineffective. However, avoidance-oriented person would want to avoid those situations which he or she anticipates would lead to failure or at best the absence of negative consequences. In the model the absolute and intrapersonal standards are viewed jointly so that they form one of the two parts of the mastery-performance dimension. This is because, according to Elliot (2001), absolute and intrapersonal competence overlap conceptually and empirically with each other so that separating the two can in many cases be impossible. It is often so that mastering a task includes also developing one's skills and knowledge beyond what one has previously known or been able to do (Elliot, 2001). This means that in the model competence definitions are divided into mastery (absolute and intrapersonal) and performance (normative) categories, and these further divide into two categories, namely approach and avoidance, based on competence valence. The 2 x 2 model echoes the trichotomous model in the performance-approach and performance-avoidance categories but instead of having only unidimensional mastery construct, divides it also according to the approach-avoidance dichotomy. The now formed mastery-avoidance category refers to a scenario where one's task-

related or intrapersonally evaluated competence is negatively valenced. In practice this would happen in a situation where the person would be focusing on trying to avoid losing ones' skills and abilities or leaving the task incomplete. Failure in the task could result in some negative consequences, such as lowered intrinsic motivation and self-determination (Elliot, 1999).

In the 3 x 2 model (Elliot, Murayama & Pekrun, 2011) the composite construct of mastery goals is taken apart and divided into separate task and self-constructs. In addition, performance goals are renamed to other goals, indicating the point of reference when judging competence. This brings the total amount of goals to six, namely task-approach, task-avoidance, self-approach, self-avoidance, other-approach and other-avoidance. The main difference compared to the 2 x 2 model is the separation of task (absolute standard) and self (intrapersonal standards) goals. In task goals competence is defined by performing either well or poorly in terms of what successful completion of the task would require. Self-goals then evaluate competence by referring to one's previous experience and performance with similar tasks or potential to do in the future. Despite its fine-grained classification of different types of achievement goal constructs, the 3 x 2 model has not yet been utilized much in empirical research (Niemivirta et al., 2019).

Multiple goal profiles

Instead of strictly variable-oriented approach some researchers have argued for a more person-centered approach when looking at achievement goal orientations. Person-centered approach can be seen as a complementary way of looking at persons' goal setting instead of arbitrarily classifying research participants based on measured variables. Person-centered approach can use for example statistical clustering and profiling methods to reveal groups within the sample that have distinct motivational profiles (Harackiewicz, Barron, Pintrich, Elliot & Thrash, 2002; Hofer, 2010; Gonçalves, Niemivirta & Lemos, 2017; Niemivirta et al., 2019). This type of approach differs from the variable-centered approach in that the exact amount of different goal constructs is not necessarily known in advance but is rather determined in the analysis. This is anticipated to give a more realistic picture of the actual achievement goal constructs that the study participants have.

Niemivirta and his colleagues have found five goal orientation profiles that are consistent across studies in different contexts, such as elementary and secondary education, and higher education. These five profiles are mastery, performance, success, avoidance, and indifferent (Niemivirta et al., 2019). Here mastery, performance, and avoidance-oriented profiles are conceptualized in a similar fashion as in previous models. Success orientation, then, is a combination of mastery and performance orientations meaning that a success-oriented person is aiming for

learning but also emphasizes performance-goals. Persons in the indifferent group are those who seek to follow task instructions and do what is asked but also minimize the amount of effort spent on completing the task.

2.3 Relationship to learning

Many studies have found mastery goals to have a positive relationship with academic achievement (Dweck, 1999; Nicholls, 1984; Harackiewicz, Durik, Barron, Linnenbrink-Garcia & Tauer, 2008). The effects of performance goals have have been viewed as less positive for learning, although some theorists have also posited that they can also appear beneficial if the focus is on outperforming others (Elliot, MacGregor & Gable, 1999; Pintrich, 2000). In their work Wigfield & Cambria (2010) review research on students' achievement task values, goal orientations, and interest and also discuss how these develop during childhood and adolescence. According to them, many theorists note the positive outcomes that mastery goal orientation brings to both learners and teachers, and that mastery goals are generally seen as something to foster and promote in schools. Mastery goals have usually been associated with positive outcomes in learning such as using deep cognitive strategies, relating material to prior knowledge (see e.g. Anderman, Austin & Johnson, 2002), effort, persistence and intrinsic motivation to learn (Elliot & Harackiewicz, 1996; Elliot, 1999). However, it is often so that school education becomes more performance-oriented the when students grow older. Increased focus on student evaluation can lead to children de-value those school subjects or learning activities that they feel they are not good at (Wigfield & Cambria, 2010). The pressure to do well in terms of evaluation can also lead to students starting to lose the intrinsic value of learning. In other words, they start to lose the feeling of enjoyment they get when engaging in the activity (Wigfield, Eccles & Rodriguez, 1998).

With a mastery goal orientation, the learner is seeking opportunities to learn even in the face of failure. Mastery orientation is also linked for choosing more difficult and demanding tasks even though they most likely require investing more effort than the easier ones (Dweck, 1999). However, mastery goals are probably not a reliable predictor of variables which involve extrinsic consideration. This is because a mastery-oriented person seeks to gain a more fundamental and broad understanding of the learned topic and not be primarily concerned of demonstrating competence in a normative manner. Mastery goals are theorized to lead to almost none or very few negative consequences. This has partly to do with the theoretical model, in which mastery goals are viewed to always be based on approach motivation which itself is seen to lead to only positive outcomes (Elliot, 1999; Elliot & Harackiewicz, 1996).

Some of the outcomes of performance-goals have also been found to be positive. When the performance-approach oriented learner aims to succeed in challenging tasks the outcomes resemble those of the mastery-oriented person (Elliot, 1999). These goals have been found to relate to e.g. high-performance outcomes (Elliot & Church, 1997), academic self-concept and self-efficacy for schoolwork (Skaalvik, 1997). It is when the pursue of these goals is in contradiction with their underlying motivational foundation that the outcomes may also be negative. Such negative outcomes may include fear of failure (Elliot and Murayama, 2008), test anxiety (Wigfield & Eccles, 1989), or cheating in the task in order to avoid failure (Midgley et al., 2001). Another explanation for negative consequences for learning relates to the idea that performance-oriented learners only want to invest effort in a learning activity if this serves the purpose of achieving a good outcome. A performance-approach oriented person aims to balance between the demands of the task and how much effort he or she invests in it (Dweck, 1999). Those tasks which are useful in demonstrating one's competence are often easier ones and such that require less effort and this might prove problematic when the learned skills should be applied in more complex settings. For this reason performance-approach goals may not provide the optimal results in more complex settings where normative evaluation is not central, such as in working life.

Performance-avoidance goals are theorized to be threat-based and from the learner's point of view stem from the possibility of negative consequences of one's actions. They have been viewed as a combination of a maladaptive motivational pattern combined with the need for positive competence judgments for the person (Dweck, 1986). With a performance-avoidance orientation the individual is incapable of setting and pursuing goals that would be personally valued and meaningful. Instead the learner is concerned of not revealing one's incompetence to others and orients towards goals that take into account the anticipated failure in the task (Elliot, 1999). Having a performance-avoidance orientation does not necessarily mean that the individual's actual level of competence is low, rather than it gives him or her the image of not being able to set and achieve more demanding goals. The orientation is rooted in the individual's experiences of self-value and worthiness as a part of the social environment and can result in various negative consequences. These negative consequences include e.g. negative emotions (e.g. fear of failure and rejection), self-image (e.g. self-validation and self-worth) and achievement strivings (e.g. need for affiliation and approval).

2.4 Stability and change in achievement goal orientations and transfer of training

The question of whether goal orientations are stable personal characteristics or change through time or even between situations has been long debated. Some researchers have viewed them as stable trait-like characteristics (Dweck & Leggett, 1988) while some have seen to be influenced by classroom structures and hence be more situational (Ames, 1992). Previous literature has found evidence for both stability and change. Reasons for stability have been found to relate to hierarchical nature of achievement motivation and the nature of continued goal pursuit (Elliot, 1999; Fryer & Elliot, 2007; Tuominen-Soini, Salmela-Aro, & Niemivirta, 2011). Muis & Edwards (2009) reviewed three empirical studies which addressed the stability-change issue in goal orientations. They associated the changes to two processes that may take place in student's goal regulation. The first one is goal switching in which the person decides to reduce the pursuit of one type of goals, typically mastery goals, and concentrate on another type of goals, such as performance-approach goals. These changes may take place as part of the student's natural developmental process or it may be enhanced by the study environment. Muis & Edwards (2009) also point out the possibility of multiple goal constructs, a view that has gained ground in recent research (Harackiewicz et al., 2002; Hofer, 2010; Gonçalves et al., 2017; Niemivirta et al., 2019), in which a person can have a second goal besides the dominant one which guides their behavior in a subsequent task. Another process that may produce changes in one's goal orientations is called goal intensification. This means that the person either increases or reduces the level of how much he or she endorses certain types of goals but does not switch into totally different ones. Changes in goal orientations have also been explained from a developmental psychology point of view. The general tendency among adolescents to shift from mastery to performance-goals is seen to be caused by the increase in judging achievement in normative, rather than intra-individual standards (Schwinger, Steinmayr & Spinath, 2016). In their study with elementary school children Schwinger et al. (2016) found that 85% of students changed their goal profiles during the four-year period, from second to fifth grade. This change was however, relatively larger within one grade, namely the fourth grade, rather than across school years. Nevertheless, only a small minority of students reported a steady mastery-oriented profile during the whole time; a finding that yet still underlines the importance of finding ways to foster mastery goals in everyday school context.

In their studies with secondary school students, Tuominen-Soini, Salmela-Aro & Niemivirta (2011; 2012) found goal orientation profiles to be relatively stable before an educational transition from lower-secondary to upper secondary school education, with 60% of students remaining within their motivational profiles (Tuominen-Soini, Salmela-Aro & Niemivirta, 2011). Similar stability has also been

found during an educational transition, with 50% of students maintaining a similar motivational profile (Tuominen-Soini, Salmela-Aro & Niemivirta, 2012). In addition 46% of the profile shifts that took place during the transition happened towards profiles that resembled the learners' original ones. Substantial shifts towards more positive motivation were seen only in 2%, and towards more negative profiles also in 2% of the learners (Tuominen-Soini, Salmela-Aro & Niemivirta, 2012).

The stability-change aspect was of interest in this study because different goal orientations have been found to correlate differently with learning outcomes and training transfer. Pugh & Bergin (2006) reviewed studies conducted on the relationship between achievement goal orientations and transfer and concluded that mastery goals had been found to relate to cognitive engagement but not as much to achievement. Performance-avoidance goals were found to relate to reduced deep-level processing and metacognitive monitoring; features which are usually seen to lead to successful transfer. The case for performance-approach goals was less clear since some studies had reported negative and some positive correlations with transfer. Although performance-approach goals were in some cases found to connect to more superficial learning strategies and even to some negative outcomes, such as focusing on taking the easiest approach, they were still found to relate to positive achievement especially in college context. However, this effect may also be produced by the normative methods of evaluation that are used in higher education contexts and may not accurately reflect the actual amount of transfer, which usually requires more long-lasting, deeper level processing (Pugh & Bergin, 2006).

Mastery goals have already for a long time been associated with intrinsic interest in learning activities (Meece, Blumenfeld & Hoyle, 1988). This association has also been found to be dependent on the quality of external evaluation in the learning situation. Evaluative feedback which concentrates on the learning task and learner's effort is more mastery supportive than feedback that turns one's attention on the self by prioritizing outcome and social comparison, such as grades or praise (Butler, 1987). In the school context extrinsic rewards have traditionally not been uncommon, and preferred behavior has often been encouraged by rewards, while unwanted behavior has often been discouraged. It is noteworthy that external feedback such as these seem to shape students' aims in the learning situation long after the reward or punishment have been implemented (Lepper & Hodell, 1989). For instance, when students seek to obtain approval from the teacher with the kind of behavior they interpret to be wished for in a situation based on a previous situation. It is when the learner chooses to engage the learning activity without being primarily encouraged to do soby external factors such as rewards or punishment, that his or her action can really be seen as intrinsically motivated.

It is unlikely that all normative evaluation can or should be eradicated from different levels of educational systems. The grading of students is deeply rooted in

the educational system as a way to rank individuals and schools in terms of their performance, for instance for tracking students into different schools, or tracks within higher education. However, because of their potential unintended and undesirable side effects, investing heavily on normative evaluation of students' learning might not yield the best motivational outcomes.

A central component in learning motivation is value. This consists of the goals that the student has concerning the task, beliefs about the importance of the task as well as interest in it. The value component essentially deals with the student's personal questions of why he or she is doing the task (Pintrich & De Groot, 1990). As past research has indicated, mastery goals combined with meaningful and interesting tasks result in more cognitive activity, meta-cognitive strategy use, better effort management, and higher transfer of knowledge between tasks (Ames & Archer, 1988; Meece et al., 1988; Dweck, 1986).

The outcomes of individual interest on learning have likewise been found to be positive. In their meta-analysis Schiefele, Krapp & Winteler (1992) combined the results of over 150 individual studies that were conducted in different contexts, ranging from mathematics and science learning to arts and music. Their results showed that individual interest was positively correlated with both natural science topics and, social science and humanities topics. However, a noteworthy observation here is that interest, especially in its most individual form, is not a general attitude towards learning but a domain-specific orientation towards a certain subject-area (Schiefele et al., 1992). In this respect it differs from goal orientations which are conceptualized as the purposes of behavior in a competence-related setting (Midgley, Kaplan & Middleton, 2001).

3 Interest

3.1 Interest research background

Research on how interest relates to learning began on a larger scale in the 1970's and by 1980's it had already been recognized as a noteworthy factor in the field of motivation research. Researchers such as Suzanne Hidi, Ann Renninger, Mary Ainley, Judy Harackiewicz, Andreas Krapp, Manfred Prenzel and Ulrich Schiefele, among others had started to publish papers that dealt with its different aspects. One particular research tradition, and that which is referred to in this dissertation, owes its origins to the seminal book edited by Renninger, Hidi & Krapp (1992). In it they for the first time drew together research conducted both in Europe and in North America in order to form a coherent picture of what was going on in the field as a whole. The book addresses topics such as how interest can be defined and conceptualized, how it relates to other motivational factors and learning, and how does it develop over time. It also distinguished between three different approaches how interest had been operationalized in the research literature at that time. On one hand interest could be viewed as characteristics of the person, an individual disposition to be interested in something. On the other hand, interest could be seen as characteristics of the learning environment; interestingness of a material or a text. Lastly, interest could be viewed as a psychological state within the person that actualizes in a situation. This theoretical tradition has since then expanded in both width and depth and remains as viable and topical as 30 years ago. Especially the division between situational and individual interest has proven to be useful in empirical educational research. Interest can explain on one hand, why people are willing to engage in certain topics, subjects or contexts, and on the other hand, why people want to withdraw from certain topics, subjects or contexts (Krapp & Prenzel, 2011; Renninger & Hidi, 2011). Engagement refers to the extent to which a person is actively involved with these topics or contexts, and 'active involvement' suggests that the person acts to maintain or extend his or her contact with the topic or object in order to increase their knowledge of it (Ainley, 1993).

In this dissertation the focus was on interest development so the chosen framework was the four-phase model of interest development (Hidi & Renninger, 2006; Renninger & Hidi, 2011). It describes the level of interest on a continuum that

has a situation-specific, temporally short-lived arousal of interest on one side, and a stable, long-lasting interest on the other. In the model these two different types of interest are called situational and individual interest, and they are further divided into two phases. The first phase is called triggered situational interest and the second one maintained situational interest. Situational interest is thought to arise when something in the situation grabs the person's attention and it may fluctuate during and between situations. It refers to a state of focused attention and affective reaction that takes place in a moment and either lasts or does not last throughout that moment. Situational interest does not necessarily depend on the person's prior knowledge about the topic but is linked to extrinsic factors in the situation (Hidi & Renninger, 2006; Renninger & Hidi, 2011).

Individual interest, then, can be seen as a more stable tendency for a person to be interested in a certain topic or domain. It relies more on the person's values and cognitive factors, such as acquired knowledge, and stretches from one situation to another. Here, the activity itself does not necessarily trigger the engagement, but the person's prior experiences of value and enjoyment in the context as well as acquired knowledge determines the level of interest (Ainley, 2012). When a person is individually interested he or she engages the content or activity on his or her own will despite it may sometimes require significant amounts of effort or cause occasional setbacks. Re-engaging the content produces not only positive emotions but also creates the sense of learning and growing value for that person.

3.2 The four-phase model of interest development

By definition interest can be described as a psychological state or a motivational predisposition to engage and re-engage with distinct classes of objects, events, or ideas over time. It is a multidimensional construct that has affective, cognitive, and value components. It is generated when an individual interacts with the surrounding environment (Hidi & Renninger, 2006) and it is always related to a certain object (Krapp & Prentzel, 2011). This object can be various things; for instance, a concrete thing, a certain subject, a situation, or an activity. The relationship between the individual and the object may also be short-lived, or it can last over time. Interest has been conceptualized as a psychological state (i.e., engagement in something), or a reasonably stable feature in someone's personality (e.g., finding similar issues interesting in certain contexts) (Krapp & Prenzel, 2011). Renninger and Hidi (2016) define interest as a motivational variable which is associated with an individual's psychological state through physiology and neurology. The affective and epistemic aspects of interest are presumed to vary in amount and relation during the interest development process. The affective component is seen to play a bigger part in the early stages of interest development, where the individual's interest towards a task,

an object or an activity is triggered, and this initial affect can either be positive or negative. Later, when the person's interest has already been established the affect is primarily positive and supports the process of knowledge and value development (Renninger & Hidi, 2016). Interest can be an already existing interest, or a new interest that is triggered when something catches the person's attention in a learning situation.

In order to trigger situational interest the task has to have specific types of situational features that grab the learner's attention. If there is no existing interest relation between the learner and the task then something has to happen in the task in order to initiate activity in the learner (Ainley, 2012). Triggered situational interest can be described by the hook metaphor, in which the person's interest and attention becomes 'hooked' by certain features in the task. These task specific features then enable the person to spend time and effort to further continue engaging with the task. As Hidi and Renninger (2006) point out, in order for the triggered interest to be maintained and re-engagement to take place over time a person's feelings and value perceptions need to guide to that direction. Triggered situational interest is a psychological state of focused attention and an affective reaction to stimuli caused by certain features in the task. It may or may not last over time and does not necessarily require the person to have prior knowledge about the activity or the content (Hidi & Renninger, 2006). In a learning situation this phase of interest may manifest itself in the individual's temporary focus in the activity at hand. Certain task features work as triggers for the energy which the person then spends in engagement with the activity (Ainley, 2012). For example, the topic of the lesson might touch on something similar to the student's prior interests or the working method might be new and exciting. Although these first signs of interest might be strong it is not guaranteed that the interest will carry on to next time. Triggered situational interest is always situation specific and the formerly interesting topic or activity may lose its appeal over time.

It may also be that the student's interest does carry on to other occasions dealing with similar topics or activities. The student seems to engage the activity with pleasure and stays focused on the task at hand without any major changes in the learning situation. Hidi and Renninger (2006) call this phase maintained situational interest and it can be defined as being a psychological state of interest that follows from triggered situational interest and involves focused attention and persistence over time. Maintained situational interest is expected to reoccur in the person during a specific learning situation, evoke positive feelings, focused attention, and again persist over to the next time (Hidi & Renninger, 2006).

Individual interest, then, can be viewed as a more permanent positive orientation toward an activity or a domain that the person has value for. With individual interest it is not so much about the activity triggering the engagement, but the person's prior

knowledge and experiences of value and enjoyment in the activity that determine his or her interest (Ainley, 2012). Emerging individual interest refers to a psychological state of interest where the person seeks engagement with a certain content or activity over a longer period of time. Emerging individual interest is usually, although not always, internally generated and it builds on the person's prior experiences of positive feelings, stored knowledge and value (Renninger & Hidi, 2011). This state may then develop to a well-developed individual interest which is a relatively enduring predisposition for the person to engage the content or activity over time. It is a long-term orientation in which the person autonomously engages and re-engages the content despite having to spend lots of effort in it and experiencing occasional drawbacks in progress. At this stage, he or she is not only experiencing positive feelings but also has increased stored knowledge and value for the content in question. The more developed individual interest is, the more a person participates in self-regulated learning activities such as seeking answers to curiosity questions (Hidi & Renninger, 2006).

3.3 Contextual predictors of interest development

From the teacher's point of view, knowing how to adjust teaching so that it helps to support the uninterested students would be essential. In this endeavor, certain types of tasks or activities might be more useful to trigger students' interest and enable it to develop even further. In their review Renninger & Hidi (2011) concluded that in the tasks and activities that have been found to support interest development, novelty, challenge and the role of others were found to be important characteristics. In addition, educators can enhance the support for students' interest development by offering them goals in which they, for example assume the role of an expert, and participate in the activity as a part of a group or a community. These features fit well in to the idea of inquiry-based learning which makes use of students' active discovery of new relations, formulation of hypotheses and testing them through experimentation (Pedaste, Mäeots, Leijen & Sarapuu, 2012).

Recent research has acknowledged the relation of interest and situational features for science learning and problem solving. Previous studies have found several factors that have the possibility to trigger interest in a learning situation as well as differences in the way certain triggering features work depending on the learner's personal characteristics. In their study with middle school students, Durik, Hulleman, and Harackiewicz (2015) found that superficial situational enhancements such as bright colors and engaging pictures triggered situational interest in science and mathematics in those students who had less individual interest in the subject domain. For those students who had higher levels of individual interest the superficial enhancements were actually hindering situational interest and they

benefited more from instructional cues that emphasized the utility value of the learning content.

In a study conducted in the context of high school science classes, Palmer (2004) reported that students' experience of task novelty, meaningfulness and involvement were key factors to triggering situational interest. In a later study Palmer (2009) also reported a somewhat unexpected finding, namely that learning itself was a major source of interest for students participating in an inquiry learning activity. This he explained to be caused by the experience of novelty that students have while they are learning something new. In addition, physical activity as well as social involvement was found to be among the factors that contributed to triggering interest. Indeed novelty, along with challenge and the role of others, has been found to be an important interest generating feature in various learning activities and tasks (Renninger & Hidi, 2011).

The use of digital devices and learning environments in education has been thought to increase students' interest, especially in the field of science and mathematics learning. In the context of digital learning environments, Tapola, Veermans, and Niemivirta (2013) reported that concrete rather than abstract computer simulations promoted ratings of situational interest in science. Knogler, Harackiewicz, Gegenfurtner and Lewalter (2015) traced trajectories of situational interest in different phases of a problem-based game scenario, which showed that the variation in situational interest is more explained by the extrinsic factors of the learning situation than by individual interest. However, it is still unclear whether these types of pedagogical approaches or tools would have positive outcomes in students' long-term interest. These and other findings (e.g., Rotgans & Schmidt, 2011) illustrate the need for research that would focus on when and how triggers work, and on how the different components of interest are related to the different phases (Renninger & Hidi, 2011) especially in science learning context, since in prior research literature inquiry-based learning has been found to positively relate to achievement and interest in science learning (Renninger et al., 2014). Ainley and Ainley (2015) conclude that besides just addressing the issue by designing new curriculum content and presentations, students should also be offered the chance for early experiences in science. By doing so, students' interest development is supported, not just through triggered situational interest to maintained, but further to the future.

3.4 Interest in science and mathematics

Students' interest to study science topics or pursue science-related careers has been reported to be in continuous decline by different international studies (Rocard et al., 2007; OECD, 2006; Martin, Mullis, Foy & Hooper, 2016). The general trend in the

findings of these studies seems to suggest that the decline is at its height towards upper secondary school, although the results vary between different science domains. Reasons behind this downward development appear to be diverse, and Krapp and Prenzel (2011) propose three possible explanations for it. These are its dependency on the quality and the type of instruction offered in schools, the psychological demands of adolescent life, and the mismatch between student's ideal self-concept and science learning. It might be that the school's organization, curriculum or environment does not support students' interest development. It may also be that in general students' are going through a phase in adolescence where coping with other developmental tasks get prioritized over academic learning. Lastly, it may also be that as a part of their search for own identity, students' come to the conclusion that science is not an ideal part of that and hence differentiate their interest from it. In this study the emphasis is on the first mentioned aspect, meaning that we are interested in the instructional, aspects of school learning that may influence students' interest generation.

3.5 Connections between task mastery and individual interest

In their work Schiefele, Krapp & Winteler (1992) make a distinction between three different factors that are usually thought to predict academic success. These three factors are cognitive abilities, such as verbal ability, general motivational factors, such as achievement motivation, and specific preferences for particular subject areas, which are typically referred to as interests. Of these three factors, cognitive abilities have been found to explain most of the variance in academic achievement, but as Schiefele et al. (1992) note, also the non-cognitive factors play a major role in learning situations, especially when looked at simultaneously with the cognitive factors. Since then, research on achievement motivation and interest has progressed and current research literature usually acknowledges the importance of several non-cognitive factors (i.e. self-perceived ability, value of learning) to learning. As one such non-cognitive factor, interest has been found to have positive outcomes in academic achievement especially when looked at from a long-term perspective. The benefits that students' gain from increased interest in learning include i.e. more positive affect, value, and knowledge gains in the learning activity (Hidi & Renninger, 2006). Interest has also been found to predict students' later choices for careers in the science domain (Maltese & Tai, 2010) and to have reciprocal relationship with mastery goals over time (Harackiewicz, Durik, Barron, Linnenbrink-Garcia & Tauer, 2008). Based on these findings it seems that mastery-oriented students' do not just exhibit more interest towards the learned topic, but that initial interest may help students to adopt and maintain mastery orientation.

This in turn may deepen the mastery-oriented students' initial interest as they engage the learning material more deeply and learn about the topic. To conclude, students' mastery goals can be seen to both be produced by interest and also to predict it and function as a mediating mechanism towards further interest development in the learned topic (Harackiewicz et al., 2008).

4 Aims

One of the main aims of study I was to clarify how the three basic goal orientations, mastery, performance-approach, or performance-avoidance were connected to learning in adult population. Results from study I, a meta-analysis bringing together 18 empirical studies on the topic of goal orientations and training transfer, indicated that mastery orientation was the main or the only sizable predictor of training transfer in adult educational context. These results were found to be unaffected by the length of the training or the time lag between training end and when transfer was measured.

As previous literature has found that many students experience a decline in their mastery orientation especially during the transitioning from elementary to middle school (Anderman & Midgley, 1997; Shim, Ryan & Anderson, 2008), this transitioning phase was chosen as the focus point of study II. The logic behind this choice was to concentrate on the age group which, on one hand, is sensitive to changes in achievement strivings, and on the other hand, might still be open to develop a mastery-orientation with the right kind of support.

However, as goal orientations are conceptually viewed to be a more general tendency towards learning, and because previous research has shown that students of that age are already starting to differentiate in terms of their interests (Krapp & Prenzel, 2011), such educational interventions that aim to increase students' interest might provide an indirect route towards fostering their mastery-orientation through increased intrinsic motivation.

Study II was a longitudinal intervention study where the study context involved an inquiry based mobile learning environment. The aim for this study was to explore if an inquiry-based mobile learning environment can affect domain specific interest generation and development in science and mathematics in secondary education.

The findings from study II indicated that there were some changes taking place in students interest levels during the school year, but the new inquiry learning environment had not significantly improved the experimental groups' students' interest in learning science. In the absence of clear effects in Study II, Study III took a different approach to look at the data from the longitudinal intervention study. Study III looked more specifically at the relation between interest and students'

grades as this may provide insights on how formative assessment may influence students' interest. The particular interest was set in how students' individual interest and grades covaried during their first year in secondary school. Findings from study II had indicated that students' interest levels experienced changes during the school year, but the new environment had not produced that kind of clear positive effects that had been hoped for. Since individual interest has been found to correlate with mastery-orientation (Harackiewicz et al., 2008) we were interested to see how students' interest develops over time as they receive feedback information on their skill levels in the form of grades. The aim was to examine the predictive relationships that students' interest had with their level of performance.

To complete these aims, the present study used different approaches in contexts of both adult and secondary education. Learning in its different forms was included in studies I and III whereas Study II concentrated more on affective factors and students' own accounts of their experiences in the new learning environment. All of the three studies focused on learning motivation; Study I on achievement goal orientations, and Studies II and III on interest. One common nominator for all of the studies was time. Each of the studies addressed the questions of change, stability, and development in motivational variables over time. In Study I the measurement time varied because the sample was compiled of several different empirical studies, and in studies II and III the time span was 9,5 months, which is the length of a school year.

5 Methods

This dissertation comprises of three studies in which different methods were used to clarify different aspects of learning motivation. All three study settings include, in one form or another, a longitudinal perspective and the methods used range from meta-analytical review on previous research literature to cross-sectional data analyzed on the individual level. The meta-analysis conducted in Study I revealed that the relationship between training transfer and achievement goal orientations is relatively stable in an adult population and this led us to concentrate more closely on the individual level processes in younger learners. For this purpose, we applied a mixed methods approach for Study II which combined quantitative data collected over three time points to focus group interviews. In Study III the quantitative data analysis was taken further by constructing a partial least squares (PLS) structural equation model to determine predictive effects between students' interest and learning outcomes in different subjects. First part of the data consisted of separate studies conducted in different parts of the world during a 30 year time period. This gave us a more reliable estimation of the true population value between achievement goal orientations and transfer. The second part of the data was collected from a Finnish secondary school as a part of the same research project. Careful planning of the data collection visits made it possible to minimize the disturbance for the school and at the same time make sure that the there was sufficient amounts of data collected.

5.1 Participants

Study I

The first study located studies published between 1983 and 2012, which had reported on the relationship between achievement goal orientations and transfer of training. Meta-analytic methods were used to psychometrically correct the population correlation estimates for sampling error and error of measurement. In total 17 studies were included in the analysis totaling to 2917 participants. Participants were undergraduate students (k = 6; 35.29%) or were employed in academic (k = 2;

11.75%), non-academic (k = 5, 29.41%), or other/mixed professions (k = 4; 23.53%). Table 1 shows age, gender, and organizational tenure as a function of training group.

Table 1. Number of Studies, Participants, and Demographic Characteristics by Training Group

			Age[1]		Gender[2]		Tenure[1]	
Training group	*K*	*N*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Undergraduate students	6	1,001	24.77	4.58	58.00	26.06	0.00	0.00
Academic professions	2	242	36.00	8.49	20.29	23.17	3.90	0.00
Non-academic professions	5	1,178	35.92	3.39	23.42	27.68	10.35	0.00
Mixed / Other	4	496	29.63	10.56	10.50	14.85	1.67	1.15
Total	17	2,917	31.57	7.61	23.67	24.43	4.83	4.21

Note. [1] in years; [2] percentages of females.

Study II and Study III

Participants in Study II were 131 7th grade students (69 girls and 62 boys, aged 12–13 years) from seven classes at one lower secondary school in Southern Finland. One class (N = 18) had been chosen by the school to undergo classroom teaching using only digital learning tools, and these students formed the experimental group in a quasi-experimental research design. The remaining students (N = 113) continued to receive more traditional teaching using materials such as books, notebooks, and handouts. From the remaining 113 students 18 propensity score-matched students were selected as the control group. The main idea behind the propensity score matching was to create matching pairs for each experimental group's student based on their initial motivational profiles at the beginning of the school year. This ensured that each student from the digital learning group had a counterpart with a similar profile at the beginning of the school year. The defining variables used for matching were general self-efficacy, intrinsic goal orientation, interest in technology, and web-user self-efficacy. By matching each experimental group's student with a controlling pair at time 1 measurement point enabled us to compare their development through measurement times 2 and 3 and reduce the risk of variance caused by other motivational factors.

Participants in Study III consisted of the same students that were used for the propensity score matching in Study II. The number of participants had to be reduced from the original 113 students to 104 because of missing data on one of the three time points. Gender distribution among the participants was 53 girls and 51 boys and their age ranged from 12 to 14 during the duration of the study.

5.2 Measurements

Literature searches and criteria for inclusion

Studies that were included in the meta-analysis were collected in a database. All the studies described training programs of professional skills, and all other kinds of training programs were excluded. Studies that reported data on individuals were included, and those studies that reported only group-level data were omitted. We included studies if information on time lag and training length were clearly stated. Finally, the included studies had to be field studies; studies that tested experimental conditions were omitted because these manipulations add artificial variance and, thus, findings would be confounded. Although experimental conditions were coded separately, there was not enough similarity across conditions to allow meta-analytic synthesis. Studies published over a 30 year time period, from January 1983 to December 2012, were located in several ways. First, those were searched through the PsycINFO, Google Scholar, and Web of Science databases using relevant keywords. Keywords were (a) for achievement goal orientations: mastery orientation, learning orientation, performance orientation, performance-approach orientation, avoidance orientation, performance-avoidance orientation, achievement goals, and achievement goal orientations, and(b) for transfer: behavior change, training application, training use, transfer of learning, transfer of training. In a second search we located studies that cited the articles retrieved. Finally, we searched for additional studies in the list of references (a) of those articles that were previously retrieved and (b) of recent narrative reviews of motivation and transfer in professional training (Aguinis & Kraiger, 2009; De Rijdt, Stes, Van der Vleuten, Dochy, 2013; Ford, Smith, Weissbein, Gully & Salas 2010; Gegenfurtner, Veermans, Festner & Gruber, 2009; Gegenfurtner, Festner, Gallenberger, Lehtinen & Gruber, 2009).

Coding of achievement goal orientations and transfer of training

Study I aimed firstly to psychometrically correct the population correlation estimates between achievement goal orientations and transfer of training for sampling error and error of measurement. The second aim was then to estimate the effects of time lag and training length on the relationship between achievement goal orientations and transfer of training. To be able to do this, the studies that were included in the meta-analysis had to report an effect size r or other effect sizes that could be converted to r (b coefficient; Cohen's d; F, t, or Z statistics).

Each study was coded for effect size estimates, time lag, and training length. (a) Recorded effect size estimates included Pearson's product-moment correlation r of the relationship between transfer of training and one of the three achievement goal

orientations, Cronbach's reliability estimate α of the independent variables (the three achievement goal orientations), and Cronbach's reliability estimate α of the dependent variable (transfer of training). We also coded the first author; publication year; and the number of participants of each study. (b) The time lag between the end of training and the transfer assessment was coded as the number of weeks. (c) The length of the training program was coded as the number of days. Two independent raters first coded a random subset of five (29.41 percent) of the included studies. Because intercoder reliability was generally high (Cohen's k = .92), one rater continued to code the remaining studies.

Study II

Study II used a quasi-experimental design to compare whether lower secondary school students in a new learning environment differed from their counterparts in the regular learning environment. The experimental group's students studied in an inquiry-based mobile learning environment that aimed to increase students' engagement in science learning and contribute positively to their interest development as it has been found to do in previous research (Renninger et al., 2014). In order to examine how students' domain-specific interest is generated and develops during the school year, both quantitative and qualitative data were collected from the students. Quantitative data was collected three times during the school year through self-report questionnaires. The first measurement time (time 1) was at the beginning of the school year. After this initial measurement, day-to-day classroom work went on uninterrupted, and teachers and students were free to implement the learning environment as they saw fit. The second measurement time (time 2) was four months after the start of the school year, and the third time (time 3) at the end of the school year, nine months after the start.

In addition to the questionnaires, the experimental groups' students were also interviewed twice during the school year. This was done in order to gain a better insight on the aspect that may have influenced their interest in the new learning environment. The interviews were carried out in groups of four or five, and they took place two months after the start of the school year (time 1,5) and at the end of the school year (time 3). The first interview time was decided to be placed in the middle of the autumn semester, because the students would by then already have sufficient amount of experience with working in the learning environment. The time period was considered short enough to enable recall of aspects of the learning environment perceived as interest-generating, and long enough for differences in interest to emerge. The second interview time was natural to place at the end of the school year when the students could reflect on their experiences throughout the whole school

year. The interviews at this time also coincided with the collection of the last set of questionnaire data.

Focus group interviews

The interviews were designed on the principles of stimulated recall, first asking students to describe an event or topic that they remembered from their studies during the past semester. Follow-up questions would then explore what had been of particular interest, and why, with additional emphasis on cross-curricular and inquiry learning elements in the students' responses. Students were also asked to identify elements that they felt had not worked, and to propose how the learning environment could be further developed.

Domain-specific individual interest

An instrument from Tapola et al. (2013) was used to assess students' domain-specific individual interest in the science domain. The instrument measured interest in three subjects (mathematics, chemistry and physics, and biology) for a single item on a five-point scale, ranging from 1 (not at all interested) to 5 (very interested). An example item would be "How interested are you in mathematics".

Interest in technology and interest in collaboration were measured for five items on five-point scales ranging from 1 (not at all interested) to 5 (very interested), with two reversed items in each. Example items for both respectively would be "I find working with technology interesting", and "Working together with other students is interesting".

Individual characteristics

Students' intrinsic goal orientation and self-efficacy for learning and performance were measured using selected scales from the Motivated Strategies for Learning Questionnaire (Pintrich, Smith, Garcia & McKeachie, 1991). Intrinsic goal orientation (e.g. In a class like this, I prefer course material that really challenges me so I can learn new things) was measured for four items, and self-efficacy for learning and performance (e.g. I'm certain I can understand the most difficult material presented in the readings for this course) was measured for eight items on a seven-point scale. In addition, students' web-user self-efficacy was measured using a modified version of the WUSE scale (Eachus, Cassidy & Hogg, 2006). The instrument consisted of 14 items, measured on a five-point scale from 1 (strongly disagree) to 5 (strongly agree) (e.g. I would never try to download files from the internet, that would be too complicated).

Study III

In Study III used the same individual interest measures as in Study II, with the exception of interest in physics and chemistry. These were left out because the teaching in those subjects took place at different times during the school year meaning that not every student would have had studied them during each measurement time.

Individual interest

An instrument from Tapola et al. (2013) was used to assess students' individual interest in mathematics, and biology. To measure interest in mathematics, a single item was used ("How interested are you in mathematics") with a five-point scale, ranging from 1 (not at all interested) to 5 (very interested).

Learning outcomes

Students' learning outcomes were measured by grade level evaluation after each semester on time points 2 and 3. Grade evaluation was done by the subject teachers and was based on students' learning and performance throughout the whole duration of each semester. Students' skill and knowledge levels were indicated by grades from 4 (failed) to 10 (excellent).

5.3 Statistical analyses

Various statistical analyses were used in each of the three studies. SPSS statistics 21 or prior was used to conduct all the analyses in studies I and II, and the structural equation models in Study III were modelled using the WarpPLS software.

Table 2. Statistical analyses used in the three sub-studies

Statistical Analysis	Study	Purpose
SPSS		
Cohen's kappa	I	To check for inter-rater reliability between two independent coders
Descriptive statistics	I, II	To give a more detailed description of the studies included in the meta-analysis
Correlation analyses	III	To determine the correlational relationships between interest and learning over the three measurement points
Pearson product-moment correlation coefficient rho	I	To estimate the true score population correlation between achievement goal orientations and training transfer based on the values of Pearson's r and corrected for sampling error and error of measurement
Weighted least squares multiple regression	I	Meta-analytic moderator estimation aimed to identify moderator biases caused by the effects of training length and time lag on the population correlation estimates
Paired sample t-test	II	To compare students' interest levels within and between the digital learning group and the propensity score-matched traditional learning group
Repeated measures ANOVA	II	To compare students' interest development over the three measurement times within both conditions
WarpPLS		
Partial least squares structural equation modeling	III	To test the hypothesized path models for how much interest and grades predict each other

Cohen's kappa

In Study I the objective was to locate studies that reported on goal orientations and transfer of training from a period of 30 years and include those into the meta-analysis. For the meta-analysis certain statistics needed to be extracted from each study and coded to a separate database. These statistics included (a) Recorded effect size estimates included Pearson's product-moment correlation r of the relationship between transfer of training and one of the three achievement goal orientations, Cronbach's reliability estimate α's of the independent variables, namely the three achievement goal orientations, and of the dependent variable, namely transfer of training. We also coded the first author; publication year; and the number of participants of each study. (b) The time lag between the end of training and the transfer assessment was coded as the number of weeks. (c) The length of the training program was coded as the number of days. In order to avoid bias in the coding

process, two independent raters first coded a random subset of five (29.41 percent) of the included studies. Cohen's kappa was used to estimate the inter-coder agreements between the two coders.

Descriptive statistics

In Study I descriptive statistics were used to give a more detailed description of the studies that were included in the meta-analysis database. The number of studies, participants, and demographic characteristics by training group were reported in a table. In Study II line charts were used to illustrate the mean level changes in students' interest levels during the school year.

Correlation analyses

Study II aimed to examine how students' individual interest in science subjects relate to their learning outcomes in those subjects. One way to do this was to look at the correlations between the interest measures and grades. Although correlational data can not reveal causal connections between variables it can supplement the results obtained from the structural equation model analyses. Correlations between the same measurements through the three measurement times could give us information on the stability of the constructs over time. In addition correlations between interest measures and grades could indicate whether they were connected or not.

Pearson product-moment correlation coefficient rho

In the meta-analysis of Study I we aimed to estimate the true score population between transfer and each of the three achievement goal orientations. For this, each individual study that was included in the meta-analysis had to report either Pearson's product-moment correlation r of the relationship between transfer of training and one of the three achievement goal orientations, or other effect sizes that could be converted to r such as β coefficient, Cohen's d, F, t , or Z statistics. First, the distribution of Pearson's r was corrected for sampling error, and then further corrected for error of measurement using the compiled Cronbach's a reliability estimates of the independent variables and the dependent variable (the three achievement goal orientations, and transfer of training respectively). This last step provided the final estimate of the true score population correlations r between the three achievement goal orientations and transfer of training. Finally, standard deviations of the corrected observed correlation r_c and of the population correlation ρ were calculated; these were used to derive the 80% credibility interval around ρ.

Weighted least squares multiple regression

In Study I the meta-analysis was conducted in two phases. In the second phase a meta-analytic moderator estimation aimed to identify moderator biases on the population correlation estimates. We estimated the a priori hypothesized effects of training length and time lag using weighted least squares (WLS) multiple regression. This method was chosen because, when estimating continuous moderators, WLS tends to be largely unaffected by multicollinearity and converges toward the true moderator effect size more reliably compared with other meta-analytic moderator test procedures. All calculations were based on the assumption that the population parameter value r vary from study to study, so we used a random-effects model to obtain realistic estimates of the width of the confidence intervals.

Repeated measures ANOVA and Paired sample t-test

In Study II a repeated measures ANOVA (analysis of variance) used to establish how the digital learning group's students' mean levels of domain-specific interest varied between the three measurement points. Since ANOVA detects differences in the mean levels throughout the whole time period but not between independent time points, a paired sample t-test was conducted to locate more accurately where the changes took place. Following repeated measures ANOVAs, statistically significant differences were compared separately for each time point, using independent samples t-tests.

Partial least squares structural equation modeling

Study III aimed to determine the predictive relationships between interest measures and learning outcomes over three measurement points. For this purpose we chose partial least squares structural equation modeling (PLS-SEM) as the method of analysis. PLS-SEM allows directional examination between different constructs in the model and for that reason offers a possibility to examine predictive effects between them. Unlike more traditional structural equation modelling techniques PLS can be applied when the sample size is small and normality estimations are violated. It is an approach which allows for predicting relationships between different factors in a model, and differs from SEM in that it does not assess overall model fit (Hair, Hult, Ringle & Sarstedt, 2017). PLS-SEM can be seen as an especially useful approach when the aim is to develop theory that has not yet been very much tested and when the main emphasis is on predicting and explaining the target constructs (Rigdon, 2012).

6 Overview of the Studies

6.1 Study I

Laine, E., & Gegenfurtner A. (2013). Stability or change? Effects of time lag and training length on achievement goal orientations and transfer of training. *International Journal of Educational Research 61*(1):71-79. doi:10.1016/j.ijer.2013.03.014

This study used meta-analytical methods to draw together 30 years of research conducted on the relationships between achievement goal orientations and transfer of training. Of particular interest was to examine how different achievement goal orientations influenced transfer of training, and whether these influences were in turn affected by the length of the training program or the time lag between the end of training and transfer measure. Previous research literature had arrived at heterogeneous and disagreeing results and the aim of this study was to estimate the true population correlation estimate between achievement goal orientations and transfer of training, when corrected for sampling error and error of measurement.

For the meta-analysis studies that reported correlations between goal orientations and transfer were located. To be included in the analysis, a study had to report an effect size of *r* or other effect sizes that could be converted to *r*. Included were studies that described training programs of professional skills, and that reported data on individuals. The studies had to clearly state information on time lag and training length and had to be conducted as field studies; experimental study conditions were omitted because of the risk of introducing artificial variance to the data.

Studies published over the last 30 years were located first by searching the PsycINFO, Google Scholar, and Web of Science databases using relevant keywords. The used keywords for achievement goal orientations were: mastery orientation, learning orientation, performance orientation, performance-approach orientation, avoidance orientation, performance-avoidance orientation, achievement goals, and achievement goal orientations. Keywords for transfer were: behavior change, training application, training use, transfer of learning, transfer of training. Second, we searched for articles that had cited the already retrieved articles. Third we

searched for additional studies in the list of references of those articles that were previously retrieved and also of recent narrative reviews of motivation and transfer in professional training (Aguinis & Kraiger, 2009; De Rijdt et al., 2013; Ford et al., 2010; Gegenfurtner, Festner, et al., 2009; Gegenfurtner, Veermans, et al., 2009). A total of 17 publications that contributed at least one effect size to the meta-analysis were included in the database. Each study was coded for effect size estimates, time lag, and training length. The time lag between the end of training and the transfer assessment was coded as the number of weeks. The length of the training program was coded as the number of days.

The 17 studies that were included in the analysis totaled 38 effect sizes from 2917 participants. Participants were undergraduate students (k = 6; 35.29%) or were employed in academic (k = 2; 11.75%), non-academic (k = 5, 29.41%), or other/mixed professions (k = 4; 23.53%). All 17studies reported information on time lag; the mean time lag was 8.71 weeks (SD = 10.44). A total of 13 studies reported information on training length; of these studies, the mean training length was 37.62 days (SD = 100.21).

Results of the primary meta-analysis revealed that the population correlation estimate between mastery goal orientation and transfer was r = 0.40 (SD = 0.17; 80% CV = .18; .62), between performance-approach goal orientation and transfer was r = 0.02 (SD = 0.22; 80% CV = -.27; .31), and between performance-avoidance goal orientation and transfer was r = -0.12 (SD = 0.23; 80% CV = -.41; .17). The meta-analytic moderator estimation tested the effects of time lag, training length, and the combined effect of time lag and training length. Sample size-weighted mean effects of time lag on the correlation between the three achievement goal orientations and transfer of training. Analysis showed non-significant effects in all three dimensions. The results were also non-significant in all three goal orientation dimensions with training length, and the combined effect of time lag and training length. This indicated that the results obtained in the primary meta-analysis were unaffected by temporal factors.

6.2 Study II

Laine, E., Veermans, M., Lahti, A., & Veermans, K. (2017). Generation of student interest in an inquiry-based mobile learning environment. *Frontline Learning Research 5*(4):42-60. doi: 10.14786/flr.v5i4.306

This study reports the development of mathematics and science interest of 18 secondary school students from Southern Finland, aged 12-13 years, and their 18 propensity score matched counterparts drawn from a total sample of N = 113. The experimental group's students consisted of a single class that had been chosen to

receive teaching using only digital learning tools. The remaining students (N = 113) continued to receive more traditional teaching using materials such as books, notebooks, and handouts. From these 113 students a control group of 18 students were chosen based on their initial motivation at the beginning of the school year. The selecting was done by using propensity score matching through which each of the 18 experimental group students received a counterpart with a similar initial motivational profile from the larger control group of 113 students. The defining variables used for matching were general self-efficacy, intrinsic goal orientation, interest in technology, and web-user self-efficacy. The aim was to take a more student-centered approach on how and when changes in interest start to occur, and how much of the development can be accounted for using digital devices and inquiry-based pedagogies in the class. For that, questionnaire data was collected from all the students (N = 131, 69 girls and 62 boys) at the beginning of the school year (time 1), four months after the start of the school year (time 2), and at the end of the school year, nine months after the start (time 3). In the questionnaires the students were asked to rate their interest three subjects (mathematics, chemistry and physics, and biology) for a single item on a five-point scale, ranging from 1 (not at all interested) to 5 (very interested). In addition, the experimental group's students were interviewed twice in focus group interviews during the school year in order to get a better understanding of how aspects in the new learning environment had influenced their interest in learning science and mathematics. A special emphasis in the interviews was put on cross-curricular and inquiry learning elements in their teaching.

A repeated measures ANOVA was conducted to determine whether interest variables, motivational variables, and school grades differed significantly between the two groups. The results showed a significant effect of classroom condition on interest in physics and chemistry. This meant that the experimental group's interest in physics and chemistry was higher than control group's at the beginning of the school year, but declined during autumn semester. During the same time period control group's students' interest increased and the both groups ended at similar values at the end of autumn semester at time 2. During spring semester both groups' interest declined slightly, but the experimental group's did so to a lesser extent. Beyond this, there was no evidence of statistically significant differences between the groups' in interest in technology, interest in collaboration, interest in mathematics, or interest in biology. Similarly, no differences were found in the development of students' intrinsic goal orientation, general self-efficacy, or web-user self-efficacy. The only significant difference between the two groups related to interest in physics and chemistry.

During the focus group interviews, experimental group students identified several features in the learning environment that they found to be interest-

generating; these were integration, illustrativeness, learning tools, hands-on activities, ability to use the digital material outside classroom, and versatility. Versatile use of learning materials was mentioned most often as interest generating feature of the environment and activities performed outside of classroom were the second often mentioned feature. After identifying things they had found interesting during their studies, students in the experimental group were asked to elaborate on why these things were interesting. In the analysis, these were categorized as components of interest. The students' answers included features such as ease of use, working with the environment as nice or fun, being able to collaborate with other students, and having autonomy over their own learning. Most often the students mentioned that the fact that the environment was easy to use was generating their interest. In general, students found the mobile learning environment to be interest-generating, with particular reference to the following specific features: 1) the possibility of integrating different school subjects; 2) the ease of use of the learning software; 3) the ability to take learning outside the classroom; and 4) the increased possibilities for learning collaboratively. Students referred to all four features on both occasions which indicate that there was no sign of a novelty effect wearing off during the one year period. However, despite mentioning several interest generating features and aspects in the learning environment, the digital learning group's students' interest in physics and chemistry declined significantly during the first half of the school year. This seemed to indicate that the new learning environment may not had been implemented to make the best use of the principles of inquiry learning and to take into account the pedagogical demands of mobile learning.

Indeed students mentioned some critical remarks related to the new learning environment during the time 2 interviews. These remarks could be divided into two broad categories, namely pedagogical shortcomings in implementing the environment, and technological challenges. The pedagogical shortcomings manifested for example in the teacher's way of utilizing the tablet computer and its applications in a minimal way, merely replicating ordinary classes with books, notebooks and handouts.

Although this study did not directly address the issue of whether interest influences learning outcomes, the interviews raised some interesting notions. Some students felt that the activities completed in the mobile learning environment helped them to memorize the material better than when reading from books. Their reflections seemed to indicate their ability to use metacognitive skills to assess their learning strategies, and suggested their preference for the new environment. Thus, a second study was conducted (Study III) which concentrated more closely on the relationship between interest and learning outcomes. The participants in this study consisted of the same students that were the control group in Study II.

6.3 Study III

Laine, E., Veermans, M., Gegenfurtner, A., & Veermans, K. (2019). Individual interest and the learning of biology and mathematics in secondary school science education.

In this study we took a closer look at those 7th grade students who functioned as the control group in Study II. The aim was to explore longitudinally how their individual interest relates to their learning outcomes in mathematics and biology during a school year. Unlike the experimental group in the previous study, participants in this study did not take part in the mobile learning environment but received teaching in ordinary way using materials such as books, notebooks, and handouts. This gave us the opportunity to observe their interest development during the school year without adding possible artificial variance to the results caused by the intervention. 9 cases had to be excluded because of missing data on one of the three time points, leaving the total number of participants to 104 (53 girls, 51 boys).

To answer the research question of what is the relationship between interest and learning in mathematics and biology education, three set of hypotheses were constructed. In the first group of hypotheses based on previous research literature (Hidi & Renninger, 2006; Ainley, Hidi, & Berndorf, 2002), interest was expected to predict learning. These were called *the standard hypotheses*. Second, based on the findings by Rotgans & Schmidt (2017), learning was expected to predict interest. For this we formulated the so-called *affective by-product* hypothesis. The third set of hypotheses were based on the idea that knowledge and interest may influence each other reciprocally. In other words, interest would initially cause learning to take place, and as consequence increased knowledge would in turn cause interest to increase (Rotgans & Schmidt, 2017). To test this we formulated *the reciprocal hypotheses.*

The study setting was longitudinal, following the same students through their first year of secondary school. Data collection occurred at three time points. Time 1 was at the beginning of the fall semester (0.5 months after starting the school year), time 2 was at the beginning of the spring semester (4.5 months), and time 3 was at the end of the spring semester (9.5 months). Students' interest in mathematics and biology were measured on all the time points, and their learning on time points 2 and 3.

An instrument from Tapola et al. (2013) was used to assess students' individual interest in mathematics and biology. To measure interest in mathematics, a single item was used ("How interested are you in mathematics") with a five-point scale, ranging from 1 (not at all interested) to 5 (very interested). Students' learning outcomes were measured by grade level evaluation after each semester on time points 2 and 3. Grade evaluation was done by the subject teachers and was based on

students' learning and performance throughout the whole duration of each semester. Students' skill and knowledge levels were indicated by grades from 4 (failed) to 10 (excellent).

In order to estimate how much students' interest predicted their learning outcomes, and in turn how much their learning outcomes predicted their interest, we constructed a partial least squares (PLS) structural equation model. It is a method similar to covariance-based structural equation models but instead of assessing overall model fit, PLS is an approach for predicting relationships in a model. This suited the design of this study well because the aim was to clarify the predictive relationships between interest and learning outcomes over three measurement points during a whole school year. Unlike other estimation techniques like multiple regression or structural equation modeling, PLS is usable with nonnormally distributed data and it is applicable to small sample sizes.

7 Main Findings and Discussion

The main aims of this dissertation were twofold. Firstly, the aim was to clarify how different ways to set goals in achievement settings relate to learners' transfer of knowledge and skills into practice. Study I was set in organizational training and higher learning contexts and the participants were either adults or late adolescents. Goal orientations were conceptualized using a trichotomous model that separated between performance-approach, performance-avoidance, and mastery goals. Mastery goals have been found to relate to positive outcomes on training transfer but findings on performance goals have been inconclusive (Chiaburu & Marinova, 2005; Tziner, Fisher, Senior, & Weisberg, 2007; Wilson et al., 2002; Maurer, Mitchell, & Barbeite, 2002; Orvis, Horn, & Belanich, 2009; Steele-Johnson, Narayan, Delgado, & Cole, 2010). In addition, the study aimed to determine whether the achievement goal–transfer relationship would change or remain stable across different training lengths and time lags between measurement points. Previous literature had been doing extensive research in the field of organizational training but these time related effects had not yet been addressed on a larger scale.

The second aim of this dissertation was formed partly based on the findings from study I. In study II the focus was shifted to younger learners and their interest development during their first year of secondary school. The study followed one class of students whose learning environment was built around tablet computers and inquiry-based pedagogy in science subjects.The study explored how students' interest developed during the first year of secondary school and what factors influenced these developments.

In Study I the main finding was that mastery goal orientation had a positive relation to training transfer. The results also revealed that performance-approach orientation did not have a statistically significant relation, and performance-avoidance orientation had a negative relation to transfer. The meta-analytic moderator estimation tested whether the relations between achievement goal orientations and training transfer varied depending on the length of each training program or the time lag between the end of training and the measurement time for transfer. This was found not to be the case in any of the three achievement goal orientations. This finding indicates that the relationships between a trainee's goal

orientation and his or her willingness to transfer the newly acquired skills and knowledge to the workplace are the same regardless of the training program's length. Similarly, the time lag between training end and when transfer was measured had no moderation effect on transfer, which meant that the relationships stayed the same independent of whether transfer had been measured immediately after the training or after a longer period of time.

The finding that mastery goal orientation had the highest relationship with transfer indicates that trainees with a mastery goal orientation are more concerned about improving their knowledge and skills and hence more open to productive use of training content to improve their practices. Performance-approach goal-oriented trainees and, even more so, performance-avoidance goal oriented trainees seemed to be somewhat more limited in their attempts to transfer training into practice. The key to this may lie in the way they view the transfer situation. Normative evaluation of one's performance may cause the trainee to limit probable sources of errors and threats to normative competence judgments. Performance-contingent rewards have been known to either enhance or reduce interest by providing either positive feedback or causing constraining behavior (Harackiewicz, Manderlink & Sansone, 1984; Harackiewicz, Sansone & Manderlink, 1985). Interest is usually seen as one facet of internally motivated behavior (Dweck, 1986) and it has been hypothesized to also increase motivation to transfer (Gegenfurtner, Veermans et al., 2009).

In Study II students' domain specific interest in science and mathematics overall remained at an average level throughout the school year and their interest in technology and collaboration remained high. This indicates that the new mobile learning environment had succeeded in engaging students to learn science. However, the most striking discovery was that the experimental group students' interest in physics and chemistry decreased during the school year and especially on the first half of it. This drop was paralleled by an increase of similar magnitude in students' interest in biology during the fall semester. The reason behind students' losing interest in physics and chemistry during the first half of the school year may at least partly be attributed to insufficient implementation of the new learning environment. This was also supported by the notion that students in the propensity score matched control group by contrast seemed to gain interest during the fall semester. The piloting project in the school had aimed to offer more engaging and interest generating study methods for the students by providing them with tablet computers and focusing on more inquiry-based pedagogies in science teaching. Clearly this aim had not been achieved completely and the implementation may have lacked in planning e.g. how to arrange instructional support, how and when to allow collaborative learning, and how to fully utilize the mobility of the learning environment.

Another possible explanation for fluctuating interest levels rises from the analyses of Study III. Although learning outcomes were not measured in Study II, in Study III they were and there interest predicted students' grades in mathematics and biology during the autumn semester. In spring semester the relationship seemed to shift so that grades were the predictor of subject interest at the end of the school year and interest had lost its predictive power towards learning outcomes. This means the theory-driven hypothesis of interest and learning outcomes, i.e. grades in this case, affecting each other reciprocally was not supported during the fall semester but during spring it was. This seems to indicate that the relationship between interest in the subject and students' learning gains did not stay the same throughout the school year. There was fluctuation in students' interest and grades over the school year which indicates that a period of transition was taking place during the research period of 9,5 months. It may be that during a period of transitioning when learners confront new circumstances that force them outside of their habitual social roles and invites them to reconsider and redefine their identities some interests gain importance and some become left on the background (Krapp & Prenzel, 2011). Later on, when the learner has received competence-related feedback, for example in the form of grades, his or her self-perceptions become more stable. Indeed, very early on in motivation research the mere presence of evaluative contingencies in a task were seen to potentially reduce interest because they would initiate controlling processes in the learner (Harackiewicz et al., 1985).

When looking at the findings from all the three sub-studies, the findings highlight the importance of supporting students' mastery goals. Designing learning environments and activities that support students' interest development holds potential to achieve this goal but the implementation of these types of learning environments is a complex matter. Previous research has suggested different pedagogical approaches that may have positive impacts on students' mastery-orientation. These include environments which encourage exploration and experimentation, allow students to make and learn from mistakes and promote personal control of learning (Bell & Kozlowski, 2008).

It is also important to consider the outcomes of normative evaluation on students' learning motivation. Making unfavorable social comparison on children's' abilities can have negative consequences on their interest and mastery-orientation. Reduced willingness to take risks, the use of less effective or superficial learning strategies, and negative affect in relation to self are some of such negative outcomes (Ames, 1992).

7.1 Theoretical implications

This study confirmed the findings of previous research that achievement goal orientations seem to have a connection to training transfer. Mastery goals which direct the learner towards intrinsic motivation had clearly the most positive outcomes. In turn, performance-avoidance goals which direct the learner towards avoiding negative consequences in the eyes of others related to negative transfer, meaning that those trainees were more likely to avoid transfer attempts after training. However, the contemporary view on achievement goals emphasizes the multiple sources of people's goal structures and the probable variation in goal setting between different situations even within the same individual (Niemivirta et al., 2019). It is possible for an individual to have multiple goals related to a task and their emphasis can vary depending on situational factors and especially between different domains. For example it would be interesting from a theoretical point of view to clarify how and under which circumstances the so-called success-oriented learners' (combined mastery and performance orientation) goals alternate in different achievement situations. This could shed light on the very essential question of how to plan education and training so that it fosters learners' striving for mastery.

Findings from studies II and III indicated that there may be time periods when students' learning motivation, in this case marked by individual interest, is in transition and that these periods are of importance for learning outcomes and perhaps also for long-lasting motivation. Traditionally interest has been viewed as an antecedent for learning; an inner drive that directs learner's attention and effort towards a particular topic or domain (Hidi & Renninger, 2006). Lately however, this view has been challenged and learning itself has been hypothesized to be a cause for interest generation (Rotgans & Schmidt, 2017). In Study III this so-called affective by-product hypothesis was tested as one of the three hypotheses that aimed to clarify the predictive directions between interest and learning. The results from the analysis supported this claim since students' grades after fall semester predicted and correlated with their interest in the subject at the end of the school year. However, the results were not conclusive because the two other competing hypotheses, namely the standard (interest predicts learning) or the reciprocal (interest and learning affect each other reciprocally) hypotheses could not be ruled out completely. In a way the results could also suggest a potential fourth hypothesis: the alternating influence hypothesis.

In connection with the findings of Study I, Study III's results, even though the focus of was not on mastery orientation, nevertheless suggest that there is room for improvement in that area. If, as Study III suggests emerging interest is easily annulled by performance feedback this suggests that this feedback was not likely viewed from a mastery orientation perspective. Rather on the contrary, the pattern seen in Study III is more suggestive of performance orientation as the primary orientation in

school. At the same time Study III also hinted that the transition to secondary may be a point where interest and probably also orientations may be in flux. This raises important questions about the longitudinal development of motivational variables during compulsory education.

7.2 Methodological implications

One implication for methodology rising from this Study is the need for more longitudinal study settings which would use multiple measurement points. This might have already been beneficial in many of the empirical studies that were included in Study I. Observing goal orientations and training transfer over a longer period would help to determine more accurately how stable the relationships are. As Niemivirta et al. (2019) note, future research should address the question of how learners' motivational profiles adapt in different learning contexts, such as high or low stakes tasks, or tasks that offer varying amount of perceived personal value and utility. How do students' motivational profiles evolve when they progress further in their educational paths? For example in higher secondary education the measurable learning outcomes usually start to gain more weight when students need to achieve good enough grades in order to qualify for higher education. The same applies to such organizational training where certain training courses function as qualifications for better positions and career progress. Yet, the optimal learner is often viewed as mastery-oriented; intrinsically motivated, individually interested in the topic, and willing to 'go that extra mile' by investing time and effort to master the task while at the same time be shielded by the negative outcomes of achievement evaluations coming from others. As Niemivirta et al. (2019) show, there seems to be a group of learners who can be labeled as success oriented and who possess characteristics from both mastery and performance-approach goal orientations. One essential question is, does this orientation emerge already at an early age or does it develop later on? Especially in the light of Study I this would be an important question to answer. It could for instance be that at least some of the learners in this group are adjusting their self-image and behavior later in life in order to cope with their (increasingly performance-oriented) surroundings? If this is the case is it then always mastery orientation turned into performance or can it also happen the other way around so that the more performance-oriented learners could shift towards mastery-orientation?

7.3 Practical implications

The results from Study I showed that mastery-oriented participants were more likely to transfer training content to the workplace than those who were more performance

oriented. This finding has some implications for designing educational and organizational training programs. The big question is how to design pedagogies so that they promote mastery goals (Study I), that in turn would foster learners' interest (Study III) and how to create interest generating learning environments (Study II). In the context of organizational training attention should be paid to generating the kind of workplace culture where making errors and mistakes are not evaluated as lack of competence, but as development towards mastery. In school context this would mean that more value should be given to students' positive attitude and interest towards learning. As Study III indicated, negative normative competence evaluations such as receiving a bad grade can have a detrimental effect on students' interest. For this reason it would be more constructive to emphasize effort and encourage students to see errors as means to get better. It would be more fruitful to reward students for good effort rather than stifle their interest already at an early stage (Dweck & Leggett, 1988). Instead of having a system that supports, maybe unintentionally, adoption of performance goals, supporting students' mastery orientation would be more important from a societal point of view. This type of support would help them to upgrade and maintain their skills and knowledge further into the future. Discussion around topics such as lifelong learning and 21st century skills touch also the mastery-performance phenomenon, and this becomes essential when thinking about the aims of modern school systems. Is the purpose to produce systemized, measurable data on learning outcomes that allows comparisons between individuals or is the purpose to arouse a learning mindset that could lead to transferable skills and attitudes for the future?

When designing interest supportive learning environments some aspects have been found particularly helpful. In general, novel tasks that allow learners to make choices, include physical activity and social involvement have been found to support interest generation (Palmer, 2009). Also, perceived autonomy, competence, and social relatedness were found to predict interest in vocational education settings (Minnaert, Boekaerts, de Brabander & Opdenakker, 2011) which would indicate that those aspects could also benefit training at workplaces. Also, learning itself has been found to generate interest which in that study was attributed to be caused by novelty (Palmer, 2009). As learning something always contains the element of gaining knowledge about something new this can be a source of excitement and interest for the learner. However, there may also be another explanation for this finding, namely that learning supports one's intrapersonal competence-perceptions and generates positive emotions through task mastery. This would in turn generate a positive cycle by encouraging the individual to learn more about the topic hence supporting the development of more intrinsic motivation and individual interest. This comes close to the idea of the knowledge-deprivation hypothesis of situational interest presented by Rotgans and Schmidt (2017). The knowledge deprivation hypothesis states that

situational interest is generated when a person realizes a knowledge gap between what presumably needs to be known in order to grasp the topic and what he or she already knows about it. This then is followed by the individual's effort to learn which closes the knowledge gap and reduces situational interest to its original level. Based on this theory, training programs as well as classroom teaching could benefit from paying attention to arousing learners' situational interest. This could happen for example by introducing a problem, a surprising piece of information or an unexpected and complex question at the start of the learning situation. It should be noted, though, that situational interest is likely to carry forward only if the learners do not already have the knowledge to solve the newly introduced problem (Rotgans & Schmidt, 2017). In the case of individual interest, the notion that knowledge acquisition precedes interest generation would bring about some instructional implications. In their study using a cross-lagged panel analysis, Rotgans and Schmidt (2017) indeed found evidence supporting this claim. Their explanation for it was, referring to Ryan & Deci (2000), that by gaining knowledge about a topic, in other words by learning, a person gains mastery and competence which in turn leads to a sensation of fulfillment through understanding something from the world. One practical implication of these findings would be that fostering students' situational interest and offering them experiences of successful learning, especially at the beginning of a transitional period, would be essential for their later interest development.

7.4 Limitations

One limitation of this study concerns the conceptualization of achievement goal orientations that was used in Study I. Although the meta-analysis consisted of mastery, performance-approach, and performance-avoidance goal orientations with transfer under three moderator conditions (time lag, training length, and the combined effect of time lag and training length) and extended beyond any previous meta-analyses on the topic, the choice of theoretical framework was partly limited due to practical reasons. The study aimed to integrate 30 years of empirical research on the goal orientation-transfer relationship and during that time achievement goal theory had already developed further. As it has been shown, new and more complex conceptual models exist that could have yielded more specific results on the topic. However, to be able to conduct a meta-analysis, sufficient amount of empirical research has had to be accumulated. It is therefore a suggestion for future research to follow up with another meta-analysis that explores these more developed models of goal orientations.

Another limitation relates to the quantitative measures that were used in studies II and III. In both studies students' individual interest in STEM subjects was

measured with a single-item instrument. Although similar measures have been used in the past (for example Tapola et al., 2013) one could argue that a more fine-grained instrument could have provided more information on the qualitative differences that may take place in students' interest development. For example an instrument that would separate value-based interest from emotion-based or knowledge-based interest (Hidi & Renninger, 2006) might be something that future research could benefit from. In addition, some attention should also be paid to how to measure reliably interest in its different developmental phases (Renninger & Hidi, 2011).

Together with the findings and implications of the three studies presented in this dissertation these limitations point out some important venues for future research. In an era where Life Long Learning and 21st century skills are high on policy agenda's these studies highlight the importance for longitudinal research into development and stability of motivational variables. Study I showed that mastery orientation was the only positive predictor of training transfer and Studies II and III showed that students' interest levels can vary within a school year and that performance feedback is a factor that contributes to its development. One idea for future research would be to look at different ways to evaluate students so that the evaluation method would pose less risk of harming students' mastery-orientation and interest.

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The aim of this dissertation was to examine how individual's achievement goal orientations and interest, develop over time and relate to different types of learning outcomes. The different ways in which learners' set goals in achievement situations and how interested they are in the task or topic have been found to relate to their learning outcomes in school context, and transfer of training to workplaces in organizational training context. Achievement goal orientations were conceptualized in a trichotomous model that consisted of mastery, performance-approach, and performance-avoidance orientations. Interest was conceptualized based on the theoretical division between the more emotion-based, short-lived, fluctuating and situation-specific situational interest, and the more stable, cognition- and value-based individual interest. The developmental framework in which these were examined was the four-phase model of interest development which separates four different developmental stages of interest, namely triggered situational, maintained situational, emerging individual, and well-established individual interest.

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