Pupils' performance in managing the holistic craft process

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The Finnish National Board of Education assessed learning outcomes in the final 9th grade of basic education in 2010. This assessment included a design task that involved testing the management of the holistic craft process (HCP), a test of theoretical knowledge and an attitude test. This article revisits the national assessment from a new perspective: to what extent do pupils have the competence to manage HCP, theoretical knowledge and what stand do they take towards the crafts subject in their attitudes? The more specific research questions strive to address: to what extent does theoretical knowledge and attitudes determine the managing of HCP? Is the performance in managing this process dependent on gender and earlier craft studies? This research focuses on a central concept: the competence to manage HCP. The assessment data was marked off into tasks that indicated the managing of HCP (n = 661 out of the sample N = 4,792). K-means cluster analysis, linear regression analysis, crosstabs with the Chi-squared test, and Spearman's rank order correlation coefficient were used as a methodological solution. The central observation is that three different groups of pupils managed HCP, the theoretical knowledge and the attitudes. These groups are: the positive achievers (43 %), the positive underachievers (29 %) and the negative underachievers (28 %). In addition the performance in managing HCP cannot be determined by the theoretical knowledge and the attitudes in crafts at all, but is rather related to gender and earlier craft studies.

Keywords: crafts, holistic craft process, theoretical knowledge, attitudes, competence, gender

Introduction

The value of having craft courses at comprehensive school is the task of the subject to offer meaningful and relevant learning experiences to pupils based on open-ended problems and challenges on a wide range of materials, related to the pupils' own material environment. The Finnish National Core Curriculum for Basic Education (NCCBE) 2004 constituted the goal of instruction: tasks in crafts subject are to guide the pupil in systematic, sustained, independent work, and to develop creativity, problem-solving skills, an understanding of everyday technological phenomena, and aesthetic, technical, and psychomotor skills (FNBE, 2004). Basic education in the Finnish context means primary (age 7-12) and lower secondary (age 13-16) education in comprehensive school. According to the curriculum (FNBE, 2004), the crafts subject is studied in basic education as a common subject for all pupils until 7th grade (age 13); it is optional, however, in 8th and 9th grades (age 14-16). The idea is that crafts subject is a common subject with a varied content of design and technology. The concept of common crafts is used to point to a combination of soft and hard materials, instead of traditionally choosing one and dropping the other (textiles versus technical work). Usually pupils have two lesson hours (45 minutes each) of crafts per week during the first six grades and three lesson hours in the 7th grade, after which there are optional weekly lesson hours in 8th and 9th grades.

A competence to manage a holistic craft process (HCP) is a goal of the crafts subject (FNBE, 2004). HCP is emphasized even more in a new National Core Curriculum for Basic Education that is implemented from autumn 2016. The crafts subject is defined as an expanding and modern multi-material school subject that includes a variety of technologies (FNBE, 2014). The focus is on developing pupils' exploratory, creative, active, and entrepreneurial future-oriented work that is realized in HCP. Hands-on learning with a wide range of materials in diverse technological areas is the main didactical guideline in promoting pupils' open-minded use and application of knowledge as well as their problem-solving

skills in inventing a solution to an open-ended problem (Lepistö & Lindfors 2015). A solution, a product to be created and made, and the freedom of choice seems to have the most significant effects on pupil's motivation (Autio et al. 2011). According to earlier research results (e.g. Cropley & Cropley, 2010; McLellan & Nicholl 2011), there is some but too few pupil involvement or use of their authentic experiences in the school planning processes, when setting out the context and the task of learning.

HCP includes various phases: needs analysis, the generation of ideas, the designing of solutions, the making or manufacturing process, and finally the reflective assessment of the artefact and the whole process (Kojonkoski-Rännäli 2014). To turn ideas into a realizable craft product, the maker must obtain information about technologies, materials and tools by asking, experimenting and examining (Lepistö & Lindfors 2015). As educators we believe that a pupil develops his/her personal traits, theoretical knowledge and practical skills as well as attitudes during HCP while he/she, at the same time, derives a viable benefit of the process – the ready-made material product or another kind of functional solution, e. g. the invention of a new way to use a tool or a machine or the construction of a robot. An educational value of HCP lies in its material and immaterial results (Peltonen 1988).

In the national assessment of learning outcomes in crafts (Hilmola 2011), the theoretical knowledge of 9th-grade pupils (15-16 years old) is, on average, at a satisfactory level (N = 4,792). The pupils could correctly answer 57 % of the theoretical questions. They knew the conventional tools and materials as well as occupational safety issues. However almost 70 % of pupils responded weakly regarding the common manufacturing technologies. The boys were weak in design and the girls in technology issues, respectively. In the practical design task (n = 661) the average level for managing HCP was satisfactory. Along with the satisfactory knowledge and skills, on average, two thirds of pupils had positive attitudes to crafts learning, while one third felt it negatively. In the study among student teachers (Lindfors 2007), they could be divided into two groups, respectively, after comprehensive craft studies: half of the student teachers had a positive attitude and the other half was negative (N = 63). After a problem-based craft course, the student teachers formed four groups on the basis of the meaning they gave to craft learning, and none of the groups were formed on the basis of a negative attitude. In turn, the comparative studies between Finnish and Estonian pupils (Autio & Soobik 2013) and Finnish and Icelandic pupils (Autio et al. 2012) indicate that the Finnish pupils, especially girls, have more negative attitudes toward technology than the Estonian and Icelandic ones.

In crafts HCP as an authentic experience is a source of learning and development which is typical in experiential learning (Kolb, 2015). Facilitating learning in authentic learning contexts connected to pupils' everyday experiences supports pupils' creative problem-solving instead of learning specific facts or skills (Lin & Williams, 2015; Twyford & Järvinen, 2000). Knowledge in action is situated and performed in a personal way (Bergren et al. 2014) and should become personal knowing (Dreyfus 2004) via the experiences gained in HCP. An authentic learning context is a frame for a holistic understanding and usually promotes good learning results (Hill & Smith, 1998; Kolb, 2015). Meaningful learning experiences seem to be related to authentic learning environments with real problems in design and technology (Hill & Smith, 1998). On the basis of the mentioned studies it is possible to assume that open design tasks are a part of an explanation for positive attitudes in craft learning.

However we do not actually know what determines pupils' performance in the holistic craft process. The traditional way is to see a competence in a certain area as a combination of knowledge, skills and attitudes. From the skills learning theories point of view (e.g. Dreyfus 2004) teachers and educators usually focus on training so-called basic skills and rules, e.g. knowledge and basic technics and technologies before they instruct pupils open-ended design tasks and trust pupils' capacity to create multiple personal solutions in HCP (e.g. Lindfors 2011).

This article studies more deeply the national learning outcome assessment data (Hilmola 2011). The research design aims at clarifying the results on pupils' performance in managing HCP and discusses the causes and effects related to learning outcomes. The objective of this analysis is to understand *to what extent the theoretical knowledge and the attitudes determine the managing of the holistic craft process.* The more specific research questions strive for answers to:

1) To what extent does theoretical knowledge about crafts determine the managing of the holistic craft process?

2) To what extent do attitudes determine the managing of the holistic craft process?

3) Is the performance in managing the holistic craft process dependent on gender and earlier crafts studies?

To be able to understand causes and effects related to teaching and learning crafts, design and technology, the current level of managing HCP as the learning outcome should be recognized as well as the possible causes and effects related to the phenomenon. This information is important from a didactical point of view, especially when trying to understand how to deal with those pupils whose attitude to learning is negative (see Lindfors & Hilmola 2015).

Theoretical background: Competence in managing the holistic craft process

Competence is commonly defined as a combination of knowledge, skills and attitudes (Mulder, 2012). It is relational to the task at hand and the context (Spencer & Spencer, 1993). The concept of competence can be seen as a combination of the task and context-related personal traits, knowledge, skills, abilities and attitudes (Edwards-Schachter et al. 2015). In the HCP a person – the maker - or a group of persons/makers carries out all the phases from ideating and designing to manipulating materials and technology to make the solution and evaluate it and the process reflectively. On the basis of the definition of the competence a maker must have knowledge, skills and attitudes to carry out the HCP in a task at hand.

Attitudes seem to be both the determinants and consequences of learning experiences (Davies & Brember 2001). According to Volk et al. (2003) learning experiences may be satisfying or frustrating: attitudes are developed and established and they enable or inhibit further learning opportunities. In math attitudes explain 35 % of the learning outcomes (Tuohilampi & Hannula, 2013). Positive self-esteem seems to be a motivating factor in learning that influences achievements, including the level of self-directed learning (see Loyens et al. 2008). Self-directed learning (Knowles 1990) is seen as a process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies and evaluating learning outcomes. If pupils are highly interested in learning, e.g. learning subjects that hold a personal relevance that are related to daily activities, this suggests the existence of intrinsic motivation (Gorghiu 2015). The more years pupils (N = 2,800) participate in design and technology teaching, the more positive are their attitudes towards the subject, especially girls' attitudes. Less positive attitudes may suggest a lack of confidence in pupils' ability to succeed or a lack of enjoyment of the learning activities (Volk et al. 2003). Autio et al. (2012) postulate that attitude is a crucial part of the competence in technology learning as it depends on technological knowledge and skills in real-life situations. Also in quite a short period of time it is possible to enjoy the learning experience, despite the challenging content of learning (Pirttimaa et al. 2015).

Attitudes are defined as a whole in this study in terms of maker's views of their own skills in craft, the overall usefulness of crafts and the interest that craft engenders. Knowledge here comprises the theoret-

ical knowledge about craft, design and technology: tools and materials, methods of making, understanding the technology of crafts, design, working safely and ideas for sustainable development. Skills are implemented in planning, making and assessing the process and the final solution/product (see Table 1). However having knowledge, skills and attitudes is not enough. The maker has to have the ability to use knowledge and skills in order to manage the HCP. The practical making and working is essential in managing HCP (see Gårdvik 2013; Lindfors & Hilmola 2015). From a didactical point of view theoretical knowledge should be put into action as early as possible in HCP (see Bergren et al. 2014).

The competence to manage HCP is a new concept as such. It is understood here as an ability and attitude to use theoretical knowledge and skills to carry out a holistic craft process: planning, making and assessment. Pupils' performance in managing HCP as such has not been researched earlier. On the basis of understanding the competence to manage HCP, the level of a pupil's craft learning could be assessed in the pedagogical context on the basis of pupils' theoretical knowledge, skills and attitudes, combined with the process of problem-solving in an open task and the assessment of the created solution in relation to the intended use. The Finnish national learning outcome data from 2010 in crafts (Hilmola 2011) was studied on this basis. According to the earlier research it was possible to form the following hypothesis (H1-3):

H1: Attitudes towards the subject determine the pupil's performance in managing HCP

H2: Good theoretical knowledge predicts good performance in managing HCP

H3: Earlier studies in the subject determine the good and weak performance in HCP

Research design: data and methods

The empirical information in this research is based on data collected in the national assessment, which the Finnish National Board of Education carried out during the spring of 2010 (Hilmola 2011). The main purpose of the assessment was to assess the learning outcomes in subject crafts, visual arts and music in the final 9th grade (15–16-year-old pupils) of basic education. The data was collected through a stratified sampling from 152 comprehensive schools (N = 4,792), which represented a wide cross-section of mother-tongue groups, geographical areas and municipality types. Pupils completed a total of 34 paper and pencil tasks pertaining to crafts subject according to the National Core Curriculum for Basic Education in Finland 2004. The assessment included choice tasks, connecting tasks, and true or false tasks. The tasks considered tools and materials, methods of making the crafts, design, understanding the technology of crafts, working safely and sustainable development. Following this part of the assessment test was a test of the theoretical knowledge in crafts. In addition a small sample (n = 661) of the pupils completed a design task, which was a test of their competence to manage HCP.

According to the idea of HCP, pupils had to make a craft product – a small container for electric equipment. The design task included the stages of planning, making and self-assessment. The craft teachers assessed the pupils' process by the shared national criteria for the assessment and four sensors of the Finnish National Board of Education assessed the uniformity of the teachers' assessment. The sensors stated that the teachers' assessment was valid and reliable (cf. Hilmola 2011, 230–232). The pupils also completed the attitude tests, which considered their relation to their own learning. The first part of the attitude test included the following stages: pupils' views of their own learning, their sensibility to learning and pupil-centred learning. The second part[1] of the attitude test included the following stages: pupils'

[1] Application of the Fennema-Sherman (1977) attitude test used by the Finnish National Board of Education

views of their own skills in crafts, the usefulness of the crafts and the interest that the crafts engender. This research focuses on a sample of pupils (n = 661) who participated in all stages of the assessment.

In this research, the original sum variables of the national assessment data of the crafts are used. All the methodological solutions related to the constructing of different sum variables have been described in more detail in the original publication of the national assessment (cf. Hilmola 2011, 160–162, 198–215). The central results of the pupils' skills in crafts and the reliability of the research are not repeated in this article but are available in an original publication (cf. Hilmola 2011, 181–223, 226–232).

K-Means cluster analysis is used as a methodological solution when the purpose is to find different groups of the pupils. It is intended to discover how managing HCP, theoretical knowledge and attitudes will settle in different groups of the pupils. Spearman's rank order correlation coefficient (rho) is used as the methodological solutions when it the purpose is to determine the connections between the different sum variables. Because the assumption of the normal distribution was not found, the Spearman's rank order correlation coefficient is used in this research. Linear regression analysis by the stepwise method is used when the purpose is to find different models of the several sum variables which will determine the management of HCP. All the original sum variables used in the national assessment data have been standardized so that the average of them is zero. That is why the Beta coefficient (β) is used as a value of the regression. Crosstabs with the Chi-squared test is used when the purpose is to describe the independence between the different groups of pupils. According to Metsämuuronen (2003, 460) the statistical significance of the different tests is reported so that the test statistic will be either significant statistically ($p < .050$) or extremely significant statistically ($p < .001$).

The results

On the basis of Figure 1, three different groups of pupils could be separated by K-Means cluster analysis. In the largest group of pupils (43 %), performance in managing HCP and theoretical knowledge are clearly better than the average level. Furthermore, their attitudes are distinctly more positive than the average level. The pupils who belong to this group can be called 'positive achievers'. These pupils have the competence to manage HCP and they like the crafts subject in general. The next largest group (29 %) consists of those pupils whose performance in managing HCP and theoretical knowledge are clearly lower than the average level. However, their attitudes are more positive than the average level in general. The pupils who belong to this group can be called 'positive underachievers'. These pupils have low competence in managing HCP but, in spite of this, they like the subject. The relatively smallest group (28 %) consists of those pupils whose performance in managing HCP and theoretical knowledge are also lower than the average level. In addition, their attitudes are altogether more negative than the average level in general. The pupils who belong to this group can be called 'negative underachievers'. These pupils have low competence in managing HCP and they do not like the craft subject at all. However, their competence in managing HCP and their theoretical knowledge are a little bit better when compared with positive underachievers.

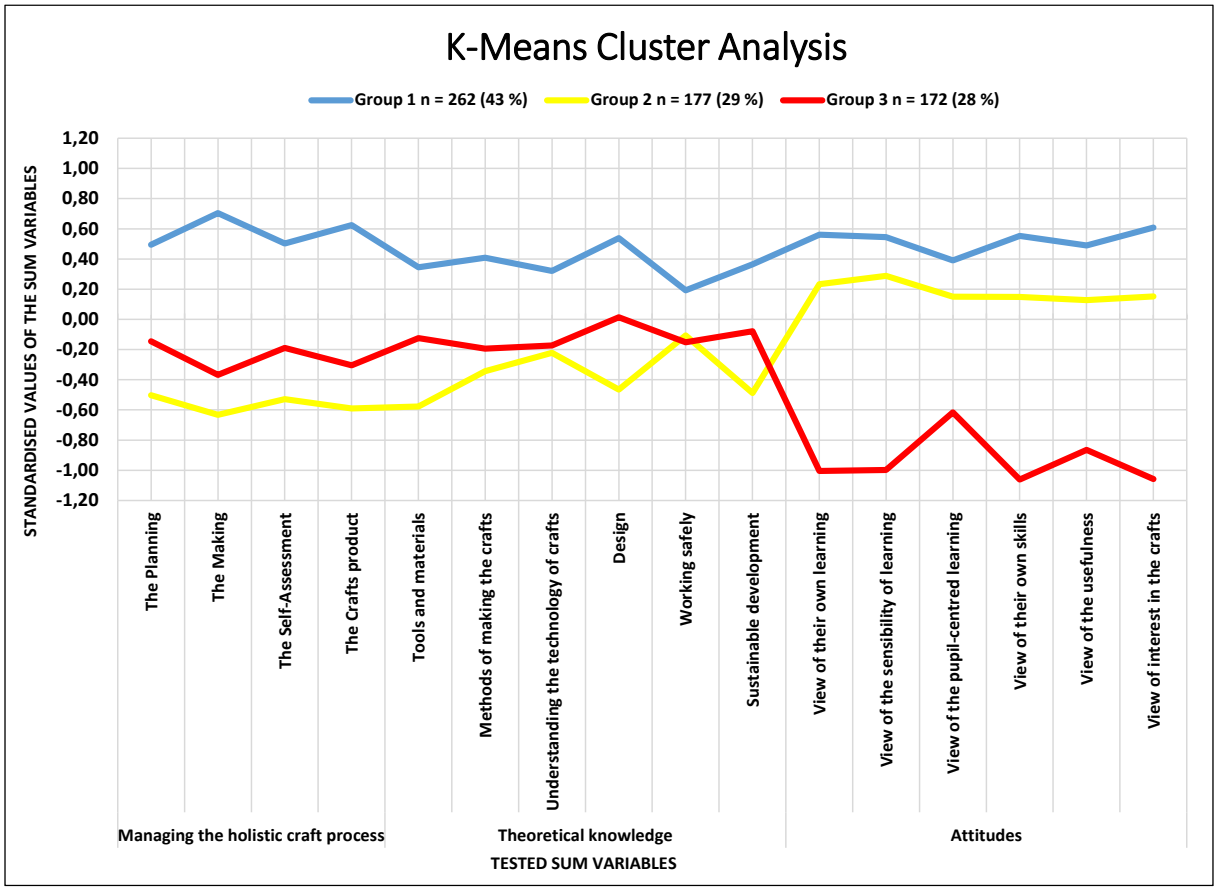

Figure 1: The different groups of the pupils

According to Spearman's rank order correlation coefficient (Table 1) there are statistically significant connections between the different sum variables that are related to managing HCP, the theoretical knowledge and the attitudes in crafts. Almost all the correlations (r) between these sum variables are significant ($p < .050$) or extremely significant statistically ($p < .001$). Only with a few sum variables can a statistical connection not be perceived. However, all the correlations are not strong so the coefficients of determinations (r^2) between the different sum variables remain at a low level. The coefficients of the determination are only in the range of a few per cent. So the undetermined shares are about in the range of ninety per cent or more. This means that the individual sum variables which are related to the theoretical knowledge and the attitudes in crafts do not determine the competence of managing HCP at all; quite the contrary. So in this context we cannot propose how much a certain variable determines another variable. It is a question of the case, in terms of how much two variables determine the variation between them.

Table 1: Coefficients of determination between different sum variables

Spearman's rank order correlation coefficient (rho)												
Managing the holistic craft process	Planning			Making			Self-Assessment			Crafts product		
Theoretical knowledge	r	p	r^2	r	p	r^2	r	p	r^2	r	p	r^2
Tools and materials	,150**	p < .001	2 %	,262**	p < .001	7 %	,182**	p < .001	3 %	,218**	p < .001	5 %
Methods of making the crafts	,129**	p = .001	2 %	,180**	p < .001	3 %	,179**	p < .001	3 %	,150**	p < .001	2 %
Understanding the technology of crafts	,061	p = .121	0 %	,124**	p = .002	2 %	,081*	p = .040	1 %	,127**	p = .001	2 %
Design	,292**	p < .001	9 %	,305**	p < .001	9 %	,199**	p < .001	4 %	,261**	p < .001	7 %
Working safely	,074	p = .061	1 %	,047	p = .231	0 %	,030	p = .448	0 %	,029	p = .461	0 %
Sustainable development	,169**	p < .001	3 %	,212**	p < .001	4 %	,102**	p = .010	1 %	,153**	p < .001	2 %
Attitudes												
View of their own learning	,171**	p < .001	3 %	,310**	p < .001	10 %	,191**	p < .001	4 %	,248**	p < .001	6 %
View of the sensibility of learning	,084*	p = .036	1 %	,270**	p < .001	7 %	,125**	p = .002	2 %	,221**	p < .001	5 %
View of the pupil-centred learning	,107**	p = .007	1 %	,225**	p < .001	5 %	,100*	p = .011	1 %	,144**	p < .001	2 %
View of their own skills	,171**	p < .001	3 %	,354**	p < .001	13 %	,146**	p < .001	2 %	,268**	p < .001	7 %
View of the usefulness	,086*	p = .028	1 %	,226**	p < .001	5 %	,092*	p = .019	1 %	,170**	p < .001	3 %
View of interest in the crafts	,142**	p < .001	2 %	,304**	p < .001	9 %	,147**	p < .001	2 %	,230**	p < .001	5 %

According to the linear regression analysis by the stepwise method (Table 2) the models of several variables which are related to the theoretical knowledge and the attitudes in crafts cannot determine the competence in managing HCP. It should be mentioned for example that the making column in managing HCP (Model 2) is only twenty-two per cent based on the pupils' theoretical knowledge, which are related to the tools and materials and the design and the attitudes and which, in turn, are related to the views of the pupils' own skills and their own learning (R^2 = 22 %). So the undetermined share is as much as seventy-eight percent. The coefficient of multiple correlation is low (R = .334). However, all the regression values (β) of this model are significant ($p < .050$) or extremely significant statistically ($p < .001$). In addition, the ready-made crafts product which describes the goal of HCP (Model 4) is only sixteen per cent based on the pupils' theoretical knowledge, which are related to the tools and materials and the design and the attitudes which, in turn, are related to the views of the pupils' own skills and the sensibility of learning (R^2 = 16 %). So the undetermined share is as much as eighty-four percent. The coefficient of multiple correlation is low (R = .395). Furthermore, all the regression values (β) of this fourth model are also significant ($p < .050$) or extremely significant statistically ($p < .001$). This means the performance in managing HCP cannot be determined by theoretical knowledge and the attitudes at all.

According to both Spearman's rank order correlation coefficient (Table 1) and to the linear regression analysis by the stepwise method (Table 2), the central observation is that the crafts as a subject contain different knowledge and attitudes which do not determine the managing of HCP at all; on the contrary. The undetermined shares are considerably large. This is an interesting phenomenon that is related to the learning and teaching of the crafts. By this data, it is impossible to find the determinants which will determine the managing of HCP.

Table 2: Coefficients of determination of the different models

Linear regression analysis - by Stepwise method								
Managing the holistic craft process	Planning Model 1		Making Model 2		Self-Assessment Model 3		Crafts product Model 4	
Theoretical knowledge	β	p	β	p	β	p	β	p
Tools and materials	-	-	,163	p < .001	-	-	,154	p < .001
Methods of making the crafts	-	-	-	-	,132	p = .002	-	-
Understanding the technology of crafts	-	-	-	-	-	-	-	-
Design	,283	p < .001	,215	p < .001	,126	p = .003	,186	p < .001
Working safely	,086	p = .027	-	-	-	-	-	-
Sustainable development	-	-	-	-	-	-	-	-
Attitudes								
View of their own learning	-	-	,114	p = .007	-	-	-	-
View of the sensibility of learning	-	-	-	-	-	-	,094	p = .045
View of the pupil-centred learning	-	-	-	-	-	-	-	-
View of their own skills	,125	p = .001	,229	p < .001	-	-	,171	p < .001
View of the usefulness	-	-	-	-	-	-	-	-
View of interest in the crafts	-	-	-	-	,122	p = .002	-	-
Coefficient of Multiple Correlation R	,334		,472		,258		,395	
Coefficient of Determination R^2	11 %		22 %		7 %		16 %	

According to the crosstabs and the Chi-squared test (Table 3) the examination is first directed to the differences between the pupil's genders. The relative shares of the girls in the groups of the positive achievers and the negative underachievers are more than the expectation value of the data. In the group of the positive underachievers, the girls' relative share is less than the expectation value of the data. Correspondingly the relative share of the boys, in the group of the positive underachievers is more than the expectation value of the data. In addition the relative shares of the boys in the groups of the positive achievers and the negative underachievers are less than the expectation value of the data. The differences between the gender groups are extremely significant statistically ($p < .001$). So this placing in the different groups is dependent on the pupil's gender. In other words, theoretical knowledge, the managing of HCP and attitudes are dependent on the pupil's gender. It can be observed that the boys (76 %) take a positive stand toward the crafts more often than the girls (68 %). In spite of this, the boys (61 %) are underachievers more often than the girls (54 %).

According to the crosstabs and the Chi-squared test (Table 3) the other interesting point is the pupil's participation in the teaching of the crafts in the lower secondary (grades 7–9) education in comprehensive school. The relative share of pupils who have participated in crafts' teaching during all three school years in the group of positive achievers is clearly more than the expectation value of the data. The relative share of pupils who have participated in crafts' teaching during all three school years in the group of negative underachievers are clearly less than the expectation value of the data. Correspondingly, the relative share of pupils who have participated in crafts' teaching only during one school year in the group of positive achievers is clearly less than the expectation value of the data. The relative share of pupils who have participated in crafts' teaching only during one school year in the group of the negative underachievers are clearly more than the expectation value of the data. In the group of the pupils who have participated in crafts' teaching during two school years, the relative shares are in accordance with the expectation values of the data. Furthermore, the number of positive underachievers in all the groups follows the expectation value irrespective of the amount of participation in crafts' teaching in the lower secondary education in comprehensive school. The differences between all the groups of the participation in crafts' teaching are extremely significant statistically ($p < .001$). So the placing in the different

groups is dependent on the participation of crafts' teaching during the lower secondary education in comprehensive school.

In other words, theoretical knowledge, the managing of HCP and attitudes are dependent on the amount of participation in crafts' teaching in the lower secondary education in comprehensive school. It can be observed that the pupils who have participated in the crafts during three school years (85 %) take a positive stand towards the crafts more often than those pupils who have participated in the crafts during one school year (56 %). Also the pupils who have participated in the crafts during three school years (42 %) are underachievers less often than those pupils who have participated in the crafts only during one school year (73 %).

Table 3: The relative share of the different groups by K-Means cluster analysis

The crosstabs between the different groups and the background variables.			
	Positive Achievers n = 262	Positive Underachievers n = 177	Negative Underachievers n = 172
Expectation (n = 611)	43 %	29 %	28 %
Gender			
Boys (n = 296)	39 %	37 %	24 %
Girls (n = 315)	46 %	22 %	32 %
Pearson Chi²: $X^2 = 17.59$, df = 2, p < .001			
Participation in the teaching of the crafts			
During one school year (n = 248)	27 %	30 %	43 %
During two school years (n = 72)	43 %	31 %	26 %
During three school years (n = 283)	58 %	27 %	15 %
Pearson Chi²: $X^2 = 68.69$, df = 4, p < .001			

In addition, the placing of pupils in the different groups was also examined according to their mother tongue, municipality types and geographical areas. By the crosstabs and the Chi-squared test, there are no statistically significant differences between these groups (p > .050). However, the number of the relative shares between some groups are clear, but the regional samples are too small for significant statistical differences. There are for instance distinctly more positive achievers in the northern part of Finland than the expectation value.

Conclusion

The research design aimed at clarifying pupils' competence in managing HCP. The objective of these analyses was to understand, to what extent theoretical knowledge and attitudes determine pupils' performance in managing the HCP. In addition, the objective of the analyses was to understand, whether the competence in managing HCP is dependent on both gender and earlier craft studies. The large data (N = 661) allow considering conclusions according to learning outcomes and their explanations, causes and effects and to consider learning outcomes in general. The research data consisted of the questionnaire answers and the practical design task. These were planned according to NCCBE 2004. Pupils' theoretical knowledge, attitudes and performance in managing the holistic craft process were assessed.

The first central observation (Figure 1, Table 3) is that there is a large group of pupils (43 %), the positive achievers, whose performance in managing HCP and theoretical knowledge are distinctly above the average level; moreover, their attitudes are clearly at a positive level. Regarding gender, 39 per cent of all boys and 46 per cent of all girls are placed in this group which is called positive achievers. The

majority of these pupils (58 %) have participated in crafts' teaching during three school years in the lower secondary education in comprehensive school.

In connection with the positive achievers, there is an interesting group of pupils (29 %) whose performance in managing HCP and theoretical knowledge are distinctly below the average level, but their attitudes are at a positive level. Regarding gender, 37 per cent of all boys and 22 per cent of all girls are placed in this group, which is called positive underachievers. There is no considerable variation in the amount of participation in crafts' teaching during the lower secondary education in comprehensive school.

There is also a group of the negative achievers (28 %) whose performance in managing HCP and theoretical knowledge are distinctly below the average and their attitudes are clearly negative. Regarding gender, 24 per cent of all boys and 32 per cent of all girls are placed in this group. The majority of these pupils (43 %) have participated in crafts' teaching during one school year in the lower secondary education in comprehensive school.

The individual sum variables that indicate theoretical knowledge and attitudes in craft subjects do not determine the ability to manage HCP convincingly; on the contrary. The coefficient of determination between two individual variables is only 13 per cent at its highest (Table 1). The case is not improved, even when the coefficients determining different variable models are examined. The theoretical knowledge and attitudes in craft subjects do not determine the ability to manage HCP either. For example, theoretical knowledge, which is related to the tools and materials and the design and the attitudes – which are related to the views of the pupils' own skills and the pupils' own learning – are able to determine only 22 per cent of the making field in managing HCP (Table 2). Hypotheses one (H1) and two (H2) are not supported: attitudes and theoretical knowledge do not determine pupils' competence in managing HCP. The third hypothesis (H3) that earlier studies in the subject determine the good and weak performance in HCP was supported. The pupils who participated in the crafts during three school years are underachievers less often than the pupils who have participated in the crafts only during one school year (Table 3).

Discussion

The data collection of this study was made in relation to the curriculum of 2004 and the definition of competence: theoretical knowledge, attitudes and skills in managing HCP. According to research results, teachers have to consider pupils' performance in crafts more broadly than before. HCP seems to be a combination of various knowledges and skills as a part of pupils' competence in managing it (cf. Kojonkoski-Rännäli 2014; Mulder 2012). However, theoretical knowledge and attitudes do not determine each other (Table 1). It can be observed in general that boys (76 %) take a positive stand towards the crafts more often than do girls (68 %), a finding that is repeated in similar international researches (Autio et al. 2012; Autio & Soobik 2013). Despite this, boys (61 %) are found to be underachievers more often than girls (54 %), who are more often negative underachievers. However girls are more often positive achievers too (Table 3). As a matter of fact, theoretical knowledge, managing HCP and attitudes seem to be dependent on the pupil's gender. This must have some relation to the actualizing of crafts' teaching. During the curriculum of 2004 (FNBE, 2004), boys studied mostly technical work and girls studied textile work. The new curriculum of 2014 (FNBE, 2014) does not allow this. All pupils have to study crafts in the wide range of materials. In the future this might have an effect on the performance of managing HCP.

On the part of negative underachievers, the result is in line with Volk et al. (2003) that fewer positive attitudes may suggest a lack of confidence in pupils' ability to succeed or a lack of enjoyment of the learning activities. However on the basis of the results (Figure 1), it can be stated that pupils' positive

attitudes towards crafts do not mean that their performance in managing HCP and their theoretical knowledge are above the average level. This is a new finding and not in line with studies that indicate attitudes being an explanation for good learning outcomes (e.g. Tuohilampi & Hannula 2013; Loyens et al. 2008), an interesting phenomenon that is assumed to be related to the learning and/or the teaching of the crafts. This might indicate that experiential learning (Kolb 2015) – making and doing – satisfies positive underachievers' personal way of learning even when, for some reason, their performance in managing their HCP is limited. Why the performance is weak needs to be studied in the future.

On the basis of the results craft teaching cannot be based on teaching knowledge and skills for the future use in HCP of a single pupil. Instead, the HCP has to be based on pupils' needs, targets and motivations (Autio et al. 2011; FNBE 2014), while she/he is learning and activating the knowledge and skills that are needed and used (Bergren et al. 2014) in the authentic and experiential learning process (Hill & Smith 1998; Kolb 2015; Lin & Williams 2015; Twyford & Järvinen 2000). The result indicates that in this respect as well, the amount of teaching is important (Table 3). Pupils who participated in the crafts during three school years take a positive stand towards the crafts more often than the pupils who participated in the crafts during one school year. This is in line with earlier researchers' results (Gorghiu 2015; Volk et al. 2003); while they posit that there is a need for teaching and tutoring, the pupils work properly to promote positive learning experiences and attitudes.

From the didactical point of view, the results indicate that teachers should pay far more attention to negative underachievers and positive underachievers. Also girls' and boys' performance in managing HCP should be considered by teachers. On the basis of NCCBE 2014 (FNBE 2014), there is no longer the option for pupils to choose either textile or technical work and omit the other. For many teachers this creates a new situation and requires them to pay attention to pupils' various needs and ways of learning. In this respect, teacher education has to develop student teachers' and in-service teachers' competence.

On the basis of the current research in explaining the effects and causes of different variables, there is the need to combine the information about personal traits (Loyens et al. 2008) to learning outcomes. In future research, pupils' self-esteem, motivation and goal-orientation as well as social background should be taken into consideration as a possible explanation or determination for the performance in managing HCP; moreover, the teaching culture in the classrooms should be taken into consideration as well. Authentic problem-solving in experiential learning might promote pupils competence to manage the HCP. However to develop teaching practices and didactics, there is a need to understand what determines the performance of positive achievers, positive underachievers and negative underachievers. Each of these groups should be researched more deeply, one at a time.

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