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From Master's programme to labour market - A study on physics graduates' experience of the transition to the labour market

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Kandidatspeciale

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Abstract

Employers call for graduates to be more oriented towards the labour market, and to have a sense of the applicability of their competencies. Existing reports on graduate transition from higher education to the labour market show that graduates experience challenges in the meeting with the first job, in the form of missing competencies, lack of academic coherence, and unfamiliar work methods.
But as these reports are surveys of graduate satisfaction they leave questions unanswered in regard to which factors influence the graduates' experiences of the transition process. The literature on this subject is very limited, which means that there is a urgent call for research on the subject. This study will try to fill in the gap by making a broad, exploratory study aiming to obtain insight on the factors that may influence the graduates' transition experience.
Graduates from the Master's programme in physics from the past five years (2007-2013) were selected for the study. The graduates were invited to participate in an extensive questionnaire survey, containing both quantitative and qualitative questions regarding the graduates' strategies during the programme, their approach to future employment, their experience of the meeting with their first job, and with their current job. The results of the survey has provided information about where the graduates were employed and the content of their jobs, as well as an insight into their experiences of the transition to the labour market. The results imply that overall the respondents experienced that they were well prepared for the labour market. But the results also imply that some graduates faced more challenges than others and that, in general, the graduates experienced challenges in regard to applying their competencies in other contexts than the field of physics. Looking at the results in the light of the employability concept, the results suggest that both the education and the students could benefit from incorporating employability into the programme in some way.
This study is one of the first steps in the research on graduate transition to the labour market and the results invite to further studies on the subject in order to get a deeper understanding of the mechanisms that are at play.

From Master's programme to labour market
A study on physics graduates' experience of the transition to the labour market

Trine Louise Brøndt Nielsen

Master's thesis

Name of department: Department of Science Education

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Keywords: physics, graduates, higher education, employability, transition, questionnaire survey

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Trine Louise Brøndt Nielsen

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1 INTRODUCTION

1.1 Framing the problem

Higher education within science and technology may appear to have a clear purpose leading the students to a variety of carrier opportunities (Hooley, Hutchinson, & Neary, 2012) and without fear of unemployment (Basle & Dubois, 2013). But it turns out that employers within the relevant job market call for graduates to be more oriented towards the labour market and have a sense of the applicability of their competencies so that they will not require much training when they encounter their first employment (Mason, Williams, & Cranmer, 2009). This appeal from employers for the higher education institutions to provide their students with employability, has led to an extensive discussion of the purpose of higher education universities as institutions for knowledge and research in itself (Knight & Yorke, 2003) or as training facilities for students to achieve 'career capital' and to provide the students' with employability (Altbach, 1999).

A report by Dansk Magisterforening (Dansk Magisterforening, 2011) showed that every fifth graduate from a higher education in science did not experience that their education prepared them well for the labour market, and close to one quarter of the graduates experienced a low or no academic coherence between their education and their job. The report showed that the graduates especially experienced to lack competencies within communication and language, IT and statistics and project management and the report actually showed that almost half of the science graduates, based on their time in the labour market, regretted their choice of education. A report by the Faculty of Science at the University of Copenhagen (Faculty of Science, 2010) showed that science graduates late in their education had paid attention to their career perspectives. In line with the report by Dansk Magisterforening (2011), this report showed that the graduates experienced that they were missing the competencies to be involved in interdisciplinary collaborations, communication of academic knowledge and project management. Together these two reports imply that science graduates experience that their education and job do not seem to be compatible. However, as the reports are surveys of graduate satisfaction they leave some questions unanswered. For example, it is unclear whether it is insufficiencies within the graduates' educational background which makes the transition to the labour market difficult or if it is a problem of transferring what they have learned into a new context in the meeting with the first job.

The transition from education to the labour market is often viewed as a straightforward process, where students are believed to plan their education towards a future work life, which is consciously chosen based on labour market demand and lifestyle choices (Jørgensen, 2009). But this is often not the case and transition processes are often much more complex. Despite this, the aim throughout the transition process is that the knowledge, skills and competencies which the graduates have learned during the education, can be transferred to the graduates' work lives. Factors affecting the transfer of knowledge, skills and competencies are factors concerning the individual graduate, the education programme and the labour market. These factors may increase or decrease the degree to which it is possible to apply what is learned in one context to another (Wahlgren, 2009). Based on the results of the reports referred to above and the complexity of the transition process questions emerge as to what it is in the transition process that causes the graduates to experience that their job and education are incompatible. To answer these questions and to

provide constructive feedback to the educations, it is important to get a more detailed understanding of the entire transition process and the factors which influence the graduates.

International reports show that in the future there will be an increasing demand for scientists (European Commission, 2004) and in Denmark reports (Dansk Magisterforening, 2011) likewise show that the demand for physicists from the labour market is high, making the unemployment rates for physicists low. Seen in the light of the previously described reports, this implies that the difficulties in the transition process for physicists are not especially due to the process of actually finding a job but that other factors are at play. However, the information on how graduates from the Master's programme in physics experience the transition to the labour market is limited. A report by Center for Naturfagenes Didaktik (Andersen & Maule, 2002) published information on the employment of, among others, physics graduates from 1985-1999 from University of Copenhagen. The report showed that the number of graduates working as high school teachers had been decreasing since the 1980s, while the number of PhD students on the other hand had been increasing. Updated information on the employment of physics graduates from the last ten years does not exist.

Since the information on physics graduates' transition from the education to the labour market is limited, it first of all calls for research to understand where physicists find employment and secondly we are left to understand the graduates' experiences in the meeting with the job market and the factors that are at play in their transition process. This survey will fill in this gap and in addition contribute to shed light on the transition process of graduates from higher education institutions in Denmark to the labour market.

1.2 Focus of this study

As described previously the transition process is a complex process. This means that it can be investigated in many ways and from various angles. I have chosen to focus this survey on newly graduated physicists and their experiences of the transition to the labour market. Since the majority of the bachelor graduates in physics enrol in a Master's programme physics (Det Naturvidenskabelige Fakultet, 2012) I have chosen to select graduates from the Master's programme.

Due to the lack of knowledge on the subject of graduate transition to the labour market the purpose of this study is to carry out an exploratory study to provide a broad picture of the transition and the factors which may influence this. This has lead to the following main research question:

How do newly graduated graduates from the Master's programme in physics experience the transition from the Master's programme in physics to the labour market and what affects their experience?

To investigate the factors which may influence the graduates' experience of the transition, I was interested in the three steps of the transition process; the study programme, the meeting with the first employment and the current job. Since the job market calls for a higher level of employability within the graduates it was important to find out if and how the students positioned themselves for the labour market, during the study programme. Because employment rates of physicists are high it was interesting to understand how graduates experience the process of finding a fitting job and how the transition into the first job was experienced. Since there is no information on what physicists actually do in their jobs it was important to investigate this subject and to understand if the competencies which they are asked to apply were com-

patible with the ones they experienced to have acquired during their education. Finally, it was of interest to find out if the graduates experienced that they were prepared for the labour market and which feedback they had to their study programme. These subjects of interest has lead to the following expansion of the main research question:

The Master's programme in physics

- *How did the graduates see their employment opportunities during the Master's programme?*
- *Did the graduates prepare themselves during the Master's programme for the meeting with the labour market?*
- *Which competencies did the graduates experience to have acquired during the Master's programme?*
- *Which feedback did the graduates have to the Master's programme?*

The meeting with the labour market

- *How did the graduates experience finding a job with matched their competencies?*
- *How did the graduates experience the meeting with the labour market?*

The labour market

- *Where in the labour market were the graduates employed?*
- *What were the primary job functions?*
- *How did the graduates experience that the Master's programme prepared them for the labour market?*
- *Which competencies did the graduates experience that they were asked to use in the labour market?*
- *How did the graduates experience that they applied the competencies which they had acquired during the Master's programme?*

1.3 Guide to the thesis

In Section 2 the theoretical framework of the thesis will be described. The terms employability, competencies and transfer will be presented. In Section 3 the method chosen to investigate the research questions and the execution of the survey will be presented. In Section 4 the general results of the survey and the interesting tendencies will be described. In Section 5 the results will be discussed in relation to the theoretical framework and in Section 6 the conclusions of the survey will be presented.

2 THEORETICAL FRAMEWORK

Employers ask for a higher level of employability within the graduates. The concept of *employability* has been around for at least a century and has changed meaning through the time. For the higher education institutions and for the students to improve the level of employability it is important to understand how the term has developed, how it can be used and how it is used. Therefore the meaning and implications of employability will be described in Section 2.1. Employability is to a high degree a concept which relates to competencies because employability concerns certain competencies of the individual. The concept of *competencies* has become highly popular within the last years asking graduates to not only know how things work but also how to apply them. Competence descriptions can be found for various contexts; the competencies needed to function well in a society to the competencies needed to function within a specific field. In Section 2.2 competence descriptions of different contexts will be presented in order to describe the competencies which are required from a graduate in science and how this relates to employability.

Employability is also a question of how well a graduate is able to transfer what is learned in the education to the work market. In Section 2.3 possible implications of *transfer* are described in order to understand which factors may influence the transition process.

In Section 2.4 a short description of the structure of the Master's programme in physics is presented to outline the framework under which the graduates in the survey structured their study programme.

2.1 Employability

The concept of employability has increasingly become popular in research on graduates transition from higher education institutions to the labour market describing the individual's ability to fulfil a variety of functions in a given labour market (Forrier & Sels, 2003). Yorke (2006) defines employability as 'the capacity of the graduate to function in a job' (Yorke, 2006, p. 7). But the term is used in a variety of contexts and by different sources. Therefore the meaning of employability has changed systematically over time and especially over the last three decades depending on the labour market conditions and government policies of the time (Rothwell & Arnold, 2007).

The term employability can be traced back at least a century (McQuaid & Lindsay, 2005). The term emerged in the UK and the US used to describe the distinction between the deserving and the undeserving poor, indicating that the existence of poverty and unemployment was not necessarily the fault of the individual (Garsten et al., 2004). The employable were those who were able and willing to work, while the unemployable were those who were unable to work i.e. those eligible for welfare benefits (McQuaid & Lindsay, 2005). Through the years the term developed into a more nuanced understanding which was concerned with the existing work abilities of socially, physically or mentally disadvantaged people and with matching these with the work requirements of employment (McQuaid & Lindsay, 2005). Since employability was a distinction between being able to work or not, unemployment was not seen as the fault of the individual but more as a result of systematic problems and thus as a collective responsibility (Garsten et al., 2004).

The economic prosperity and a tight labour market of the 1950s and 1960s lead to an encouragement of the underprivileged unemployed to take part in the labour process (Forrier & Sels, 2003). State responsibility for full employment became a part of a general policy consensus (Garsten et al., 2004). Now employability was mainly determined by an individuals' attitude towards employment and by the self-image each indi-

vidual developed during its career. The term developed to a socio-medical focus which included other socially disadvantaged groups than the poor. The individual's abilities were identified through functional tests of work capacity (Garsten et al., 2004) with the goal of pairing the individuals work abilities with the work requirements (McQuaid & Lindsay, 2005). Influencing and adjusting attitudes as well as changing the perception of each individual's abilities was a part of the objective rehabilitation which contributed to a successful labour market (Sanders & de Grip, 2004), (Garsten et al., 2004).

Though in the 1960s a new understanding of employability as a purely statistical definition was on the way. This understanding referred to employability as the probability for a given group at a given time to find a job, implying a more macro-economic perspective in the sense that fluctuations in the labour market were taken into account (McQuaid & Lindsay, 2005). This definition focused on the demand from the labour market and the accessibility of employment within local and national economies, where one would expect that an individual with high employability would have a very good chance of finding a job. In this way employability was "the objective expectation, or more or less high probability, that a person looking for a job can have of finding one' (McQuaid & Lindsay, 2005).

In the 1970s the economic situation changed. As a result of inflation the focus of employability shifted to concentrate on skills instead of on the worker's attitude (Forrier & Sels, 2003). Now, due to the economy, it was not a question about wanting or not wanting a job because everybody wanted a job. Instead it was about seeking to be as qualified, as employable as possible. The main purpose of employability was though still to achieve full employment. It was slowly realized that merely having the skills needed for a specific job was often not sufficient to remain attractive in the labour market. The importance of a worker's transferable skills was acknowledged. Examples of such skills were the social and relational skills important not only to get a job but also to keep it and to move on to another job if necessary (Sanders & de Grip, 2004).

In the 1980s the transferable skills indeed came into focus and employability was now concerned with the flexibility of the individual (Forrier & Sels, 2003). For the companies to cope with the constant changes of the society that they were confronted with, they had to be flexible. And therefore the staff had to be flexible. There was an acceptance among individuals and organisations that successful career development required the development of skills that were transferable and the ability to move between jobs and roles (McQuaid & Lindsay, 2005). The focus was on the individual with the responsibility of the workers to develop their skills and networks in the workplace, to strengthen their position when they wished or were required to move (McQuaid & Lindsay, 2005). Employment was no longer an instrument of the labour market to get people into work but rather a Human Resources instrument used to optimize the deployment of staff within companies (Forrier & Sels, 2003). Later on, while maintaining the emphasis on the individual initiative, it began to be acknowledged that the employability of an individual was seen relative to the employability of others and the institutions and rules that governed the labour market. The role of the employers and the labour demand was accepted to have a role in determining a person's employability (McQuaid & Lindsay, 2005), (Sanders & de Grip, 2004). The employability of each individual was an expression for the individual's possibilities, its position in the labour market and the employment situation in general. In this way, employability had an important influence on a worker's career whether it was in the beginning, building or final stage of her career (Sanders & de Grip, 2004).

Since the 1990s attention has shifted back to employability as a labour market instrument. However employability was no longer just for those who were unemployed but for the entire active population. The focus had changed from unemployed/employed to unemployable/employable with the properties of the individual in focus (Garsten et al., 2004). Employability was not just used to rank individuals but also to legitimize their status in the labour market – unemployment was explained and to some extend legitimized with reference to lack of employability (Garsten et al., 2004). The problem of unemployment was individualized in the sense that the causes of unemployment were sought at an individual level (lack of employability) (Garsten et al., 2004). Employability now denoted the capacity of individuals to adapt to the demands of the labour market (Garsten et al., 2004).

2.1.1 Views of employability

Based on the previous section it is clear that the term employability has changed meaning frequently due to economy and society since it was developed. The different definitions and understandings of the term reoccur in literature on employability today. Overall it is clear that the definitions of employability depend on from which side of the labour market you look at the term (Forrier & Sels, 2003). From the *society*, and above all the *government's* point of view, work means employment. In this case employability is an indicator of an individual's chance of full employment. While from an *organisation's or a company's* point of view work is employment of employees which means that an *employer* will understand employability as an indicator of the possibility of matching labour supply with labour demand and to obtain the highest gain from the employee. From the *individuals* point of view work is perceived as an attractive job. In this case employability is an indicator of the chance of getting a job or a career.

The various objectives are of course interconnected and rely on each other to have an active labour market. But as Harvey (2001) notes it may not be possible to maximize the benefits to all interested parties. While the main interest of the government is to employ as many graduates in the labour market, the benefit of the firms and of the individual may be of second order. As well as the interest of the individual to contribute to the economy of society is not the main goal with employment.

2.1.2 Implications

The following section goes through the dimensions of employability and how the indicators of employability can differ sharply.

Internal and external employability

There is a clear division in definitions of employability between those who focus on the factors of the individual and those who also focus on the factors of the labour market. Forrier and Sels (2003) calls this *internal employability* and *external employability*. In recent literature and research definitions of employability mainly focus on the abilities of the individual - internal employability (Forrier & Sels, 2003; McQuaid & Lindsay, 2005). As Rothwell and Arnold (2007) writes 'The proposition that employability is built upon a number of attributes seems to be widely accepted' (Rothwell & Arnold, 2007, p. 25). An example of this is Yorke (2006) who defines employability as 'a set of achievements – skills, understandings and personal attributes – that makes graduates more likely to gain employment and be successful in their chosen occupations, which benefits themselves, the workforce, the community and the economy' (Yorke, 2006, p. 8). Yorke though describes that an individual that possesses the desired characteristics will not with certainty convert high employability into employment. External socio-economic variables will have an effect on the actual employment such as national/regional/local economic health and the demand/supply ratios for the

characteristics in question. Other authors also argue that the factors of the labour market must be incorporated in the employability term. Rothwell and Arnold (2007) writes 'But employability is not only about individual attributes. Within-organisation factors such as the current and predicted state(s) of internal labour markets are also likely to affect employability as defined above. There are also external factors including the state of the contemporary external labour market' (Rothwell & Arnold, 2007, p. 3).

Brown, Hesketh and Wiliams (2003) states clearly that 'Employability will vary according to economic conditions' (Brown et al., 2003, p. 110) and continues 'Employability cannot, therefore, be defined solely in terms of individual characteristics' (Brown et al., 2003, p. 110) and argues that one must acknowledge that the conditions of the local, national and international labour markets is a powerful determinant of graduates' success. Brown et al. (2003) see employability as a combination of the relative and the absolute; the absolute dimension relates to the individuals skills, knowledge and commitment needed to carry out the job and the relative dimension relates to the state of the labour market as the laws of supply and demand within the job market. In this way the employability of an individual is not static but depends on time and place in the form of personal and labour market contexts. This means that an individual may be 'difficult to place' here and now but may be highly 'employable' at a different time or in a different place, as a result of changes in the individual and in the number or requirements of the available jobs (Forrier & Sels, 2003).

Worth noting is that some authors like (Blasko, Brennan, Little, & Shah, 2002) instead of focusing on internal or external employability focus on the socio-economic background of individuals that may influence the employability such as ethnic background, gender, age, the choice of educational programme and their aspirations affect their relative chances.

Employment or not

In employability literature as well as in the historical review it is clear that there is a division in employability definitions in regard to whether or not employment of the individual is a part of employability. Yorke (2006) clearly states 'Employability is not the same as employment' (Yorke, 2006, p. 6) and describes employability as 'a set of achievements which constitute a necessary but not sufficient condition for the gaining of employment' (Yorke, 2006, p. 2). To Yorke the focus of employability is on the abilities and characteristics of the individual and is seen as a potential within the individual instead of an achievement. Others like Hillage and Pollard (1998) describe that an individual's employability is directed towards work and 'Employability is about having the capability to gain initial employment, to maintain employment and to obtain new employment if required' (Hillage & Pollard, 1998, p. 2). This definition goes beyond the individual's potential and focuses on the individual's ability to fulfil the potential and gain a job and retaining it.

Job type

While employment may or may not be included in the definition of employability, the aim of employability is to obtain a job. But exactly which type of job the individual should obtain differs from definition to definition. Some authors argue that the aim of employability is to find any job while others argue that it must be a job related to the individuals degree e.g. a graduate job. Authors argue that it is not possible to delimit what a graduate job is and therefore any job that a graduate can hold is a graduate job (Harvey, 2001). Others argue that since employability is a product of the individual's skills and knowledge a job should utilize and exploit these and let the individual demonstrate its abilities otherwise the employability of the individual would not be used fully (Yorke, 2006). Such definitions talk about ''fulfilling work', or as a job that 'requires graduate skills and abilities' or as a 'career-oriented' job' (Harvey, 2001, p. 98) and Hillage and

Pollard talk about 'suitable jobs' (Hillage & Pollard, 1998, p. 3). In another line Rothwell and Arnold writes that the employability is about finding 'work of the kind they want' (Rothwell & Arnold, 2007, p. 23).

While most authors agree that the aim of employability is for the individual to obtain a graduate job of some kind it is worth noting that the demand of the labour market does have an influence on the jobs which the graduates are able to obtain. As Yorke(2006) writes graduates may not be able to get their first choice of job under the prevailing circumstances and instead aim for other options that call on their characteristics.

Timing

The time from graduation to the first employment is also an implication of the employability term. In the UK employability is measured by evaluating the number of graduates who have secured a job within a specific amount of time (Knight & Yorke, 2003). But as Purcell and Elias note (in Yorke (2006)) graduates from different disciplinary backgrounds tend to differ in the time they take to get a graduate job due to supply and demand of the local and regional labour market. This means that a graduate with high employability may not be able to find a job and is therefore not included in a employability measurement.

Harvey (2001) imply that the time limit of employability may be the amount of time that goes by before an individual need retraining to obtain a job. Others argue that employability is an ongoing process which continues through an individual's entire work life since one always can look for new assignments and new jobs (McQuaid & Lindsay, 2005). This is related to the discussion about whether graduates with high employability should be able to demonstrate the desired attributes at the point of recruitment (Harvey, 2001). Some authors argue that employability is based on the achievements at graduation which means that when the graduate finishes the education the individual should have learned all that it needs to know (Harvey, 2001). Others believe that employability is developmental and indicate that a graduate with high employability has the ability to develop the desired attributes rapidly (Harvey, 2001). These authors believe that `the degree is not the end of learning' and values graduates who are ready for further development. In this view employability is an expression for a continuous learning process which includes both the unemployed who are looking for work and the employed who are looking for alternative jobs or are looking for a promotion.

Employability skills

As previously described employability is based upon a number of abilities of the individual. In the literature these abilities can be found to be divided into two groups; the academic abilities which are competencies, skills and knowledge primarily gained during education and the general abilities which cover a broader package of competencies, skills and knowledge.

The literature imply that the academic abilities is the entrance ticket to a job where the broader competencies are determining for whether or not the graduate will function well in the job. As Brown et al. (2003) writes 'academic qualifications are the first tick in the box and then we move on' (Brown et al., 2003, p. 120). This attitude may be an expression of that the graduates often are perfectly qualified within their academic field and therefore the challenges of increasing the graduates' employability have to do with the general abilities (Stiwne & Jungert, 2010). Yorke (2006) writes that learning what is in the curricular may *facilitate* the development of prerequisites appropriate to employment but some achievements vital for a workplace success might not be covered during the education, maybe due to the difficulty of placing a grade on aspects such as leadership and co-operation (Yorke, 2006).

The general abilities (also called transferable skills, generic skills, key skills) are constituted by a variation of competencies and abilities depending on the context. Examples of these abilities are career management and job search (Hillage & Pollard, 1998), learning from own experiences (Yorke, 2006), willingness to display mobility and to follow job training courses (Forrier & Sels, 2003), adaptability, versatility, showing an entrepreneurial attitude, and being service-minded and accepting continuous evaluation and ranking (Garsten et al., 2004).

McQuaid and Lindsay (2005) has set up a whole framework of employability abilities which contains skills and competencies of various kinds (McQuaid & Lindsay, 2005, p. 209):

Essential attributes: Basic social skills, honesty and integrity, basic personal presentation, reliability, willingness to work, understanding of actions and consequences, positive attitude towards work, responsibility, self-discipline

Personal competencies: Pro-activity, diligence, self-motivation, judgement, initiative, assertiveness, confidence, act autonomously

Basic transferable skills: Prose and document literacy, writing, numeracy, verbal presentation

Key transferable skills: Reasoning, problem solving, adaptability, work-process management, team working, personal task and time management, functional mobility, basic ICT skills, basic interpersonal and communication skills, emotional and aesthetic customer service skills

High level transferable skills: Team working, business thinking, commercial awareness, continuous learning, vision, job-specific skills, enterprise skills

Others like Knight and Yorke (2003) view general employability abilities as a confluence of understanding, generic social practices, meta-cognition and being persistent based on what is reported about what employers ask for.

2.1.3 Employability today

The term of employability is increasingly becoming popular due to its relevance for the entire active population. In an increasingly competitive and knowledge-driven economy enhancing qualifications and skills of the workforce is perceived as a way to increase national growth and prosperity. The popularity of the term is especially seen in policy discourses (Lim & Morris, 2006) where employability has been used to describe the objectives of economic strategies promoted by institutions as the EU, the UN and the OECD (McQuaid & Lindsay, 2005).

While employability was primarily put on the political agenda in order to break the division between the working and not working population the concept was also introduced in the EU to improve the employability of the younger generation. This was reflected in the European Employment Strategy where employability formed one of the four original pillars (Moreau & Leathwood, 2006). This lead to a promotion of employability among young people (McQuaid & Lindsay, 2005) as a strategy for improving and developing the general competence level as well as the willingness to work and the access to the labour market (Garsten et al., 2004).

Though employability is not merely a subject of theoretical agendas. The concept has become important in many countries putting graduate employability high on government agenda with the expectations that higher education contribute to national economic growth (Harvey, 2001), (McQuaid & Lindsay, 2005). Especially in the UK the employability of graduates has become a 'part of a wider strategy to extend the skill

base' (Harvey, 2001, p. 4). In 1999 the UK government introduced a performance indicator based on graduates' employment rates to measure the performance of institutions in higher education reflecting a growing attempt to develop links between higher education and the labour market (Moreau & Leathwood, 2006). In this context employability is measured in terms of the percentage of graduates in work six months after graduation. Funding for UK universities is partially contingent upon visible graduate outcomes which has caused an increasing pressure on higher education institutions to produce employable graduates.

These tendencies shows that employability is being measured by the outcome in the form of graduate employment rates and that employability has shifted towards institutional achievements rather than the potential of the individual student to get employed (Harvey, 2001). This is most likely because job acquisition is easier to measure than preparedness for employment, but in doing so the effectiveness of the institution is measured rather than the actual employability of the graduate (Harvey, 2001).

Opposite to the UK the concept of employability is not yet widespread in Denmark. As Denmark often turns to the UK for inspiration it is just a question of time before the concept of employability reaches Denmark.

As a part of a European collaboration, the so called Bologna-process, Denmark and other countries committed to increase employability of the students and ensure that students acquire the knowledge, skills and competencies needed in the labour market (Danske Universiteter, 2012). To meet the goals of the Bologna-process learning aims were introduced in the Danish educations including the universities (Danske Universiteter, 2012). These learning aims were set up to describe what the students should gain from courses and the educations as a whole. The aims were introduced to make it more apparent for students and employers which skills and competencies the graduates had acquired based on their education. Though while these learning aims may function as a clarification for students and employers as to what the graduates are capable, these learning goals do not enhance the employability of the student.

2.2 Competence descriptions

As implied in the previous section the notion of competencies is an important ingredient of the employability concept. Competence definitions can be found in many variations depending on the context which the competencies are developed and used in, but basically competencies are formed by knowledge, skills and attitudes (Europa-Kommissionen, 2007) which are put into action in a context (V. Andersen, Ulriksen, & Bering, 2006).

The concept of competencies saw the light of day in the 1980s as a part of the modernization of the labour market (Dolin, Krogh, & Troelsen, 2003). This was due to the rapid evolution in the work conditions and the competition of the labour market where the solution was to invest in resources of the employees (Illeris, 2011). New tendencies such as work management and motivation for work became important giving rise to concepts such as New Public Management and Human Resource Management and the concept of competencies was a part of these (Dolin et al., 2003). Overall the transition from an industry- and service society to a knowledge society meant that knowledge was no longer a static product but instead a product in constant evolution. This led to a change of the goal being to obtain an extensive knowledge to instead being the ability of mastering processes and obtain skills. This meant that the focus had changed to lifelong learning.

To educate and qualify people to the knowledge society various competence descriptions were made to describe what individuals had to learn to function optimally in a given context. These competence descrip-

tions specify which competencies are needed to function in a specific context which can either be a larger context such as an entire society or a more defined context such as a study programme. In the following sections examples of such competence descriptions will be presented.

2.2.1 National and international competence descriptions

In Denmark it was the business industry who initiated the development of the concept of competencies (Illeris, 2011). The newspaper Huset Mandag Morgen introduced the concept in 1998 by establishing Kompetencerådet (The Competence Council) (Dolin et al., 2003) which consisted of about 70 members from the business industry, various labour market organizations and from the public sector (Illeris, 2011). The purpose of the Competence Council was to analyse the existing definitions of the competence concept and then based on economic, humanistic and social perspectives construct a national competence description for a competitive society. This resulted in the formulation of four key competencies which should be a part of a national competence account. From 2001 the Competence Council handed this competence account over to the state where the National Competence Account took over (Illeris, 2011). The National Competence Account began as an interdisciplinary project between ministries. But from 2002 it belonged to the Ministry of Education where it though was carried out by a group with participants from several ministries. The main achievement of the National Competence Account was the participation in the international project DeSeCo (The Definition and Selection of Competencies). This project was initiated in 1997 by the OECD organization[1] (The Organization for Economic Co-operation and Development). The goal of the project was to identify a set of key competencies and based on these establish a framework of competencies needed for individuals to lead a successful and responsible life and for society to face the challenges of the present and the future (OECD, 2001). Each of the 34 OECD countries were able to contribute to the process of defining and selecting competencies based on their national priorities. The Danish report was prepared by the National Competence Account and the Ministry of Education. Based on the national contributions ten key competencies were identified. The final framework of the DeSeCo project merged these ten competencies into three broad competencies which were published in the final report "Key Competencies for a Successful Life and a Well-Functioning Society' (Rychen & Salganik, 2003). The three categories establish by the project were; *use tools interactively*, *interact in heterogeneous groups* and *act autonomously,* see Figure 1.

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[1] OECD is an international economic organization officially founded in 1961 to stimulate economic progress and world trade. The mission of the organization is to promote policies that will improve the economic and social well-being of people around the world. The organization is a forum for governments to work together and share experiences and seek solutions to common problems. Assessment of knowledge and skills has become a key focus to the OECD.
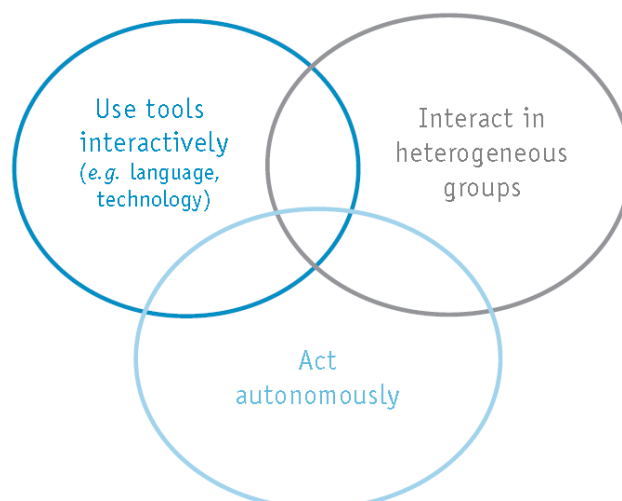
Figure 1
The three key competence categories developed by the OECD (Rychen & Salganik, 2003, p. 5)

The three competencies are described as following (OECD, 2001):

Using tools interactively is understood as the use of both physical tools such as computers but also as socio-cultural tools such as language. Using tools interactively is not just about knowing how to use the tools but also to understand them well enough to adapt them to various purposes. This requires a familiarity with the tool as well as an understanding of how the tool can be used to interact with others and to accomplish goals. In this way a tool is not just a passive instrument but an instrument used between an individual and her environment.

Interacting in heterogeneous groups is to be able to engage with others. In societies, which are increasingly becoming more focused on independence, it is important for an individual to be able to interact in groups with people from a range of backgrounds. Networking, cooperation and working in teams is the way of the future to manage and solve problems. The competencies in this category are required for individuals to learn, live and work with others and are therefore important to all contexts of life.

Acting autonomously means that the individual is aware of her environment, of social dynamics and of the role she plays and wants to play. The individual must be able to manage her own life in a meaningful and responsible way by exercising control over her living and working conditions. The individual must situate her own life in the broader context in the way she wishes to do. To participate in social contexts it is important for the individual to be able to act autonomously and not to just go along with the group but contribute with her own individual knowledge and opinions. In the modern world being autonomously is especially important because the position of individuals is not as well-defined as earlier which means that the individual has to create a personal identity in order to figure out how to fit in.

In line with the DeSeCo project the National Competence Account carried out a national project to measure the national competence level of Denmark. The project ran from 2001 to 2003 and in 2005 the final report 'Det Nationale Kompetenceregnskab - Hovedrapport' (Det Nationale Kompetenceregnskab, 2005) was published. The National Competence Account was build upon the ten key competencies identified through the DeSeCo project with the overarching goal of mapping the human resources of Denmark and identifying the challenges of competence development in Denmark. The ten competencies which the National Competence Account established were (Det Nationale Kompetenceregnskab, 2005)[2]:

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[2] Freely translated by author.

- Literacy competence
- Learning competence
- Self-confidence/self-management
- Creative and innovative competence
- Social competence
- Communicative competence
- Intercultural competence
- Democratic competence
- Health, sports and physical competence
- Ecological competence/relationship to nature

The project of the National Competence Account was carried out as a survey to measure the competencies of the work force of Denmark. This was done by assessing each competence based on a number of indicators developed by researchers within the field of each competence. The results were used as indications of the challenges within the work force of Denmark.

While the key competencies identified through the DeSeCo project were developed to help individuals to lead a successful and responsible life and to make the human capital of each society as competent as possible these competencies are quite alike some of the competencies included in the concept of employability. Using tools interactively covers a broad range of the competencies taught as curricular competencies while the categories interacting in heterogeneous groups and acting autonomously were some of the competencies which the employers especially requesting when they were asking for a higher degree of employability within the graduates.

2.2.2 Competencies of science

While the competence descriptions presented in the previous section were developed for an individual to function well in a society and for the society to be equipped for the future other competence descriptions are concerned with more defined contexts such as the competencies of a specific academic field.

In a report from 2000 by the Ministry of Education the challenges of the educational system were described based on a rapidly changing world where the conditions and perspectives for education changes quickly along with the information technology and globalization. Based on this report it was decided to investigate the content of Danish educations and disciplines in regard to knowledge, skills and competencies. Science was one of the chosen disciplines. This lead to the report 'Fremtidens naturfaglige uddannelser' (N. O. Andersen, Busch, Horst, & Troelsen, 2003) which described and defined the future for educations in science.

In the report it was described that by incorporating the concept of competencies into the educational system the goal was to shift the focus from students reproducing what the teachers taught to instead mastering the field of science and obtain an extensive gain from the education which could be used in the students' further education and life. In this way the science competencies were not just relevant within science but to all contexts of the student's life. In the report a science competence was defined as 'The ability and will to act, alone and together with others, in a way which use the ability of to wonder, knowledge, skills, strategies and meta cognitive processes within science to create meaning and autonomy and to prac-

tice self involvement in relevant contexts of life[3] (Dolin et al., 2003, p. 72). The report defined four competencies characteristic of science (N. O. Andersen et al., 2003). These four competencies were[4]:

- *Empirical competence* which contains the abilities to make experiments, to observe and describe experiments, to classify, to have manual skills, to be able to collect data and process it, to be aware of safety methods, and to make uncertainty analysis, to be able to criticize methods and to make generalizations between practice and theory
- *Representation competence* includes the ability to work with symbols and representations, to observe and to present, to be able to distinguish and to shift between representation levels, to analyse and to reduce a problem, to understand the power of explanations, to ability of abstracting
- *Modelling competence* means to be able to formulate problems, to set up a model and to distinguish between model and reality, to be able to reduce, analyze and specify, to use methods and theories appropriately, to verify and to falsify, to determine causalities, to criticize and to develop
- *Perspective competence* is about the ability to make links within the subject and to make links outside science, historical/cultural links, links to the near and distant surroundings, to be able to reflect about the role of science and technology in the development of a society, to critically evaluate science in relation to other knowledge

The report stated that these four competencies should be included in every education which includes elements of science. For students enrolled in higher education in science it is especially of importance to be able to put science into perspective both within the field of science and outside and to independently apply the subject in various complex contexts (N. O. Andersen et al., 2003).

2.2.3 Study competencies

Study competencies are a group of competencies related to different aspects of the learning process and not specifically to the subject which is being learned. These competencies have therefore become increasingly popular since the 1990's for formulating curricula (Ulriksen, Horst, Jensen, Sørensen, & Holmegaard, 2011). These competencies concerns the methods used to study a subject and the attitude towards the learning process which means that they are relevant for all processes of studying and learning.

Beck and Gottlieb (2002) defines a study competence as 'the ability, motivation and insight to complete a higher education' (Beck & Gottlieb, 2002, p. 11). Beck and Gottlieb (2002) discuss study competencies in relation to high school students and their transition to a higher education but the definition of a study competence can also be understood in the context of students enrolled in a higher education. Beck and Gottlieb (2002) describe that a student with study competencies has the ability to study a subject on a higher level, meaning that the student is able to embrace and study a subject thoroughly. Besides this, the student must possess personal and social competencies which include good study habits and the ability to function in a study environment were the demand to be independent is high but where the ability to do teamwork also is important. The student has to be motivated to embrace and excel within a given field. This means motivation for immersing in a subject and further education within it. The student must possess the ability and will to make choices about the future. This means that the student is able to acquire insight in future opportunities as well as being aware of herself to understand her own abilities and desires.

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[3] Freely translated by the author.
[4] Freely translated by the author.

Study competencies are primarily trained in the primary and especially secondary educations while in the tertiary educations more weight is put on the students to independently train the study competencies. But this does not mean that the training stops when entering the tertiary education. Beck and Gottlieb (2002) argue that exactly because the training of study competencies in the universities is up to the student herself it is important that educators think about good learning processes in their education and incorporate various study methods in their courses.

Because the study competencies are competencies which are used when working with and studying a subject these competencies are not just relevant in the context of education but also in the job market. The study competencies trained in the university is training in becoming aware of the process of learning and making independent choices. Consciousness and independence were also some of the competencies which the employers requested for when they asked for employable graduates. This means that the study competencies are relevant when training students to become more employable.

2.2.4 Curriculum for the Master's programme in Physics

According to the University-law (The Ministry of Science, 2011) the rules and goals of a university study programme must be written in a curriculum. The curriculum for the Master's programme in physics is governed by the Study board of Physics, Chemistry and Nano-science at the Faculty of Science. The latest version of the curriculum is the Curriculum for the Master's programme in Physics, September 2010, revised with effect from 2013 (Faculty of Science, 2013). The curriculum includes a paragraph with objectives and descriptions of the general qualification profile in physics and include competences, skills and knowledge which all graduates from the Master's programme should have acquired through the programme.

Analysing the competencies, skills and knowledge written in the curriculum relative to the three competence categories of the DeSeCo project it is clear that the majority of the skills and competencies from the curriculum fall under the category *Use tools interactively*. This is not a surprise since the science competencies primarily fall within this category. Looking at the curriculum relative to the study competencies only a few of the competencies in the curriculum are study competencies.

2.3 Transfer

Transfer can be described as 'student's ability to transfer what they learned to new situations' (Bransford, Brown, & Cocking, 2000, p. 235). Since a higher purpose of education is for a student to be able to apply what is learned in new contexts, it is relevant to understand the factors which can influence the transfer process. The three primary factors which have an influence on transfer is the characteristics of the student, the design of the study programme, and the work environment (Alawneh, 2008). These three factors and their relation to the concept of transfer will be described in the following.

2.3.1 Transfer factors related to the students' characteristics

Characteristics of the student to a high degree influence the process of transferring knowledge and skills from a study programme to the job situation.

To increase transfer the student has to be motivated for transfer, and wish to apply what is learned in a new situation (Wahlgren, 2009). Motivation is based on the student having a goal which she wants to achieve. This means, that in order to increase the students motivation for applying what she has learned,

the student has to be able to see a goal with what is learned. In the context of transition from education to the labour market the goal is the application opportunities of the learned in the labour market. If the student knows how the subject, which she is learning, can have a positive influence on her future job then the motivation will increase. This means, that the more clearly the student can see the purpose of learning, which in this case is based on the job opportunities, the more transfer.

Motivation can further be increased if the student is involved in the planning of her study programme. Active involvement can entail an obligation within the student to make an effort to apply what she has learned (Wahlgren, 2009). This is connected with the ability to set goals and commit to these goals. Setting a goal (personal or collective) requires commitment which entails a higher motivation towards applying the learned (Washington, 2000).

The students' faith in her own abilities, her self-efficacy, has also been shown to have an effect on the degree of transfer (Washington, 2000). If the student has confidence within her knowledge and skills, she is more likely to apply these in the new situation. Therefore the higher self-efficacy, the higher degree of transfer.

2.3.2 Transfer factors related to the design of the study programme

A prerequisite for transfer is that the student has learned the knowledge and skills which are to be transferred, and that the student has learned them to the degree that she is capable of applying them. If the student understands what she learned, it has a higher chance of being transferred, than if she learns by memorizing facts or procedures (Bransford et al., 2000).

The design of the study programme should depend on how the learned is going to be applied. This means that design of the study programme should depend on the type of transfer. Transfer can either be near or distant transfer.

Near transfer means that what is learned is applied in situations which are relatively similar to the learning situation (Wahlgren, 2009). To optimize near transfer there should be identical elements in the learning situation and the application situation. This implies that the content of the study programme to a high degree should reflect the content of the application situation, that it should be clearly specified how the learned is going to be applied and that the student has to learn the subject quite thoroughly and detailed (Wahlgren, 2009).

Distant transfer on the other hand entails that the learned knowledge and skills are applied in situations which are different from the learning situation (Wahlgren, 2009). If the goal is to obtain distant transfer it is of importance that the student learns to understand underlying principles and terms and that the student learns to apply the learned in different contexts. The learning situation should encourage the student to independently apply the learned in new contexts and discuss the content in relation to the new context (Wahlgren, 2009). And finally the student should be encouraged to continue this practice after the education is finished.

While near transfer implies that the two contexts should be as alike as possible to obtain the highest degree of transfer, distant transfer suggests that it is possible to transfer knowledge and skills to an application situation by understanding the meaning behind the methods and the knowledge. In this way the purpose of the education, whether it is near or distant transfer, has great impact on how the study programme should be structured. Both near and distant transfer agree that the content and methods of the learning situation in some way should relate itself to the application situation to obtain a high degree of transfer. This means that elements from the application situation should be embedded in the education and that

methods to transfer the learned should be taught. This means that the individuals should be trained in the process of transfer.

The teacher plays an important role in the learning situation and therefore also in transfer. A fair teacher, who is interested in the student, can develop a trusting relation with the student which makes it more likely that the student will apply the learned (Alawneh, 2008). A trusting relation with the student can encourage the student to commit to the education because the she feels that she owes it to the teacher. This leads to student involvement which, as described above, can increase transfer.

The teacher can also play an important role in the transfer process by engaging in discussions about application opportunities of the learned, by guiding the students in the learning process and by giving positive feedback to the students (Lim & Morris, 2006). In these ways the teacher is indirectly involved in the transfer process by building an acceptance of the importance of applying what is learned.

2.3.3 Transfer factors related to the work environment

The last factor which can influence the transfer process is the work environment. It has been shown that organizational and personal relations in the work environment have can have a great impact of the opportunities for transfer (Wahlgren, 2009). But the research is though quite diverse in regard to which factors that have the most influence of the degree of transfer. This is, to a high degree, because studies have been carried out in various work environments where some factors are more pronounced than others. In general it can though be said that to increase the degree of transfer, the workplace must provide the opportunities to apply the learned and the work environment must be supportive and encourage the employee to apply the learned. Examples of this are that technical facilities (such as computers, software and other resources) are present, that it is a part of the job tasks to apply the learned and that there is time for the individual to work with and apply the learned. A supportive environment can come from leaders, managers or colleagues who encourage the employee to be ambitious in applying what she has learned. It can also be supported in the form of feedback to the employee when she has applied the learned.

It has been shown that transfer can be increased if the learned is applied immediately after the learning situation. If there on the other hand is a large time period between it is learned and it is applied then the chances of transfer are smaller (Wahlgren, 2009). Immediate application requires that it is possible to apply the learned immediately and that it is supported by the work place.

2.4 Structure of the Master's programme

The Master's programme in physics is a two year education following a Bachelor's programme in physics. The Master's programme constitute 120 ECTS points. Courses constitute at least 60 ECTS point and the remaining ECTS points constitute the Master's thesis. The Master's thesis can constitute 30, 45 or 60 ECTS points. The standard is to complete one year of courses and use one year to produce the Master's thesis.

Courses are build around the block structure in which one year consists of four blocks. Each block consists of two courses summing up to a total of eight courses per year. Courses can be chosen at Niels Bohr Institute, at other institutes within University of Copenhagen or at other universities in Denmark or universities abroad. Courses at the Master's level can be taught every year but at the Niels Bohr Institute a number of courses are only taught every second year.

The students of the Master's programme in physics can choose to specialize themselves within a qualification profile. The qualification profiles are astrophysics, biophysics, geophysics and general profile. Students enrolled in the Master's programme in physics automatically obtain a general profile when completing the programme. In order to obtain a qualification profile other than the general profile the student must take a number of courses within the subjects of the qualification profile. Students can follow courses within another subject to graduate with an elective subject. To become a high school teacher this is often done.

3 METHOD

3.1 Selection of respondents

To investigate the transition from the Master's programme to the labour market, graduates from the Master's programme in physics, from the last five years of the programme, were selected[5]. These graduates were selected because they were newly graduated and so the transition would be present in the memory of these graduates, relative to graduates from earlier years.

From the Faculty of Science, at the University of Copenhagen, a list containing names and graduation dates of the selected graduates was provided. The list contained 312 graduates[6]. These graduates constituted the total population of the survey. In Table 1 the distribution of the selected graduates in regard to gender, qualification profile and year of graduation is presented.

Table 1 Distribution of graduates from the Master's programme in physics 2007-2013

Selected graduates	Total: 312 graduates
Gender	Male 214
	Female: 98
Qualification profile	Astrophysics: 19
	Biophysics: 34
	Geophysics: 53
	General profile : 206
Year of graduation (calendar year)	2007: 9
	2008: 46
	2009: 61
	2010: 71
	2011: 57
	2012: 58
	2013: 10

3.2 A questionnaire survey

The aim of this thesis is to investigate the graduates' experience of the transition from a higher education to the labour market and present a broad picture on this subject. This included quantitative results on the graduates and on some subjects qualitative results.

Due to the aim of the thesis, I chose to make a survey. A survey collects information that can be converted into quantitative analysis and is based on number of units (in this case the graduates) and a number of variables (written in the thesis outline) which one wants to investigate (Hansen & Andersen, 2000). The survey made it possible to collect the results needed to enlighten the research questions of the thesis.

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[5] Graduates from the period 1/10-2007 till 22/5-2013 (the day the data was extracted).

[6] The list included international graduates with a Bachelor's degree from a university abroad, but a whole Master's degree in physics from the University of Copenhagen. Students who were registered under the 4+4 PhD programme who had submitted and passed their Master's thesis were also included on this list.

A way to conduct a survey is by making a questionnaire. A questionnaire is a way to make sure that the same questions are presented to all respondents. This property was especially important in order to be able to produce quantitative data. Data for a questionnaire survey can be collected in two ways: interview-based surveys and enquete surveys. While the interview-based surveys are questionnaires presented to the respondents by a reader, the enquete surveys involve that the respondents have to fill in the questionnaires by themselves. Due to the size of the total population and the time limit of the thesis, an enquete survey was chosen. The questionnaire was distributed via the Internet instead of distributing it via mail. This was done because the response rate generally is higher on questionnaire distributed via the Internet then via mail and also it was easier to find online contact information on the graduates, than it was finding mail addresses.

3.2.1 Advantages and disadvantages of a questionnaire survey

There are several advantages to using a questionnaire. Most importantly questionnaires are an efficient way of collecting large amounts of data easily (Patten, 1998). Due to the relatively large number of selected graduates, large amounts of data were produced which made this property of the questionnaire important. In addition to this, questionnaires yield responses that are usually easy to tabulate or score and the resulting data is relatively easy to analyze compared to interview data (Patten, 1998). This is especially true, if the questionnaires mainly contain questions with options to be ticked off. Due to the diversity of the graduates this property especially became important since the questionnaire inevitably became quite extensive in order to contain this diversity.

Another advantage of a questionnaire is that it can be administrated anonymously (Patten, 1998). This is especially useful when collecting information on sensitive matters. The subject of this questionnaire was somewhat sensitive since it was concerned with the experiences and feelings of the graduates. The anonymity allowed the respondents to answer the questionnaire and still feel comfortable.

Lastly a questionnaire survey is economical (Hansen & Andersen, 2000; Patten, 1998). Using the Internet to distribute the questionnaire made it possible for geographically distant graduates to respond to the questionnaire. Since the graduates in principle could have been employed all over the world it was quite essential to distribute the questionnaire through a media which the graduates easily could contacted through in order to get a higher response rate.

A disadvantage of questionnaire surveys is that the response rate often is low (Hansen & Andersen, 2000; Patten, 1998). This is especially true, if the questionnaire is sent to potential respondents who do not personally know the researcher. In general, one can expect higher response rates when contacting potential respondents by telephone and even higher response rates when contacting them in person for interviews. In the case of this questionnaire, I knew some of the respondents personally, which may have increased the response rate. Also, since I had the same educational background as the respondents and I was sitting in a situation, writing the Master's thesis, within which they could identify themselves, it may have lead to more responses. I addition to this, this survey was the first survey that focussed on the experiences of the graduates from the Master's programme in physics. This means that it was the first opportunity for the graduates to give feedback to the Master's programme. This may have encouraged the graduates to answer.

Another disadvantage is that questionnaires generally work best, if they only contain objective questions (Patten, 1998). Patten (1998) defines objective questions as 'items to which the responses can be scored objectively, such as items with choices that respondents check and short answer items that require very

limited responses, such as responses to the question "What is your age?" ' (Patten, 1998, p. 3). Objective questions require short responses, which mean, that the respondent can move through the questions quickly, giving the response that first comes to mind. Due to the objective questions, questionnaires usually provide a snapshot of a subject rather than a rich, in-depth picture of the area of concern. Also, it is not possible to easily follow up on interesting leads compared to an interview, which can be more explorative and discover interesting subjects. A questionnaire must provide the possible answers (through the options) and therefore it is decided on beforehand which options that are possible. This means that the questionnaire does not have the possibility of discovering 'hidden' experiences or feelings. Since this survey focussed on the experiences of the graduates, it would be difficult to only ask objective questions. Adding open questions to the questionnaire, gave the respondents the possibility to provide descriptive answers and thereby give a richer picture of the transition.

A danger associated with questionnaires is that if they are not clearly formulated it can be difficult for respondents to understand the meaning of the questions. This is compared to interviews where the interviewer can contribute by clarifying questions whereas in a questionnaire there is no one who can take on this role. This means that the questions in a questionnaire must be carefully formulated and tested, in order to make sure that the respondents answer the questions as intended.

Besides giving the 'wrong' answers due to misunderstandings the respondents may also be swayed to give inaccurate answers due to social desirability (Patten, 1998). That is if the respondents answer the questions with in regard to what they think is socially acceptable – even if it is not fully accurate. Interviews are also subject to social desirability, and may be even more so since the respondents are not anonymous to the interviewer. The anonymity of the questionnaire will reduce the effects of social desirability but the need for approval can still be so strong that the respondents will give the desired answers.

In the construction of the questionnaire and in the analysis of the results, these disadvantages were taken into account in regards to how they could affect the results. Despite of the disadvantages of a questionnaire a questionnaire survey was still chosen, as the method to enlighten the research questions, because the advantages presented previously were quite essential for the aim of the thesis.

3.3 Inspiration for the content of the questionnaire

Inspiration for the content of the questions in the questionnaire was primarily based on three sources:

- Literature (previous surveys and literature presented in Section 1 and 2)
- Café interviews with graduates from the physics programme
- Personal knowledge about the Master's programme in physics at the Niels Bohr Institute

Overall 'Dimittendundersøgelsen for Det Naturvidenskabelige Fakultet 2010' (the Graduate Survey for the Faculty of Science) (Faculty of Science, 2010) survey was used as inspiration for the structure of the questionnaire in regard to interesting variables and relevant background variables.

The publication 'Kandidater til livet' by (Horst, 2003) contains interviews with graduates in physics and mathematics from Roskilde University. In these interviews, the graduates were asked to describe how their careers had evolved since graduation. These interviews made it possible to obtain insight into the various paths that physicists could have taken after graduation, the factors that had affected their transition to the

labour market and the reflections the graduates had had about their career relative to their education. Question 50 in the questionnaire emerged based on these interviews.

To understand which competencies the respondents experienced to have had acquired during the Master's programme and which competencies they experienced to use in their jobs the respondents were asked to evaluate two lists of competencies, one with scientific competencies and one with general competencies (question 43 and 44) and report the degree to which they had acquired/used the listed competencies. The list of competencies were inspired by the competencies written in the 'Curriculum for the MSc in Physics' (Faculty of Science, 2013), in the Graduate Survey (Faculty of Science, 2010), in 'Fremtidens Naturfaglige Uddannelser' (N. O. Andersen et al., 2003) and in the publication 'Elev/student - en teoretisk og empirisk undersøgelse af begrebet studiekompetence 1-2' (Beck & Gottlieb, 2002).

In addition to inspiration from the literature, I conducted a small number of quick café interviews at a reunion for physics graduates. These interviews revealed that a number of graduates were actually unemployed and were quite frustrated with their situation. Based on this, a series of questions directed towards unemployed graduates were incorporated (question 51-56). The café interviews also revealed that some graduates had found it difficult to identify which competencies they had acquired during the Master's programme and how to find employers that were looking for physicists. Based on these interviews, question 19 and 23 were formulated.

Finally my personal knowledge about the Master's programme and the structure was used to compose questions which considered factors that where especially relevant for the Master's programme in physics.

3.4 Designing the questionnaire

When designing the questionnaire various factors were considered in order to have the respondents experience the questionnaire as uncomplicated as possible and to have the respondents answer the questions as was intended. These factors concerned the structure of the questionnaire, the formulation of the questions, the construction of the options to the questions, and the events which the questions regarded.

In the following four sections the various factors which could have affected the results to the questionnaire will be reviewed, and a reflections upon the design of this questionnaire will be described. At first, the overall structure of the questionnaire will be presented and then the three dimensions of a questionnaire; the question, the answer and the tense (Hansen & Andersen, 2000) will be described.

3.4.1 Structure of the questionnaire

The questionnaire consisted of 60 questions. The first 12 questions were questions collecting background variables about the graduates. Question 13-20 were concerned with the Master's programme in physics, question 21-25 were concerned with the respondents' first job after graduation. Question 26-50 were concerned with their current job, and question 51-56 were constructed to those respondents who had never had a job after graduation. Question 57-59 concerned how the Master's programme could be improved.

Not all 60 questions were presented to all respondents. The number of questions, which each respondent was presented to, depended on the answers of each respondent. For this, logical filters were used. An example of a filter is found in question 21 when asking about the number of jobs since graduation. For the respondents who had never had a job after graduation, they would answer '0 jobs' and be redirected to questions about being unemployed, and their experiences with this. Due to the filters, the respondents

who had never had a job since graduation were only asked approximately 25 questions. The employed respondents were asked approximately 45 questions.

When constructing a questionnaire, it is worth considering the length of the questionnaire (Kruuse, 2000). If the questionnaire is too long the respondents will become tired and may consider to drop out before being done. A suitable number of questions for a questionnaire cannot be determined exactly. The questionnaire has to have enough questions to make sure that the research questions can be answered, but few enough questions for the respondents to not drop out. Due to the extent of the thesis outline the length of the questionnaire was quite extensive.

A chronological structure was chosen for the questionnaire, starting with questions regarding the Master's programme, going on to questions concerning the respondents' first jobs and then finally questions regarding the respondents' current/most recent jobs. This was done to give the respondents a logical evolution of the questionnaire from the beginning to the end. Each part of the questionnaire began with factual and general questions and then moved on to the more specific questions about the respondents' experiences. This technique is called a funnel technique (Kruuse, 2000). This technique can be imagined as a funnel, starting widely and then narrowing more and more. The funnel technique allows the factual and general questions to be answered, without being affected by the specific contexts of later questions. Also, it gives the respondent a soft introduction to heavier questions.

When going from one subject to another it is useful to make linking texts (Hansen & Andersen, 2000). This makes the transition from one subject to the next more smooth. In the questionnaire, the linking texts worked as closures to previous subjects, introductions to new subjects and also as clarifiers of the connection between two subjects. Linking texts were applied throughout the questionnaire.

To make sure, that the respondents answered each question, validations were inserted. A validation is a control making sure that a respondent answers a question satisfactory (Deibjerg, 2012). This means that if a respondent did not answer a question adequately, then it was not possible to continue to the rest of the questionnaire. Validations were inserted to avoid a high response rate with a low answer rate. For the open questions, validations were not inserted. This is because many respondents find this type of question irritating and frustrating. The respondents may feel that they have to deliver a well-crafted essay which could give rise to a degree of performance anxiety. Also, open questions can be time-consuming which could lead the respondents to drop the questionnaire.

3.4.2 Questions

Questions in a questionnaire can ask for different kinds of information. *Factual questions* are concerned with behaviour, incidents, extrinsic properties and characteristics. A*ttitude questions* are concerned with the respondents opinion or attitude towards a subject, and *evaluative questions* are concerned with product evaluation. Depending on the type of question, different conditions have to be considered. These three types of questions will be described in the following sections.

Factual questions

Factual questions were implemented in the questionnaire to test basic hypothesis from the research questions e.g. to test if there was a pattern in the answers in regard to age, gender, qualification profile, year of graduation of the graduates and so on. Examples of these types of questions can be found in question 1-12 in the questionnaire.

The factual questions have an objective nature and therefore it must be considered if they can be perceived as intrusive by the respondent (Patten, 1998). In this questionnaire the factual questions mainly asked the respondents for information about the Master programme and their job situation. These questions are not likely to be perceived as invasive. One question though, question 59, may seem intruding. Question 59 asked the respondent to state its name and email. This question was inserted as a help to administrate the questionnaire. The request may seem peculiar to the respondent since the questionnaire was anonymous. Due to the sensitive nature of the question it was placed last in the questionnaire, as is recommended for sensitive questions (Patten, 1998). Having invested time and thought in answering the earlier questions, respondents who would object mildly to the personal nature of the question, may have decided to go ahead and answer it anyway. Other respondents who decided to leave the question blank, returned the questionnaire mostly completed. If the question had been at the beginning of the questionnaire these respondents might not have answered any of the questions in the questionnaire. In addition to the placement of the question in the end of the questionnaire, a separate introduction to this question was written. This explained why the information was needed, and intended to reassure the respondents that the information would remain confidential.

Attitude questions

An attitude is a general predisposition towards a subject (Patten, 1998), in this case towards the Master's programme and the labour market. When measuring an attitude the questions are asking about feelings, actions and potential actions (Patten, 1998). The purpose of this questionnaire was to investigate the graduates' experience of the transition from the programme to the labour market. The experience of a respondent is based on the respondent's attitude. Since the experience is the subject of interest of the thesis, several attitude questions were inserted into the questionnaire.

A way of investigating an attitude is by using Likert-type items[7]. Likert-type items are simple declarative statements regarding the subject of interest. The respondent is asked to score each statement in regard to the extent to which they agree or disagree. An example of a Likert-type item is seen in question 14, see Figure 2. In this figure, the respondents were asked to report to how high a degree they chose courses based on stated motives.

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[7] Likert-type items; in 1932 the psychologist Rensis Likert (1903-1981) developed the Likert scale to identify the attitude towards some object.

Figure 2
Question 14

Though while attitudes, such as an attitude towards work, are complex constructs consisting of many elements, several statements must often complement each other to give a whole picture. This means that the questionnaires must include a large series of questions or Likert-type items in order to fully identify an attitude. Thus Likert-type items used in this questionnaire were expressions of the respondents' subjective evaluation of the statements based on their experiences, and not a measurement of their experience.

Evaluative questions

The function of an evaluative question is to gather information that may be used to improve products, services, and programs (Patten, 1998). When writing evaluative questions the questions have to be precise about what one wants to be evaluated. This is because the major function of an evaluation is to gather information that may be used to improve specific aspects of the subject in question. If the questions are not specific, the answers will not be either. Containing ambiguous answers, the questionnaire will not be useful for improvements. In this questionnaire the respondents were asked to evaluate the Master's programme in physics. Since the feedback could concern many aspects of the programme the respondents were asked to fill in both question 58, which consisted of a list of possible improvements which they could choose from, and question 59, where they freely could write their feedback.

For evaluating a subject it is recommended to include a question to solicit an overall picture (Patten, 1998). In the questionnaire questions asking for an overall evaluation were included. An example was question 57 where the respondents were asked how they in general had experienced that the Master's programme had prepared them for the labour market. Although this question did not ask for specific characteristics of the Master's programme to be evaluated it still provided information because the respondents emphasized different elements in arriving at their overall evaluation. Thus an item requesting an overall evaluation provides a picture of the whole, while the other questions on specific characteristics provide information on the specific parts. The overall question will provide information on how important specific parts are perceived to the respondent.

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Question-order effect

If the placement of a question has an effect on the respondents' answer then there is a question-order effect (Hansen & Andersen, 2000; Patten, 1998). This can only be eliminated by having only one question in the questionnaire. Since this is often not possible then the effect is something one has to try to control.

A question affected by the question-order effect is affected by the context of the question. Often, factual questions are not especially sensitive to the effect while attitude questions are quite sensitive. When structuring the questionnaire one can try to control how these questions are affected by certain effects. If some questions should not be affected at all, they should be placed after the factual questions or at least in the beginning of the questionnaire. If it does not matter if a question is affected by earlier questions or if the question should be affected by earlier questions then the question should be placed in the end of the questionnaire. An example of this are questions 42 and 43. Question 42 was an open question asking the respondents to describe the competencies they experienced to use in their job while question 43 was a closed question asking the respondents to evaluate to which degree they experienced they used the listed competencies in their job. Placing the open question after the closed question would result in the closed question having an effect on the open question making the answers more qualified. But, since I was interested in the respondents' immediate answers, I chose to insert the open question before question 43.

Asking the right questions

When designing the questions for a questionnaire one must ask oneself 'Am I getting the answers to what, I am asking about?' and one must be aware that the respondents do not answer what they are asked about, but what they think they are asked about.

To avoid the respondents misunderstanding the questions or not understanding the questions at all, it is important to be specific in the requests for information. Clearly stating the context of every question was important because it informed the respondent about which situation the question was related to. In this questionnaire examples of contexts were the Master's programme, the first job and the current job of the respondents. Stating the context in each question gave numerous repetitions, but in made sure that the respondents were answering the questions as intended.

To emphasize the importance of specific words in the questions, visual aids, such as bold print were used. The intention of this was to draw the respondents' attention to important terms. Overdoing this can have the opposite effect and distract the respondents from the few terms that were important to notice. Therefore the use of visual aids were kept at a minimum.

Also, to avoid misunderstandings, acronyms were spelled out and difficult or new terms were explained. Despite the graduates being familiar with most of the acronyms and terms related to the Master's programme and the labour market a clarification was inserted in question 6 regarding the qualification profiles. To make sure that the graduates understood exactly what was meant by 'General profile' a clarification was written in parenthesis 'General profile (all sub-fields of physics as well as elective subjects)'.

The use of value-laden words or words with ambiguities were carefully considered since they can cause a bias (Hansen & Andersen, 2000). In question 26, where the respondents were asked about their current job situation, two value-laden words were presented as options; 'unemployed' and 'enrolled in a PhD programme'. Especially the Danish word for unemployed 'Arbejdsløs' is value-laden. Stating these two options next to each other made them even more value-laden because they were associated with two distinct social statuses. To avoid affecting the respondents' answers, the word 'Arbejdsløs' was accompanied by the more neutral synonym 'Ledig' meaning free/available.

Finally, it is also important that each question only asks one question. Two questions in one can confuse the respondents and make it difficult for them to know which answer they should select. A simple way to solve this problem is to break the double question into two questions. This was done several times in the designing of the questionnaire.

3.4.3 Answer options

The questions in a questionnaire can be followed by two types of answer options; *open answers* where the respondents can write their answers freely, and *closed answers* where the respondents have to choose between the presented options (Hansen & Andersen, 2000). This questionnaire contained both open and closed questions.

Questions with open answers

A question without fixed options is usually called an open question (Hansen & Andersen, 2000). Here the respondents can freely write their answers giving rise to qualitative answers. Open-ended questions can be appropriate when exploring a topic which concerns a new subject (or is just new to you). Open questions are preferably inserted at the end of a series of closed questions. This allows room for the respondents to elaborate on their responses in earlier questions and to address issues not covered by earlier questions.

Throughout the questionnaire six open-ended questions were inserted. Question 20 and 42 were open-ended questions designed to make the respondents reflect about their competencies in regard to their education and their current jobs. The answers to these questions were an opportunity to get insight into which competencies the respondents especially experienced to have acquired during the Master's programme. Question 53 and 54 were presented to the unemployed respondents and asked them to describe their job search and the reflections they had had about being unemployed. Since this subject was new to me the questions were designed to explore these topics.

Open questions though, have to be inserted with caution. As described earlier many respondents find this type of question annoying and time-consuming. Since the questionnaire was relatively short for the unemployed respondents, I assessed that two open-ended questions would not be too overwhelming, compared to how they might have been for respondents answering the whole questionnaire.

Questions with closed answers

Unlike an open question, a closed question is followed by a number of fixed options. A closed question presents options that are formulated on beforehand specified in the form of items, statements or quantitative units. Most of the questions in this questionnaire were closed questions. The advance of closed questions is related to one of the major advances of a questionnaire; the answers are returned as quantitative data that can be easily processed.

Because the options to a closed question must be determined on beforehand, one must be sure that all the options which the respondents may wish to choose are available. Also, as was the case with the formulation of the questions, one must make sure that the respondents are not confused or misunderstand the options, since that will result in ambiguous answers.

A typical closed question consists of a question and a list of options from which the respondent have to tick off one option or more to answer the question. The options to a question must be mutually exclusive when it is required that the respondent only choose one option. If the options are not mutually exclusive the respondent will not be able to answer the question correctly which give rise to problems when analyzing

the question. If the options cannot be mutually exclusive, it must be possible to choose more than one option.

Besides being mutually exclusive the options for a question must also be exhaustive. This means that they shall allow for all possible options. Not having all options can result in the respondent not feeling able to answer the question. Previous graduate surveys and the café interviews described in Section 3.3 gave insight to the various paths that the graduates could have taken after graduation. This made it easier to provide the options that the respondents needed for the questions. To be sure that the respondents were able to answer any question the option 'Other' was added to the majority of the questions followed by a blank space where the respondent freely could write. An example of this was question 26 where the respondents were asked about their current employment situation. The presented options covered the employment situations of most respondents but in case that there was an employment type which did not fit into the categories the respondents had the possibility to tick off 'Other' and then write what 'Other' meant.

When making a list of options for the respondent to evaluate agreement with, like the earlier mentioned Likert-type items, the structure of the question becomes a battery (Deibjerg, 2012). A battery has the list of options as a column on the left and the attitude scale listed on a row right under the question. An example of a battery is question 14, see Figure 2. This questionnaire also contained examples of double batteries, question 43 and 44, where the respondents were asked to reflect on the statements in two different contexts, see Figure 3. Because these questions with double batteries are quite extensive they can be overwhelming. Therefore only two questions of this type were included in the questionnaire.

Figure 3
Question 43

The number of choices of agreement on an attitude scale is usually five or seven. If there are more than seven options the respondent will not be able to make a reasonable distinction. For most purposes five choices can be used (Patten, 1998). The options on the scale must be arranged one dimensionally, in a unique sequence. For an odd number of options the option 'Neutral' should always be inserted as the middle category. In this questionnaire the scale had a set of five choices: 'To a high degree', 'To some degree', 'Neutral', 'Not especially', and 'Not at all', see Figure 2.

The presence of the option 'Neutral' is though debatable (Hansen & Andersen, 2000; Patten, 1998). The option may encourage some respondents to take the easy way out of the questionnaire, rather than to spend time on reflecting on the options. 'Neutral' may also be attractive to respondents who do not wish to reveal their position on the subject in question. This speaks for excluding the option but on the other hand, the absence of a middle position may be frustrating to respondents who truly were neutral. Exclusion would force the respondents to choose one of the other options which often would be one of the options in the middle. This would then cause an overestimation of these two options. There are no clear conclusions on this subject but in general it depends on the subject as well as the purpose of the question. In all questions with attitude scales I chose to include the neutral option since I estimated that for all of the questions it was truly possible to have a neutral attitude.

It is worth noting that the option 'Neutral' is not the same as the option 'Don't know'. The option 'Don't know' is for respondents who do not know what their attitude towards a subject is. Stating the option 'Don't know' must, generally advised, be considered carefully. Providing the option to questions where respondents probably know the answer invites them to avoid answering the question. Since respondents often need to ponder a moment to answer an item this option provides them with an easy way out. The option is only appropriate when it is reasonable to expect that some respondents have very little or no knowledge of the subject in question and is not able to answer. On the other hand, a consequence of omitting the answer can be that some respondents, who really do not know the answer to a question, are forced to give an answer which is not true. This consequence must be taken into account when analyzing the results of the questionnaire. Common practice is that this option is omitted (Hansen & Andersen, 2000). Research shows that the distribution of the answers are significantly affected by the presence of the option 'Don't know'. A much higher number of respondents chose this option instead of other options when it was stated, than when it was not (Hansen & Andersen, 2000). I chose to only include the option 'Don't know' in only one question, question 49. This question asked the respondents whether they experienced that their colleagues knew what to expect from them as a physicist. If the respondent did not have any colleagues or did not have any cooperation with them it would be difficult for them to answer this question. Therefore the option was provided.

Formulation of the options to a question must be done carefully. To avoid misunderstandings the same rules as when formulating questions goes: clarify, and be specific. In addition to this there are some more factors one has to be careful about when constructing the options to a question. One of these is the use of negatives. Inserting negatives into options can cause confusion since they can be understood in two ways. In question 14, option 4, see Figure 2, is a negative 'I did not choose courses based on any system'. A respondent could be confused about how to answer this question. Does the option mean that one chose courses based on a system or does it mean that one did not choose courses based on a system? To avoid confusing the respondent it was noted that 'To a high degree' meant that the statement was true.

The use of absolute statements should also be carefully considered. When asking questions about facts, absolute statements are natural such as in question 1 where the respondent were asked if they were graduates from the Master's programme, or not. When asking about attitudes and opinions, however, the respondents are not able to answer as clearly. In these cases providing 'Yes' and 'No' as the only options would pose a dilemma for the respondents. In these cases, a scale of agreement is more suitable. The use of absolute statements depends on the type of question and the type of answer that is needed. In question 40, the respondents were asked to how high a degree they had experienced lacking knowledge about certain areas. The options to this question could be '100%' or 'Lack knowledge all the time' which would be

absolute statements. But since these two options represent cases that are very seldom, the options would likely end up with only a few respondents choosing them. This would distort the distribution of answers and give rise to problems in the analysis.

When constructing the options to a closed question one must consider how the options can be used in an analysis. An example of this is a question with ranges of values. In question 3 the respondents were asked to report their age. The ranges are of five years. The ranges could also have been designed to cover 50 years but this range would be so large that the information from this question would not really provide much information. The ranges should yield information that can be used. This can be done by breaking the ranges into smaller sizes. The size of the ranges depends on what the possible answers are and what the answers should be used for in the analysis. For the analysis it is preferred that the ranges have the same size.

The order in which the options to a question are presented can also have an effect of the respondents' answers. This effect is called a *response-order effect* (Hansen & Andersen, 2000). Research on this effect have not come to any conclusions about how to avoid the effect. Actually it has just been showed that it is difficult to say anything about when such an effect occurs (Hansen & Andersen, 2000). There are examples of the first options being chosen simply because it was the first option – the so called *primacy effect*. But there is also examples the last option being chosen simply because it was the last option – the so called *recency effect*. It is usually thought that the response-order effect is most apparent when the number of options is large even though there are also examples of the effect on questions with only two options. It has also been seen that the more linguistically complex the options are formulated, the higher the probability of an effect. Since there are no conclusions on this effect one just has to place the options in some order and then take into account that it might have an effect on the answers.

At last the results can also be affected by the *halo effect* (Patten, 1998). If a respondent has a very positive attitude toward the subject of a question the respondent may simply tick off 'Strongly agree' for each option without taking a stand to each option. Respondents responding negatively or neutral to all options can also be seen. Due to this, one has to be aware of the response sets of a respondent. To reduce the halo effect and to break down the response sets, it is recommended that some of the options are favourable and some unfavourable (Patten, 1998). If this does not reduce the halo effect it will at least show that the response sets are the same.

In the questionnaire, I tried to take the possibility of these effects into account, but ultimately they have to be taken into account when analyzing the results of the questionnaire.

3.4.4 The tense of the questions

The time dimension of the questions is concerned with effects on the results due to time. In this questionnaire the questions were concerned with events in the past (The Master's programme and the first employment) and in the present (the current employment).

When asking questions about events in the past the conclusions that can be made from the results depend on the respondents' remembrance of the events (Hansen & Andersen, 2000). In general, the longer time since an event was experienced, the more affected by time the memory of the experience is. But the temporal distance does not just depend on time, it also depends on the event in question. The more significant the event has been to the respondent, the clearer the respondent may remember the event and the longer back in time the respondent's memory can go. The effect of time on the memories, though, does not mean

that the results are invalid. The answers based on memory are just as valid as any other answer. The temporal distance just has to be taken into account when analyzing the answers.

Since the results of the questions regarding the present were not affected by the temporal distance, these results are clear of any effects caused by the memory. But these answers may be a affected by the so called *narrative psychology*. Narrative psychology assumes that we perceive our everyday life as a progressive story in which one possesses a coherent self (Holmegaard, 2013). In this way we continuously construct a cohesive story which makes sense in relation to one self and ones surroundings' sense of self. This process involves an ongoing negotiation of who you are (present), who you wish to be (prospect) and how it suits your notion of self (retrospect) (Holmegaard, 2013). This means that depending on what the current situation of a respondent is, the questions about the past and the present are answered based on how the respondents is making meaning of the events in relation to the transition to the labour market and the current situation that they are in. Though, if the respondent had been in a different situation, the respondent's answers may have been different.

Understanding, that the respondents' answers were a product of their experiences and their current situation emphasizes how this survey investigated the respondents' experiences and how the results were an expression of these. This is also why the results cannot be seen as a direct one-to-one relationship between the labour market and the Master's programme, where the two should align to satisfy demands and supply.

3.5 Developing the questionnaire

After designing the questionnaire, based on the above described guidelines, a pilot-testing was conducted. First, the questionnaire was reviewed by colleagues in order to remove the worst misunderstandings and make up for the worst deficiencies. Hereafter, eight people were asked to fill in the questionnaire. These test-respondents were not a part of the selected graduate group but had a similar background and were familiar with the physics programme. The test-respondents were asked to report back on the amount of time they used on the questionnaire, if there were any ambiguities, missing options, and if any questions or options were difficult to understand. Also, they were asked if they knew what a competence is and if they experienced that they were able to answer the questions regarding competencies. This was due to my considerations on whether or not to include a definition of the term 'competence' in the questionnaire.

Seven out of the eight test-respondents answered the questionnaire. Based on the feedback, the following major changes were made to the questionnaire.

Several test-respondents commented on the open questions. They found these questions irritating and time consuming. Some commented that if they had participated in the actual survey they would have dropped out of the questionnaire when they reached these questions. Because of this, I changed the validation on the open questions allowing the respondents to continue through the questionnaire without answering the open questions.

In regards to whether or not to include a definition of the term 'competence' the test group did not think that it was needed in order to fill in the questionnaire. Based on this I did not incorporate it. Even though I believe it has to be taken into consideration when analyzing the results, the term competence it widely used but not clearly understood by many. Therefore the respondents will answer the questionnaire based on different perceptions of the word. This may have an effect on the results.

Another recurring comment in the feedback was based on the length of the questionnaire. Several test-respondents experienced it to be too long. Especially the questions with the lists of competencies were commented on. To try and address this feedback I gathered the questions with the competence lists from four questions into two questions. The earlier four questions asked the respondents to evaluate their scientific and general competencies, first in regard to the Master's programme, and then in regard to the labour market. In the two new questions the respondents were asked to evaluate their scientific and general competencies in regard to the Master's programme and the labour market in the same question. This was done technically in a double battery.

This change shortened the questionnaire but also it affected the type of answers that came out of the two questions. Before, the respondents were simply asked to evaluate their competencies in two different contexts. In the new questions the respondents evaluated their competencies relative to the two contexts. Since it is the difference between the competencies in the two contexts that I was interested in, the answers to the new questions made sense.

Despite the aggregation of the four questions into two the questionnaire is still long. I felt that all of the questions in the questionnaire were necessary and therefore I did not feel that I could shorten it any more. To warn the respondents of the length of the questionnaire I stated the approximate time it took to carry out the questionnaire (the mean reported time used on the questionnaire by the test respondents was 30 minutes). Also the respondent had the possibility of pausing the questionnaire and finishing it at a later time.

3.6 Executing the questionnaire

The questionnaire was designed in the Internet based system SurveyXact. The questionnaire can be found in Appendix A. The questionnaire was developed within this system and validations and filters were inserted through this. Both an English version and a Danish version was designed. The layout options of this system were limited, but the one which was most clear and logic was chosen.

The names of the selected graduates were inserted to Google. Based on this search, contact information was found on 257 out of the 312 graduates. These 257 graduates constituted the accessible population of the survey. Usually a sample would be selected from the accessible population based on a systematic selection method. But due to the relatively small size of the accessible population I chose to include all of the graduates, who were in reach of contact, in the survey.

The graduates, on whom it was possible to find the e-mails addresses, were generated as respondents in the SurveyXact. The graduates who were only possible to find on Facebook or LinkedIn were contacted via personal messages in which a link to the questionnaire was inserted. The questionnaire was also shared through my personal network of tutors and students from the physics programme. The purpose of using combined sources of collecting responses was to reach as many respondents as possible.

The questionnaire was launched on June 21st 2013. The questionnaire was primarily distributed via e-mail. Two reminders were send out. The questionnaire was closed for answers on the 12th of August. This relatively long period of time was chosen in order to get as many respondents as possible.

3.7 Validity and reliability of the survey

The validity of a survey refers to how well the instrument of a survey can measure what it is meant to measure (Kruuse, 2000). In this way, the validity of an instrument describes the appropriateness, meaningfulness, correctness and usefulness of the inferences one can draw based on the data obtained with the instrument (Fraenkel & Wallen, 2000). Basically the question is whether the instrument adequately captures the actual subject of interest (Robson, 2002).

The validity of an instrument can be determined by comparing the results of the instrument being validated with the results of another independent instrument which measures the same variable (Fraenkel & Wallen, 2000).

I have not determined the validity of the questionnaire survey but I argue that the validity of the qualitative results of the questionnaire is high while the validity of the qualitative data may be up for discussion. The questionnaire is limited in that it can only investigate some of the factors which may have affected the respondents' experience of the transition to the labour market. Therefore the results of the questionnaire can only be seen as indications of the factors which were at play in the respondents' transition to the labour market.

If the validity of the questionnaire survey was to be determined It could be done by comparing the results of the questionnaire to a series of interviews among the respondents in order to see if this would yield the same, or maybe new results.

The reliability of a survey refers to the consistency of the answers obtained with the instrument, (Fraenkel & Wallen, 2000), in this case the questionnaire. The question is if the exact same questionnaire was repeated on the exact same group of respondents, would the results then be the same? Off course, when people take a test twice they will seldom perform exactly the same but within the margin of error the results should be the same in order for the results to be reliable.

I have not tested the reliability of the questionnaire used in this survey. If I were to test the reliability of the questionnaire, one approach would be to ask the respondents to answer the questionnaire again within a short amount of time (long enough for the respondents to forget the content of the questionnaire and short enough to make sure that the circumstances of the respondents have not changed), the so-called test-retest method (Kruuse, 2000). Although I have not determined the reliability of the questionnaire I would guess that the responses to the questionnaire would be close to the same.

Overall, it is worth noting that unless a measurement is reliable, it cannot be valid. However, while reliability is necessary it is not sufficient to ensure validity (Robson, 2002). This is because, although a measurement is not valid it can still be a result as long as the circumstances of the instrument is being taken into account.

3.8 Generalizability of the survey

The generalizability of a survey refers to the degree to which a sample represents the population of interest. Since this survey does not aim at generalizing the results to all graduates from the Master's programme, because the content of the Master's programme differs from year to year, as does the labour market, the population of interest for this survey is the total population of the 312 graduates described in Section 3.1.

Usually a sample would be selected through a systematic selection method in order to obtain an unbiased sample. A sampling bias occurs if some graduates from the total population had a greater chance of being selected than other graduates. A biased sample would produce misleading results which then would require that generalizations should be made with caution. In this survey the respondents who were accessible on the Internet had a higher chance of being selected than the respondents who were not. It is difficult to estimate if some of the graduates in the total population were more likely to be registered on the Internet than others but based on the Google-search it could seem that graduates employed at universities were easier to find than other graduates. To investigate if the accessible population was representative of the total population the two populations could be compared on known variables such as gender, qualification profile and graduation year. However since the bias is suspected to be related to the employment of the respondents (which was unknown for the total population) it is not possible to determine if the accessible population was representative of the total population. If the accessible population was biased then only cautious generalizations of the results to the total population can be made, but it would though permit for sound generalizations to the accessible population (even if the accessible population is a biased subgroup of the total population) (Patten, 1998).

4 RESULTS

Based on the previously described method, the questionnaire survey was produced and distributed to the selected graduates from the Master's programme in physics. In the following section the response to the questionnaire will be described. The response will be analysed and evaluated relative to the total population in order to examine the validity and generalizability of the results.

4.1 Response

The questionnaire was distributed to a minimum of 252 graduates. Of these 252 graduates, 180 graduates received the questionnaire via e-mail through SurveyXact, 26 via Facebook, 26 via LinkedIn and 20 through contacts (5 via e-mail and 15 via LinkedIn). In addition to this, a link to the questionnaire was distributed via LinkedIn and Facebook forums and the graduates were asked to pass the link on to other graduates from the Master's programme. In total 144 graduates answered to the questionnaire. 109 of the respondents answered via e-mail and 35 answered via the link (through Facebook, LinkedIn and other sources). Of the 144 respondents who answered the questionnaire 101 respondents completed the entire questionnaire, 40 dropped out during the questionnaire and three were not graduates from the programme (and were therefore not asked to answer the questionnaire). 99% of the respondents had graduated in the years from 2007 to 2013, see Figure 4, which was the time period the survey focused on. Two of the respondents (1%) had graduated before 2007. Although these respondents did not fall within the selected time period, they were still included in the results.
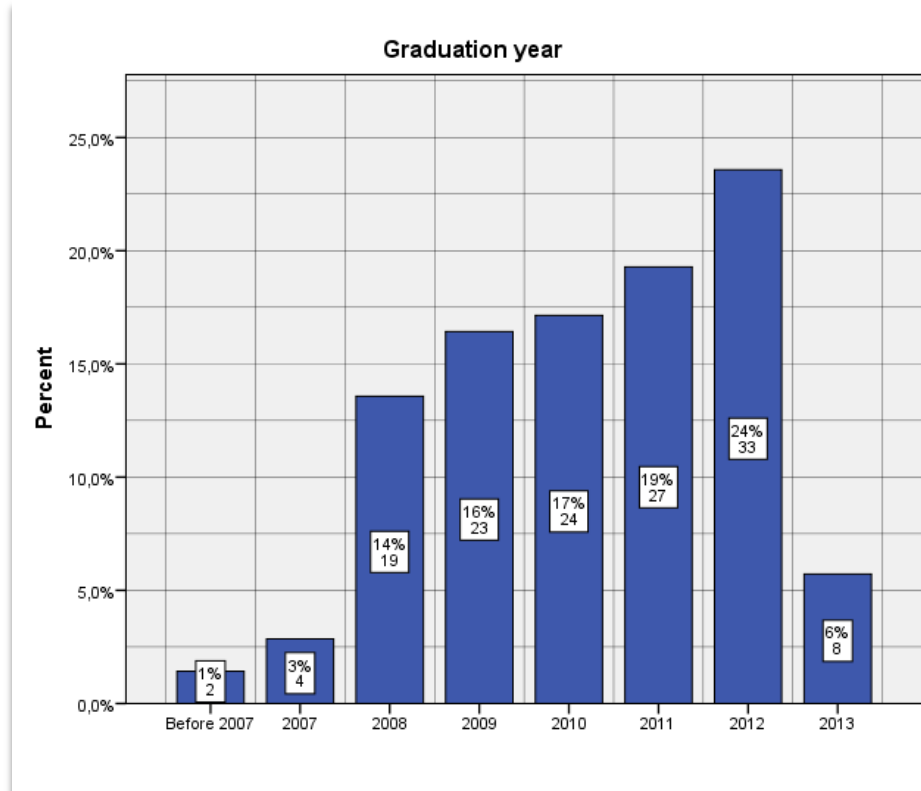
Figure 4
Question 5 'Which year did you graduate from the Master's programme in physics? (the year you defended your Master's thesis)'

4.2 Evaluation of the response

Before analyzing the answers to the questionnaire, the response to the questionnaire was evaluated. Of the accessible population (252) at least 108 graduates did not respond to the questionnaire. This missing response is called the *non-response* (B. H. Andersen & Hansen, 2000; Boolsen, 2004). In addition to the non-response, there were respondents who began to fill in the questionnaire but dropped out before completing it. This group is called the *partial-non-response* (B. H. Andersen & Hansen, 2000). In this questionnaire survey the partial-non-responses contained 40 respondents.

The existence of non-response causes a bias in the results of a questionnaire. The effect of the bias on the results, and thereby the generalizability, depend on characteristics of the non-response. If the characteristics of the non-response are significantly different than the characteristics of the total population, then this bias must be taken into account when analysing the questionnaire results.

Determining what causes a respondent to not be a part of a questionnaire survey is complex, since many various factors can have an effect, and in most cases it is a combination of systematic and random factors. The fundamental way to evaluate the non-response though, is to determine the *size* and *composition* of the non-response and compare it to the total population (B. H. Andersen & Hansen, 2000).

Size of the non-response

If the size of the non-response and the partial-non-response is large, relative to the size of the total population/response, the statistical uncertainty on the results will also be large. And so, the relative size of the response determines the certainty with which the results can be generalize to the accessible population and the total population. The relative size of the non-response, the response rate, is calculated with the formula (Bryman, 2012):

$$reponse\ rate = \frac{number\ of\ useable\ questionnaires\ \cdot 100\ \%}{N_{total}} \qquad (Equation\ 1)$$

where N_{total} is the accessible population.

To evaluate the size of the response, the response rates for the non-response and the partial-non-response relative to respectively the total population and the number of respondents, is determined in the following. In addition to this the statistical uncertainty of the response rates are determined. This is done with the formula (Boolsen, 2004):

$$\Delta = \mu_{1-\alpha} \cdot \sqrt{\frac{\frac{1}{N}(1-\frac{1}{N})^2}{N}} \qquad (Equation\ 2)$$

where N is the total number of respondents, $\mu_{1-\alpha}$ is the wanted significance level and Δ is the statistical uncertainty. In the social sciences the significance level is normally set to 0.05 (Fraenkel & Wallen, 2000), giving $\mu_{1-\alpha}$ the value of 1.96 (Patten, 1998). This significance level is applied throughout this section.

Composition of the non-response

If the composition of the non-response and the partial-non-response was considerable different from the composition of the response and the total population, the results can no longer be seen as representative of the accessible population or of the total population and so generalizations cannot be made. To evaluate the composition of the response (and thereby the composition of the non-response) the response is com-

pared to the total population on known variables (gender, qualification profile, year of graduation and, if possible, the job situation of the graduates). This is done with a χ^2-test. The χ^2-test compares frequencies actually observed in a study with calculated expected frequencies, to understand if they are significantly different (Fraenkel & Wallen, 2000). The χ^2-values are determined with the formula (Taylor, 1982):

$$\chi^2 = \sum_{k=1}^{n} \frac{(O_k - E_k)^2}{E_k} \qquad (Equation\ 3)$$

where O_k is the observed number of respondents, E_k is the expected value and χ^2 is the chi squared value. To evaluate the composition of the response χ^2-tests for the non-response and the partial-non-response relative to respectively the total population and the number of respondents were performed and presented in the following.

4.2.1 Evaluation of the partial-non-response

Response rate of the partial-non-response
40 respondents dropped out during the questionnaire. Using Equation 1 the partial-non-response for the entire questionnaire was determined to be 28% with $N_{total}=141$ respondents. So more than 2/3 of the respondents completed the entire questionnaire.

Calculating the statistical uncertainty, the response-rate was determined to be 72% ± 8%. This means that if this questionnaire was distributed to the total population (312 graduates) then, with 95% confidence, 72% ±8% of the population would complete the questionnaire.

The dropout of respondents through the questionnaire was not constant. Figure 5 shows the number of respondents per question in the questionnaire. The green bars show the number of respondents who did not answer the specific question number and neither the following questions and have therefore been classified as a partial-non-response. Figure 5 shows that there was an increase in the number of partial-non-responses at question number 20 and question number 43. The response-rate until question 20 was 98% ± 2% and from question 20 to 43 it was 90% ± 5%. The response-rates clearly show that for at low partial-response-rate the precision of the results is higher.
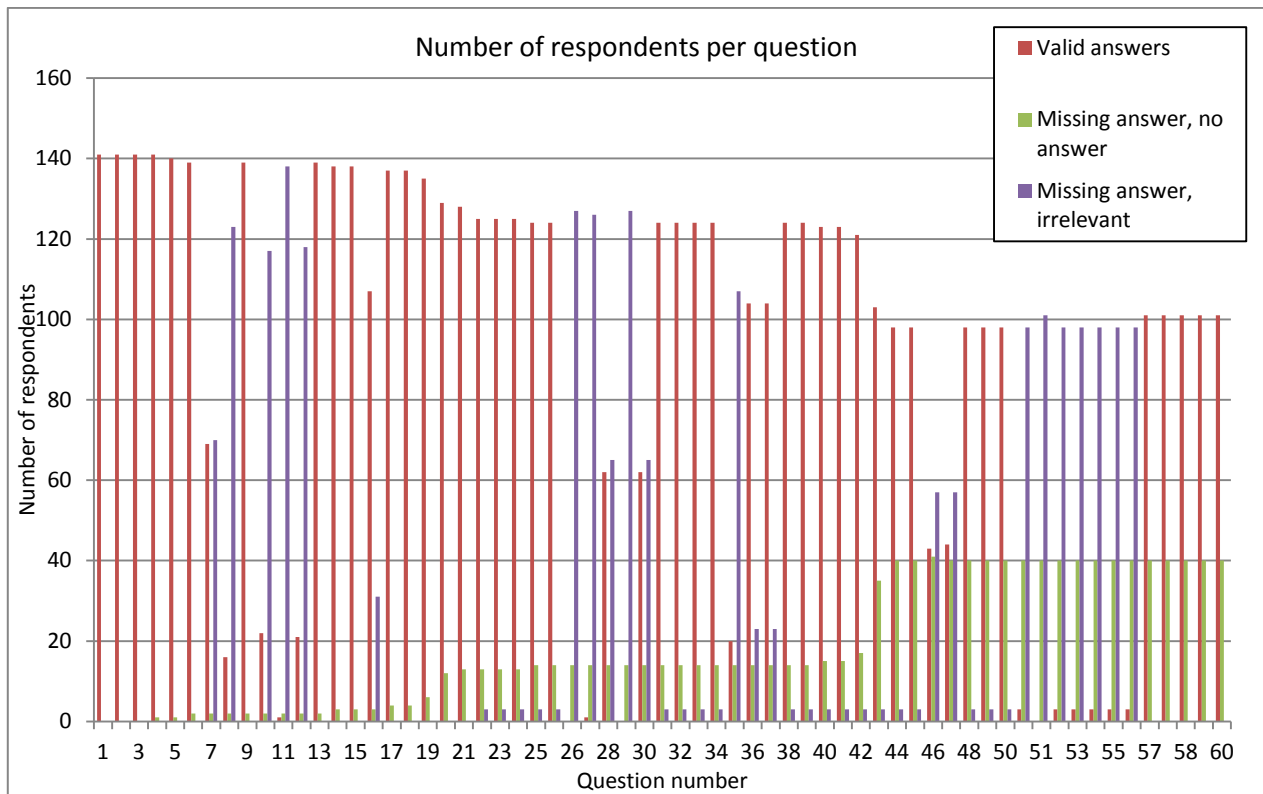
Figure 5
Number of respondents per question, question 1 to question 60

Composition of the partial-non-response/response

To investigate if there were any differences in the characteristics of the respondents beginning the questionnaire and those completing it, the composition of respondents answering question number 1 and those who answered question number 60 is compared.

A χ^2-test was performed on the four available background variables (gender, qualification profile, year of graduation and when available job situation). The null hypothesis is that the distribution was the same for the population of respondents of question 1 and of question 60, meaning that the distributions were random.

Table 2 shows an example of a contingency table for the gender distributions of the two questions.

Table 2 Contingency table for gender distribution at question 1 and question 60

Gender	Question 1, number of respondents	Question 60, number of respondents	Total number
Observed, male	**90**	**67**	157
Expected, male	91.5	65.5	
Observed, female	**51**	**34**	85
Expected, female	49.5	35.5	
Total	141	101	242

The degrees of freedom are calculated by the formula: df= (#columns - 1)* (#rows - 1), which for the example in Table 2 gave 1 degree of freedom. Using Equation 3 the χ^2-value was determined to be 0.162.

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In a χ^2-distribution table the calculated χ^2-value for 1 degree of freedom was found to be below the 0.05 probability. Therefore we fail to reject the null hypothesis and conclude that the a difference in the distributions is random.

This process was repeated for the next three variables. The χ^2-values are shown in Table 3 below.

Table 3 Frequencies of the respondents answering question 1 and question 60 in regard to gender, graduation year and qualification profile

Variable	Q1, number of respondents	Q60, $N_{60}=101$, number of respondents	Degrees of freedom	χ^2
Gender Question 1 $N_1=141$ respondents	Male: 90 Female: 51	Male: 67 Female: 34	1	0.162
Graduation year Question 5 $N_5=140$ respondents	Before 2007: 2 2007: 4 2008: 19 2009: 23 2010: 24 2011: 27 2012: 33 2013: 8	Before 2007: 2 2007: 3 2008: 13 2009: 23 2010: 19 2011: 17 2012: 23 2013: 6	7	1.52
Qualification profile Question 6 $N_6=139$ respondents	Astrophysics: 17 Biophysics: 18 Geophysics: 35 General profile: 69	Astrophysics: 11 Biophysics: 15 Geophysics: 26 General profile: 49	3	0.266
Current job situation Question 26 $N_{26}=127$ respondents	In work: 61 Unemployed: 3 Enrolled in a PhD programme: 63	In work: 48 Unemployed: 3 Enrolled in a PhD programme: 50	2	0.0822

For the four variables the χ^2-values, for the respectable degrees of freedom, were found to be below the 0.05 probability. Therefore we fail to reject the null hypothesis and conclude that the differences in the distributions at question 1 and question 2 were random.

This conclusion was supported by Figure 5. The content of question 20 and 43, at which there was a strong increase in the size of the partial-non-response, may indicate why the respondents dropped out, and if it was due to factors related to specific characteristics of the respondents. In both question 20 and 43 the respondents were asked to describe their competencies. Since none of the four variables listed above seem especially vulnerable to the content of the two questions, it suggests that the strong increase in partial-non-response at these two questions do not create a bias in the composition of the respondents. This argument supports the above conclusion that partial-non-response is random and does not skew the results in any particular way.

4.2.2 Evaluation of the non-response

Response rate of the non-response

The non-response of the questionnaire consisted of 108 graduates. Using the Equation 1 the rate of the non-response for the questionnaire was determined to be 43% with $N_{total}=252$ accessible graduates. So more than half of the accessible population answered the questionnaire survey. Calculating the statistical

uncertainty, the response-rate was determined to be 57% ± 6%. This means that if this questionnaire was distributed to the total population (312 graduates) then, with 95% confidence, 57% ± 6% of the population would respond to the questionnaire. If the response-rate instead is calculated based on the number of completed questionnaires (100) it is 40% ± 6%.

The composition of the non-response/response

To investigate if there were differences in the characteristics of the total population and the respondents, the composition of the graduates was compared in regard to three background variables (gender, qualification profile and graduation year). The numbers on the total population were based on the name list provided by the Faculty of Science[8]. There exists no information on the job situation of physicists[9] and therefore the job situation of the graduates could not be compared.

To evaluate if the distribution for the two populations were the same on the three variables χ^2-tests were performed as described for the partial non-response. The χ^2-values are presented in Table 4.

For the distributions of gender and graduation year, within the two populations, the χ^2-values for the respectable degrees of freedom were found to be below the 0.05 probability. Therefore we fail to reject the null hypothesis and conclude that the differences between the distributions of the two populations were random. For the distribution of the qualification profile the χ^2-value was found to be above the 0.05 probability. Since 2007 the Master's degrees in physics have been registered without a qualification profile and therefore all graduates fall into the General profile category. Due to this the distribution within the qualification profile is skewed towards the General profile which would be the cause of the high χ^2-value.

Table 4 Frequencies of the total population and the respondents in regard to gender, graduation year and qualification profile

Variable	Total population, number of graduates	Respondents, number of respondents	Degrees of freedom	χ^2
Gender Question 1 N_1=141 respondents	Male: 214 Female: 98	Male: 90 Female: 51	1	0.99
Graduation year Question 5 N_5=140 respondents	Before 2007: NA 2007: 9 2008: 46 2009: 61 2010: 71 2011: 57 2012: 58 2013: 10	Before 2007: 2 2007: 4 2008: 19 2009: 23 2010: 24 2011: 27 2012: 33 2013: 8	6	4.83
Qualification profile Question 6 N_6=139 respondents	Astrophysics: 19 Biophysics: 34 Geophysics: 53 General profile: 206[10]	Astrophysics: 17 Biophysics: 18 Geophysics: 35 General profile: 69	3	12.4

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[8] The list provided graduation date and qualification profile (as registered by the Faculty of Science). The gender distribution has been based on the names of the graduates.

[9] The Faculty of Science, The Ministry of Science, Innovation and Higher Education and Statistics Denmark did not have these information.

[10] Since 2007 the Master degrees have been registered without a qualification profile and therefore all graduates fall into the physics category. Due to this the distribution within the specialization is skewed towards the physics specialization.

4.2.3 Conclusions of the evaluation of the questionnaire response

The size of the partial-non-response and the non-response have been evaluated. The response rate of the questionnaire was 57% ± 6% with a questionnaire completion rate at 72% ± 8%.

Boolsen (2004) states that a response rate between 50-60% is 'less acceptable' when wanting to generalize the results of the questionnaire and Fraenkel and Wallen (2000) advises that a survey that looses over 10% of the respondents must acknowledge this a limitation and qualify conclusions accordingly. These guidelines imply that the response to this questionnaire survey is relatively poor. But the response rate is actually quite similar to much other academic research. Baruch (1999) found that the average response rate, based on 175 academic studies, was 55.6% ± 19.7%. The response rate of this questionnaire is quite similar to this average but with a smaller statistical uncertainty. Since this questionnaire was not just a simple multiple choice questionnaire but a rather difficult questionnaire due to the length and the content of the questions the response rate is actually surprisingly high. Overall the response rate to the questionnaire is actually acceptable compared to other questionnaire surveys and taking the content of the questionnaire into account. But still the response is lower than what could be wished for which means that generalizing the results to the total population will be made with caution.

The composition of the non-response and the partial non-response of the questionnaire was evaluated. The χ^2-test, performed on both the partial-non-response and the non-response, showed that the distributions of the variables (except for the qualification profiles in the non-response) were statistically significant. Based on this, the results of the questionnaire can be seen as representative of the accessible population.

Based on the evaluation of the questionnaire response, the results of the questionnaire will be seen as an expression of the respondents in this questionnaire survey and not as an expression of all graduates. But the results can be used as an indication of information on and experiences of the accessible population and the total population.

4.3 Guide to the analysis

In the following five sections the respondents' experiences of each step in the transition from the Master's programme to the labour market will be presented.

The frequency distributions of the respondents' answers to the questionnaire will be presented. The respondents' answers have also been split in regard to the background variables; gender, age, admission- and graduation year, qualification profile, student job or not, job type and location of work place. The results which showed interesting differences within the variables were selected and will also be presented in the following sections. A chi-square test was performed on these selected results to determine the significance level of the results. Chi-square tests showed variation in the chi-squared significance levels with some being significant at the 0.05 level, and others not. For the results with a lower significance level than 0.05 it implies that the found differences are statistically significant. This means that there with a high certainty is a difference within the variable. For the results with a higher significance level than 0.05 the certainty with which the results can be generalized to the total population is not as high.

Because of the variations in the significance levels of the presented results, the results will not be taken as conclusive but instead as indications of a tendency which collectively with other results can provide a picture of the mechanisms which are at play.

First, the results on how and where the respondents were employed will be described followed by an introduction to the general results of the respondents' experience of the transition to the labour market. The general results have been analysed in regard to the background variables and the most interesting tendencies will be presented in the following four sections. First the respondents' choices and strategies through the Master's programme will be described, secondly the respondents' experience of the transition into the first job and the content of their current jobs and finally the respondent's feedback to the Master's programme will be presented.

4.4 Introduction to the results

In the following section the general results on who the respondents were and where they were employed will be presented. Following this the general results on the respondents' experience of the transition will be presented.

4.4.1 The respondents

Of the 141 respondents who completed the questionnaire survey about two-thirds (64%) were male and one-third (36%) were female. More than half of the respondents were between 25 and 29 years old, while one-third were between 30 and 35. The majority of the respondents had completed a Master's degree in general physics (38%), see Figure 6. 12% of the respondents had completed a degree in general physics with an elective subject, which for the majority was mathematics. 25% of the respondents had finished a degree in geophysics, 12% in astrophysics and 13% in biophysics.
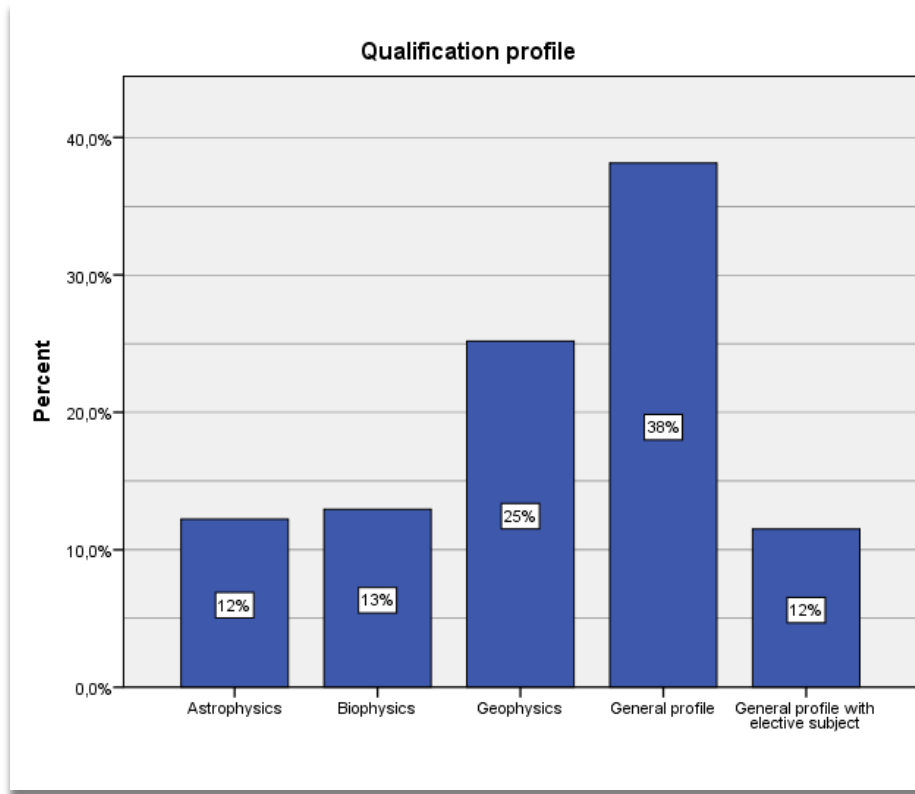
Figure 6
Question 6 'Which qualification profile did your Master's programme have?' and question 7 'Do you have an elective subject?'

Respondents in the labour market

88% of the respondents were employed within six months after their graduation, see Figure 7. 98% of the respondents had been employed since graduation, while 2% had not. This result agrees with the generally low employment rates for physicists in Denmark.

The majority of the respondents were in their first or second job after graduation. 84% of the respondents were employed in Denmark while 16% were employed abroad, mainly in Europe. Splitting the respondents in regard to qualification profile, it is clear that the majority of the respondents with a geophysical qualification profile were employed in Denmark (97%) while just 3% were employed abroad, see Figure 8. Of the astrophysicists, on the other hand, 69% were employed in Denmark while 31% of were employed abroad. The difference between the two qualification profiles could to some extend be explained by the differences in the two industries. The Danish labour market has a large industry which consists of institutions (both private and state) who work within subjects within geophysics (ground water, windmills, climate, oil). The industry within astrophysics is more constrained to research institutions and museums. For the respondents with an astrophysical qualification profile the employment opportunities would be limited in Denmark and therefore the respondents would be more likely to go abroad. And also, within astrophysics international research and career experience is highly valued if one wants to continue into a research career. Not surprisingly the majority of the respondents who were employed abroad were respondents enrolled in a PhD programme (70%), see Figure 9.

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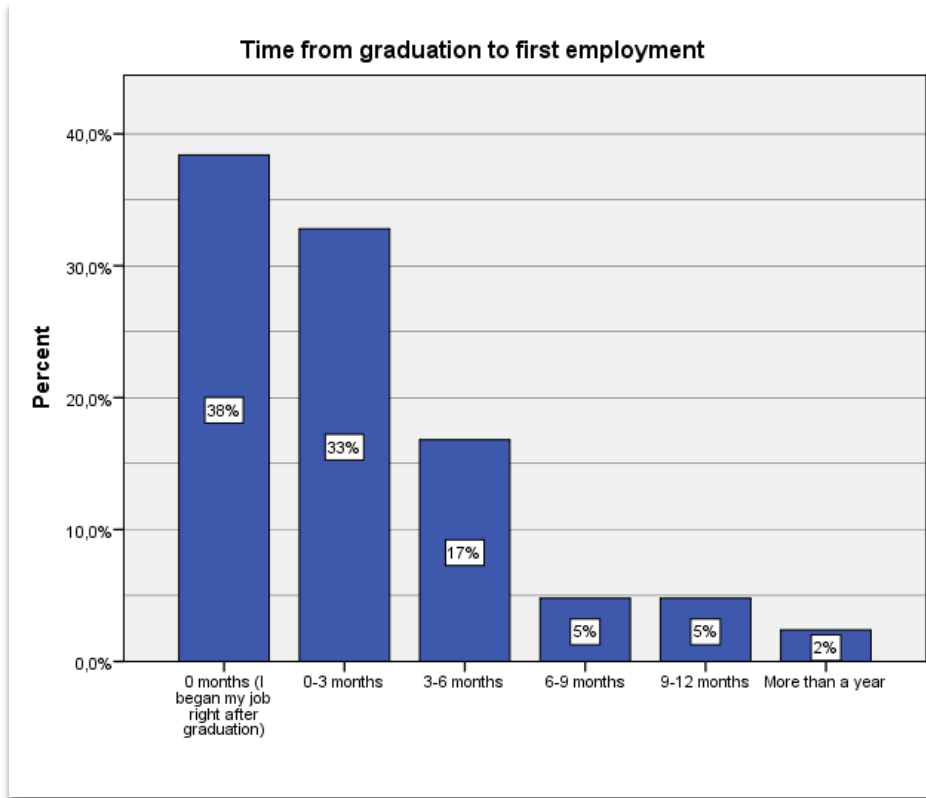
Figure 7
Question 22 'How long time went by from your graduation until your began your first job?'
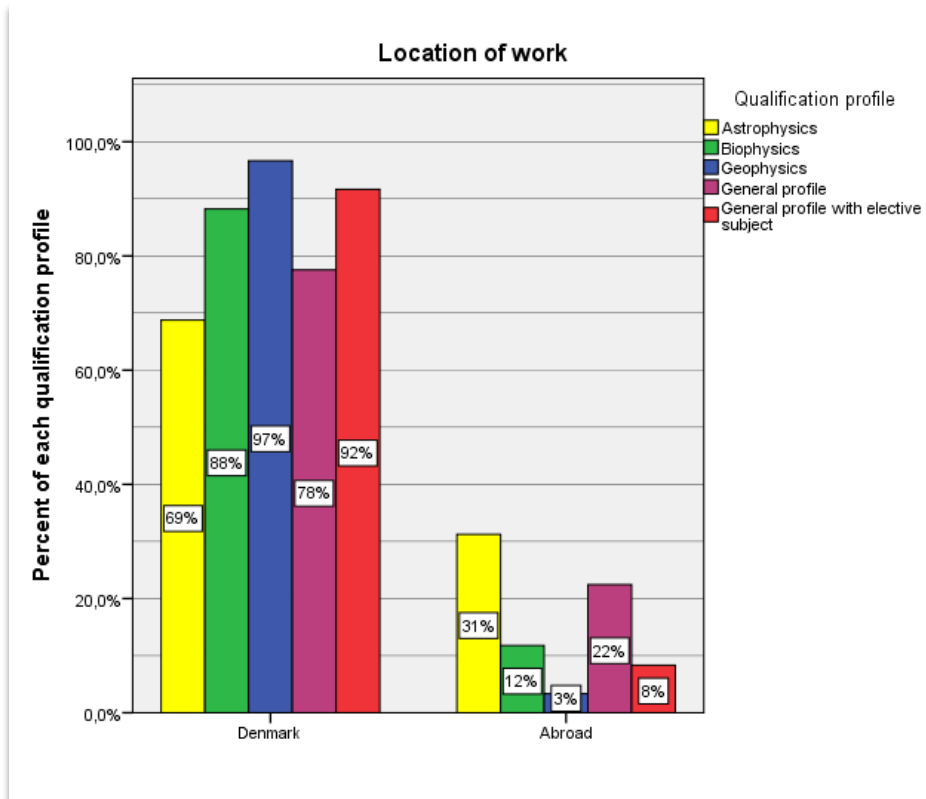
Figure 8
Question 33 'What is the location of your current/most recent workplace?'
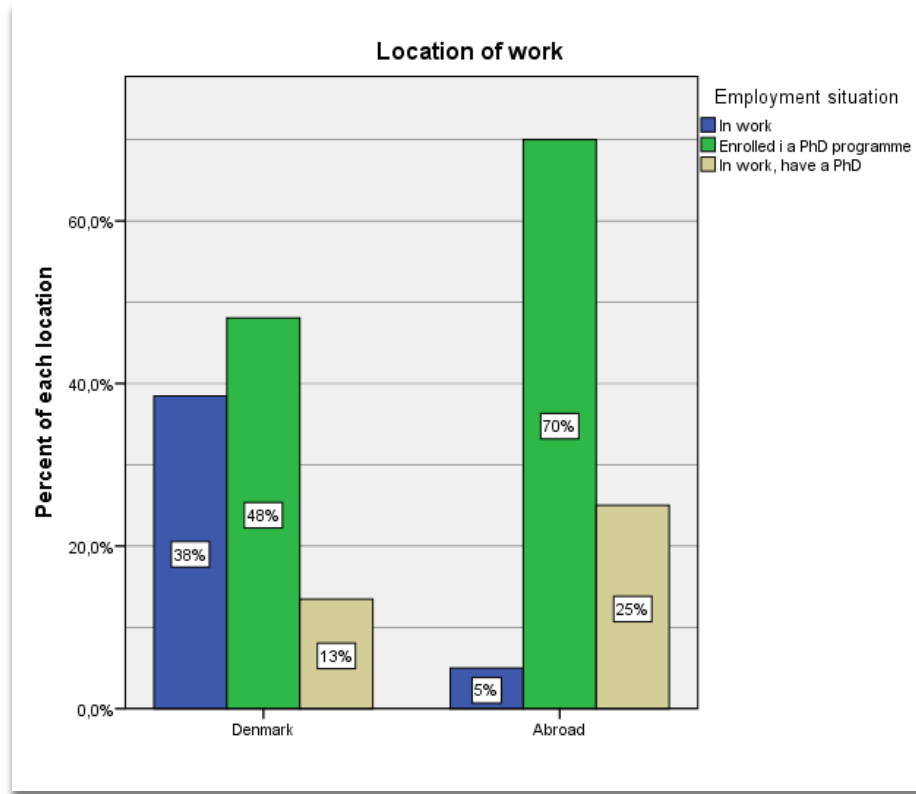
Figure 9
Question 33 'What is the location of your current/most recent workplace?'

51% of the respondents were enrolled in a PhD-programme, 48% were employed in a job (of which 33% had finished a PhD degree) while 1% were unemployed[11] at the time of the survey. None of the respondents in this questionnaire were enrolled in a new programme or working as an independent. The high percentage of respondents enrolled in a PhD programme illustrates that the PhD position is a frequent career choice for graduates from the Master's programme in physics.

The respondents primarily found their job through the Internet or through contacts at the university, see Figure 10. The majority of the respondents who were enrolled in a PhD programme (47%) found their PhD position via contacts at the university, see Figure 11, such as their supervisors and research group. In addition to this, the Internet was used for example when PhD positions were posted on university websites.

For the respondents in work, the most common way to find a job was the Internet. Examples of this were job announcements at job banks and at company and firm web sites.

The respondents who were in work (with a PhD degree) had mainly used contacts at their university to find their job. Examples of this were PhD supervisors and research groups helping the respondents to find Post Doc positions. These respondents also reported that they to a high degree used the Internet to find a position. Examples of this were respondents who did not wish to continue a Post Doc position and therefore were looking for jobs in the same ways as the respondents in work (without a PhD degree). Interestingly 21% of the respondents with a PhD degree reported that they got their job because they were approached by their future employer. This suggests that these respondents were contacted by their future employer via

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[11] These respondents were asked to answer the questions regarding their experiences with the labour market based on their previous job.

network, or in some cases the respondents may have been headhunted by employers who were interested in their profile.
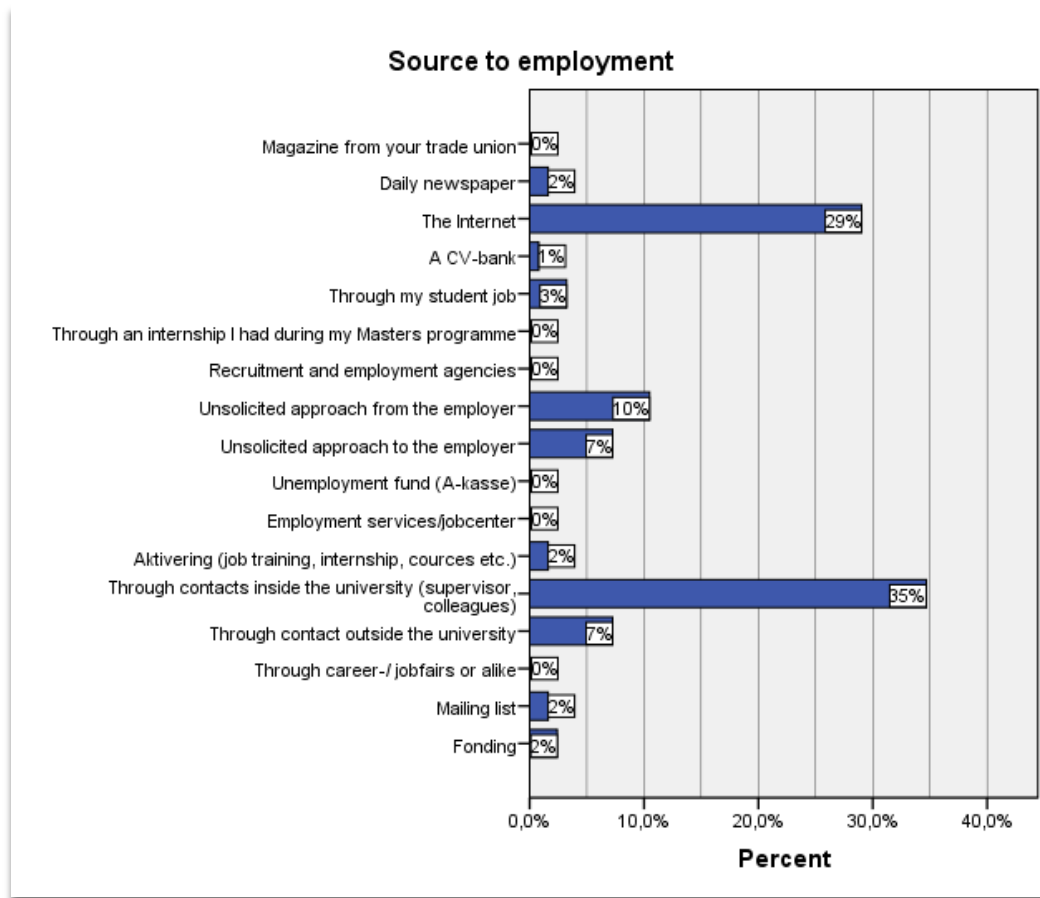
Figure 10
Question 32 'How did you find your current/most recent job?'
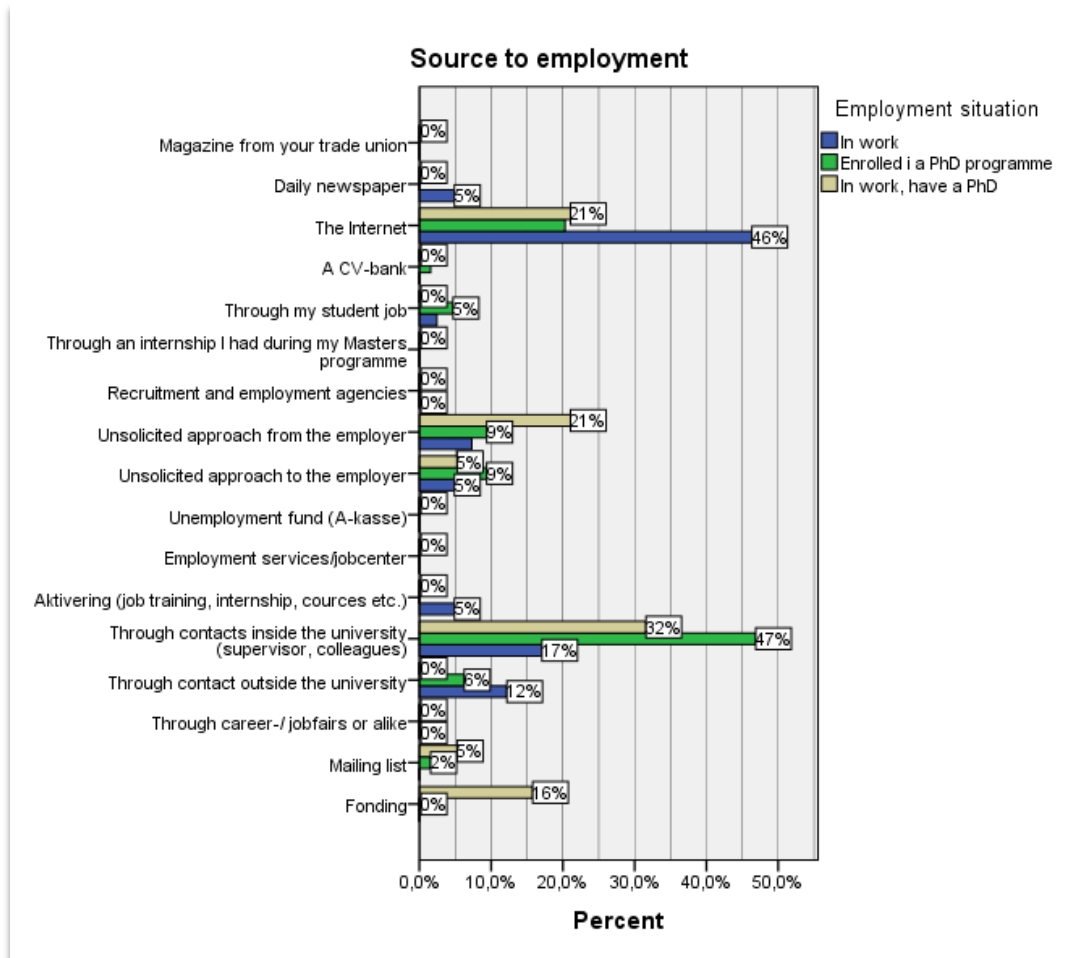
Figure 11
Question 32 'How did you find your current/most recent job?'

A high percentage of the respondents were employed in the state (80%) of which the majority (60%) were enrolled in a PhD programme. 17% of the respondents were employed in the private sector and 3% in the municipalities. The majority of the respondents were employed in the *knowledge services* (75%) which includes scientific research, PhD positions, counselling and consulting, see Figure 12.

15% of the respondents were employed in the *education industry* which includes education at all levels (elementary school, high school, adult education) but the majority of these respondents were though employed as high school teachers. Only 3% of the respondents were employed in the *financial sector* (banks, insurance and pension, financial services), despite that the financial sector often is presented as a frequent career choice of physicists. This is for example seen at the website of the Master's programme in physics where one out of three videos about the career options for physicists is about working in the financial sector (Københavns Universitet).

Few percent of the respondents were employed in the *information and communication industry*, *mining* and *quarrying, public administration* and *trading*.

I had expected to see more variation in the distribution of the respondents within the industries. From personal knowledge about the respondents, it was clear that some respondents identified themselves with the work they performed and not with the industry in which they were employed. For example, a respondent who was employed at a hospital reported that he worked in the knowledge industry and not in the health

and social work industry. This knowledge could be taken into account for a future survey, but for now this result is an indication that the education has a large influence on how the respondents defined themselves.
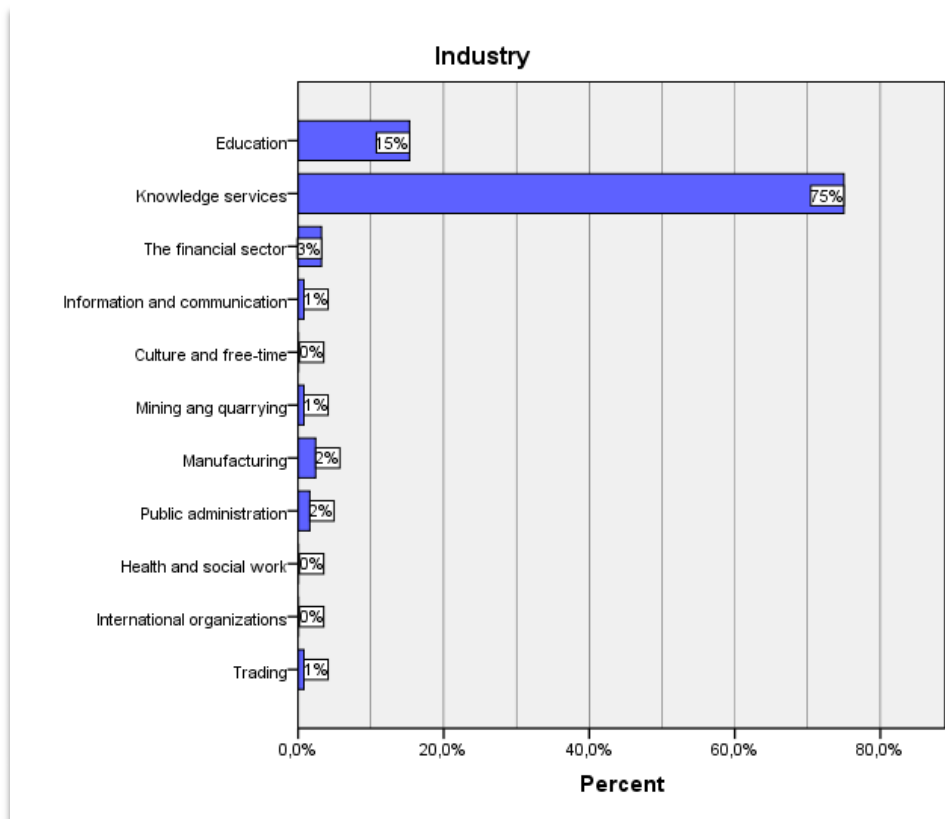
Figure 12
Question 38 'In which industry is your current/most recent job?'

The majority of respondents, within each qualification profile, were employed in the knowledge industry, see Figure 13. However, of the respondents with an elective subject, equally as many respondents were employed in the education industry as in the knowledge industry. This result is not surprising, since students often complete an elective subject to be qualified to become a high school teacher. But it is surprising that no more than 42% of the respondents with an elective subject were employed in the education industry. Compared to the respondents who did not have an elective subject only 12.5% were though employed in the education industry, making it three times more likely to be employed in the education industry for respondents with an elective subject.
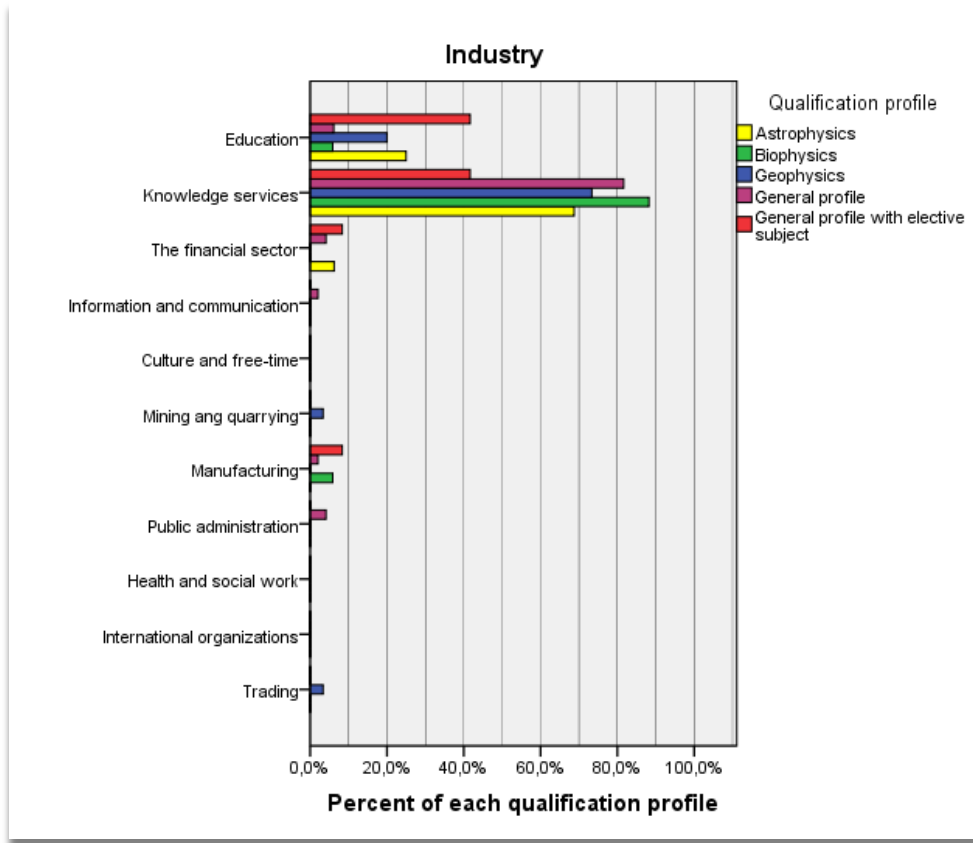
Figure 13
Question 38 'In which industry is your current/most recent job?'

Physicists in work

48% of the respondents were employed in the labour market (of which 33% had finished a PhD degree). About two-thirds of the respondents in work were permanently employed, while the other third was temporarily employed. More than 90% of these respondents were employed in Denmark, primarily in firms located on Zealand, mostly in Copenhagen.

The majority of the respondents in job were employed in the knowledge industry (48%), see Figure 14. These respondents were employed in research positions as Post Doc's and research assistants but also as consultants in various firms. Examples of respondents working in the knowledge industry were medical physicists working at hospitals and institutions handling radiation, geophysicists working in the oil business and in companies such as COWI, Rambøll and Vestas and physicists handling analytical and evaluative tasks in firms such as Banedanmark.

32% of the respondents in work were employed in the educational industry where they primarily were employed as high school teachers. 7% of the respondents in work were employed in the financial sector. Examples of these were respondents employed in companies such as Saxo Bank, Danske Bank and various insurance companies. A small percentage of the respondents in work were employed as programmers, software- and system developers in companies such as Novo Nordisk.

33% of the respondents, who were in work, had finished a PhD degree. 5% of these respondents had finished an industrial PhD degree in collaboration with the Technical University of Denmark while the remaining 95% had finished a 'regular' PhD degree. 52% had finished the PhD degree at the Niels Bohr Institute,

11% at other institutes at the University of Copenhagen, 32% at other universities in Denmark primarily the Technical University of Denmark and 5% at universities abroad.
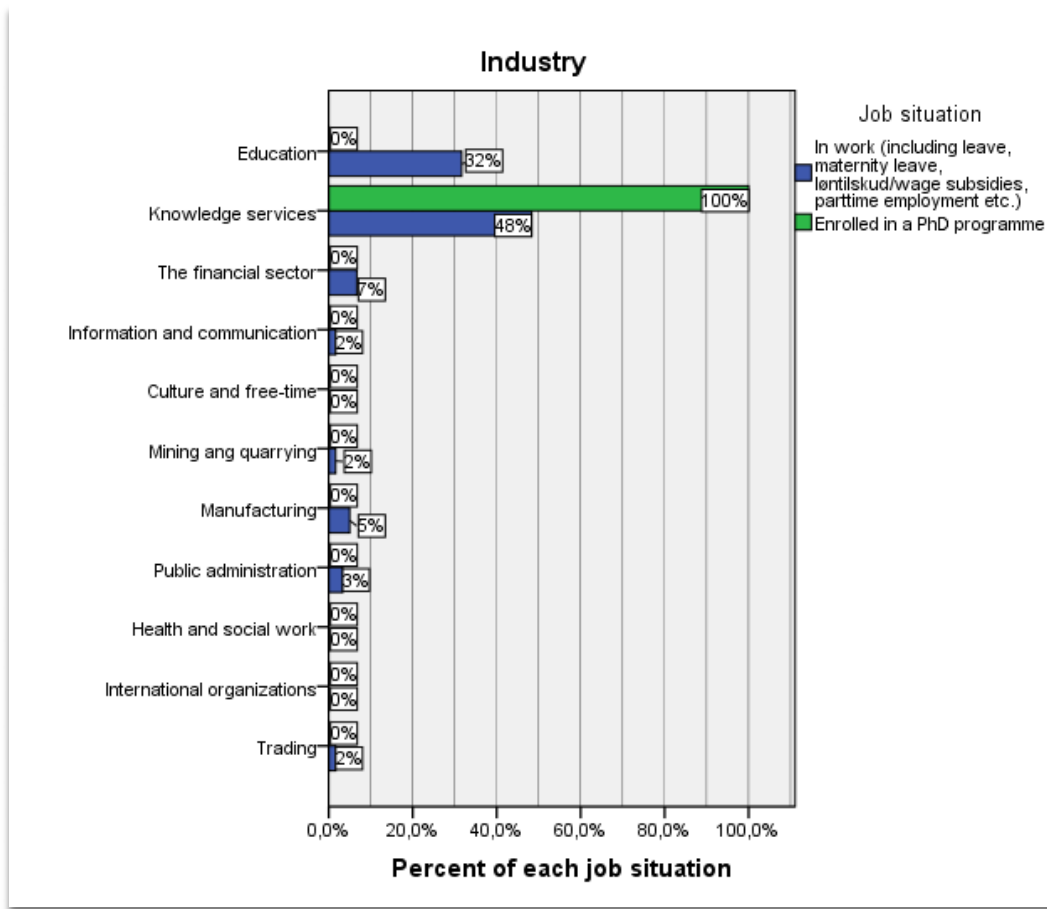
Respondents enrolled in a PhD programme

51% of the respondents were enrolled in PhD programme. 67% of these respondents were male and 33% female. This gender distribution is close to the same as for all of the respondents which positively implies, that there is no difference between who were employed in a PhD position in regard to gender.

37% of the respondents who were enrolled in a PhD programme, were associated with the Niels Bohr Institute, 26% with the Technical University of Copenhagen, 19% were employed at universities abroad while the rest of these respondents were associated with either other institutes at the University of Copenhagen or with universities of Denmark.

The distribution of qualification profiles within the respondents enrolled in a PhD programme was somewhat skewed compared to the distribution of qualification profiles within the respondents in work, see Figure 15. Figure 15 shows that quite a high percentage of respondents with a general profile were enrolled in a PhD programme (73%) while the minority of the respondents with a qualification profile in biophysics, geophysics and with an elective subject were enrolled in a PhD programme. A possible explanation for this could be that there were more PhD positions available within general physics per student than within the other qualification profiles. Another explanation could be that within general physics PhD positions were a more traditional career path than continuing into the labour market. The study programmes in biophysics,

geophysics and general profile with an elective subject were on the other hand more oriented towards the labour market and therefore the graduates naturally continued into the labour market, after graduation. Most likely it is a combination of both explanations which causes the distribution of qualification profiles to be skewed. This implies that there is a connection between the students choice of qualification profile and the career path after graduation. The question is though if the students choose a qualification profile because they wanted a specific career path, or if they ended up in a specific career path because they choose a qualification profile.
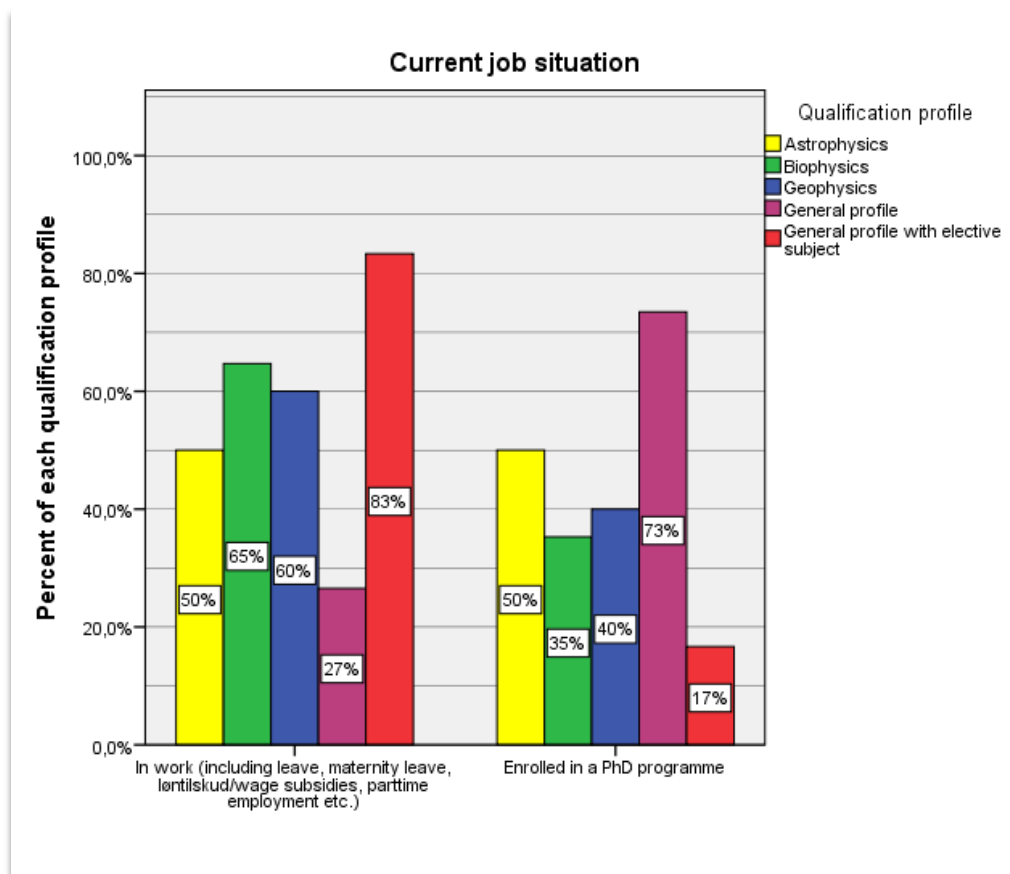
Figure 15
Question 26 'What is your current job situation?'

4.4.2 General results on the transition to the labour market

The results imply that the respondents, during the Master's programme, were quite decided on which qualification profile they were going to study, see Figure 16. The respondents reported that they mainly chose courses based on their interest within certain subjects, see Figure 17. Since the Master's programme is a programme with few requirements in regard to the structure of the study programme, it gives the students the possibility to enrol in the courses they find interesting and structure the education thereafter. This leaves the students with the responsibility to independently design the study programme based on whatever structure that makes sense at the time.

The respondents reported that their choice of courses also depended on which courses were offered. As many courses on Master level often were only offered every second year, the respondents described how it was not possible for them to follow certain courses since they were offered coincident with their Master's

thesis. Quite a few respondents reported this as problematic, since it made it difficult for them to follow courses within their primary subject of interest. The respondents also reported that within the subjects they were interested in, there were not offered any courses because there was no professor/research group within that subject. Overall the respondents reported that the limited offer of courses was a quite frustrating influence on their course choices.
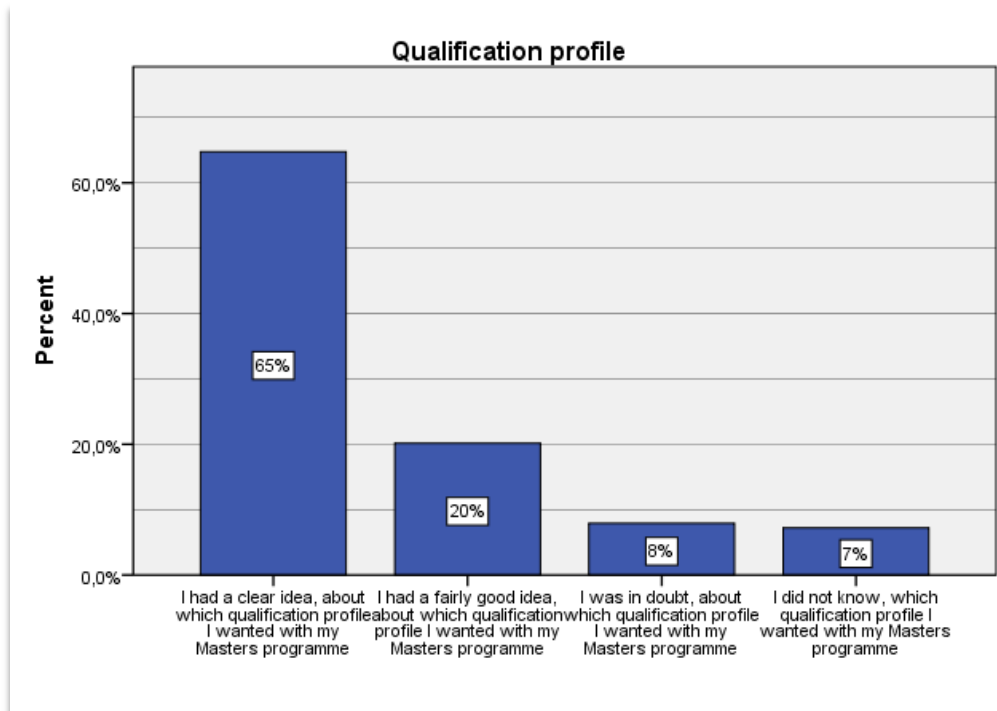
Figure 16
Question 13 'Which of the statements, listed below, describes your choice of qualification profile (astrophysics, biophysics, geo-physics and general profile) during your Master's programme?'
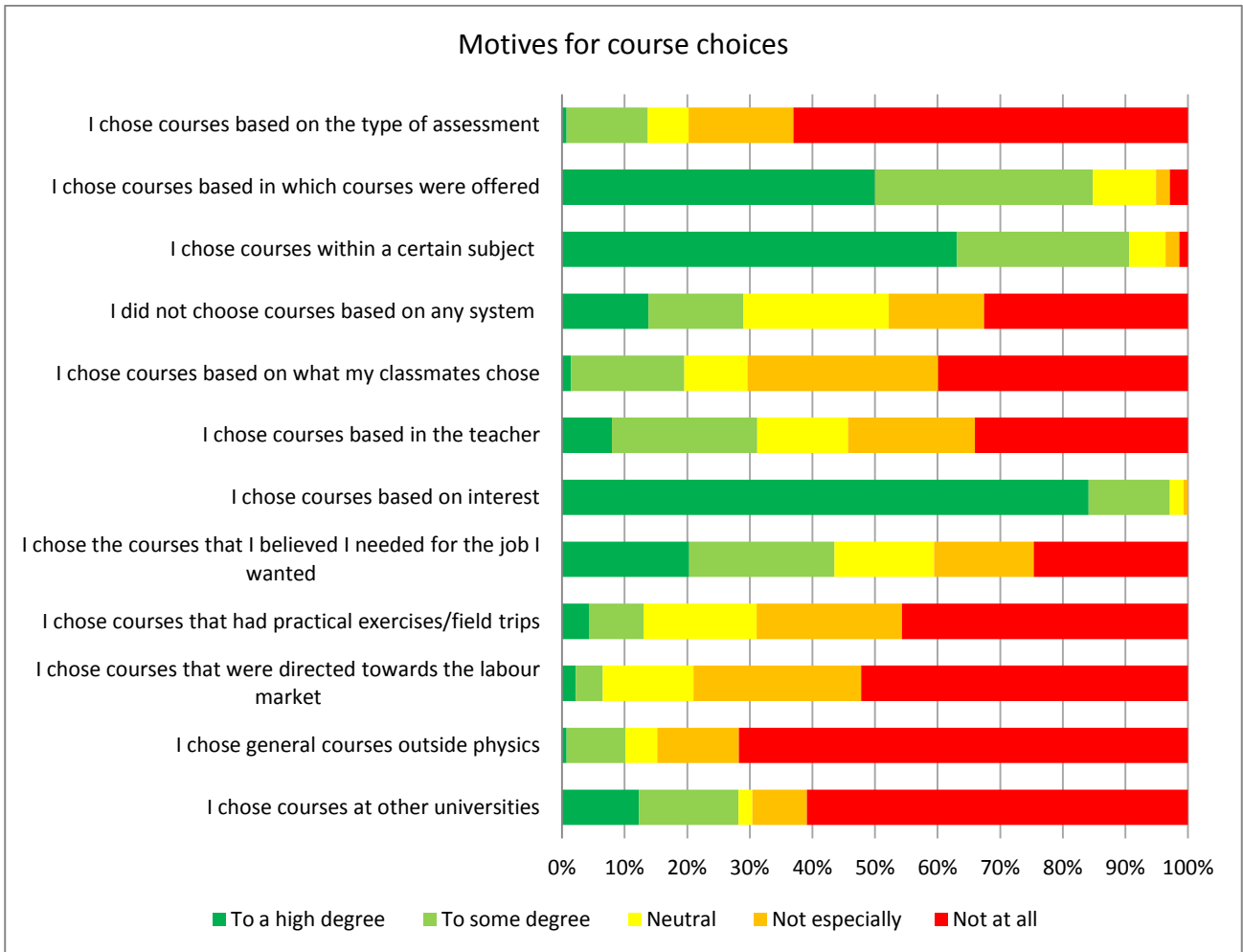
Figure 17
Question 14 'To how high a degree does the statements listed below describe your choices of courses during your Master's programme?'

When it came to the respondents' thoughts about their future career options, they reported that they did not have any specific job positions in mind, but that they had an idea that they would be able to be employed in many different industries, see Figure 18. This result may to a high degree reflect that the Master's programme in physics does not especially educate graduates to a specific job function, but is a broader education which contains many job opportunities. When the respondents were asked if it was important for them to know their employment opportunities the answers were mixed with 41% replying that is was *important* or *very important*, 32% did not *find it that important* or not *important at all* while 26% were *neutral*, see Figure 19. Overall these results may be understood in the light of a telling at the physics education that the employment rate for physicists was high, meaning that the respondents did not especially have to worry or pay attention to their future employment opportunities.
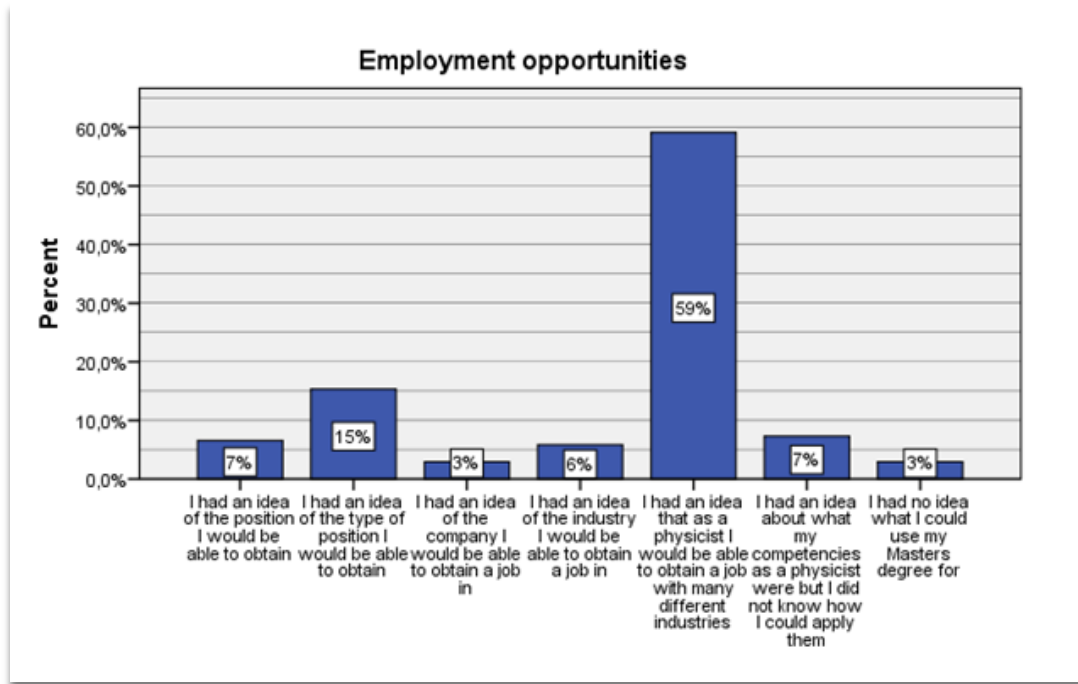
Question 17 'Which of the options below describes you best regarding how you saw your job opportunities during your Master's programme?'
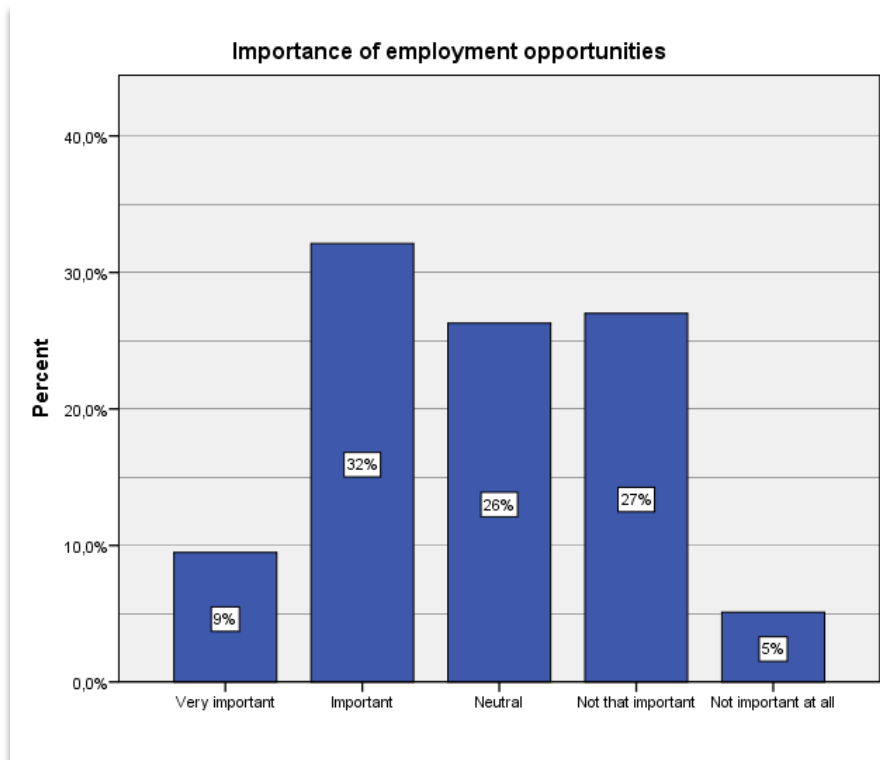
Question 18 'How important was is to you, during the Master's programme. to know what job opportunities you had access to based on your Master's degree?'

Graduating from the Master's programme the respondents experienced that they had a good idea about which competencies they had acquired during the programme, see Figure 20. The majority of the respondents experienced that it was easy to find a job were their competencies were sought for, Figure 21. The respondents primarily described the transition to the labour market as a *learning* and *challenging experience* but words such as *good*, *exciting* and *getting responsible* were also frequently used as descriptive of the experience, see Figure 22.
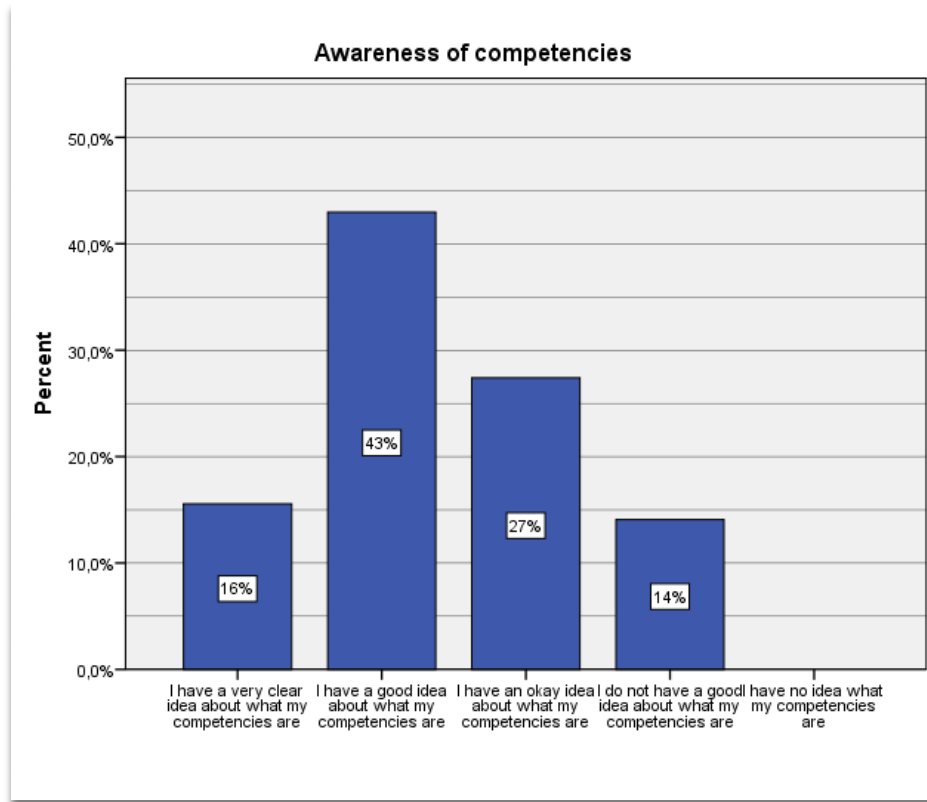
Figure 20
Question 19 'How aware are you of the competencies you have with you from your Master's programme in physics?'
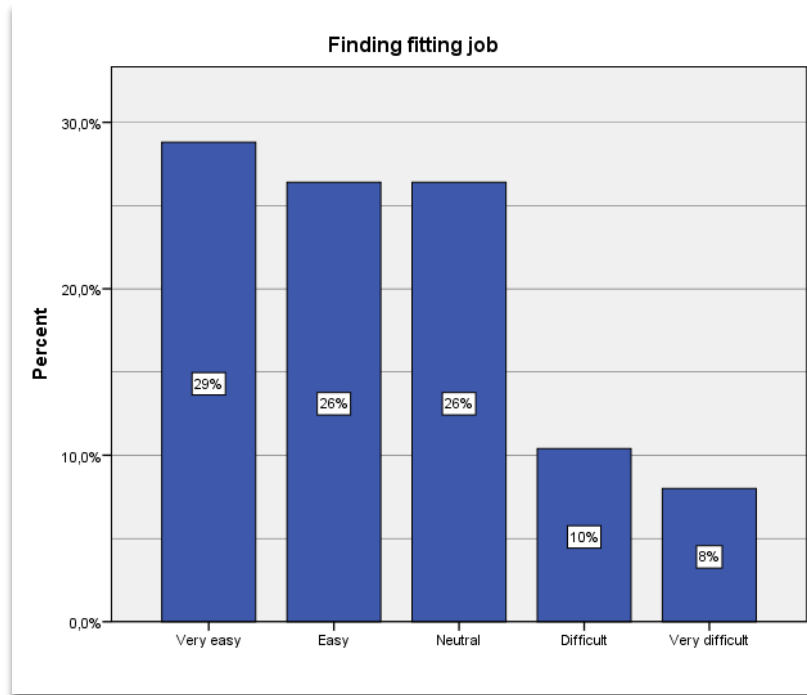
Figure 21
Question 23 'How did you experience, trying to find a job which demanded your competencies?'
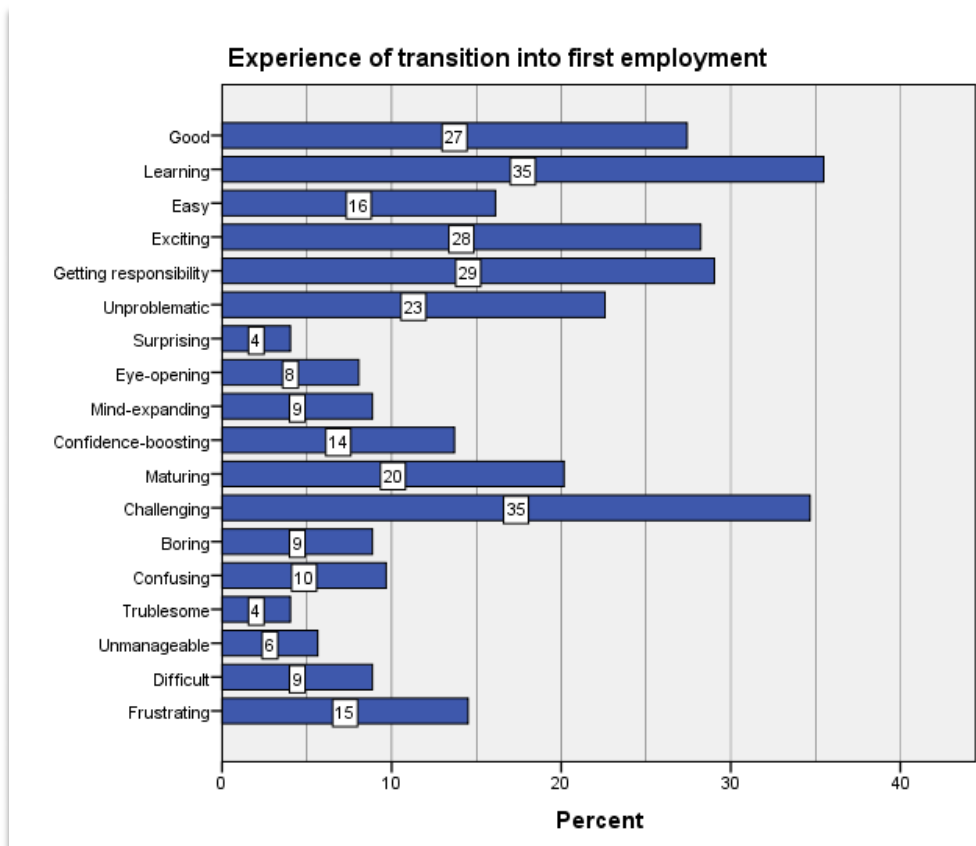
Figure 22
Question 24 'How did you, in general experience the transition from university to the labour market based on your first job?
Choose the three words that describes the transition the best.'

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In their current jobs the respondents reported that *basic research*, *teaching* and *communication* were their primary job functions and they experienced that they utilized the competencies which they felt they had acquired through the Master's programme, see Figure 24. The majority reported that at least half of the competencies they applied in their job were competencies which they had gained through the programme, see Figure 23. Though most of the respondents also reported that they had experienced a difference between their competencies and what they had to do, see Figure 25 .

Based on their experience with the labour market, the respondents reported that the Master's programme had prepared them well for the labour market, see Figure 26.
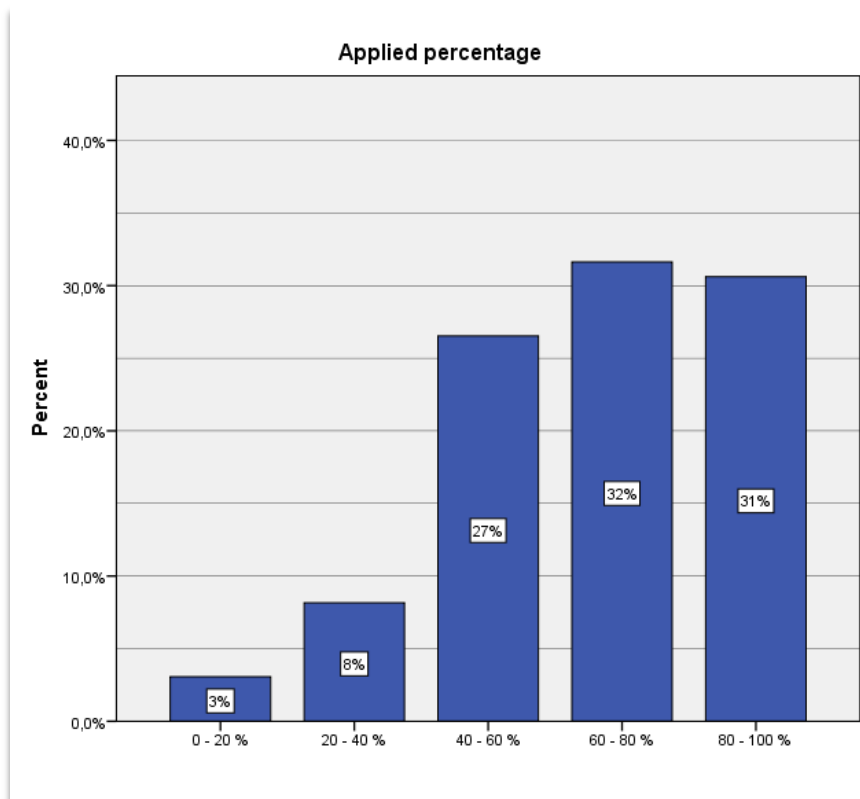
Figure 23
Question 50 'How big a percentage, of what you use in your job, have you acquired through your education in physics, relative to how big a percentage you have acquired in other places? Choose how big a percentage you have acquired through your physics education.'
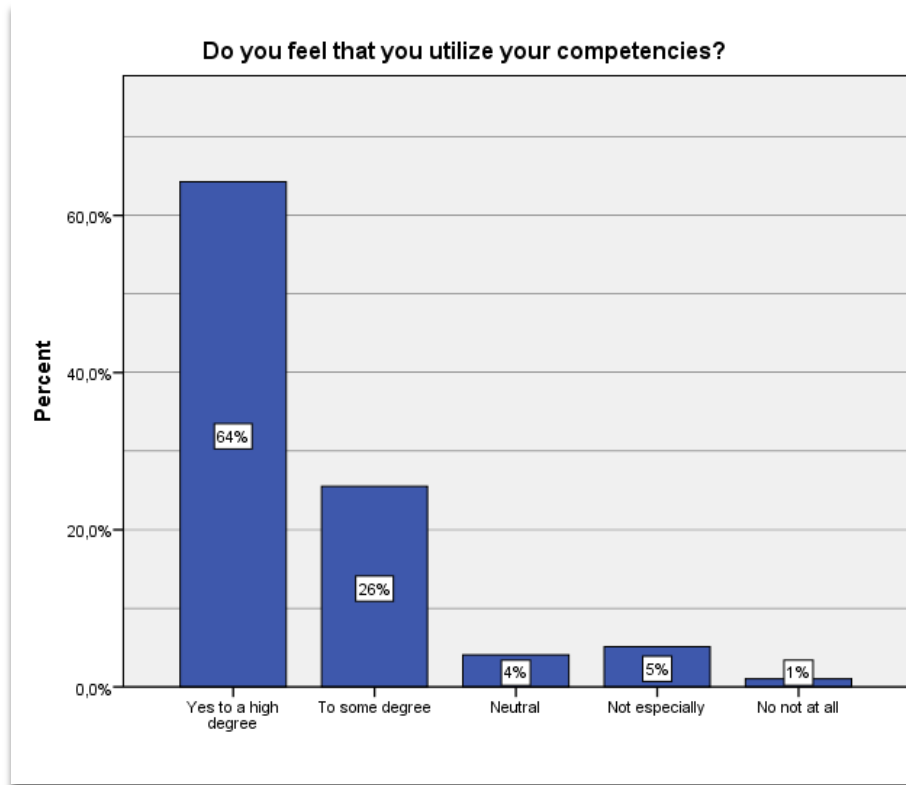
Figure 24
Question 48 'Do you feel that you utilize your competencies from the Master's programme in your current/most recent job?'
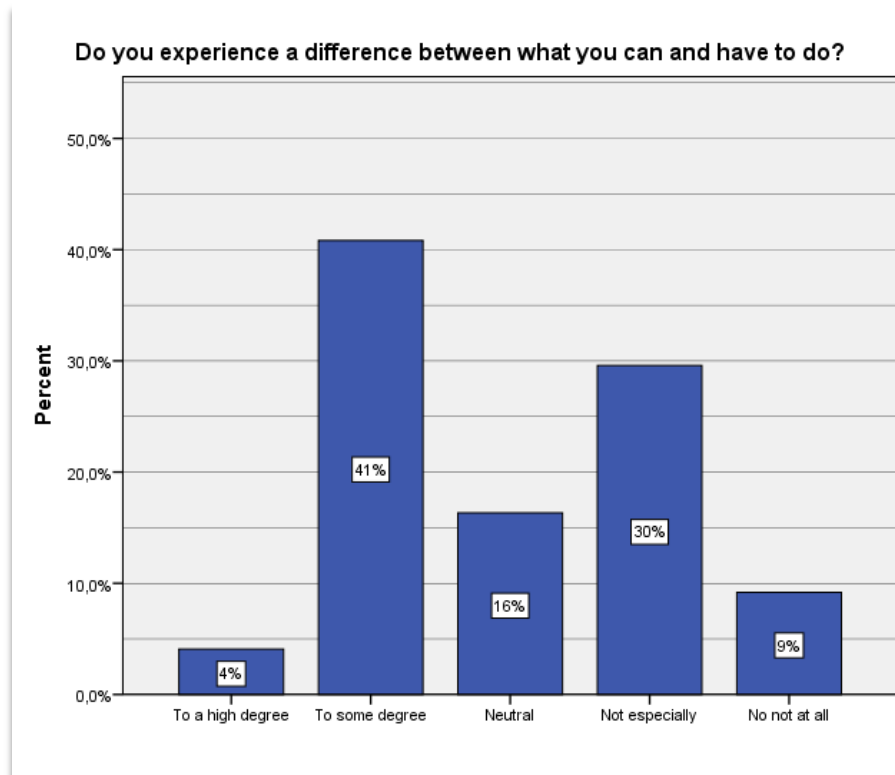
Figure 25
Question 45 'Do you experience that there is a difference between what you can and what you have to do in your current/most recent job?'
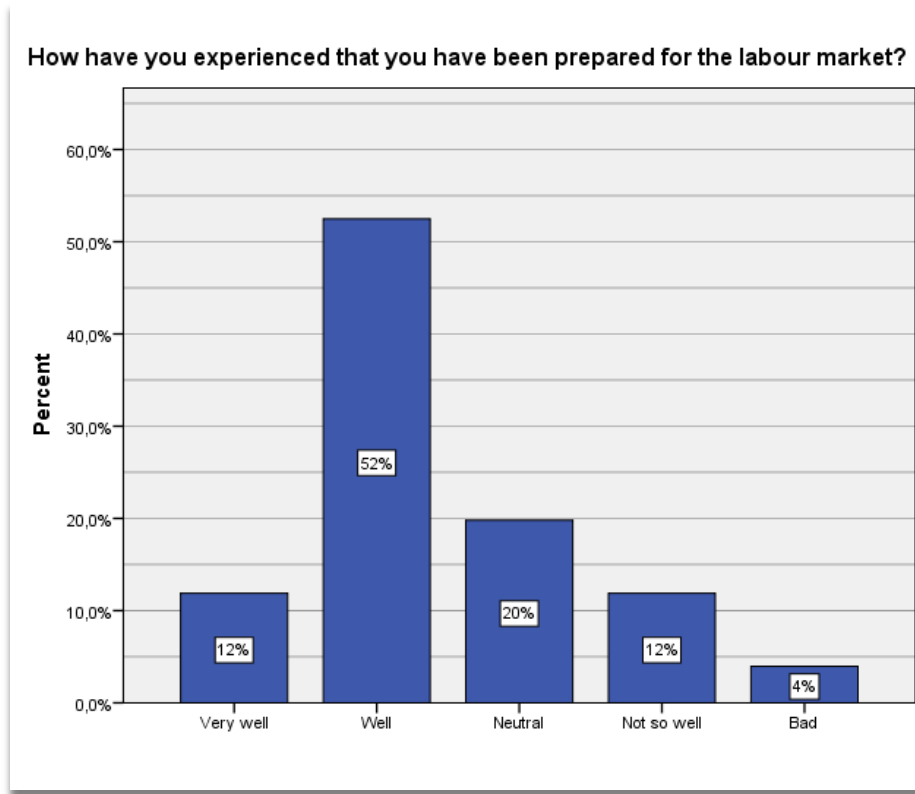
Figure 26
Question 57 'How have you in general experienced that your Master's programme has prepared you for the labour market?'

4.5 The Master's programme

In the following section the results on the respondents' thoughts and choices about the labour market during the Master's programme will be presented. This section describes the respondents' choices in regard to qualification profile and courses, the respondents' view on their employment opportunities, and finally a description of the competencies which the respondents experienced to have acquired during the Master's programme.

In the introduction it was presented how the respondents were quite settled with the qualification profile they had chosen and that their choices of courses were based on their interest within certain subjects. The respondents reported that during the study programme they thought that they would be able to be employed in many different jobs and industries and that some found it important to know their employment opportunities more specifically while others did not.

By analysing the respondents' answers to the first part of the questionnaire (question 13-20), two variables seemed to be significant, these were gender and qualification profile. In the following two sections these two themes will be presented.

4.5.1 Gender

The results implied differences between the male and female respondents in regard to how they navigated through the Master's programme.

Figure 27 shows how certain the respondents were, retrospectively, about their choice of qualification profile during the Master's programme. An overwhelming majority of the female respondents (78%) reported that they had *a clear idea* about which profile they wanted, while just 57% of the male respondents reported the same. Overall the male respondents were less settled with their choice of profile compared to the female respondents. 10% of the male respondents actually reported that they *did not know which profile they wanted*.

Figure 28 shows which motives the respondents had when choosing courses. More than 80% of both male and female respondents reported that they primarily chose courses based on *interest*, *courses within certain subjec*ts and the *frequency of the course offering.* In addition to these factors, the female respondents also especially chose *courses they believed they needed for the job they wanted* (50%) and *courses at other universities* (40%). For the male respondents the respective percentages for these two categories were 40% and 20%.

The fact that the female respondents to a larger extend chose certain courses in order to qualify themselves for a specific job, suggests that the female respondents to a higher degree than the male respondents directed their Master's programme towards the labour market. The motives to take courses at other universities can be various but since it requires planning well in advance to take courses at other universities the difference implies that the female respondents were more structured in the planning of their study programme. The result of Figure 27 and Figure 28 implies that the female respondents approached their study programme differently than the male respondents. This difference is also seen in other research which have shown that male and female students develop differently and therefore approach their education differently (Felder & Brent, 2004a).
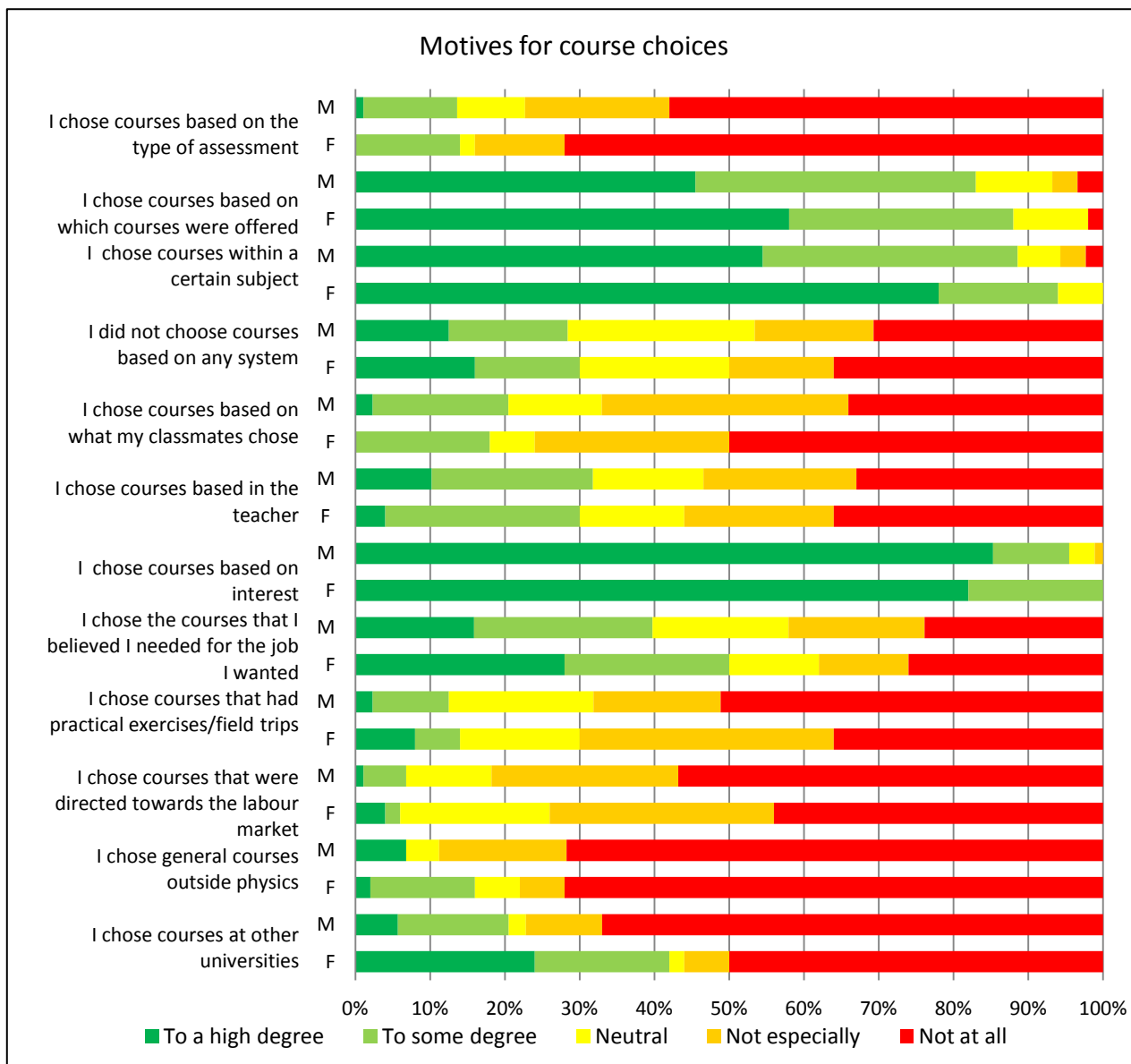
Figure 28
Question 14 'To how high a degree does the statements describe your choices of courses during your Master's programme?'

Figure 29 shows how important it was for the respondents to know their employment opportunities during the education. 48% of the female respondents reported that it was *important* or *very important* to know their employment possibilities. 38% of the male respondents reported the same. 36% of the male respondents reported that it was *not that important* or *not important at all*. Overall the figure shows that the female respondents thought it was more important to know their employment opportunities than the male respondents. This result explains some of the spread in the general picture from Figure 19.
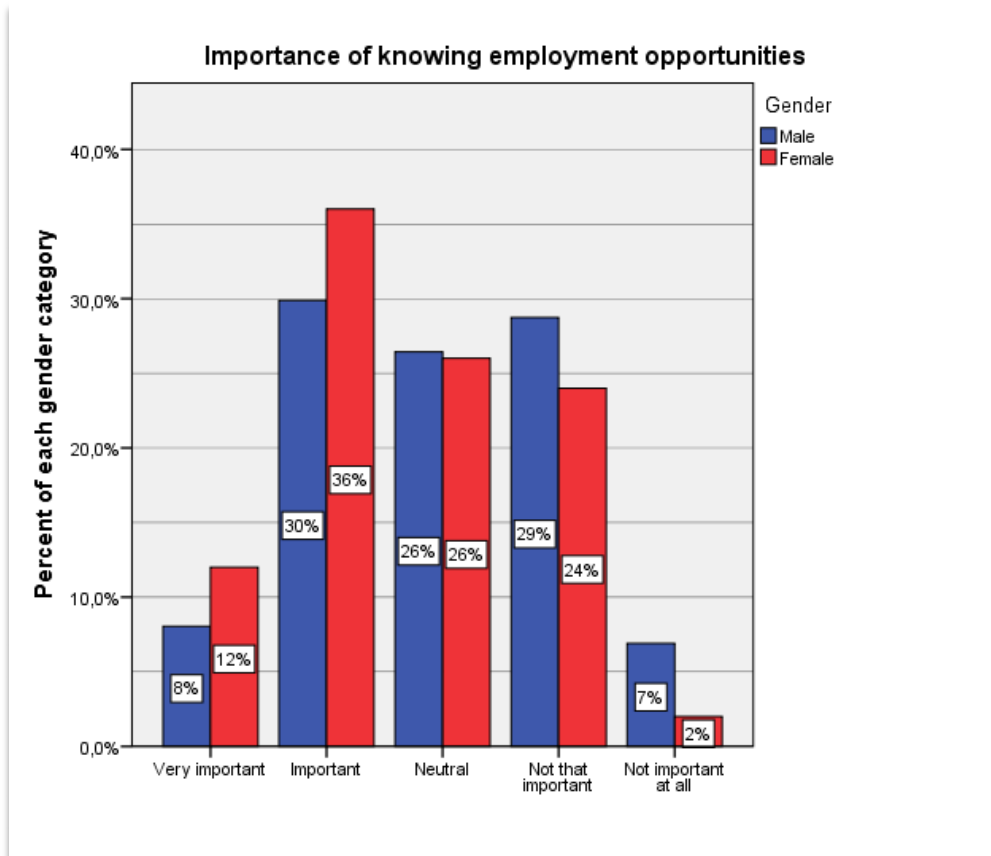
Figure 29
Question 18 'How important was it to you, during your Master's programme, to know what job opportunities you had access to based on your Master's degree?'

Although the female respondents to a higher degree then the male respondents found it important to know their employment opportunities, the results did not imply a significant difference between how the male and female respondents viewed their employment opportunities, see Figure 30. The majority of both groups reported that they *had an idea that they would be able to be employed in many different industries*. Based on the earlier results this is quite interesting as it could be expected that the female respondents had a specific job position in mind when they chose courses to acquire skills for the jobs they wanted. Since all of the respondents experienced that they had broad employment opportunities, the female respondents' search for meaning and purpose in their study programme may be a gendered expression of the students' approach to the education.
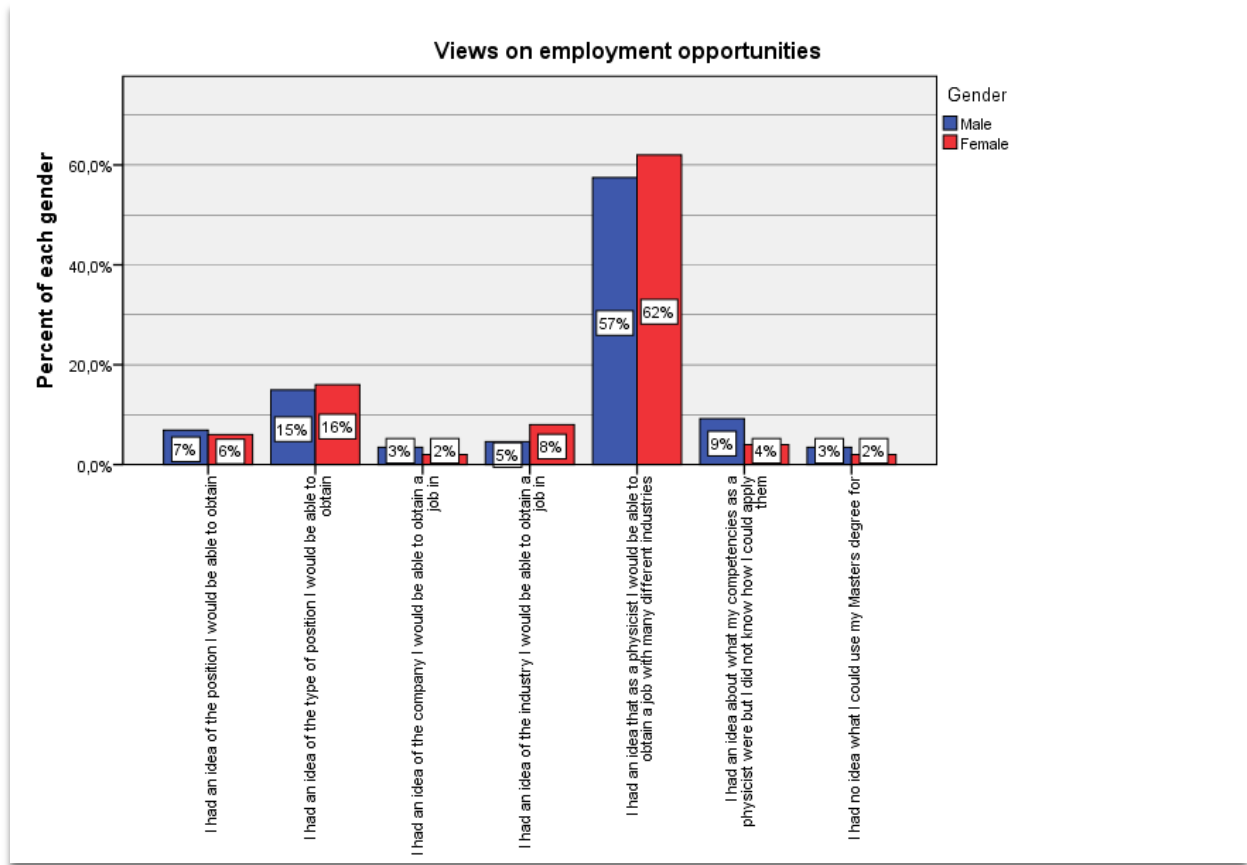
Figure 30
Question 17 'Which of the options describes you best regarding how you saw your job opportunities during your Master's programme?'

Summing up, the results show differences between the male and female respondents in regard to their choices during the Master's programme. The results indicate that the female respondents were more determined in their choice of qualification profile and courses, and that they in terms of planning the content of their Master's programme appeared to be more focused than the male respondents. The male respondents to a lower degree knew which qualification profile they wanted and basically chose the courses which were available and interesting. The female respondents found it important to know their employment opportunities to a higher degree than the male respondents, suggesting that female respondents were more aware of the future than the male respondents.

Other research has also found these differences between male and female students. Hutters, Nielsen and Görlich (2013) in their research on gender in youth educations in Denmark found that female students were more structured and organized than male students, and that they were more concerned about their future career (Hutters et al., 2013). The female students were more worried and concerned during the education than the male students, who let themselves be more loose and allowed themselves to be more expressive. In the study by Hutters et al. (2013) it was shown that the loose strategy of the male students was associated with a lower grade point average as well as a lower graduation rate compared to the female students. Related to this survey it is not possible to see from the production numbers from the university (Det Naturvidenskabelige Fakultet, 2012) if the male respondents had a lower graduation rate or a lower grade point average.

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While it is possible that the different strategies of the male and female respondents have the same consequences as in the youth educations, another possibility is that the male respondents may have taken longer time to finish their Master's programme than the female respondents. In the physics programme there is a telling that male students are not as concerned about completing the Master's programme within the prescribed two years as the female students. Taking longer time to complete the Master's programme to a higher degree allows the male students to follow their interest and not take courses outside their field of interest.

The existence of the different strategies between male and female respondents invites to a discussion about which factors affect the students' strategies - is it the students themselves who chose to apply a certain strategy to their study programme? Or is there also factors within the Master's programme and the field of physics which make the students approach the study programme differently? Research in support of the latter has shown that in physics education there is a culture in which male students are privileged over female students because the education praises and values the characteristics typical of males (Kost-Smith, Pollock, & Finkelstein, 2010), (Hasse, 2002). To change this culture the education should acknowledge and embrace the different developmental stages that male and female students go through during the education to promote the growth of all students (Felder & Brent, 2004b).

If the different strategies between male and female students have consequences in regard to how many students that complete the Master's programme or the time it takes for the students to complete their Master's degree it would cause a skewing in the characteristics of the graduates in regard to the number of graduates within each gender and the grade point average of the student. An inquiry at the Niels Bohr Institute would help to understand if the different strategies have any consequences and would be an input into understanding how to handle these.

Since the female respondents were more focused and conscious about their future during the programme, one could expect that they knew which competencies they had acquired through the education. But the results show that it is not so. Figure 31 shows the respondents' self-awareness of the competencies they had acquired during the Master's programme. The male respondents had a *good idea* about which competencies they had gained, while quite a high percentage of the female respondents had a more vague idea about what their competencies were. This result is opposite of what I had expected to find. A possible explanation could be that despite being more structured and well-planned, the female respondents in general had a lower self-efficacy than male respondents. This result only support the above encouragement for the education to embrace the different developmental stages of the students.

In the next section it will be presented how this may have affected the respondents' transition to the labour market.
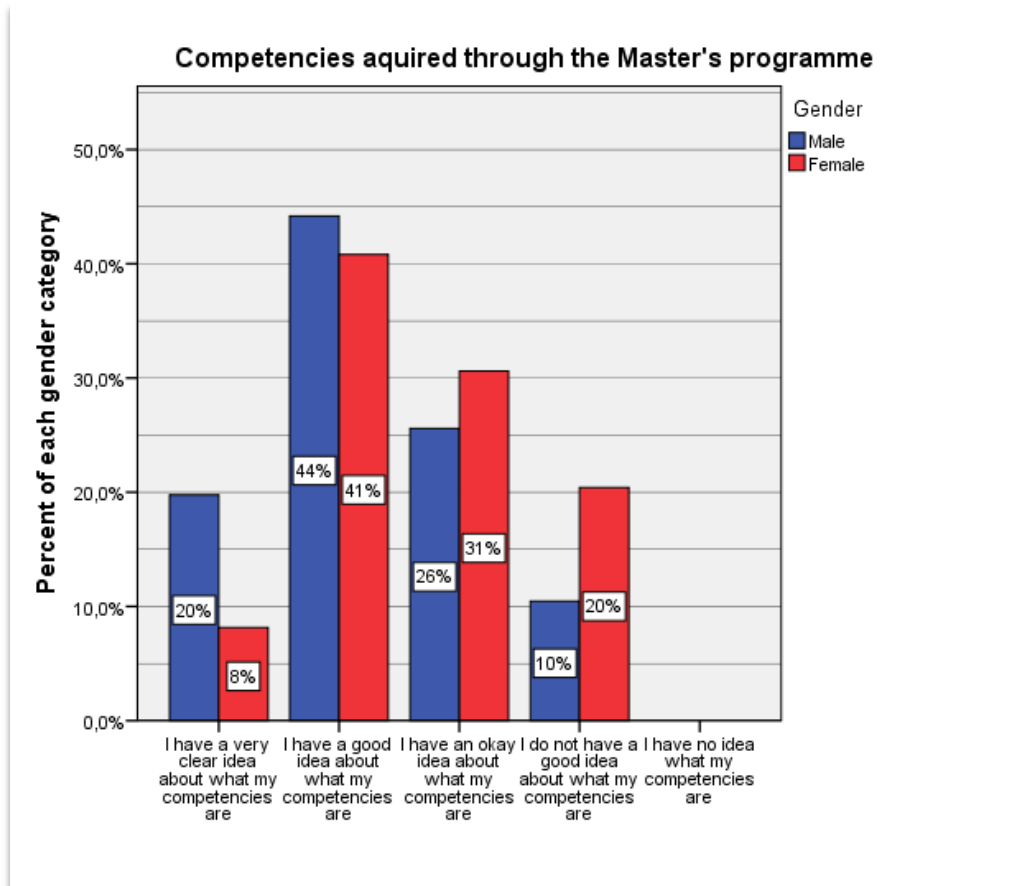
Figure 31
Question 19 'How aware are you of the competencies you have with you from your Master's programme in physics?'

4.5.2 Qualification profile

Besides differences in gender the results also show a difference between the respondents choices and thoughts about the future in regard to their qualification profile.

In the introduction it was shown that the majority of the respondents had *a clear idea* or *a good idea* about which qualification profile they wanted. But looking at Figure 32 it is clear that the respondents with a general profile were more insecure about their choice of qualification profile than the other respondents. Actually 32% of the respondents with a general profile reported that they were *in doubt about their choice of qualification profile* or *did not know which qualification profile they wanted*. An explanation for this may be found in the difference between the profiles; while astrophysics, biophysics, geophysics and general profile with an elective subject are quite specific profiles in terms of content and courses the general profile covers a broader spectrum of subjects. The general profile also includes graduates who do not take courses within any specific subjects. Though in the group of respondents with a general profile there were respondents who studied specific subjects within physics such as solid state physics or theoretical physics, but it also contained a group of respondents who were in doubt about which profile they wanted or even did not know it.
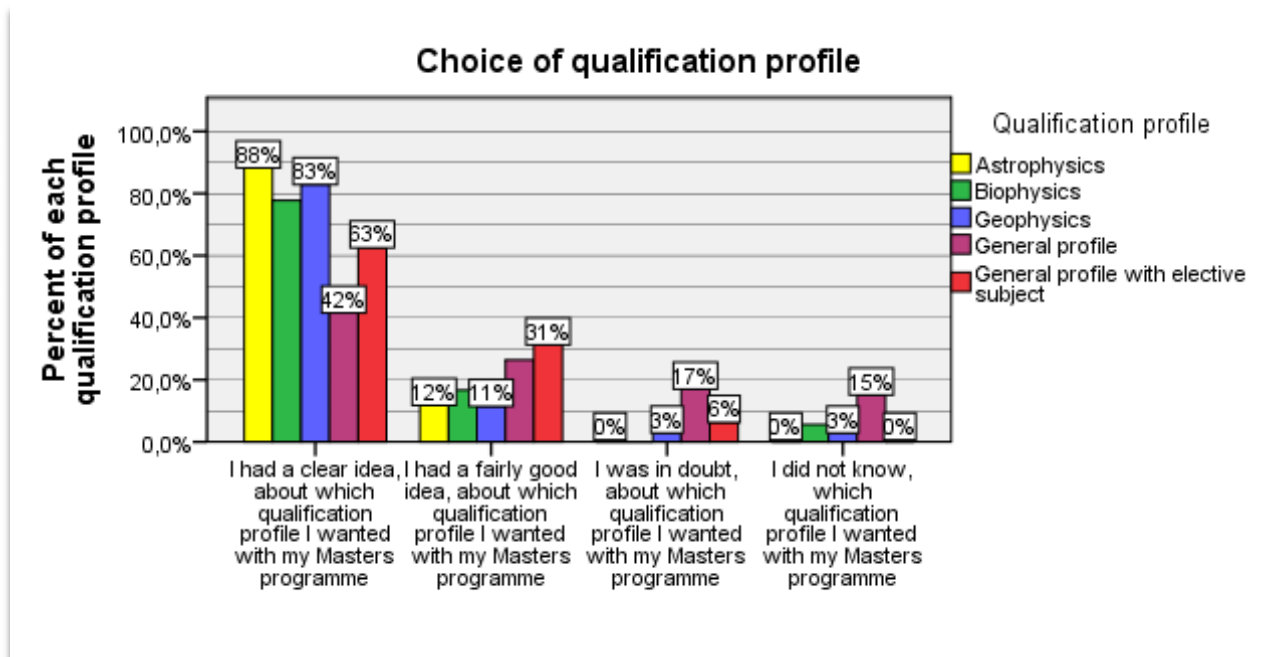
Since the majority of the respondents knew which qualification profile they wanted one may also think that it was important for them to know their employment opportunities. But the results show the importance of knowing what the employment opportunities were depended on the qualification profile. Overall the respondents with a geophysical and an astrophysical profile found it more important to know what their employment opportunities were than the other respondents, Figure 33.

The reason for this may be related to how the two industries are settled in Denmark. As earlier described there is a large industry within geophysics in Denmark, which would have given the respondents various job opportunities. This may have made it more important for the respondents to know exactly what their employment opportunities were in order to qualify themselves more specifically towards a position. Figure 34 shows that 27% of the respondents with a geophysical profile knew specifically which company, type of position or the position they were able to get employed in after graduation. Overall the various employment opportunities may have made it more crucial for the respondents to know their employment opportunities leading them to investigate more specifically what possibilities they had.

Within astrophysics on the other hand, the industry in Denmark is not big. This would especially be a reason for astrophysics respondents to investigate which job opportunities they had. But Figure 34 shows that only 18% of these respondents knew which type of position they were able to be employed in (which may be the PhD position since that is a common career path within astrophysics). But the majority (65%) of the respondents with an astrophysical profile only had an idea about which industry they were able to be employed in.

About half of the respondents with a biophysical profile and about half of the respondents with an elective subject found it important to know their employment opportunities while the other half did not find it especially important. The majority of the respondents with a biophysical profile (72%) had an idea about the industry they were able to get employed in. This is quite interesting since there would be good employ-

ment opportunities for respondents with a biophysical background because of the fast development of the bio-industry.

33% of the respondents with an elective subject knew which type of position they were able to obtain. It seems reasonable to assume that this is because they with their elective subject were qualified to become high school teachers. But research on how and why students choose to educate themselves to become high school teachers is limited, which means that we do not know if the choice to become a high school teacher is made from the beginning of the education or if it is a choice which comes along the way. This question is distinctive for Denmark because, unlike most other countries, high school teachers are educated as a part of an education within an academic subject and not as a specific education aimed for high school teachers.

The respondents with a general profile reported that they had an idea that they *would be able to obtain a job in many different industries*. Despite this unspecified view on the employment opportunities the respondents with general profile reported that they were *neutral* or that they *did not find it that important* to know their employment opportunities. This is quite interesting since a high percentage of these respondents also replied that they were quite undecided on which qualification profile they wanted. One could think that these respondents, who were less resolved with their choices, were more concerned about their future employment opportunities. But it does not seem that it is so. Though, looking at Figure 35 it stands out that the respondents with a general profile were the respondents who were most aware of what their competencies were. This may explain why these respondents did not put much importance into knowing what their employment opportunities.

Figure 35 may also give an indication to why the respondents with a geophysical profile put more importance into knowing what their employment opportunities were, since these respondents overall were the respondents most unaware of their competencies.
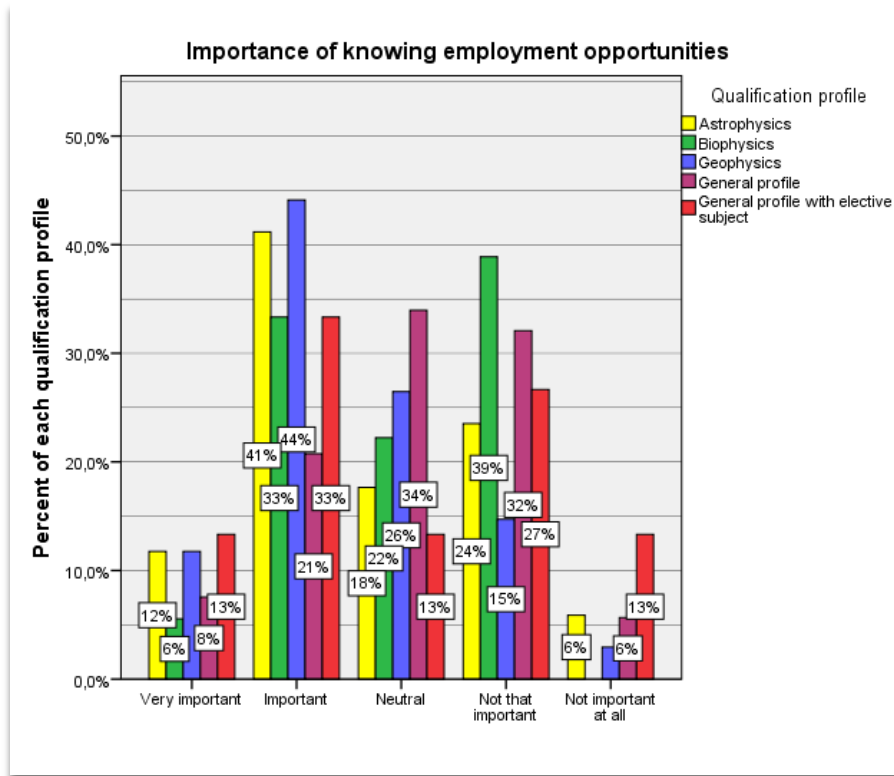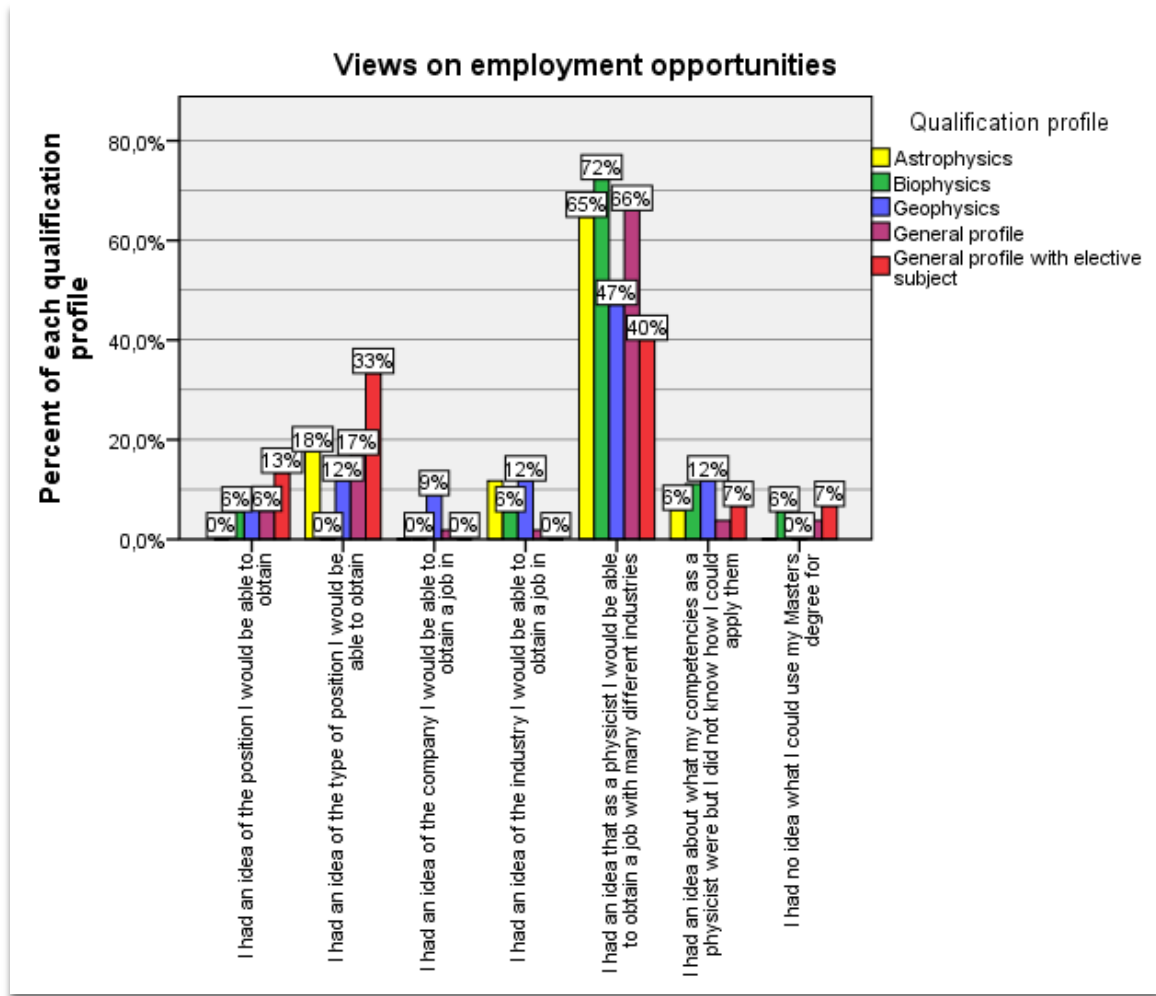
Summing up, the results imply that within the qualification profiles the respondents had different thoughts and strategies in regard to their views on their future employment. These differences may be due to the traditions within the profile, employment opportunities, and the demand of the labour market within the industries of each of the profiles. But overall it is quite clear that the respondents were unclear about their future employment opportunities. This result may be problematic, but research shows that students first late in their development engage themselves in commitments they have made (Perry Jr, 1999). This means that although the respondents had committed themselves to the Master's programme and to a future where they were most likely going to be working as physicists of some kind, following up on this commit-ment and taking it upon themselves to find the career path suitable for themselves is a process which first would have happened late in the respondents' life, probably during the Master's thesis and after gradua-tion.

In the next section it will be presented how these differences affected the respondents' employments. For this section though it is worth noting that to a large group of the respondents it was important to know their employment opportunities while they did not know very specifically which employment opportunities they had. This result may invite the Master's programme to clarify, to the students, what the employment opportunities for graduates from the Master's programme.
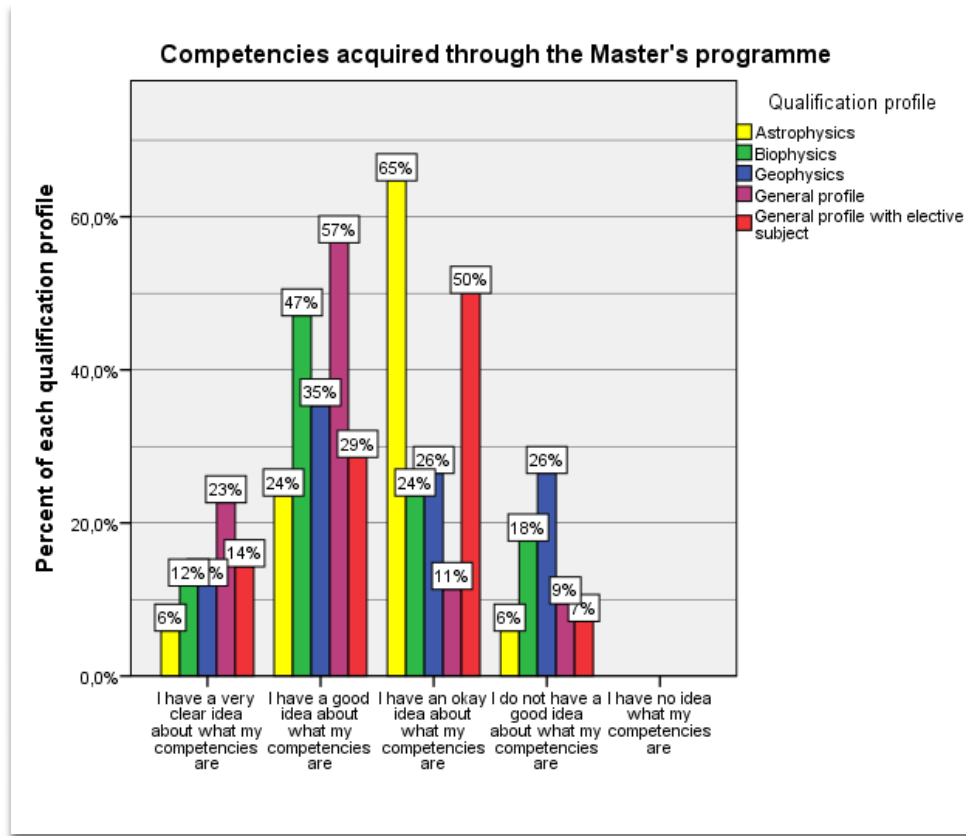
Figure 35
Question 19 'How aware are you of the competencies you have with you from your Master's programme in physics?'

4.5.3 Competencies from the Master's programme

In Section 4.4.2 it was presented that the majority of the respondents reported that they had a clear idea about which competencies they had acquired through the Master's programme in physics. To understand which competencies the respondents experienced to have acquired they were asked to freely describe the three competencies that they especially experienced to have gained.

The respondents' descriptions are visualized in Figure 36[12]. In this word cloud the size of each word is proportional to the number of times the word appeared in the respondents' descriptions.

The largest words in the cloud are; knowledge, programming and problems. These words indicate that the respondents experienced that they had acquired knowledge and the abilities to program and to work with problems.

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[12] As the respondents' answers were in Danish the word cloud is also in Danish. For an English translation of the word cloud please contact the author at nrx246@alumni.ku.dk.

To get a more in-depth picture of the respondents' perception of their competencies their descriptions were analysed. Supporting the results from the word cloud, the analysis showed that the scientific competencies were the ones that the majority of the respondents had emphasized. The analysis yielded three overall categories; *Problem solving by logical and analytical thinking*, M*athematical and technical skills* and *A solid ballast within physics and the ability to embrace new knowledge.*

The respondents were also asked to look at two lists of competencies and evaluate to how high a degree they had acquired the listed competencies during the Master's programme (question 43 and 44). The response to the lists of competencies and the three themes from the analysis will be presented in the following section.

The results on the experienced differences between the gained competencies and the applied competencies will be presented in Section 4.7.3.

Problem solving by logical and analytical thinking

One of the emphasized words in the word cloud is problems. In the open questions the majority of the respondents reported in short descriptions that problems, analysis, logic, and rational thinking were competencies which they had gained from the Master's programme. In the more descriptive answers from respondents, they described how they were able to solve problems through logic and systematic thinking. They described how they were able to solve complex problems with systematic methods. The respondents described that when presented to an abstract problem they were able to understand it as a system and analyse it, in order to pinpoint the essential factors and describe how they influenced the system. By reducing a problem to its fundamental variables the respondents were able to analyse the system and thereby provide a solution to the given problem. The respondents described how this process required the ability to quickly get an overview of the problem, deductive and rational thinking to break the problem into its elements and the ability to cut to the bone to find the significant factors of the problem. Some respondents also described that through this systematic approach they were able to argue objectively and logically when presenting a solution to the given problem. With this logical and analytical thinking the respondents described how they were able to solve any arbitrary problem.

These descriptions were supported by the results of question 43 where about 80% of the respondents reported that they to some degree or to a high degree experienced that they were able to identify problems, select the relevant theories and methods and based on this formulate the problem, see Figure 37.

Other research on physics graduates has also found that problem solving is one of the particular strengths of physicists (Sharma et al., 2008).
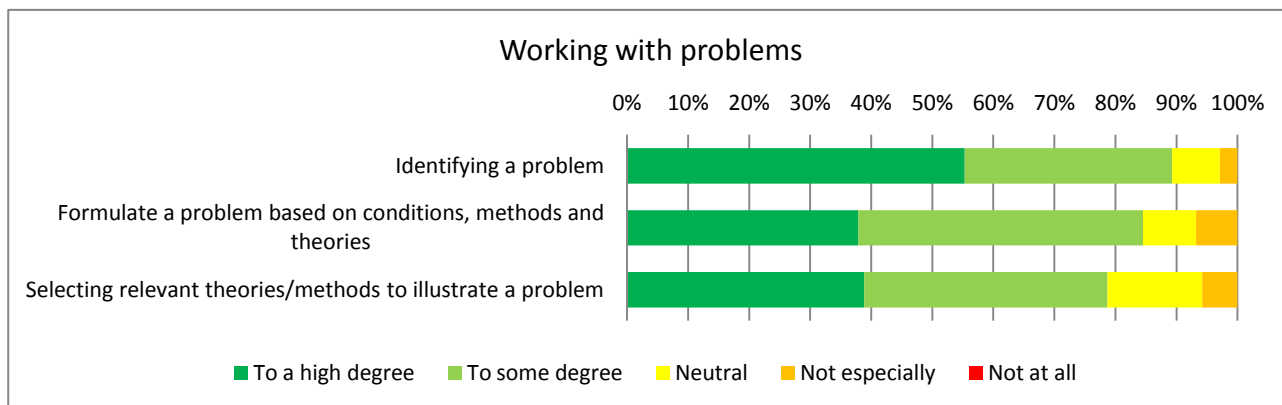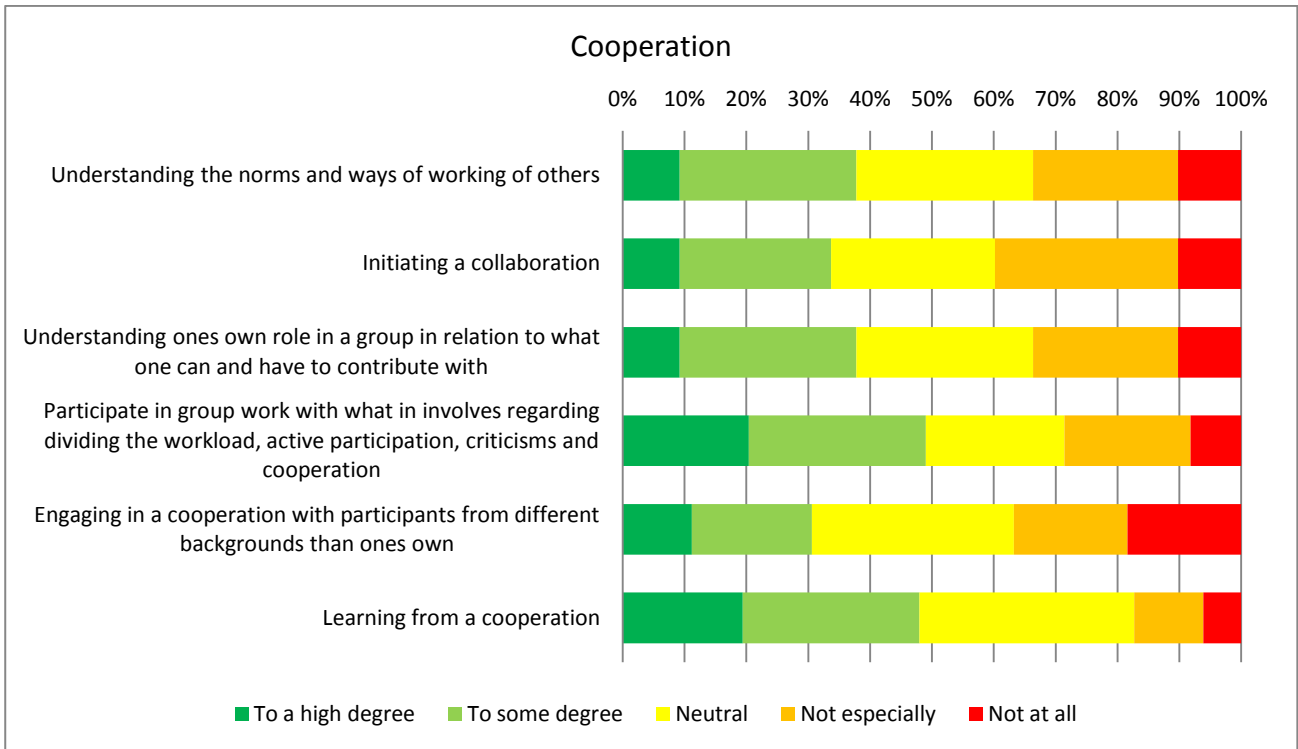

Figure 37
Question 43 'To which degree have you experienced to have the competence with you from the Master's programme?'

Mathematical and technical skills

The respondents succinctly described that they experienced they had learned how to do programming, make models, calculate and process data. In the more descriptive responses the respondents described how they were able to solve a given problem with the use of their mathematical and technical skills. Some respondents described how they had good mathematical skills which made them confident with numbers and able to make extensive calculations. Others wrote that they had learned how to describe the world with equations, how to logically derive equations, and how to interpret the meaning in order to understand these. Quite a few respondents described that they had experience with processing and analysing large amounts of data and knew how to analyse it statistically and numerically. The majority of the respondents wrote that they were able to produce mathematical models and simulations via programming in specific code languages specific to their qualification profile. These descriptions are supported by the results of question 43 where 70% of the respondents reported they knew how to set up a model to illustrate a problem and 84% knew how to apply a model to solve a problem, see Figure 38. Overall the mathematical and technical methods were the tools which the respondents experienced to have learned to use when solving problems.
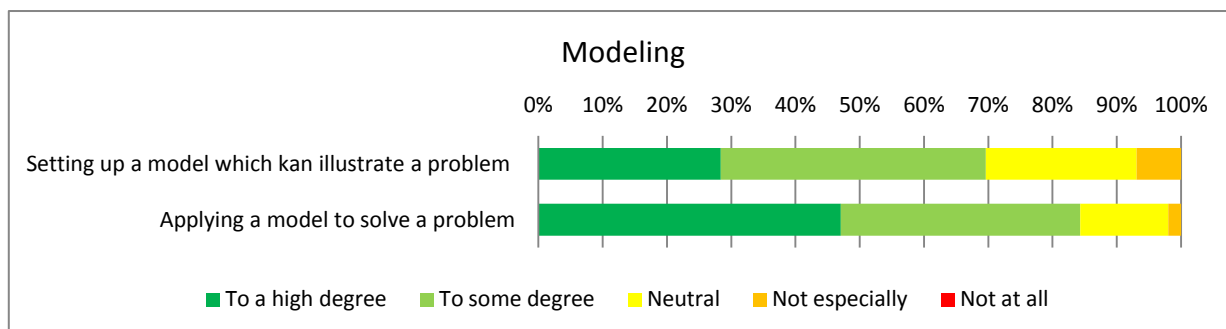
Figure 38
Question 43 'To which degree have you experienced to have the competence with you from the Master's programme?'

In addition to these technical skills, the respondents described how they felt that problems were easiest and most naturally solved with a computer, and how they felt comfortable using IT. These results are supported by the responses to question 43 where 77% of the respondents reported that they knew how to use IT as a tool and 74% knew how to use it in their daily work, see Figure 39.
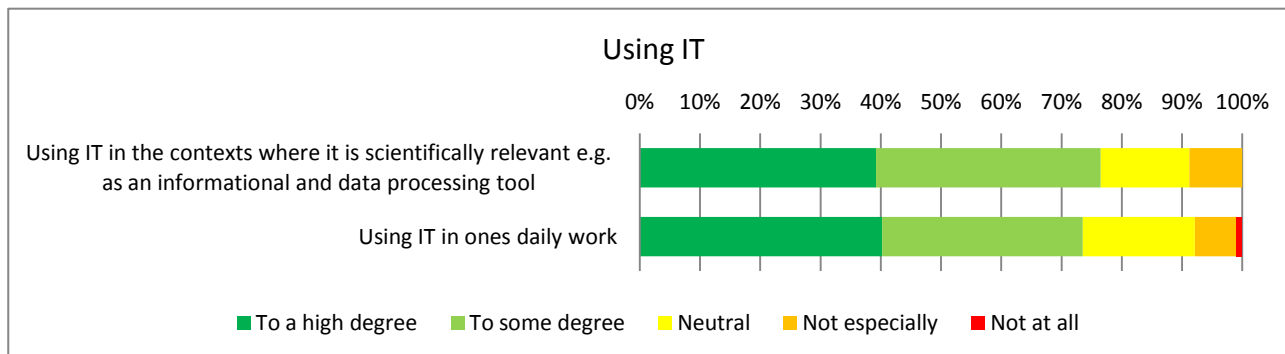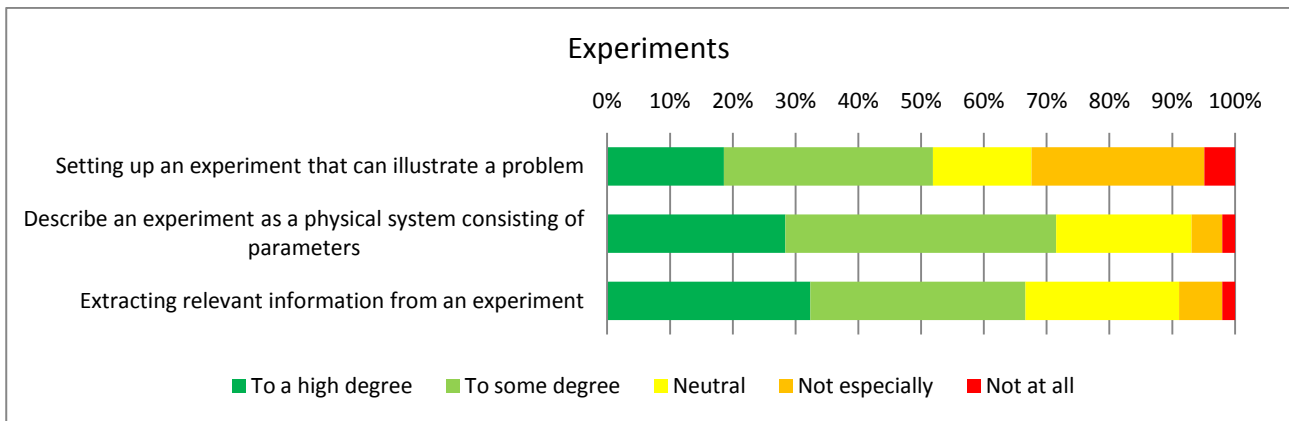

Figure 39
Question 43 'To which degree have you experienced to have the competence with you from the Master's programme?'

The skill to use tools to approach data and solve problems was promoted by the DeSeCo project, see Section 2.2.1, as a key skill, implying that the respondents were able to use this skill not just within physics but as a transferable competence in other fields.

A solid ballast within physics and the ability to embrace new knowledge

The majority of the respondents reported in short descriptions that knowledge within the subjects of physics were one of their main competencies. The respondents described this knowledge as a broad physical insight and understanding of the world, the laws of nature and the guiding forces, but also detailed knowledge about specific subjects within e.g. quantum field physics, astronomy, geophysics or biophysics. The respondents described how this knowledge had given them a fine physical intuition when approaching problems. That a broad knowledge basis provides the student experience when confronting problems has been know for a long time (Glaser, 1984). There has been a debate though within educations about how much emphasis should be put on learning knowledge relative to learning processes (Murphy & McCormick, 1997). The results of this survey show that the respondents experienced that their broad knowledge gave them a confidence underlining the importance of learning knowledge during educations.

In addition to a large basic knowledge the respondents described that they had learned how to acquire and embrace new knowledge easily. This competence included all from knowing where to find the needed information, how to approach it, and immerse oneself in it to make it useful in new contexts, all within a limited time period. These descriptions are supported by the results of question 43 and 44, were more than 90% of the respondents reported that they knew how to acquire knowledge, and almost 70% of the respondents knew how to find, sort, evaluate and summarize relevant information and the latest knowledge, see Figure 40.
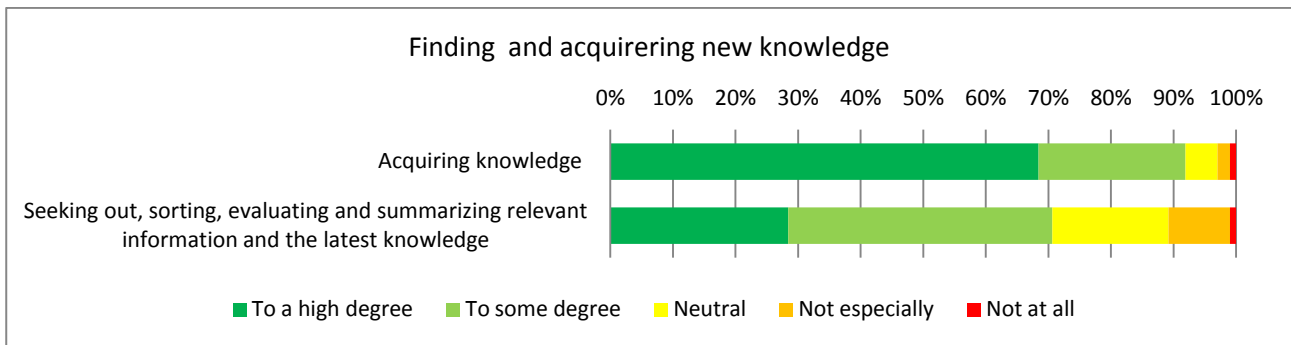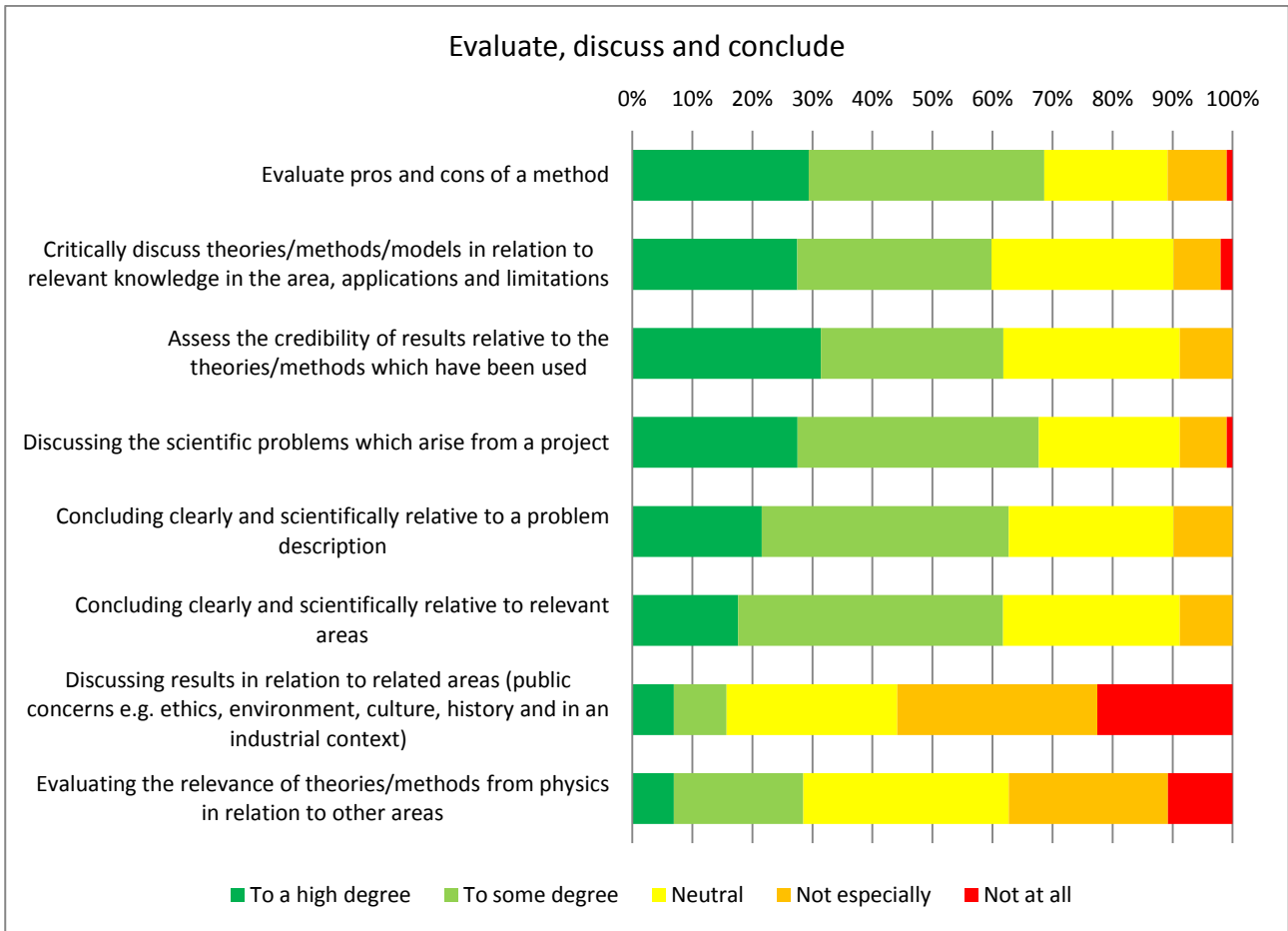
Figure 40
Question 43 and 44 'To which degree have you experienced to have the competence with you from the Master's programme?'

Competencies described in the Curriculum

The three categories: Problem solving by logical and analytical thinking, Mathematical and technical skills, and A solid ballast within physics and the ability to embrace new knowledge, were repeated throughout the respondents descriptions and so they were clearly primary competencies to the respondents. In the following the three competencies will be related to the Curriculum of the Master's programme to get an understanding of their importance in the Master's programme.

Logical and analytical thinking was described by many respondents. In the Curriculum it is written that graduates from the Master's programme in physics are capable of *'solving complex mathematical problems using both analytical and numerical methods*' (Faculty of Science, 2013, p. 3). While this statement to some degree contains what the respondents described, it revolves more around mathematical problems and may focus more on the mathematical methods to solve a problem than the scientific approach which the respondents described. Though the majority of the respondents did experience that they had acquired mathematical and technical competencies through the Master's programme and this is also stated in the Curriculum as a competence of the graduates. The Curriculum states that graduates in physics are capable of *'making use of IT as a tool for both information- and data-processing, and in other contexts where it is academically relevant, e.g. in developing numerical models and experiments'* (Faculty of Science, 2013, p. 4).

The mathematical and technical competencies are written as an essential part of the Curriculum which makes it for a constructive alignment that the respondents also experienced that they especially had gained these competencies.

The respondents expressed that they especially experienced to have acquired a knowledge about physics in general but also a more specialized knowledge within the subject. This knowledge, at both levels, is also described detailed in the Curriculum. But the respondents also described that they especially experienced that they had learned how to find and embrace new knowledge. In the Curriculum it does not clearly state this ability, it states that the graduate is capable of *'seeking out and summarising the latest knowledge within a particular subject area' (Faculty of Science, 2013, p. 3).* This statement does not exactly contain all the steps in the process of finding and embracing new knowledge as the respondents' described they were capable of. Based on an article by Felder and Brent (2004b) on the intellectual development of students the results imply the respondents were at a higher developmental level than what the Master's programme was teaching. Research on physics graduates have found that the ability to retrieve information was seen, by the employers of the physicists, as the most prominent competence of physicists (Sharma et al., 2008). This all suggest that the Master's programme could be more ambitious in regard to demands and ambitions

of to the students' abilities on finding and embracing knowledge since this ability seems to be a core competence within physics.

Overall it does not seem that the three competencies which the respondents especially experienced to have gained during the Master's programme are the main competencies written in the Master's programme. Mathematical and technical competencies were written in the Curriculum as well as having an extensive knowledge, but the analytical and logical thinking as well as the ability to find and embrace new knowledge were not as specified as the respondents had experienced them to be. It is interesting that the respondents especially experienced these competencies as their main competencies considering their importance in the Curriculum.

Competencies rarely mentioned in the open questions

While the three themes above were the most frequently described competencies by the respondents other competencies were only reported by few respondents or not reported at all. This is only expected since the respondents were asked to report the competencies they *especially* experienced having gained from the Master's programme. But these 'missing' competencies were interesting because they are essential for physicists (Etkina et al., 2006), described in the Curriculum or both. In the following section five of these competencies will be described.

'Having confidence in own competencies'-competence

In the open question a number of the respondents described a certain confidence within their abilities and a faith in knowing that they were able to solve any arbitrary problem. The respondents described how they approached new problems fearlessly because they felt confident with their knowledge and methods. But this confidence only applied to few respondents. Looking at the responses to question 44, see Figure 41, only 49% reported that they had faith in their own abilities and 39% of the respondents knew how to apply the theories and methods from physics to other problems within other fields than physics.

In the Curriculum it does not state anything about the graduates being confident in their abilities but it is written that graduates are capable of '*applying model solutions and methods of quantification in adjacent areas, e.g. biological, geological, chemical and economic systems*' (Faculty of Science, 2013, p. 3). Since the majority of the respondents described that they experienced to have strong mathematical and technical skills it seems a shame that only half of the respondents had faith in their abilities. And also since the respondents described that they experienced that the methods they had learned were such strong tools for problem solving it would be a gain for the respondents if they were able to apply their methods to other areas than physics. It is worth noting though that transfer of knowledge and skills is notoriously difficult to perform (Packer, 2001).
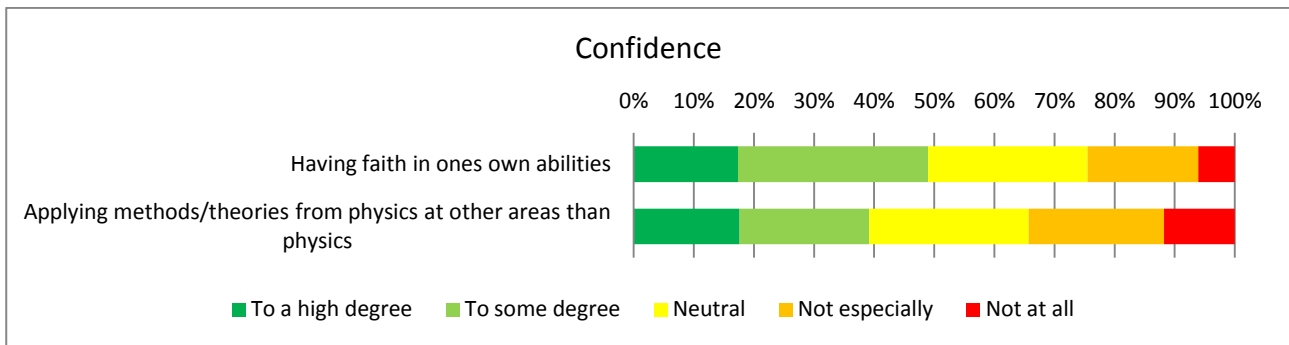
Figure 41
Question 43 and 44 'To which degree have you experienced to have the competence with you from the Master's programme?'

Communication

A couple of respondents reported communication and teaching as important competencies. The respondents described that they knew how to present research results to their supervisor, research group and other researchers. They felt confident both within written and oral communication of scientific subjects. This result is supported by the results of question 43; around 80% of the respondents experienced that they knew how to communicate expert knowledge on a scientific level both written and orally and in both Danish and English, see Figure 42. But although the respondents experienced to have good communicative skills only 32% of the respondents reported that they experienced that they were able to communicate expert knowledge to a layman, see Figure 42. In the Curriculum it is written *'One of the most importance competences for physicists is the ability to communicate an issue in plain language, on both a general and a scientific level, both orally and in writing'* (Faculty of Science, 2013, p. 3).

Few respondents described that they especially experienced having acquired communicative competencies during the Master's programme, implying that communication was not a competence in focus during the programme. The results in Figure 42 show that the respondents to a high degree experienced to have gained communicative skills, but only one third of the respondents experienced to be able to communicate to laymen. Due to the status of communication in the Curriculum, this result poses a challenge to the Master's programme to improve the communicative abilities of the students - both scientific but indeed also the general communicative competencies. Besides satisfying and complying the Curriculum, graduates and students who can communicate their interests and the importance of the discipline is essential to the recruitment of new students, obtaining public interest and research funding.
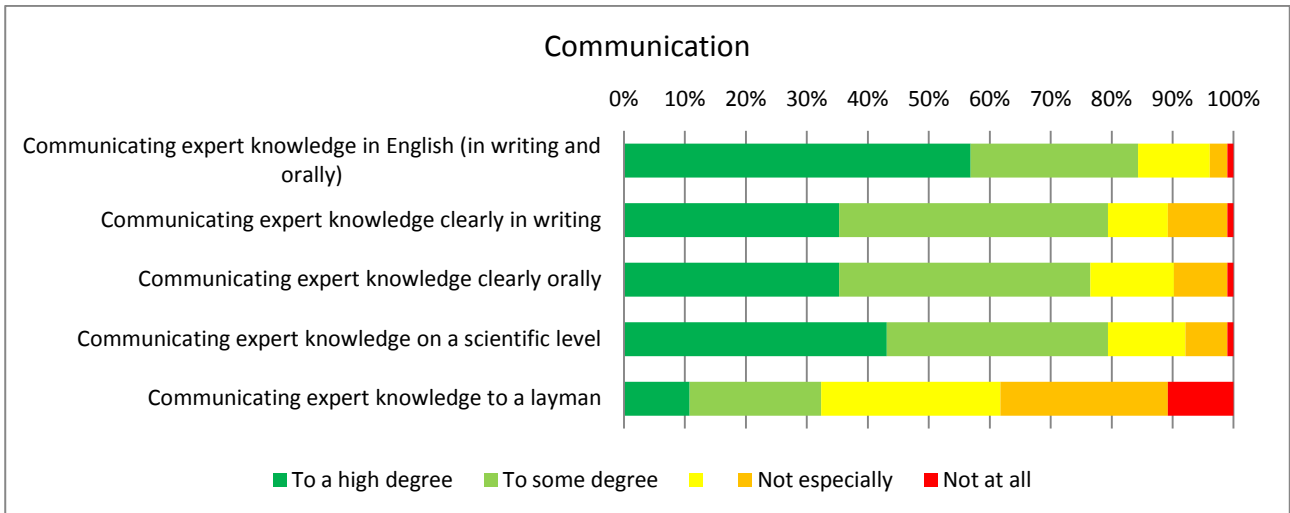
Independent projects rather than cooperation

In the open questions only few respondents mentioned cooperation and team work as competencies they experienced to have gained. Actually more respondents reported that they felt confident with independent work than with teamwork. When mentioned, cooperation was described in relation to members of research groups or in relation to research projects. The responses to question 43 and 44 support this result; only 50% of the respondents experienced that they knew how to participate in group work with all it involves and how to learn from a cooperation, see Figure 43. Only 31% reported that they knew how to engage in a cooperation with participants from different backgrounds than their own, 23% understood the norms and ways of working with others and 34% knew how to initiate a collaboration, see Figure 43. 39% understood their roles in a group in relation to what they could and had to contribute with. These numbers illustrate a group of respondents who did not experience that they knew how to collaborate and engage with people outside their field. This result is somewhat problematic since the ability to collaborate is essential both in research and in general as described in Section 2.2.

Processing data, but not producing it

Surprisingly few of the respondents reported that they had practical experience setting up experiments and make measurements in order to collect relevant data. Previously it was described how the respondents experienced to have learned how to process data and the respondents' descriptions were clearly concentrated on how to select and process data rather than on how to produce it. This observation is confirmed by the results of question 43; only 52% of the respondents reported that they knew how to set up an experiment to illustrate a problem, see Figure 44, while about 70% of the respondents reported that they knew how to describe an experiment as a physical system and how to extract relevant information from it. These results support that to some degree the respondents experienced that they had learned how to process data rather than how to produce it. In the Curriculum it is written that a graduate from physics is capable of *'organising measurements for studies of systems in which physical entities play a role' (Faculty of Science, 2013, p. 3).* The results suggest that the respondents did not experience that they had learned how to organize measurements in order to process data. This may invite the Master's programme to consider whether or not it should be incorporated into the programme to a higher degree from earlier on. While the respondents described how they experienced to be able to solve given problems theoretically and practically, the addition of learning how to produce data would, besides fulfilling the statements in the Curriculum, also give the student a competence within the entire process of solving a problem. This insight would not just improve the respondents' competencies when working with problems, but may also give the students and graduates the ability to independently find problems and understand how to shed light on them.

Figure 44
Question 43 'To which degree have you experienced to have the competence with you from the Master's programme?'

Evaluate method and results

In the open questions only few respondents described that they experienced to have learned how to evaluate their results, methods and theories. When the respondents were asked to evaluate which competencies they had acquired, between 60 and 70% of the respondents reported that they knew how to evaluate pros and cons of theories and methods, how to assess the credibility of results relative to the theories that had been used and how to critically discuss applied theories and methods in relation to their affect on a project, see Figure 45. So despite that the respondents did not experience that they especially had learned how to evaluate and discuss results, methods and theories the results show that the majority of the respondents actually did experience that they had gained the competencies to do so.

In the Curriculum it is not written that the graduates should be capable of evaluating results. It does though state that a graduate should be able to '*discussing the application of the subject's results in an industrial and social context*' (Faculty of Science, 2013, p. 3). To question 43, 62% of the respondents actually reported that they experienced to be able to conclude clearly and scientifically on results relative to related areas, see Figure 45, but just 29% of the respondents experienced to know how to evaluate methods and theories relative to other areas than physics, and only 16% knew how to discuss results in relation to related areas. In relation to the aim of the Curriculum these percentages are quite low. The results suggest that the respondents had a solid understanding of how to evaluate, discuss and conclude on results, methods and theories within the field of physics but were missing the abilities to relate this interdisciplinary. In regard to the aim of the Curriculum it would be worth considering to incorporate these competencies into what the students already are educated in. This would meet the aims of the Curriculum to a higher degree as well as making the field of physics relevant in other contexts than physics.

Figure 45
Question 43 'To which degree have you experienced to have the competence with you from the Master's programme?'

4.6 Transition to the labour market

In the following section the results on the respondents' experience of the transition to the labour market in the form of their first employment will be presented. This section describes how the respondents experienced the meeting with the labour market and the factors which seem to have influenced their transition.

In the introduction it was presented that the majority of the respondents found a job within six months, and that they experienced that it was easy to find a job which required their competencies. The respondents described the meeting with the labour market as a *learning* and *challenging* experience.

By analysing the results of the second part of the questionnaire (question 21-25) it is been shown that the experience of the transition depends on various variables from the type of employment and job experience to gender and qualification profile. These variables' effect on the transition will be described in the following.

4.6.1 Type of employment

66% of the respondents, who were employed in a PhD position as their first employment, experienced that it was *easy* or *very easy* to find a job that required their competencies, see Figure 46. Only 39% of the respondents who were employed in the labour market reported the same, while 32% of these respondents

reported that it was *difficult* or *very difficult*. An explanation for this difference may be found in the different ways the respondents found their job. While the respondents who were enrolled in a PhD programme primarily found their position via their Master's thesis supervisor and research group, the respondents who transitioned directly into the labour market primarily used the Internet, see Section 4.4.2. In addition to this, PhD positions are often quite specific about which candidate they want in regard to degree, background and skills, while positions posted from the labour market often are more broad and relevant for candidates with various backgrounds.
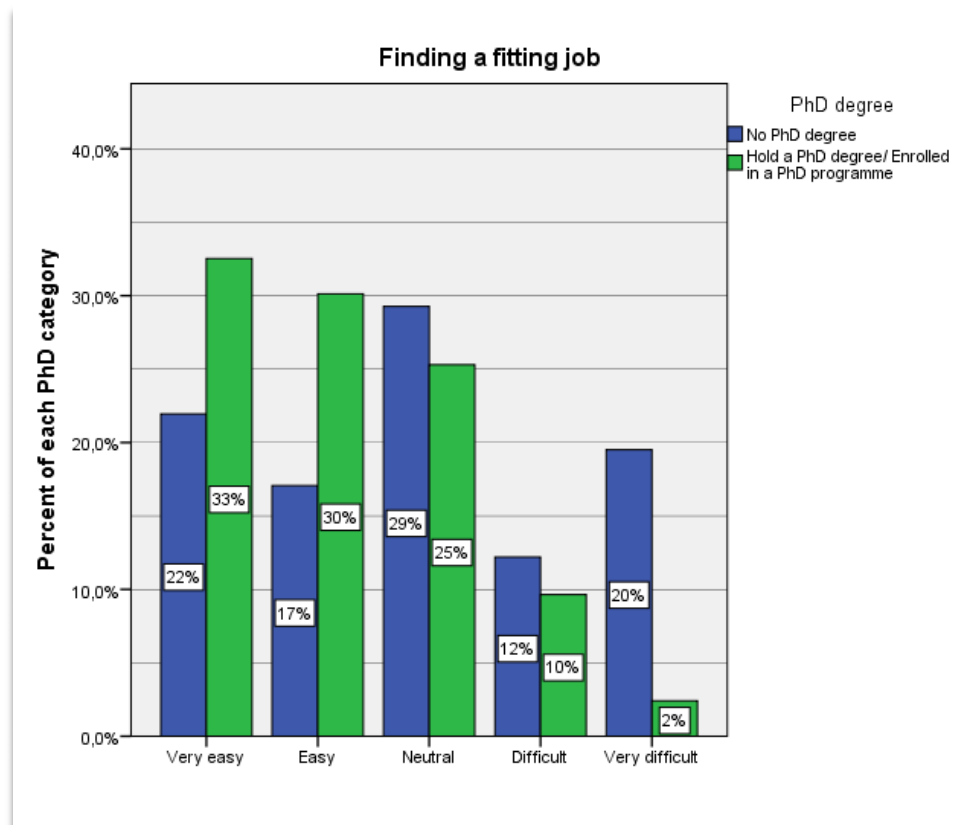
Figure 46
Question 23 'How did you experience trying to find a job which demanded your competencies?'

Figure 47 shows the words which the respondents chose as descriptive of their transition to the labour market. While the overall result is the same as the picture for all respondents, where *challenging* and *learning* stood out, there are some interesting differences between the respondents who were enrolled in a PhD programme and those who were not. The respondents who were enrolled in a PhD programme chose to a higher degree words such as *unproblematic, exciting* and *good* while the respondents who were in work chose the word *confusing*. Overall this result supports the result from Figure 46 that the transition to the first employment was easier for the respondents who became enrolled in a PhD programme than for the respondents going into the labour market. A part of this difference may be explained by the difference in academic coherence between the Master's programme and the respondents' jobs. Figure 48 shows the differences in academic coherence between the Master's programme and the respondents' jobs. 52% of the respondents who were enrolled in a PhD programme reported a *direct coherence* between their Master's thesis and their PhD programme. Only 15% of the respondents who were not enrolled in a PhD reported the same. Overall the figure shows that respondents who were employed in the labour market were

employed in jobs with less academic coherence than the respondents enrolled in a PhD programme. This result may not be surprising since the PhD programmes are a natural continuation of the Master's programme, while the jobs in the labour market are not necessarily as closely linked with the Master's programme. But it is still an interesting result since it seems to have had an influence on how the respondents experienced the transition to the labour market.
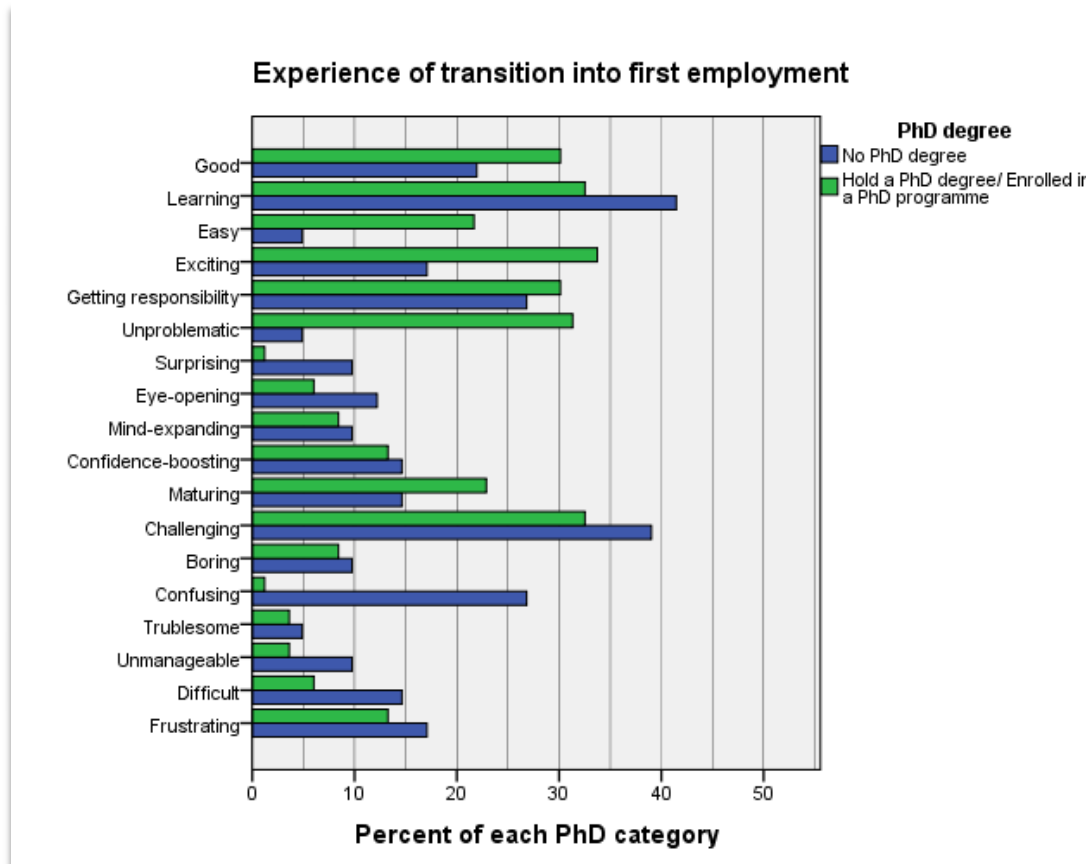
Figure 47
Question 24 'How did you, in general, experience the transition from university to the labour market based on your first job?'
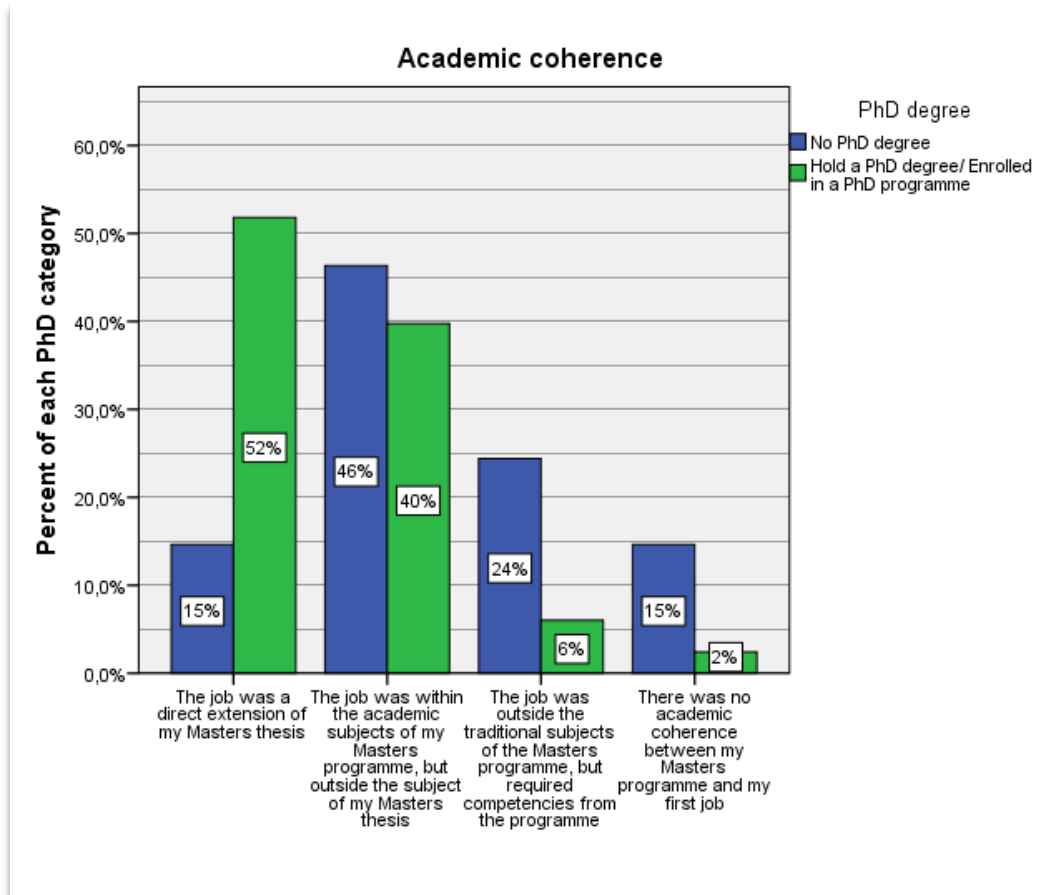
Figure 48
Question 25 'How was the academic coherence between your Master's programme and your first job?'

4.6.2 Student job or not

The results suggest that the respondents who had a student job during the Master's programme experienced an easier transition to the labour market than the respondents who did not have a student job. 58% of the respondents who had a student job found it *easy* or *very easy* to find a fitting job while 46% of the respondents who did not have a student job expressed the same, see Figure 49. 28% of the respondents who did not have a student job experienced it as *difficult* or *very difficult* to find a job that required their competencies. The relevance of the student job in regard to the Master's programme did not seem to especially have had an influence on how the respondents experienced the process of finding a job, see Figure 50. Although the majority of the respondents with a very relevant student job found it *very easy* to find a fitting job. The respondents who did not have a student job overall found it easier to find a fitting job than the respondents with a rather relevant student job.
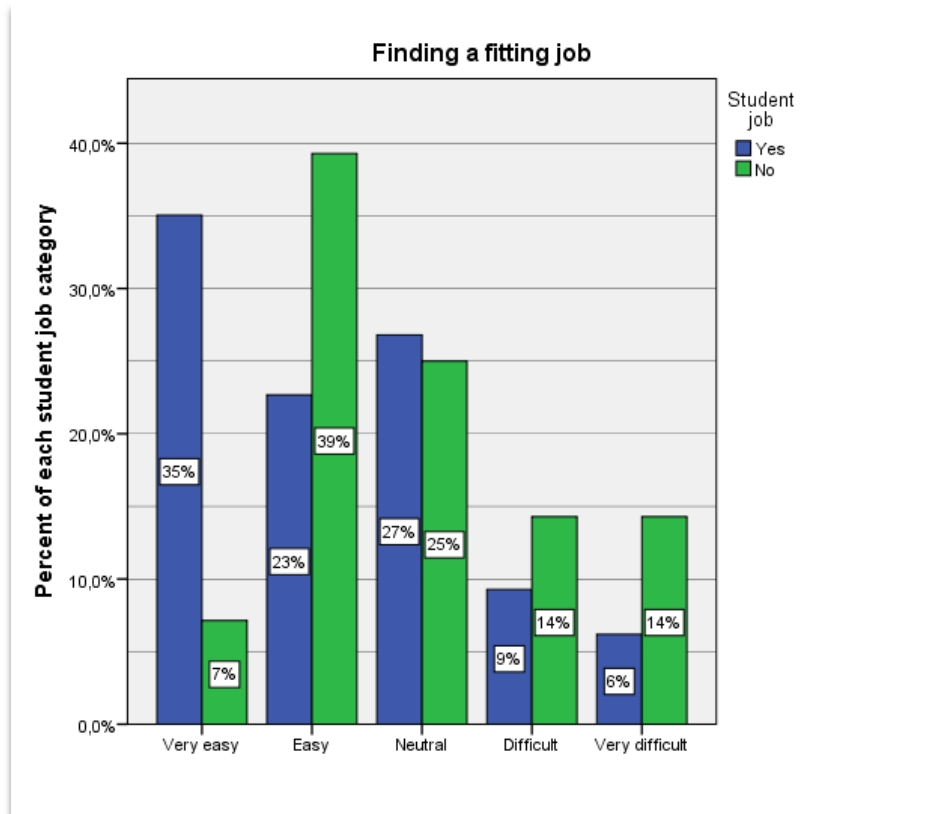
Figure 49
Question 23 'How did you experience trying to find a job which demanded your competencies?'
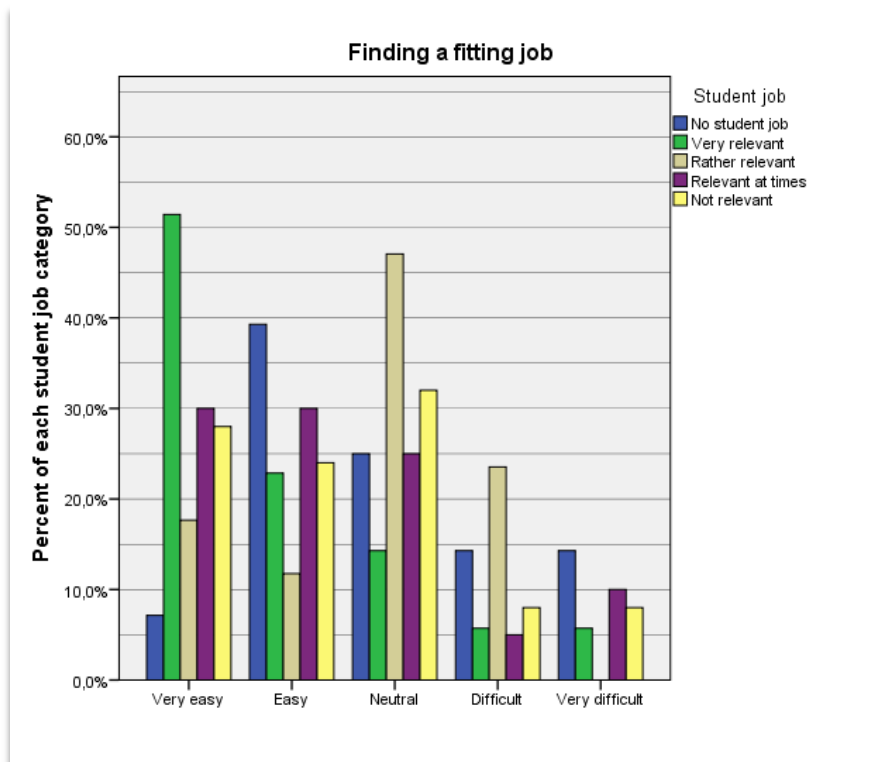
Figure 50
Question 23 'How did you experience trying to find a job which demanded your competencies?'

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Looking at the words which the respondents chose as descriptive of their transition to the labour market the respondents who did not have a student job especially chose the words *good, exciting, eye-opening* and *frustrating*, see Figure 51, compared to the respondents who had a student job who especially chose the words *easy, getting responsible* and *maturing*. The differences in the respondents' choice of words suggest that the respondents who did not have a student job experienced the transition to the labour market as an eye-opening experience where they for the first time got an insight into the labour market. While the words which the respondents with a student job chose indicate that they experienced the transition more as a process of taking on new tasks. One may suspect that the respondents with a student job found it easier to find a fitting job and experienced the transition easier because they were hired at the place where they were employed in their student job. But Figure 10 showed that only 3% of the respondents found their first employment through their student job. Instead an explanation may be that the student jobs gave the respondents experience and insight into the labour market, which became helpful when applying and talking to employers during the job search.
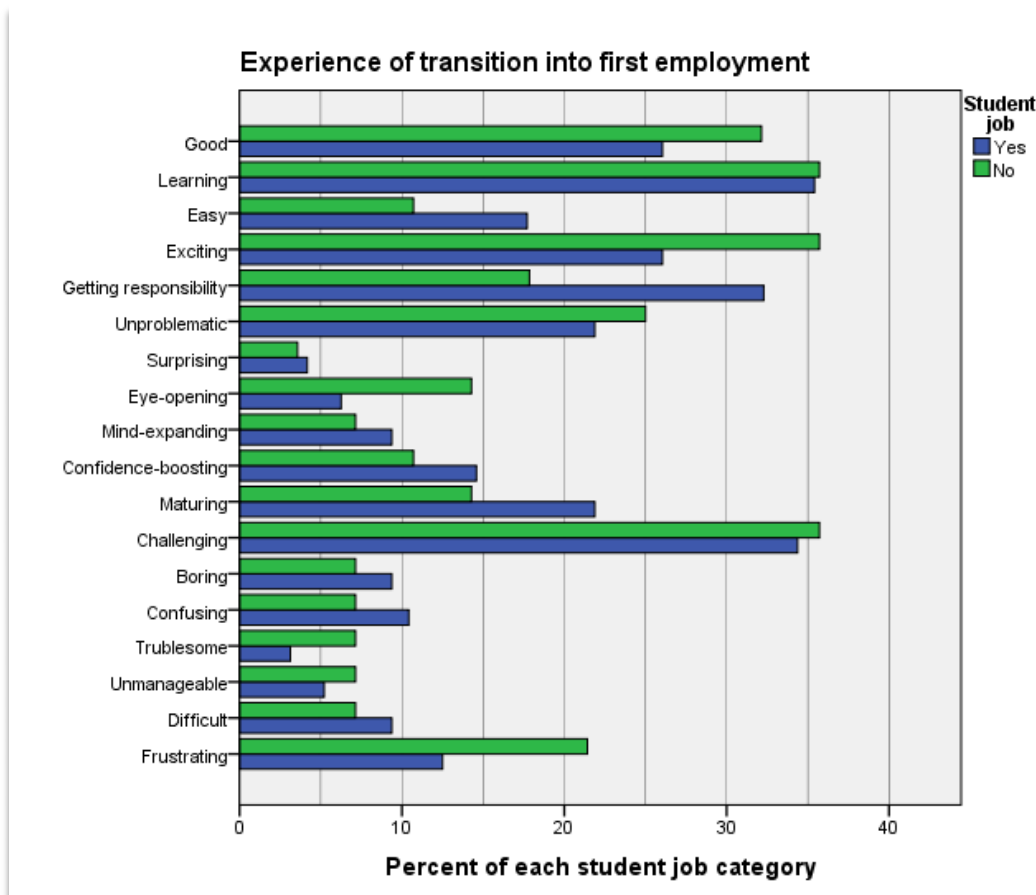
Figure 51
Question 24 'How did you, in general, experience the transition from university to the labour market based on your first job?'

4.6.3 Gender

While most of the respondents were employed in their first job within six months after graduation the female respondents on average used a couple of months more on finding their first job than the male respondents, see Figure 52. Quite a high percentage (46%) of the male respondents were employed right after graduation, compared to 30% of the female respondents. The female respondents reported that they

found it more difficult to find a job which required their competencies than the male respondents, see Figure 53. 59% of the male respondents reported that they found it *easy* or *very easy* to find a fitting job while 47% of the female respondents reported the same. 26% of the female respondents reported that they found it *difficult* or *very difficult* to find a job which required their competencies.
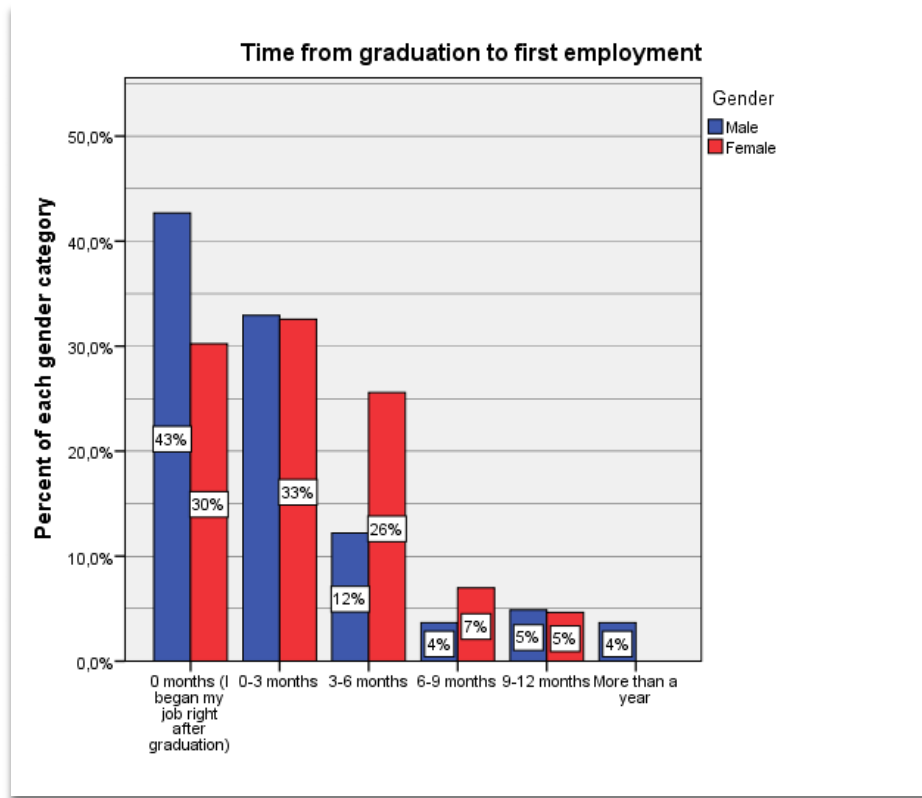
Figure 52
Question 22 'How long time went by from your graduation until you began your first job?'
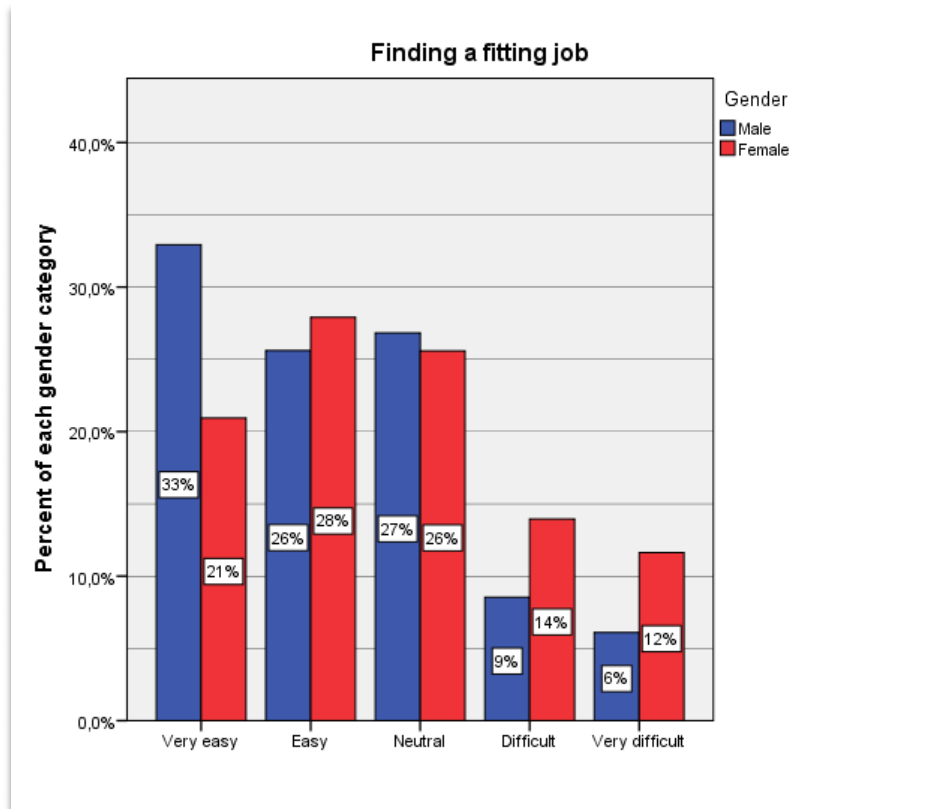
Figure 53
Question 23 'How did you experience trying to find a job which demanded your competencies?'

Figure 54 shows the words which the respondents chose as descriptive for their experienced of the transition to the labour market. The male respondents especially selected the words *good, exciting, maturing* and *confidence boosting* compared to the female respondents who especially chose *learning, getting responsible, challenging* and *mind-expanding*. These words suggest two different processes in the meeting with the labour market. While the male respondents expressed that it was a positive and confirming process the female respondents described a maturing and eye-opening process.

The difference in the male and female respondents' experiences may be a reflection of their different strategies as seen in Section 4.5.1, or it may reflect the circumstances around the jobs which the respondents applied for. In Section 4.5.1 it was shown that the female respondents were less aware of which competencies they had acquired from the Master's programme, despite the fact that they were quite determined and focused in their choices during the programme. This may explain why the female respondents found the transition to the first job more difficult since a low awareness of competencies could have made it difficult for the female students to convince an employer that they were qualified for a job. On the other hand the differences between the male and female respondents may be due to circumstances around the job they were applying for. In Section 4.4.1 it was shown that there was no difference in the gender distribution between who were employed in the labour market and who were employed in PhD position. But it may be that the female respondents in the labour market were applying for different jobs than the male respondents, that they became employed in different positions, or maybe the employers expected different things from the female respondents than the male respondents.
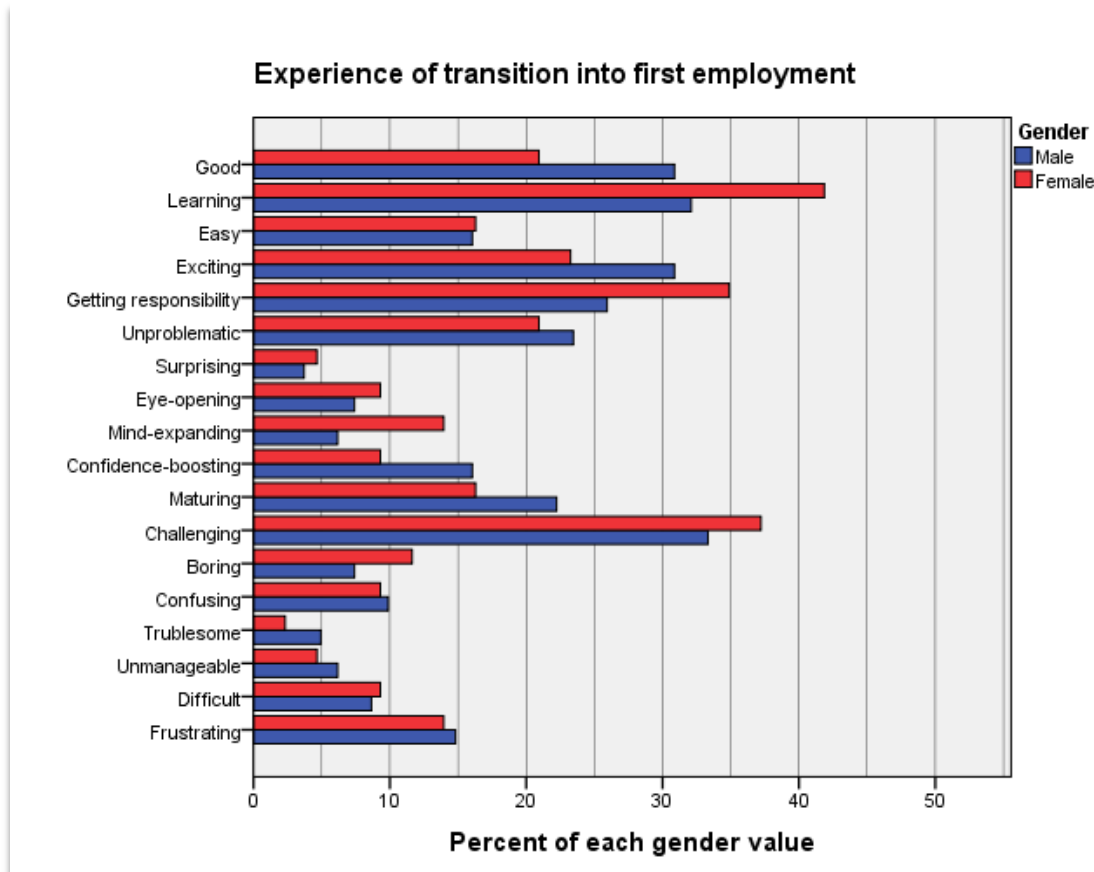
Figure 54

Question 24 'How did you, in general, experience the transition from university to the labour market based on your first job?'

4.6.4 Qualification profile

Looking at the respondents' experience of the transition to the labour market in regard to qualification profile the results suggest that depending on the qualification profile, some respondents found it more difficult than others to find a fitting job.

Figure 55 shows how the respondents experienced the process of finding their first job. Overall the majority of respondents within each qualification profile reported that they found it *easy* or *very easy* to find a job which required their competencies, but 37% of the respondents with a geophysical qualification profile reported that they found it *difficult* or *very difficult* to find a fitting job. This percentage is quite high. Looking at the words the geophysicists selected as descriptive for their transition, see Figure 56, it stands out that 27% of the geophysicists chose *difficult* and 23% chose *frustrating*, where around 5% and 15% of the other respondents respectively chose these words.

The results show that it did not take the geophysicists especially longer to find a job than for the other respondents, see Figure 57. Neither was the academic coherence higher for the other respondents than the geophysicists, see Figure 58. In the previous sections it was shown that the majority of the respondents with a geophysics profile went directly into the labour market and did not enrol in a PhD programme. And it was also shown that these respondents, during the Master's programme, found it more important to know their employment opportunities compared to the other respondents. A possible explanation for the difficulties, which the respondents with a geophysics profile experienced, could be that something in the content of the geophysics programme made it difficult to match the obtained competencies with the demands

of the labour market. In the open questions some respondents with a geophysical profile expressed that many courses within the geophysics programme were actually within climate physics, to some degree due to the prominent position of the Centre for Ice and Climate at the Niels Bohr Institute. The respondents experienced that they automatically became specialized within climate research when enrolling in geophysics. The respondents who did not continue into a PhD position within climate physics expressed that they experienced that it was difficult to find positions where skills, knowledge and competencies within climate research were applicable.

Despite what the cause is to the respondents' experience of the transition to the labour market, it is troubling that such a high percentage of the respondents with a geophysical profile found the transition more difficult than the other respondents. Since the Master's programme in geophysics primarily educates graduates to the labour market it would be interesting to investigate more specifically what the challenges are for this group.
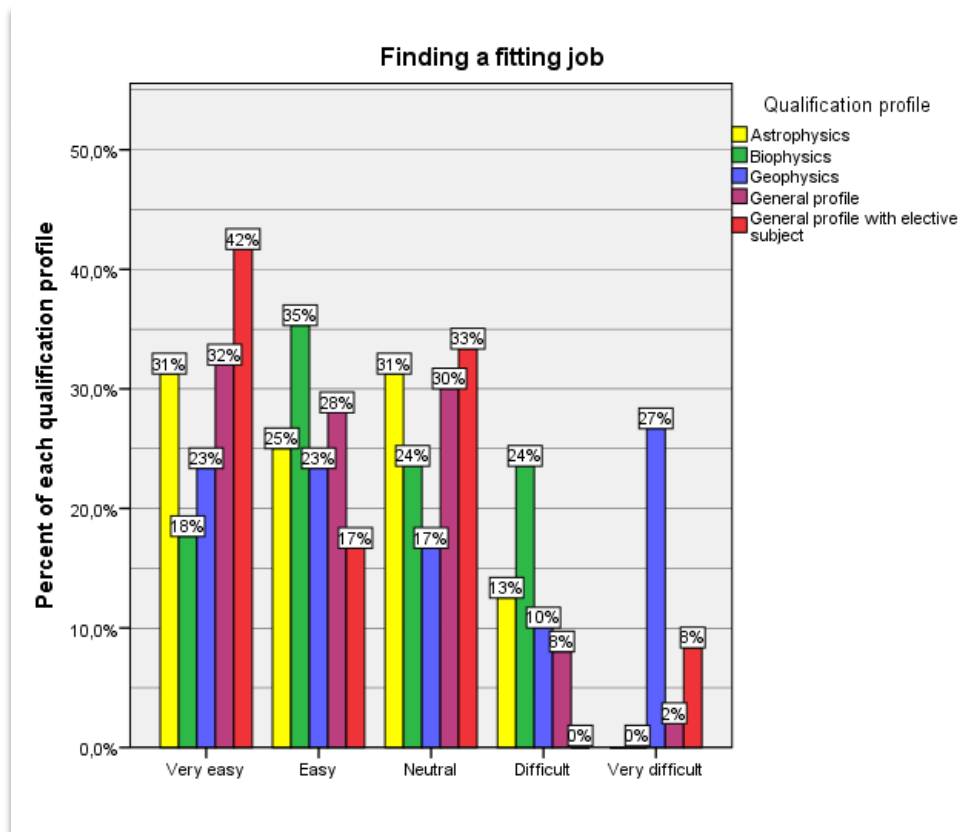
Figure 55
Question 23 'How did you experience trying to find a job which demanded your competencies?'
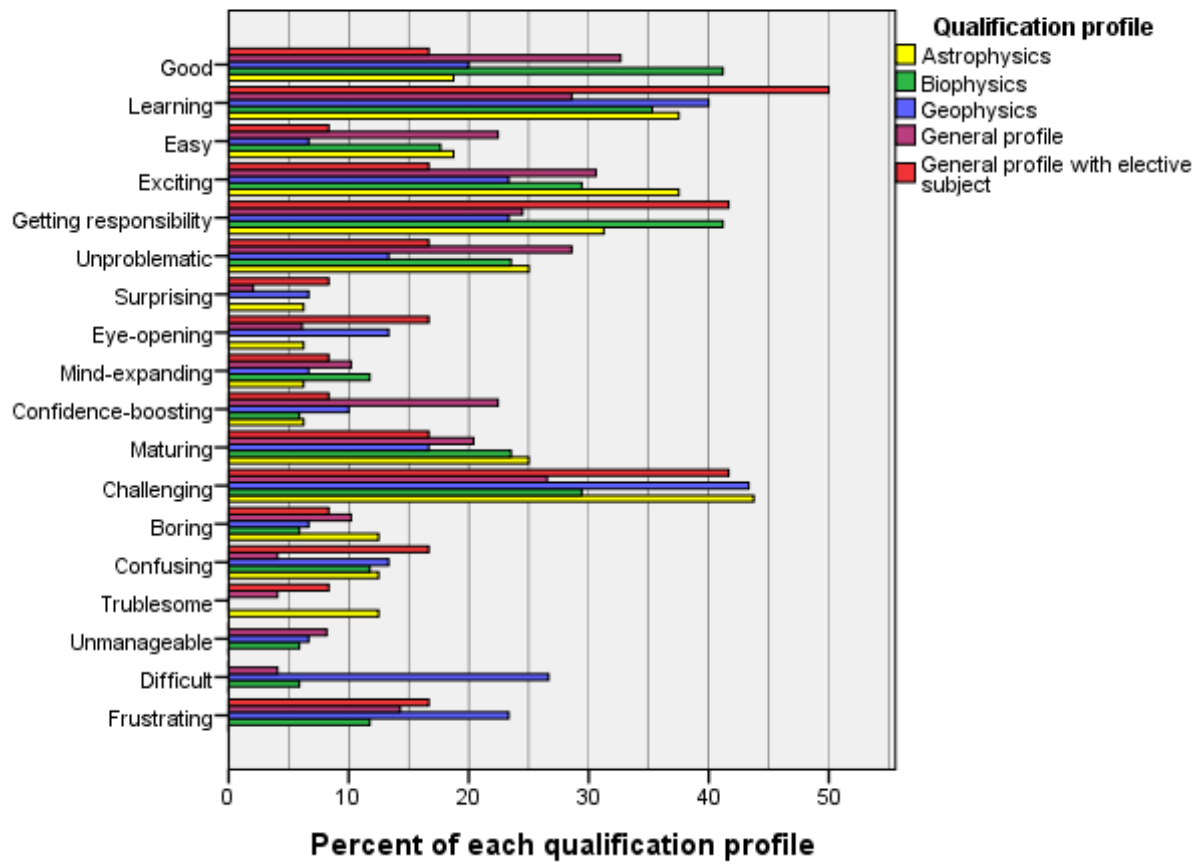
Figure 56
Question 24 'How did you, in general, experience the transition from university to the labour market based on your first job?'
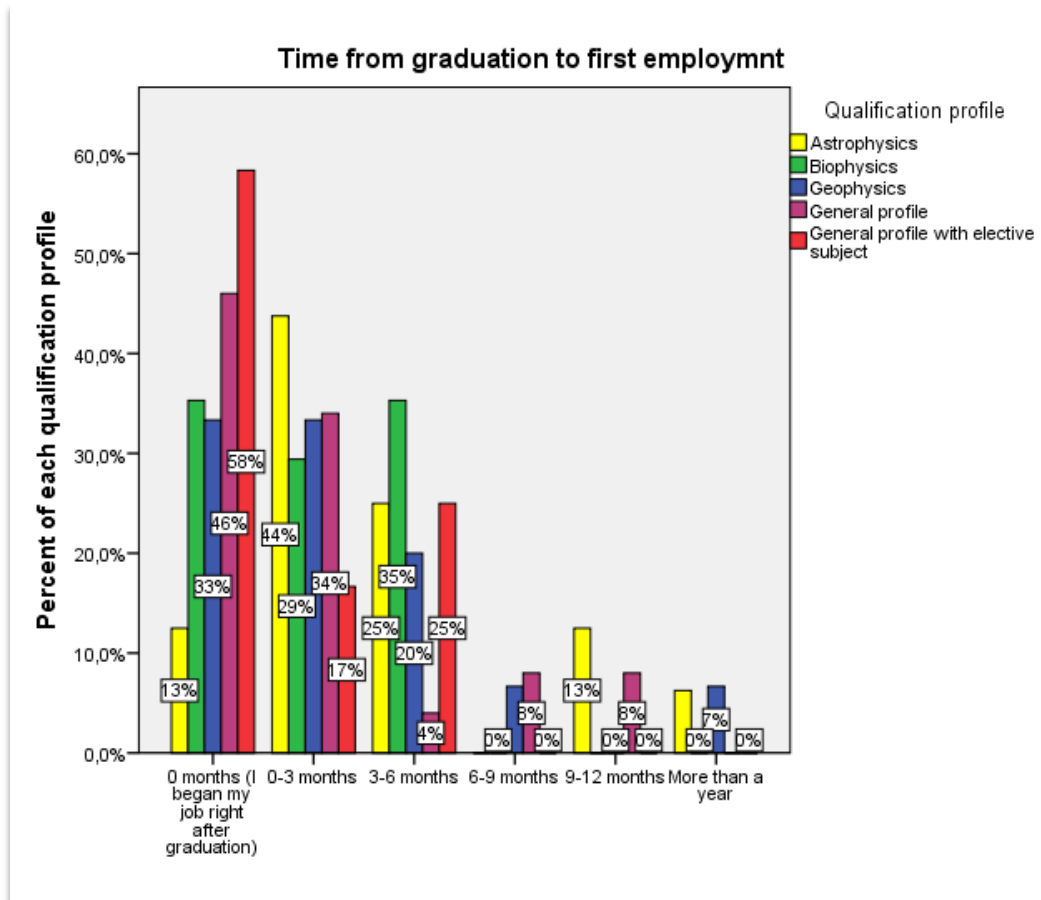
Figure 57
Question 22 'How long time went by from your graduation until you began your first job?'
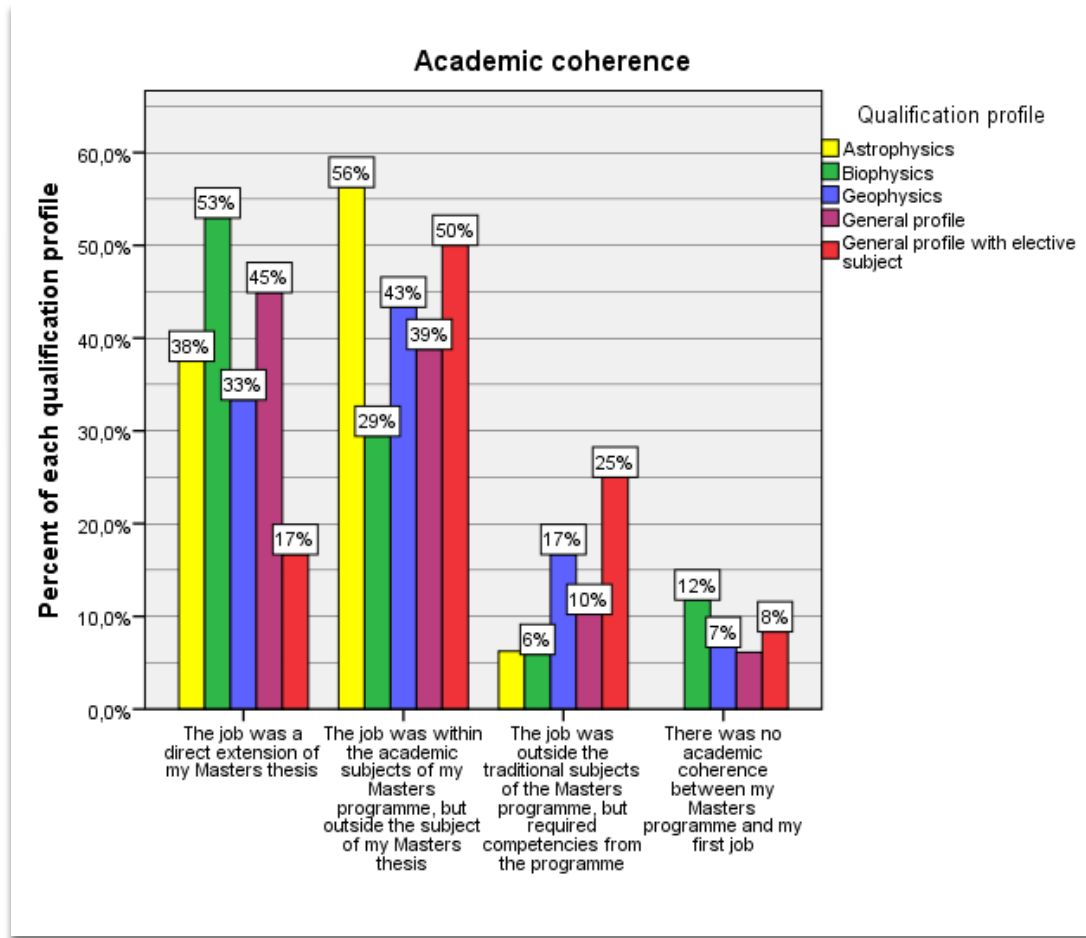
Figure 58
Question 25 'How was the academic coherence between your Master's programme and your first job?'

4.7 In work

In the following section the results on the content of the respondents' jobs will be presented. This section contains descriptions of the respondents' job functions, the competencies which the respondents experienced to apply in their jobs, how the respondents experienced to utilize their competencies in their jobs as well as the results on how well they experienced to be prepared for the labour market.

In the introduction it was presented that the majority of the respondents reported that at least half of the competencies which they applied in their job were competencies they experienced to have gained through the Master's programme. Most of the respondents though also reported that they had experienced a difference between what they could and what they had to do.

The results of the final part of the questionnaire (question 26-50) showed some clear differences between the content of the respondents' jobs, the competencies which the respondents had experienced to gain during the Master's programme and the competencies which they experienced to apply in their job. In the following sections these differences will be described. The questions in this section have been split in regard to the industries the respondents were employed in, and in regard to whether or not they were, or had been, enrolled in a PhD programme. This section presents the results of the respondents employed in

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the knowledge and education industries. Too few respondents were employed in the remaining industries to get a proper picture of the characteristics of the industries and will therefore not be presented.

4.7.1 Utilizing competencies

In Section 4.4.2 it was shown that the majority of the respondents reported that more than half of the competencies, knowledge and skills that they used in their job were abilities they experienced to have acquired during their Master's programme. Within the various employment types and industries of the respondents, there were variations though. Figure 59 shows that PhD positions were the job type which asked the respondents to use most of the competencies they had learned during the Master's programme. 80% reported that between 60-100% of their job consisted of competencies which they had acquired from the Master's programme. This may not be surprising due to the high academic coherence between the Master's programme and the respondents' PhD programmes, as described earlier. Not surprisingly the majority of these respondents (84%) also experienced that they, to a high degree, utilized what they had learned during the Master's programme, see Figure 60.

Within the respondents who were working in the knowledge industry (with a PhD degree) there was some variation in the applied percentages; about one third reported that 80-100% of what they used in their job were competencies from the Master's programme and one quarter having a job where less than 40% of the job required competencies learned during the Master's programme, see Figure 59. This spread could be explained by the various jobs which these respondents could had taken after their PhD. Some of these respondents have continued into Post Doc-positions, and have had the opportunity to apply a high percentage of what they had learned. Others may not have been employed in research and could therefore possibly have applied less of the competencies gained from the Master's programme. Despite the variation within the applied percentages between these respondents, the majority (88%) reported that they to some degree or to a high degree experienced that they utilized what they had learned during the Master's programme, see Figure 60. A reason for this may be that, although these respondents did not experience that they were asked to apply much of the competencies acquired during the programme, they were still able to apply their competencies and therefore reported that they experienced that they utilized their competencies.

The majority of the respondents who were working in the knowledge industry (no PhD degree) reported that 40-80% of the competencies they applied in their job were competencies they had acquired during the Master's programme, see Figure 59. In accordance with this, the majority of these respondents (76%) reported that, *to some degree* or *to a high degree* they experienced that they utilized their competencies, see Figure 60. But 25% of these respondents also reported that they *did not especially* or *not at all* experience that they utilized their competencies. Although these respondents 'only' were able to apply their competencies from physics in 40-80% of their job it is interesting that these respondents experienced that they utilized the competencies to such a low degree.

The respondents who were employed in the education industry had the jobs which requested the smallest use of the competencies learned from the Master's programme, as compared to the other respondents. Even though the majority of this group had jobs of which 40-60% consisted of competencies learned in the Master's programme. These respondents may not have felt that they were able to apply the majority of their knowledge and competencies from the Master's programme in their jobs or maybe their jobs required that they applied other competencies than those they had learned. The majority of these respondents

though, did though experience that they utilized the competencies which they had acquired during the Master's programme.
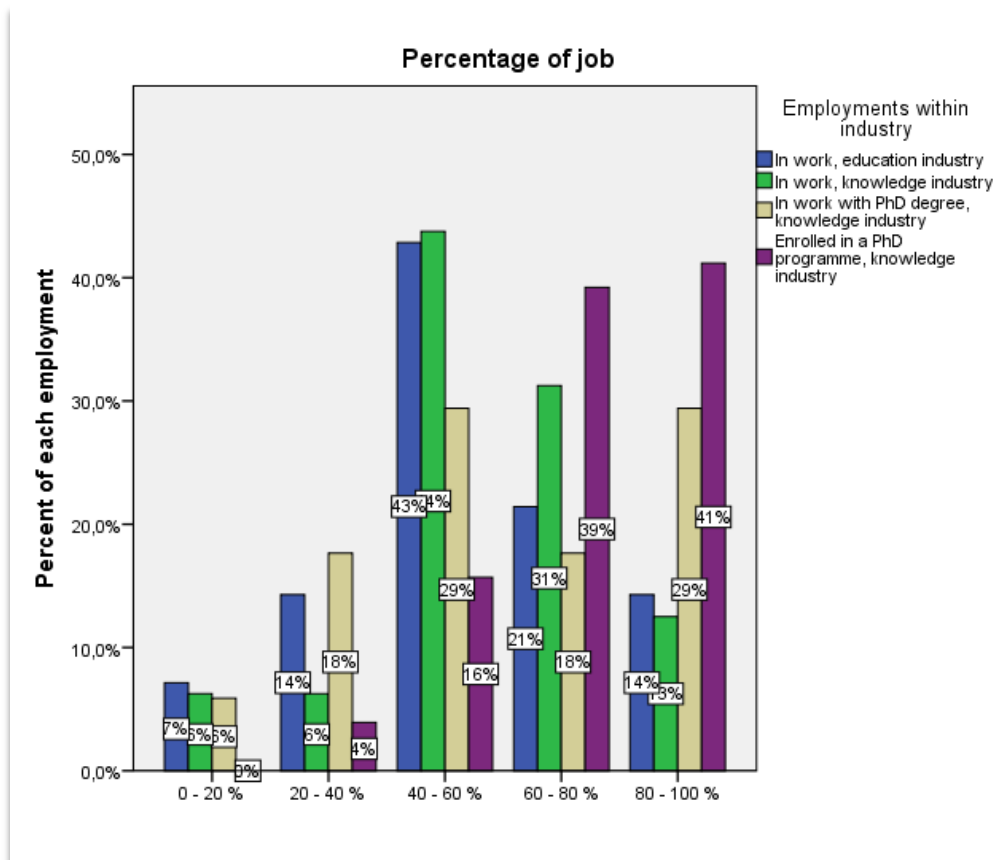
Figure 59
Question 50 'How big a percentage of what you use in your job have you acquired through your education in physics relative to how big a percentage you have acquired in other places? Choose how big a percentage you have acquired through your physics education.'
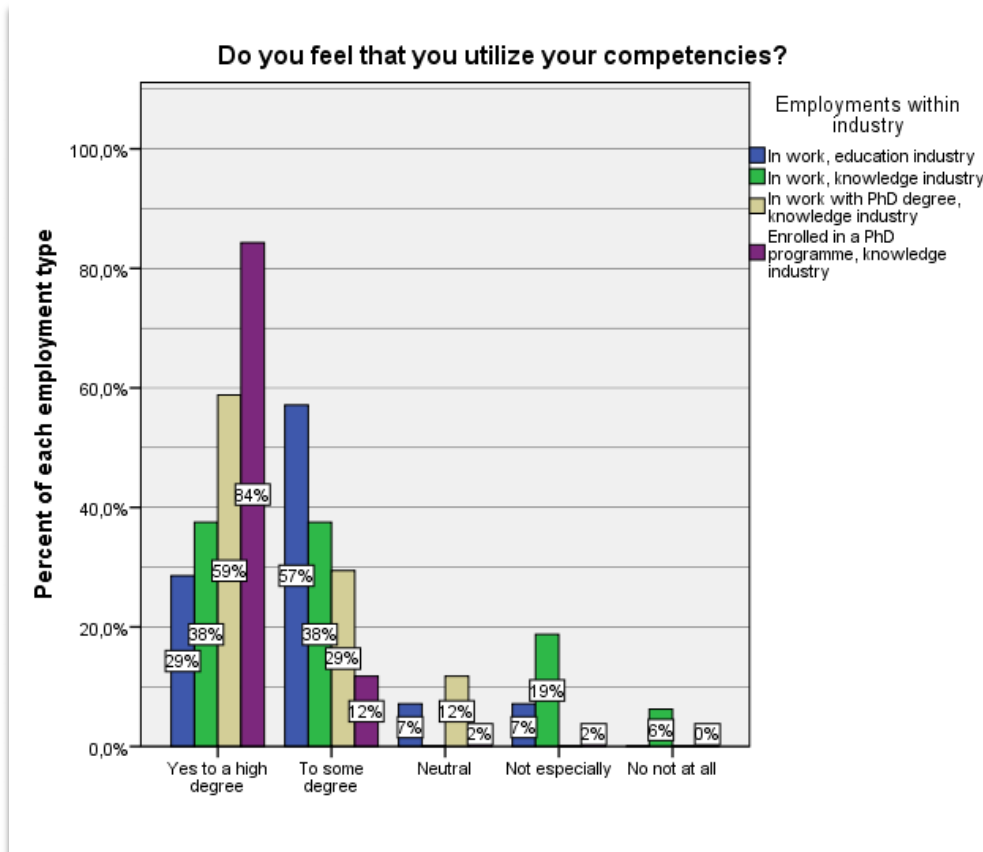
Figure 60
Question 48 'Do you feel that you utilize your competencies from the Master's programme in your current/most recent job?'

The differences between the employment types in regard to how big a part of their job that requested competencies gained from the Master's programme and the degree to which they experienced to utilize their competencies may either reflect the applicability of the competencies from the Master's programme to the demands of the labour market, or it could reflect the respondents' ability to apply their competencies in the labour market.

4.7.2 The respondents' primary job functions

While the majority of the respondents reported *basic research*, *teaching* and *communication* as their three primary job functions, as shown in Section 4.4.2, the results have shown some clear differences between the job functions of the respondents who worked within research and the respondents who did not.

In the following the job functions of the respondents within the two represented industries and employment types will be presented.

Job functions in the education industry

The job functions of the respondents in the education industry are shown in Figure 61 (top). The respondents reported that 59% of their job was t*eaching* and 25% was c*ommunication*. This makes good sense since these respondents were employed at schools where teaching and communicating science to students were the main job tasks.

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Respondents in the education industry, in work

Job functions
- Teaching
- Analysis and evaluation tasks
- Project management
- Corporate governance
- Production
- HR/personnel administration
- Sales/marketing/advertisement
- Customer-and citizenservices
- Personnel management
- Finance and accounting functions
- Political work
- Basic research
- Communication
- Product development
- Applied research
- IT-service functions
- Counselling
- Administration
- Documentation (quality assurance)

Respondents in the knowledge industry, in work

Figure 61
Question 39 'What is your primary job functions in your current/most recent job? Choose three options.'

Job functions in the knowledge industry

The job functions in knowledge industry were split in regard to the three present employment types (enrolled in a PhD programme, in work with and without a PhD degree). The results are shown in Figure 61 and Figure 62.

The respondents in work (without a PhD degree) reported that their primary job functions were a*nalysis and evaluation tasks* (22%) and a*pplied research* (15%), see Figure 61 (bottom). Even though their jobs also consisted of many other job functions. Since these respondents were employed in various jobs, from museum presenters to bank analysts, the variety in job functions could be a result of a heterogeneous group which would not give a clear picture of the respondents' job functions.

The respondents who were enrolled in a PhD programme reported that their job primarily consisted of *basic research* (38%), *teaching* (24%) and *communication* (18%) as their primary job functions, see Figure 62 (top). These three job functions clearly reflect the main tasks of the PhD programmes, which consist of research projects, mandatory teaching, and the production of articles where research results must be communicated to others.

The respondents who were in work (with a PhD degree) reported that they primarily did *basic research* (31%), and a*pplied research* (20%) in their jobs, see Figure 62 (bottom). This employment category consisted of both respondents working at the universities (researchers), as well as respondents who worked outside the university. This means that the reported job functions are expressions of the primary job functions of a 'combined' group. One could guess that *basic research* was a main job function of the respondents who worked as researchers while *applied research* was the main function of the respondents who had continued into a job in the labour market based on their PhD study.

Overall, we see that the job functions of the respondents who were in work (education and knowledge industry) were quite different from the job functions of the respondents enrolled in a PhD programme and the respondents holding a PhD degree. The respondents who were employed in the education industry did not do any research while the other respondents to a high degree did either basic research or applied research. All of the respondents did to some degree use teaching and/or communication in their job but probably at different levels and with different purposes.

The variations in job functions in regard to industry and employment type show how many different jobs the Master's programme educates physicists to. This variation poses a challenge for the programme, as the programme must be able to provide the students with competencies that can be applied in all of these different jobs.

Respondents in the knowledge industry, enrolled in a PhD programme

Job functions
- Teaching
- Analysis and evaluation tasks
- Project management
- Corporate governance
- Production
- HR/personnel administration
- Sales/marketing/advertisement
- Customer-and citizenservices
- Personnel management
- Finance and accounting functions
- Political work
- Basic research
- Communication
- Product development
- Applied research
- IT-service functions
- Counseling
- Administration
- Documentation (quality assurance)

Respondents in the knowlege industry, in work (with a PhD degree)
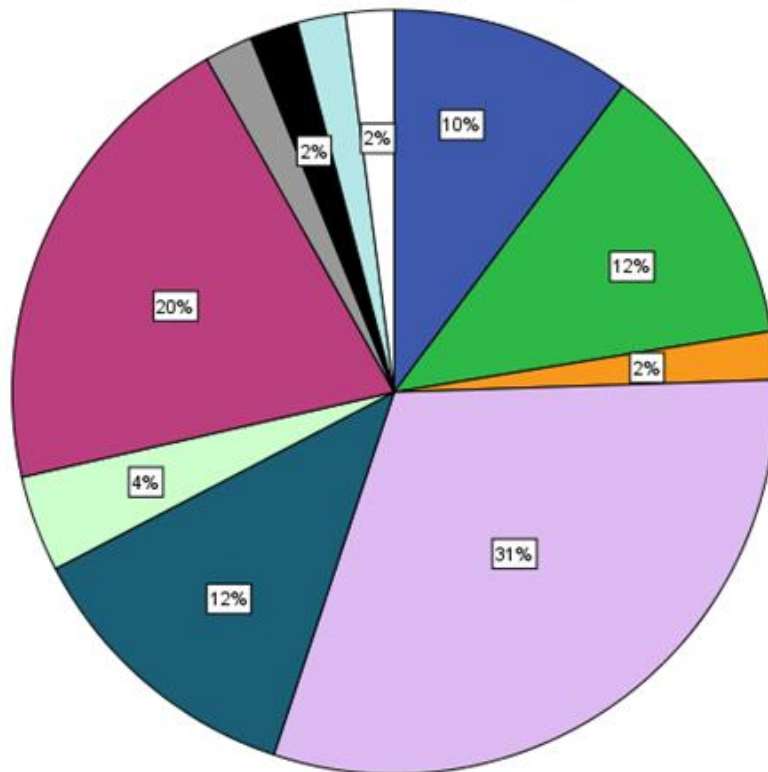
Figure 62
Question 39 'What is your primary job functions in your current/most recent job? Choose three options.'

4.7.3 Competencies applied in the labour market

To understand which competencies the respondents experienced that they had to use in their job, they were asked to freely describe the three competencies that they especially experienced to use in their current job. The respondents' answers are visualized in Figure 63. In the word cloud, in Figure 63, the largest words are; *programming*, *communication* and *physics*. This suggests that especially programming and communication played a big role in the respondents' job. Physics was mentioned several times as an indication that the respondents were working with or within the field of physics.

Figure 63
Question 42 'Which competencies do you especially experience using in your current/most recent job? Describe the three that are most important to you.'

The respondents were also asked to freely describe the differences which they had experienced between what they experienced that they *could* and what they *had to do* in their current job. The answers to the question are visualized in Figure 64. In the word cloud statistics, projects, knowledge and IT are the largest words. These words are interesting since IT, statistics and knowledge were mentioned as key words in the competencies which the respondents experienced to have gained from the Master's programme. Projects on the other hand were not mentioned in those descriptions.

Figure 64
Question 46 'What differences between what you can and have to do in your recent/most current job have you especially experienced?'

To get a more in-depth picture of the competencies which the respondents experienced to use, the responses to the open questions 42 and 46 were analysed. This analysis showed that the respondents in some ways did apply the competencies which they experienced to have gained from the Master's programme but it also showed that they were asked to apply competencies which they did not experience to have learned.

In the following section the competencies, which the respondents described they experienced to have used in their jobs, will be presented. The differences between the competencies the respondents experienced to have acquired through the Master's programme and the competencies which they experienced to use in their job, will be presented as well.

In addition to the open questions the respondents were asked to look at two lists of competencies and evaluate to which extend they experienced to be asked to use the listed competencies in their job (question 43 and 44). The response to the lists and the results of the analysis of the open questions will be presented in the following section.

Competencies from the Master's programme used in the labour market

The three main competencies (*Problem solving by logical and analytical thinking, Mathematical and technical skills* and *A solid ballast within physics and the ability to embrace new knowledge*) described in Section 4.5.3 reappeared in the respondents descriptions of the competencies they experienced to use in their job. The reappearance of these three competencies indicates that the respondents were able to apply the main competencies, that they had experienced to have gained through the Master's programme, in the labour market. Though there were variations in their use of the competencies relative to the descriptions of how they learned to use them.

The majority of the respondents described that they experienced to have acquired analytical and logical thinking during the Master's programme. While the respondents also described that they experienced that they had to apply analytical and logical thinking in their job, it was though not as prominent as in the descriptions of the competencies gained from the Master's programme. The descriptions about the competencies used in the job revolved more about how to work with and manage a problem systematically rather than solving the problem as a system of variables as described in Section 4.5.3.

Mathematical and technical skills were described as one of the main competencies gained from the Master's programme and the majority of the respondents also described that they applied these skills to a high degree in the labour market. This was also reflected in Figure 63 where the word *programming* was distinct. The word 'IT' though stood out in Figure 64 implying that the respondents experienced that there was a difference between what they could, and what they had to do within IT in their job. In the descriptions quite a few respondents reported that they would had liked to be better at programming and had more experience with it. When the respondents were asked if they had experienced to lack knowledge within any subjects almost 30% of the respondents reported that they *to some degree* or *to a high degree* had experienced to lack knowledge about *IT* and *statistics*, see Figure 65. The respondents described how they experienced that they had to teach themselves many of the programming skills which they had used during the Master's programme and in their job. The respondents especially described that they had to program in other languages than they had learned. Within each qualification programme the respondents described that they had been specialized in one specific language for example the astrophysicists learned IDL while the geophysicists learned MATLAB. This left the respondents in a position where they had to learn a new language when they became employed. One might argue that knowing one programming language makes

it easier to learn a new programming language. Even though, it may be worth for the Master's programme to consider if the students should be introduced or learn more languages than the one which are taught within the specific qualification profile.

A majority of the respondents described that they had to do statistics in their job, and therefore the word stood out in Figure 64. But a majority of the respondents also described that they did not feel equipped for it and lacked knowledge about how statistics should be applied, causing the word to stand out in Figure 65. The respondents described that they did not feel that there was enough focus on statistical methods during the Master's programme and that they experienced that their job required the use of statistical methods. This result is quite a clear feedback to the Master's programme to considering if statistics in some way could and should be incorporated better into the education. This would not only meet the demands of the labour market but it would also make the students stronger in evaluating data and results,

Overall the results indicate that the respondents experienced that they used mathematical and technical skills in a large part of their jobs. Although the majority of the respondents reported that mathematical and technical skills were some of the main competencies which they had gained from the Master's programme the results suggests that the Master's programme could consider if these competencies could be tuned and focused in order to fit the needs of the graduates to a higher degree.

A number of respondents described that they experienced to lack knowledge about subjects relevant in their new job or that they had lacked detailed knowledge about subjects taught in the Master's pro-gramme. Nearly 20% of the respondents reported that they *to a high degree,* or *to some degree,* had experienced that they lacked knowledge within subjects within and outside physics, see Figure 65. In the open question 41 the respondents described that they had experienced to lack knowledge about specific subjects within physics such as particle physics, x-ray physics, and mathematics, but also subjects within chemistry, biology, geology, and medical issues. Despite this, the respondents described how they were able to make up for their limited knowledge by using their abilities to find and embrace new knowledge. While the Master's programme cannot be held responsible for teaching students all subjects relevant and related to physics it is positive that the respondents experienced that they were able to use the ability to find new knowledge and thereby find the needed knowledge by themselves. This underlines the importance of these competencies and their relevance for graduates.
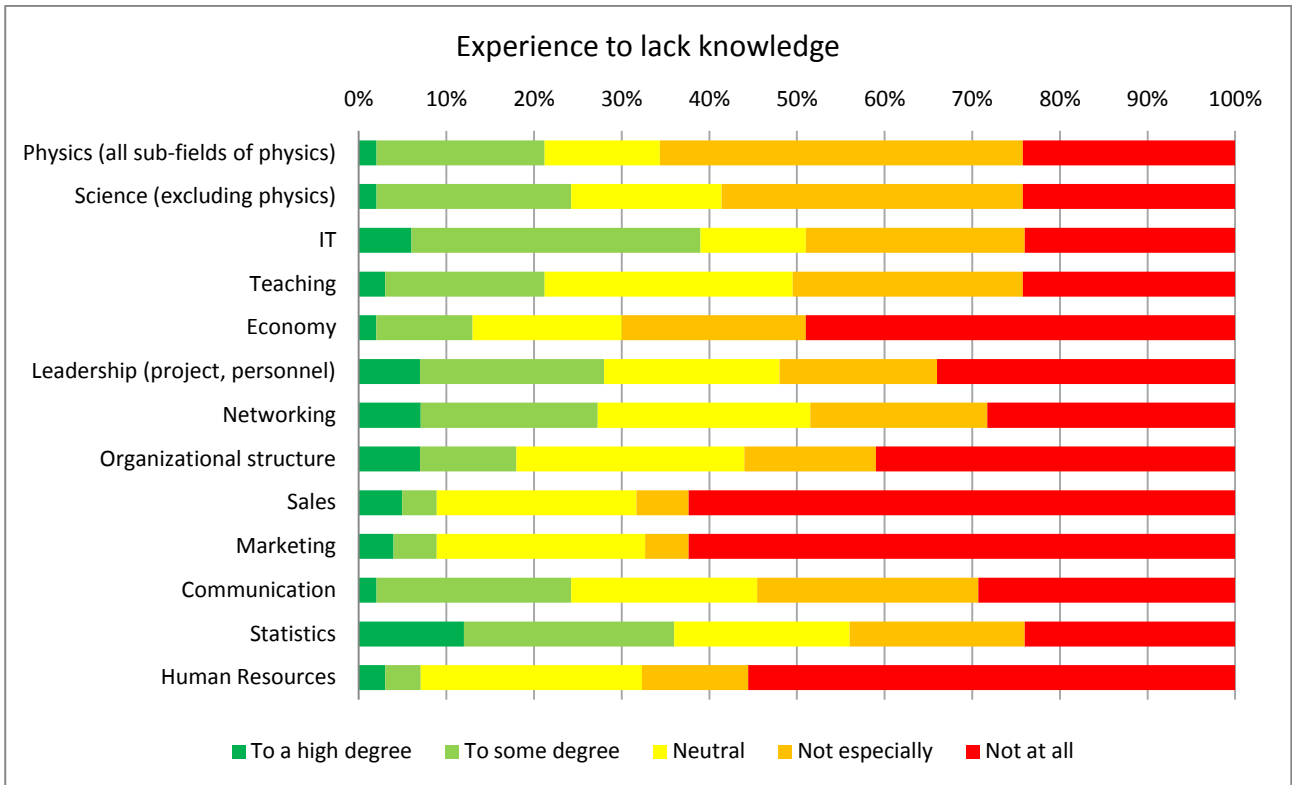
Figure 65
Question 40 'To how high a degree, have you experienced that you lack knowledge within the areas listed below, in your current/most recent job?'

Working with projects

The word cloud in Figure 64 showed that projects were mentioned frequently by the respondents in their descriptions. In the open questions the respondents described that they experienced that much of their work consisted of projects but they did not experience that they had learned how to make projects during the education. Asides from the Master's thesis, and the Bachelor's project, they had not had any training in the process of making projects. The respondents described how their jobs asked for them to plan, organize, prioritize and lead projects but that they did not feel equipped for these tasks. Overall the respondents reported that they did not experience that they knew how to execute projects, and lacked experience with the whole process. On question 43 and 44, 88% of the respondents reported that they had to plan longer projects in their job, see Figure 66, while only 36% reported that they experienced that they had learned how to do so during the Master's programme. Even though the results imply that it is not a problem of dedication or focus throughout the project because 89% of the respondents reported that they knew how immerse themselves in longer projects, see Figure 66, and 65% of the respondents were able to focus on all parts of a project, the interesting as well as the boring, see figure 44.
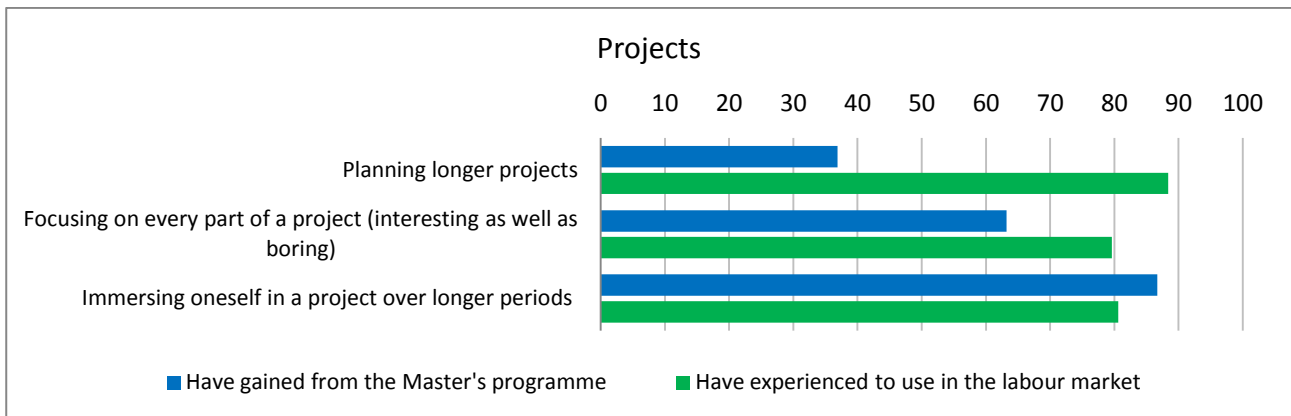
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Overall, the results suggest that the respondents' challenges with projects were concentrated on how to execute and manage the projects, and not especially about being a part of the projects. The result that the majority of the respondents reported project work as an essential part of their job and did not experience to have the competencies to execute a project is a feedback to the Master's programme to consider if project work could be incorporated into the Master's programme to a larger extend. Another possibility could be to articulate the phases and steps of producing a project in order to make the students become more conscious about the process they go through when they write their Bachelor's, and Master's thesis.

Broader communication competencies

In Section 4.7.2 it was presented that the majority of the respondents reported that communication and teaching were some of their main job functions. While few respondents in the open questions described communication as a competence they experienced to have gained from the Master's programme, many of the respondents described that they were asked to use various communicative competencies in their job. The respondents described that in their job they had to communicate using various media (conferences, articles, teaching, funding applications), communicate with different people (physicists, supervisors, experts, students, colleagues and laymen), communicate various subjects and topics (physics, research results, survey documentation) and communicate in specific ways (diplomatically, in English, written, orally). 25% of the respondents reported that they experienced that they lacked knowledge about communication, see Figure 65. On question 43 and 44, only 32% of the respondents reported that they knew how to communicate expert knowledge to laymen while 61% of the respondents reported that they were asked to communicate expert knowledge to laymen in their current job, see Figure 67. This difference is quite large and emphasize the need for the Master's programme to consider how communication, especially the broader communicative competencies, could be incorporated in the study programme to a larger extend.
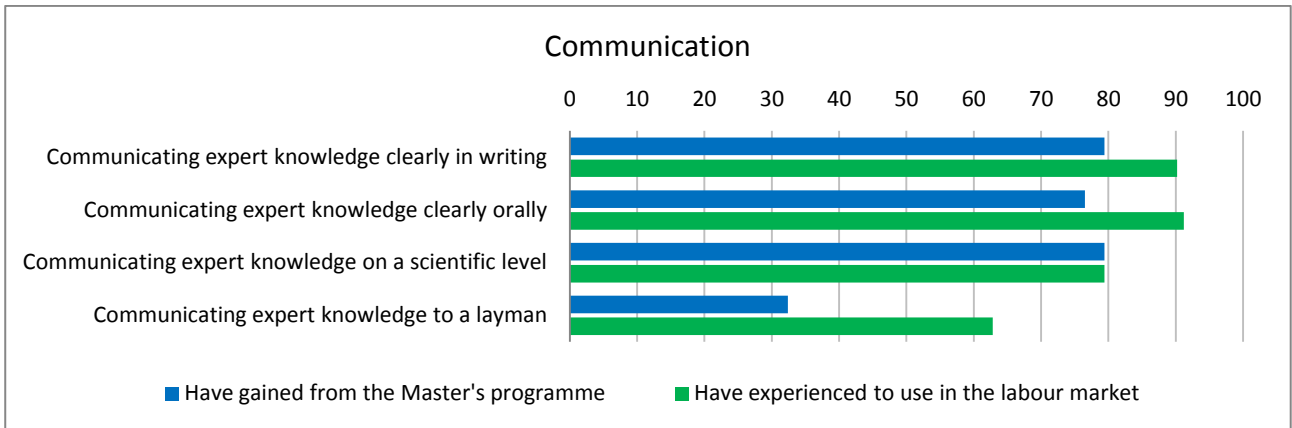
Figure 67
Question 43 and 44 'To which degree have you experienced to have the competence with you from the Master's pro-
gramme/experience to use the competence in your current/most recent job?'
The categories 'To a high degree' and 'To some degree' have been merged in the figure.

From working independently to working with social competencies

In the open question, question 20, respondents described that during the Master's programme they had learned how to work independently. However, only few respondents experienced that they had acquired social competencies in regard to collaboration and teamwork. In the open question, question 42, the respondents described that they experienced that they had to apply various aspects of social competencies in their job. This included networking, team work, cooperating about projects, organising collaborations between larger groups of researchers and interaction with colleagues, work partners, and students. A number of respondents wrote that they had to use pedagogy and empathy in their job.

The gap in social competencies seen in open descriptions is also reflected in the results of question 43 and 44; less than 50% of the respondents reported that they knew how to collaborate with others, while more than 65% of the respondents reported that they had to work in collaborations, see Figure 68. All listed competencies concerning collaborations showed a big gap between what the respondents experienced that they could, and what they had to do, see Figure 68. This is except for the competence *Feeling safe when participating in social activities* which the majority of the respondents reported that they had acquired during the programme. 23% of the respondents also reported that they in their job experienced that they lacked knowledge about how to network, Figure 65.

The results clearly show that the respondents, in addition to projects, experienced that cooperation was a much more applied way to work in the labour market than what they had experienced during the Master's programme. In the Curriculum it is written '*Graduates are also trained to work with others, both by playing an active role within research teams and by working closely with fellow students*' (Faculty of Science, 2013, p. 3) and thus the Curriculum does aim for the graduates to be able to work with others. The Master's programme may consider if team work should be incorporated into the programme to a higher degree. Not just to fulfil the aims of the Curriculum but also because the ability to collaborate and network, as previously described is one of the most important competencies of the knowledge society of today.
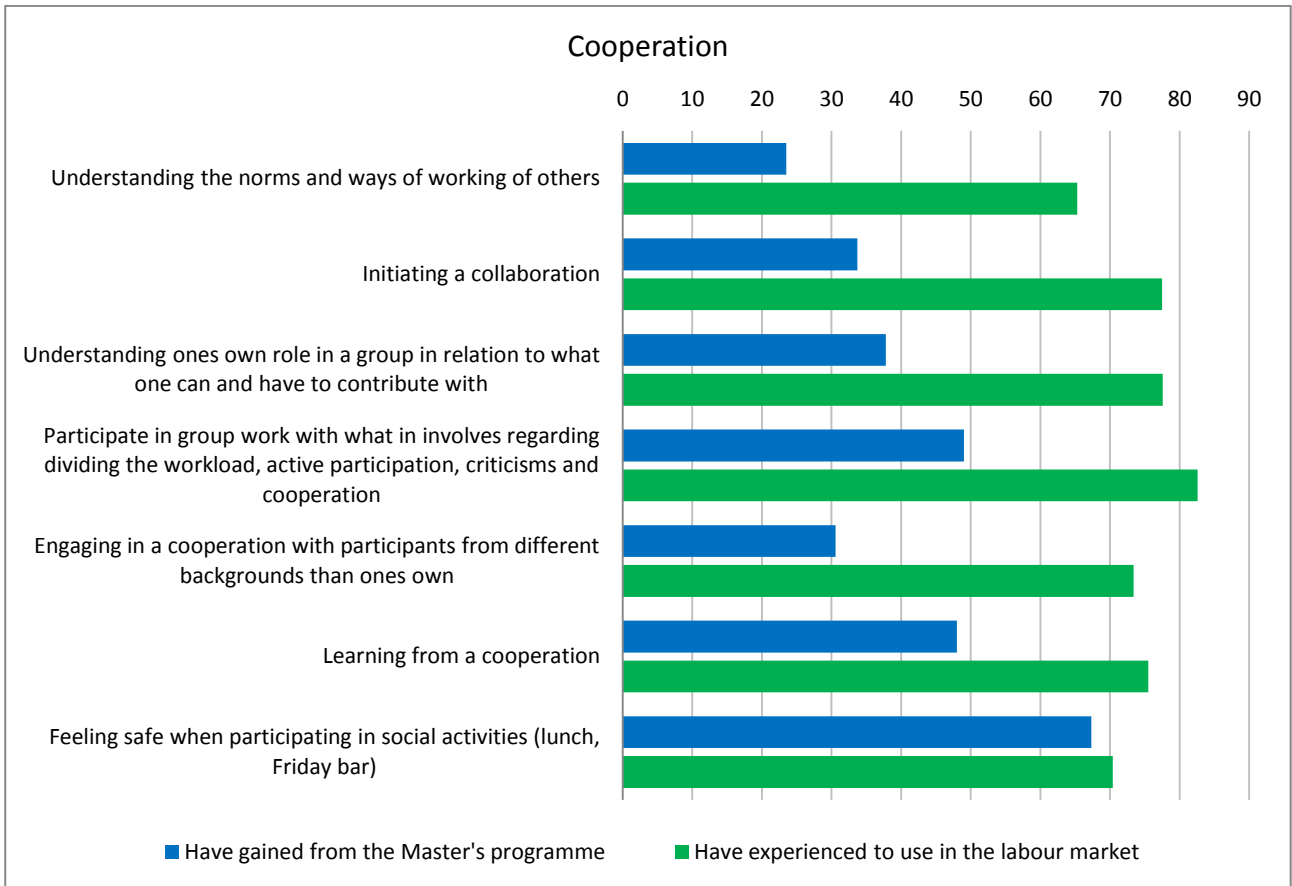
Figure 68
Question 43 and 44 'To which degree have you experienced to have the competence with you from the Master's programme/experience to use the competence in your current/most recent job?'
The categories 'To a high degree' and 'To some degree' have been merged in the figure.

4.7.4 Can do and have to do

In the previous sections we saw indications of differences between what the respondents experienced to have learned in the Master's programme and what they experienced they had to do in their jobs. In Section 4.4.2 we saw that a small majority of the respondents reported that they had experienced that there was a difference between what they capable after graduating and what they had to do in their jobs.

Looking at how big a difference the respondents experienced, depending on their employment type and industry, it is seen that 39% of the respondents who were enrolled in a PhD programme reported that they did *not especially* or *not at all* experience a difference, see Figure 69, while 43% of these respondents reported that they *to some degree* or *to a high degree* experienced a difference. Although almost as many of these respondents experienced a difference, as respondents who did not experience a difference, it is still worth noting that quite a big group of the respondents enrolled in a PhD programme experienced a difference.

The majority of the respondents working in the education industry reported that they *did not especially* or *not at all* experience a difference between what they could and what they had to do. This is quite surprising since we previously saw that there was quite a difference between the communicative competencies which the respondents had acquired during the Master's programme, and the ones they experienced they were asked to apply in their job. Since the primary job functions of these respondents were communication and teaching one would expect that they would have experienced this difference. The fact that these respon-

dents did not experience a difference may be explained by the fact that most respondents who worked in the education industry had taken the relevant courses during their Master's programme and therefore had been directly prepared for the job as a teacher. The respondents may not see teaching and communication as competencies that they experienced to have gained from the Master's programme and therefore they did not describe them in the open question, question 20. This may also explain why these respondents reported that they only applied half of what they had learned in their Master's programme, see Section 4.7.1. The majority of the respondents who were employed in the knowledge industry (56%) *to some degree* experienced a difference between what they could and what they had to do. This may be explained by the previously described challenges for this group based on their various job functions.

The majority (47%) of the respondents employed in the knowledge industry (with a PhD degree) reported that they *to some degree* experienced a difference between what they could and what they had to do while 24% of these respondents reported that they did not at all experience a difference. 24% is quite a high percentage which may be because some of these respondents had continued working within the same subjects in their PhD as with their Master's thesis, and therefore they did not experience the difference as pronounced.
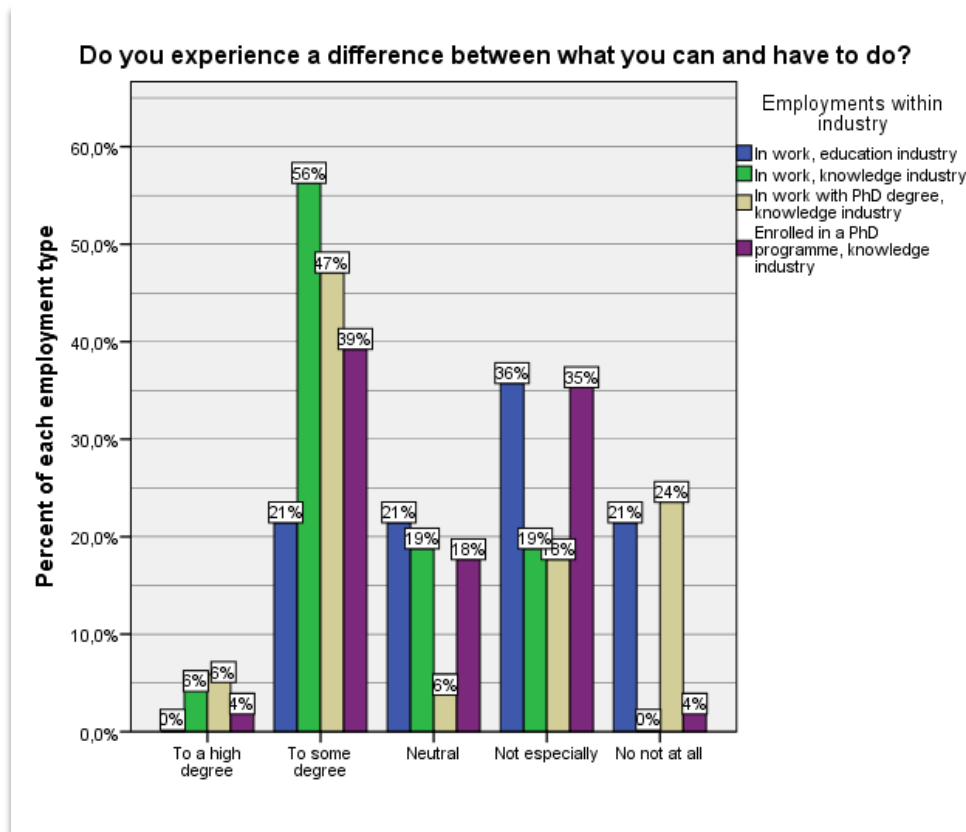
Figure 69
Question 45 'Do you experience that there is a difference between what you can and what you have to do in your current/most recent job?'

Despite the overall tendency of the respondents to experience a difference between what they could and what they had to do, the majority of the respondents who did experience a difference, did *not especially* or *not at all* experienced it as a pronounced problem, see Figure 70. 27% of the respondents who experienced a difference *to some degree* or *to a high degree,* did experience it as a pronounced problem. Out of all the

respondents 13% had experienced a difference between what they *could* and what they *had to do* and experienced it as a pronouced problem.
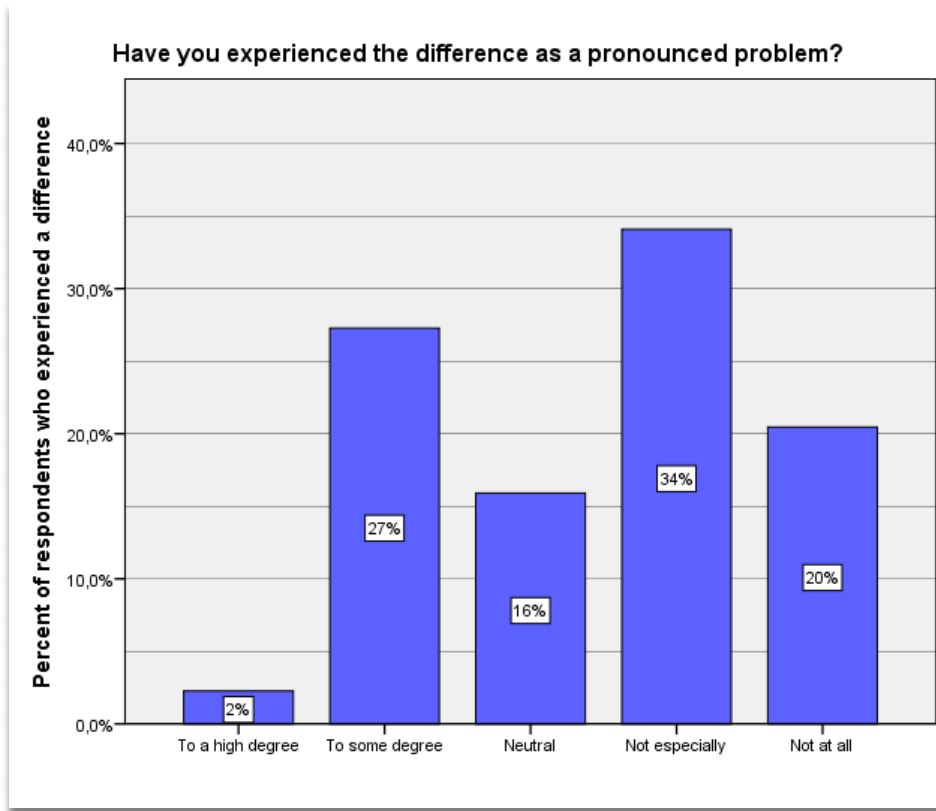
Figure 70
Question 47 'Have you experienced that the fact that there is a difference between what you can and have to do in your current/most recent job as a pronounced problem?'

While there will always be a difference between what the graduates can and what they have to do, simply because an education is not the same as the labour market, it is still worth considering how big a difference there should be between the two. The question, though, is if and what the Master's programme can do in order to make the difference between what graduates can and what they have to do smaller. The differencies in competencies previously described could be a possible focus area.

4.7.5 Did the respondents feel prepared for the labour market?

Based on the results shown in the previous sections the next step is to ask if the respondents felt equipped for the labour market. In Section 4.4.2 it was shown that the majority of the respondents felt that the Master's programme had prepared them well for the labour market.

Figure 71 shows how the respondents felt prepared for the labour market split in regard to employment type and industry. While the majority of the respondents enrolled in a PhD programme, the respondents employed in the knowledge industry with a PhD degree and the respondents employed in the education industry reported that they felt *well* or *very well prepared* for the labour market the respondents employed in the knowledge industry seem to be the respondents who overall felt least prepared for the labour market. While 29% experienced that they felt *well prepared* 25% reported that they did *not feel well prepared*. Quite a high percentage of these respondents reported *neutral* (31%). These results may be explained by

earlier results which showed that these respondents had various job functions leading them to experience the greatest difference between what they could and what they had to do out of all the respondents and thereby also feeling less prepared for the labour market.
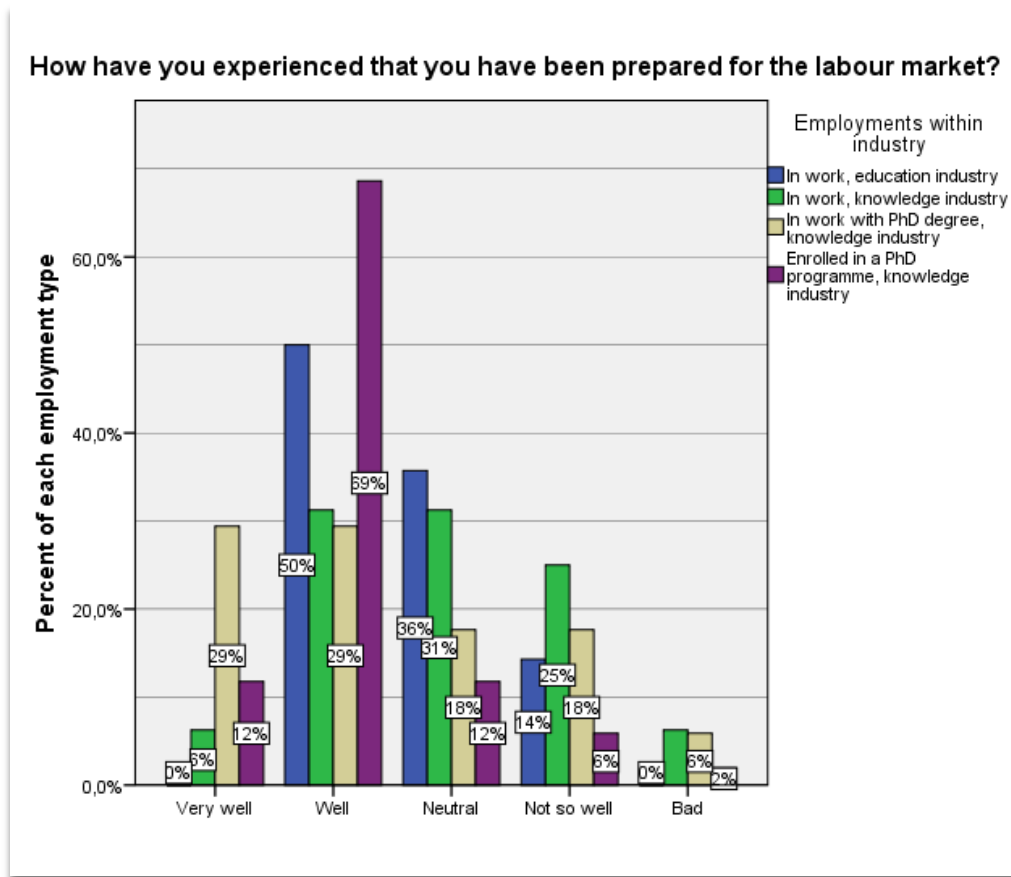
Figure 71
Question 57 'How have you in general experienced that your Master's programme have prepared you for the labour market?'

Figure 72 shows that there was a difference between the male and female respondents in regard to how well prepared they felt for the labour market. Although the majority of each gender felt *well prepared* for the labour market, the female respondents felt less prepared, overall, than the male respondents, with almost 25% of the female respondents reporting that they did not feel that the Master's programme had prepared them well for the labour market. The reasons for this difference could be many. In relation to the results of Section 4.5.1 this may be the result of the different approaches the respondents had to their education. The female students may either actually have been less well prepared for the labour market because the education did not create a culture in which there was room for the strategies of the female students. Or they may have become more aware, than the male respondents, of what differences there were between the competencies they had acquired during the Master's programme and the competencies they used in their job causing them to feel less prepared for the labour market.

Overall, this result, together with the earlier results on gender, suggest that gender is a topic worth considering for the Master's programme.
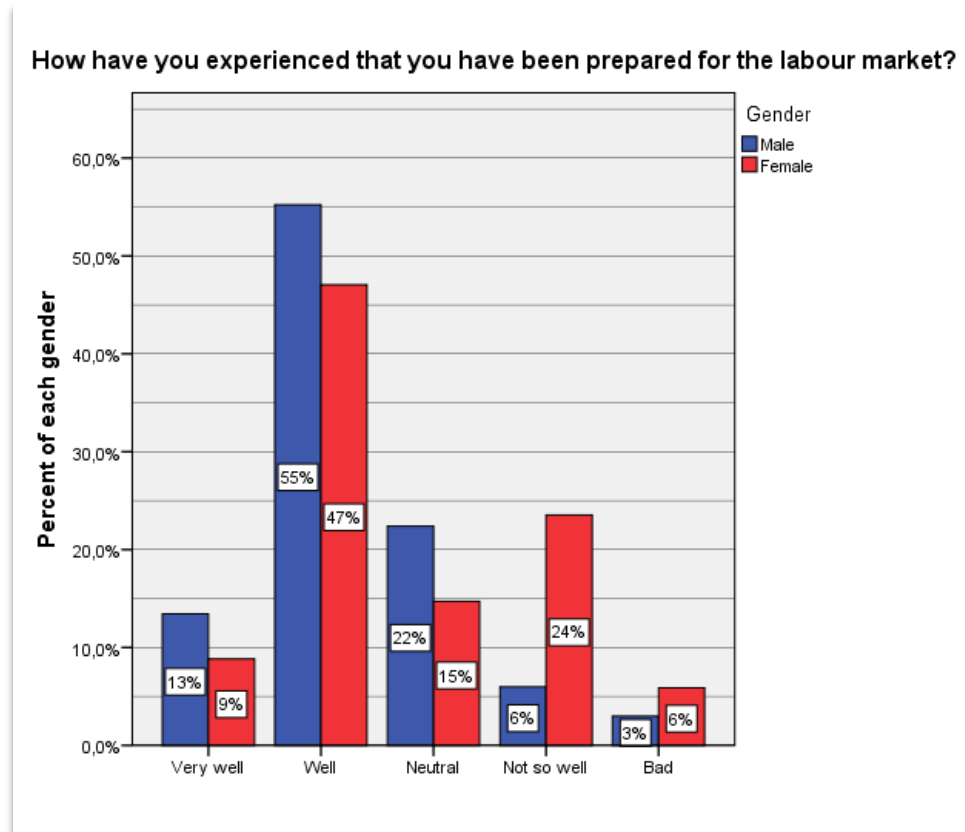
Figure 72
Question 57 'How have you in general experienced that your Master's programme have prepared you for the labour market?'

4.8 Feedback to the Master's programme

Based on the respondents' experiences with the labour market they were asked to report, on a list of possible improvements, which subjects they felt should be improved so that the graduates of the Master's programme would be better prepared for the demands of the labour market. The results of the respondents' feedback are shown in Figure 73. The three most chosen statements were; *Problem solving in collaboration with companies as an embedded part of the Masters programme* (52*%), Linking the contents of the courses to applications (both within physics but also greater perspectives)* (47%) and *Better career counselling (about the possibilities at the labour marked)* (37%). These three feedback points indicate that the respondents experienced that they would have benefitted from a higher degree of understanding of how the learned competencies could be applied both within physics but also within other areas. This confirms earlier results that the respondents were missing interdisciplinary competencies. The results also imply that the respondents would have liked more guidance about what their employment possibilities were, before they graduated. This confirms the results that the respondents had quite unspecified employments opportunities during the Master's programme and did not find their future employment opportunities important. In question 59 the respondents were asked to freely describe what they felt they could be done to improve the Master's programme. The majority of the respondents described that they would have liked to have known which competencies the labour market was looking for and which employment opportunities they had as physicists. In Section 4.4.2 it was shown that the respondents had a quite unspecified idea about

where physicists could be employed. This result could reflect the diversity within the employment opportunities of physicists, but it could also imply that the respondents were unsure of where they possibly could be employed. On question 59 several respondents described *researcher* and *teacher* as the employment opportunities they had been presented for during the Master's programme. Other than these two job opportunities the respondents described that it had been difficult to figure out where they could be employed. A respondent wrote *'I tried to ask around at the institute* [about employment opportunities] *but nobody could say anything specific besides the option of becoming a researcher. Nobody knew what the possibilities were in the private sector since they did not deal with it in their job'*. The respondents described that it was difficult to be in an institution were research was such an obvious career opportunity because most of the teaching, projects and counselling in the programme were directed towards basic research. A respondent wrote *'Professors should remember that after the Master's there are other options, besides doing a PhD'*.

In question 59 the respondents wrote that they would have liked more counselling and focus on future employment opportunities during the Master's programme. The respondents suggested presentations and conversations with physicists working in the labour market or simply updating the employment descriptions on the institute home page, as possible improvements.

The respondents also wrote that they would had liked more guidance and counselling in regard to which specialization they could choose and which choices to make in order to get in the direction they wanted. In section 4.4.2 it was shown that the respondents reported that they primarily had chosen courses based on their interest but in the open question 59 the respondents described that they would have liked to make their choices more consciously. A respondent wrote *'Make the student more aware of what it wants besides studying and being social'*. Several respondents wrote that they felt that the students should be made aware that there is a difference between aiming for a research career and aiming for a career in the labour market. The respondents wrote that no matter if the students know what they want or not, they would have liked more guidance on how to structure their study programme in regard to choosing courses and choosing thesis subject in the smartest way.

Some respondents described that somehow the labour market should be informed and advised about what physicists can do. The respondents wrote that they had experienced that employers had difficulty figuring out what a physicists could. A respondent wrote *'My experience is that the labour market does not know what a physicist can'*.

The results imply that working with projects have been one of the essential differences which the respondents experienced between the Master's programme and the labour market. In the open question 20 regarding which competencies the respondents experienced to have acquired from the Master's programme working with projects was not mentioned. In the open question 42 regarding the competencies which the respondents experienced to use in their job project work was especially mentioned. The results of the survey have shown that the respondents especially experienced that they were missing the competencies to carry out projects. In the feedback, question 59, a respondent wrote '[by including project oriented work to the education] *the education at the university will look like the common work forms of the labour market and the ones which the high school students are being trained in'*.

Throughout the respondents' feedback in question 59 programming and statistics kept appearing. The respondents wrote that they felt that the students should be trained in programming and especially statistics to a higher degree than they had been. In previous sections it was described that although the respondents experienced that they had acquired competencies within these fields they did not fell competent enough

because it was such a big part of their job. A respondent wrote '*Programming/data processing is maybe the most useable ability at all in the labour market today and in the future*'.
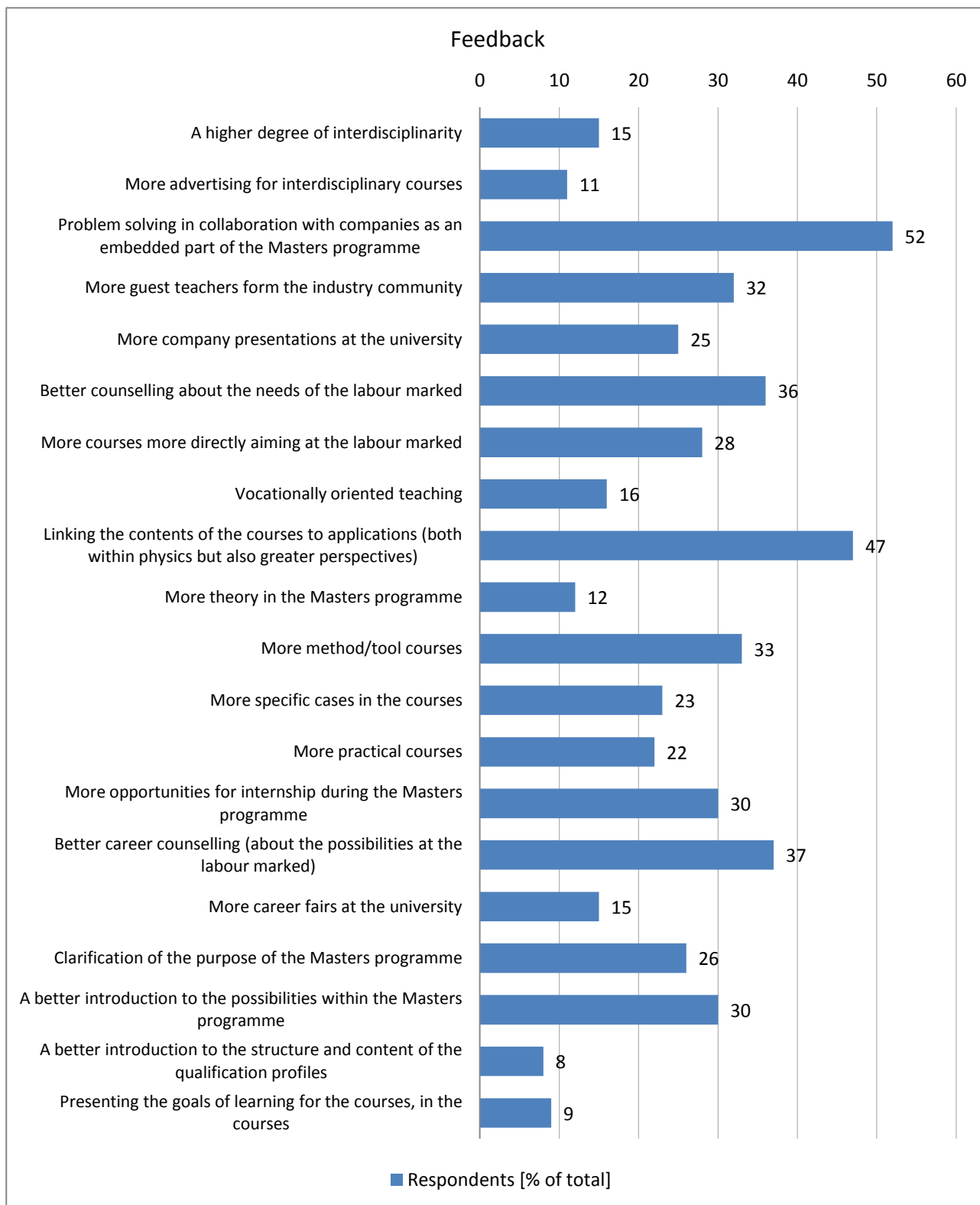
Figure 73
Question 58 'How can the Master's programme be improved so that the students are better prepared for the demands that the labour market have? You can choose several options.'
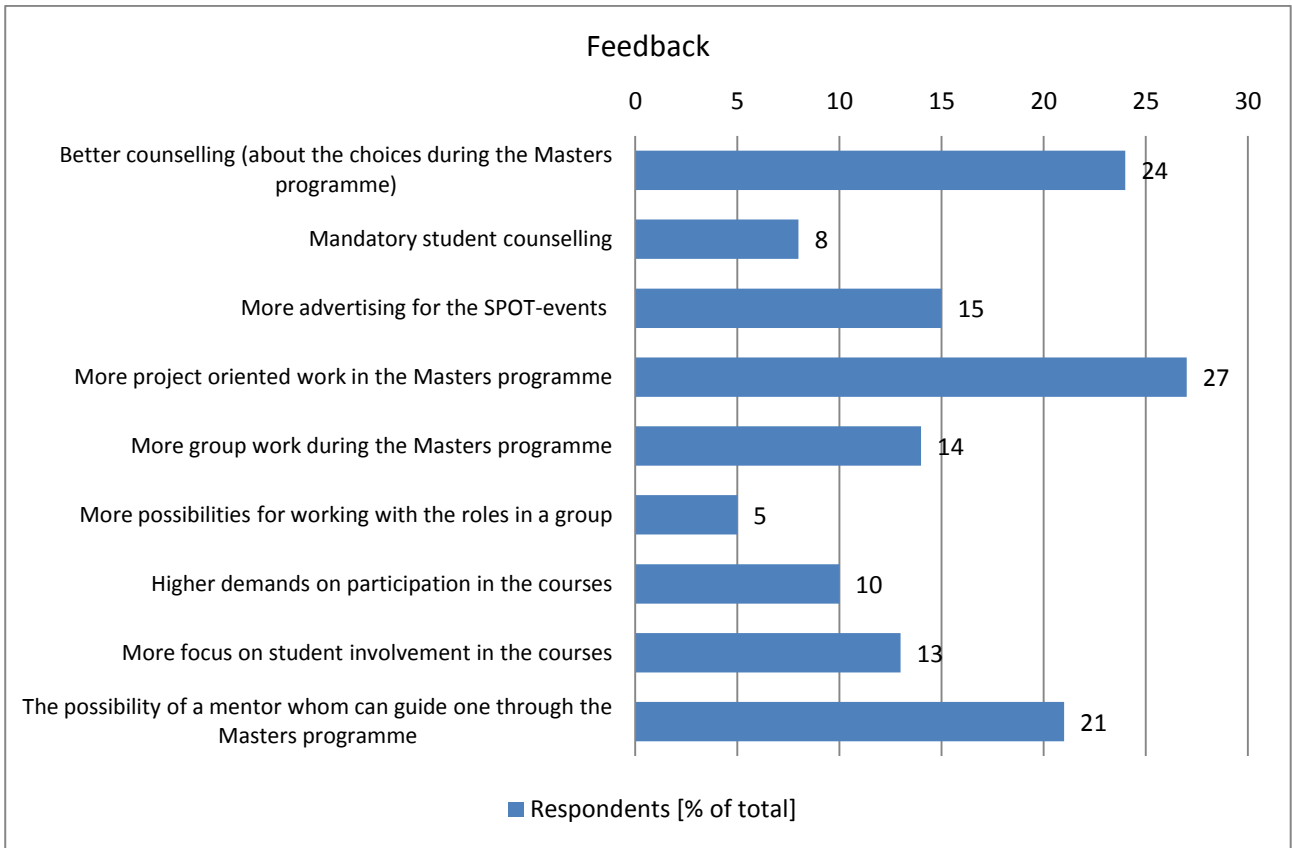
Question 58 'How can the Master's programme be improved so that the students are better prepared for the demands that the labour market have? You can choose several options.'

5 DISCUSSION

5.1 Overview of the results

The results of the questionnaire survey showed that the respondents were interest driven students, who did not especially structure their study programme in order to qualify themselves to a specific job. Instead they chose courses within their qualification profile and within specific subjects of interest. The respondents reported that during the programme they did not have any specific future job position in mind but instead they had an idea that they would be able to be employed in many different industries. Furthermore some respondents did not find it especially important to know what their future employment opportunities were while others did. The results also implied, though, that within gender and qualification profile the respondents had different strategies and approaches to the study programme and their future employment.

When graduating from the Master's programme, the respondents experienced that they had a good idea about which competencies they had acquired. The respondents described that they especially experienced to have acquired the competencies *Problem solving by logical and analytical thinking*, *Mathematical and technical skills,* and *A solid ballast within physics and the ability to embrace new knowledge,* from the Master's programme.

The majority of the respondents experienced that it was easy to find a job in which their competencies were sought for and they described the transition to the labour market as a *learning* and *challenging experience.* The respondents who transitioned into a PhD programme as their first job overall found the transition easier than the respondents who were employed directly into the labour market. The results implied that respondents who had had a job during their education found the transition to the labour market easier than the ones who did not.

The respondents reported that *basic research*, *teaching* and *communication* were their primary job functions though with variations depending on their type of job and the industries they were employed in. The respondents reported that they, in their job, utilized the competencies they had acquired during the Master's programme and that at least half of the competencies they applied in their job were competencies which they had gained through the programme. The respondents described that they applied the competencies which they had acquired during the Master's programme, but they also described that there were competencies and work methods, such as the ability to work interdisciplinary, and to carry out projects, which they did not feel equipped for. Most of the respondents reported that they had experienced a difference between what they could and what they had to do, but only a small percentage had experienced these differences as a pronounced problem.

Based on the respondents' experience with the labour market, they reported that they had experienced that the Master's programme had prepared them well for the labour market. They also reported, though, that the students of the Master's programme could benefit from better information and counselling about the employment opportunities following the Master's programme.

From the results various questions emerged; results implied that the respondents had different strategies and approaches to the study programme and their future employment. How can the study programme embrace and support the students in their different strategies? The respondents had found jobs in various

industries and of various types. How can the programme prepare the students optimally to such a broad range of employment opportunities? The respondents experienced that they lacked the abilities to transfer their science competencies into other contexts. How can the study programme train the students for transfer to other contexts?

5.2 Discussion of the results in the light of the theoretical framework

Why incorporate employability?

Looking at the results of the questionnaire in the light of the employability concept, it is clear that the external employability, i.e. the current demand from the labour market, was high for the respondents. The majority of the respondents had been employed within six months after graduation and were employed at the time of the questionnaire. This confirms that the employment rates of physicists are high, and that there is a demand in the labour market for the competencies which physicists have. The high employment rate of physicists is promoted on the web site of the Master's programme in physics (Københavns Universitet) and the prospect of almost immediate employment after graduation is embedded in the education. This may explain why the respondents primarily based their study programme on their interest and did not put much importance into knowing their employment opportunities. In this way the choice to enrol in the Master's programme in physics truly is a choice of study and not a choice of job. More than half of the respondents were enrolled in a PhD programme after graduation. These respondents continued in the academic tradition of the Master's programme and reported that there was a high academic coherence between the Master's programme and their PhD programme. State funding for PhD positions has been increased in the last years (Universiteter, 2012) and numbers tell us that the PhD programmes are becoming an increasingly frequent career path for physicists (Andersen & Maule, 2002). These future prospects for graduates who do not have to fear unemployment and who, with a high possibility will continue in the same path of the Master's programme may imply that there is no need for incorporating employability into the study programme or for encouraging the students to make an effort to enhance their employability. But high employment rates may be an expression of a limited supply of physicists and not an expression of an unlimited demand from the labour market. With the aim that 25% of a cohort must achieve a Master's degree (Thorning-Smith, 2011) the concept of the mass university is becoming a reality, causing the supply of graduates with a Master's degree in physics to increase. This poses the question if the demand for physicists will continue to be high in future as well as a question of which type of physicists will be needed. Numbers show that today the demand from the labour market for physicists is especially a demand for high schools teachers (Dansk Magisterforening, 2011). But while the number of graduates enrolling in a PhD position is increasing the number of physicists working as high school teachers has steadily been decreasing since the 1970s (Andersen & Maule, 2002). This survey confirms that today only few graduates continue into a career as a teacher.

The challenges of the mass university and the differences between the supply of physicists and the demand from the labour market suggests that the external employability of physics graduates may not be as high in the future as it is today and that it may change nature. In addition to this, it is worth noting that that not all graduates continue into a PhD programme and that the graduates with a PhD degree cannot all continue into a research career. This poses a challenge to the Master's programme. Instead of settling with high employment rates, the programme should start considering the internal employability of graduates', i.e. the

abilities of the graduates, since abilities are useful for the graduates no matter what the demand from the labour market is.

Challenges for transfer and employability

The results of the survey showed that the respondents' overall feeling was that the Master's programme had prepared them well for the labour market. However, it also showed that there were some essential differences between the competencies which they experienced to have acquired and the competencies which they were asked to use in their job. The competencies which the respondents especially experienced to have acquired were primarily science competencies. This is no surprise and would also be expected, as the Master's programme is an education in science, and the Curriculum is based on science competencies. The respondents described that generally there was a good consistency between the science competencies which they had gained in the programme and the science competencies which they were asked to apply in their job. Looking at the challenges which the respondents experienced in their job, the results implied that these challenges were concerned with using the science competencies in a broader context than physics, and with unfamiliar work methods. The respondents reported that they did not especially experience that they had learned how to evaluate, discuss and conclude results in regard to other areas than physics, or that they had confidence with applying methods and theories from physics to related fields. The respondents reported that they, in their job, had to communicate and cooperate with and to others with backgrounds different to their own, but that they did not know how to do so. This collectively implies that the respondents found it difficult to relate and transfer the competencies of physics to other areas.

Looking at the results in regard to what they implied about the three factors of transfer, i.e. the students' characteristics, the design of the study programme, and the work environment, it seems that there were certain barriers preventing transfer. The results showed that the respondents primarily chose courses based on their interest within specific subjects, and did not particularly choose courses directed towards the labour market or more general courses. This suggests that the respondents themselves did not especially explore how their competencies could be used in broader contexts. Based on the competencies which the respondents experienced to have gained from the programme it is implied that the Master's programme did not present possible situations of applications to the respondents, or teach the respondents how to put the learned into other contexts. In the respondents' feedback it was reported that they experienced that problem solving in collaboration with the companies, linking of the contents of the courses with the contents' application possibilities, and better career counselling should be incorporated into the Master's programme to a higher degree. The respondents described that applications of the learned and career options within physics were the only options presented to them during the programme and that they did not experience that there was an environment for talking about other possible application situations of the learned within the programme. Overall the results imply that the study programme to a higher degree could relate the education to other possible application situations, and teach the students how to use the learned theory and methods in various context and not just in the context of physics.

Evaluating the transfer factors related to the work environment based on this survey is difficult, but what can be said is that the short amount of time from graduation to the respondents' first job provided good chances for transfer of the learned. While the academic coherence between the Master's programme and the first job was high for the respondents enrolled in a PhD programme, it was somewhat lower for the other respondents. This implies that for the respondents enrolled in a PhD programme the education should be a case of near transfer, where the learned is applied in situations relatively similar to the learning

situation, while for the other respondents the education should be a case of distant transfer, where the learned is applied in situations which are different from the learning situation. Since the respondents who were enrolled in a PhD programme experienced being better prepared for their job it suggests that the Master's programme was structured in favour of PhD students. This could imply that the Master's programme could be restructured to contain both ways of transfer. This would prepare the students for both a future career in the labour market, and for enrolling in a PhD programme.

Applying the employability concept

The results of the survey implied that overall the respondents had a good transition to the labour market, but they also implied that some groups found the transition more difficult than others did. The results implied that the challenges which the respondents met in their jobs were not especially related to their science competencies but more so to using the science competencies in other contexts than physics, such as social and interdisciplinary contexts.

A report from Konsulenthuset ballisager (2013) showed that the factors on which the employers select job applicants for job interviews are primarily relevant job experience, and motivation for the job. A relevant education was number four on a list consisting of six factors. Research has shown that employers tend to value generic skills higher than disciplinary-based understanding and skills (Yorke, 2006). This means that while the degree is important, other factors are at play too when graduates are searching for jobs. Employers of course want graduates who can present convincing evidence that they have both personal qualities and complex achievements that will lead to a good workplace performance. Based on the results of the survey, this poses a challenge to the Master's programme to consider how employability can be incorporated into the programme and how the students can be encouraged to strive to acquire these competencies. Since research has shown that not until late in their development students begin to reflect and engage in their commitments (Perry Jr, 1999) it is somewhat up to the programme to make the students conscious about their competencies (also in social contexts) and empower them to start thinking about how they see themselves in the labour market and how they can work on getting there.

The question, though, is how higher education institutions approach the process of making the educational system more effective and ensure that the graduates get prepared for the labour market as society demands, while still maintaining the high academic standard that has been embedded in the universities for centuries. While an obvious response would be to increase the vocational content of the Master's programme in order to meet the demands of the labour market, this seems drastic. An objection would be that higher academic institutions are primarily about basic research, and about developing advanced understandings of worthwhile subject matter (Knight & Yorke, 2003). But this also seems extreme. The question is how employability can be incorporated into the programmes without completely rewriting the curriculum to become a vocational education. Research shows that good subject matter *understanding* comes from instruction, performing tasks and from learning environments that call upon incremental self-theories, self-motivation, reflection and a range of social practices, amongst other things (Knight & Yorke, 2003). Incorporating these factors will give good subject matter understanding and foster the employability of students, making higher academic education compatible with employability policies. In this way transfer and employability could be incorporated into the Curriculum and the study programme on various levels and in various ways. Examples could be outside-coming influences such as student counselling and collaborations with companies, or more indirectly by incorporating teamwork and projects into courses via assignments, presentations and exams. A third way would be to work with the students' awareness of the

competencies which they train and learn in the courses and the education. In these ways the Curriculum does not have to be completely redone but instead the concept of employability can become an underlying concept in the education.

Employability is coming

From the previously presented literature in section 2 it is clear that the concept of employability is coming to stay and is going to affect the higher education system, and the students, in the future. Policy today is focusing on getting more young people into the higher education institutions, getting them quickly through the programmes and directly into the labour market in order to increase growth and welfare of the society. In October of this year the Minister of Education Morten Østergaard appointed a committee to evaluate the quality and relevance of the higher education in Denmark (Uddannelsesministeriet, 2013 ENREF_65). This was done in order to increase the quality and intensity of the higher education, and to increase the economic growth and employment in Denmark. A possible outcome of this committee could be that the taximeter system is going to be based on the employability of the graduates as seen in the UK (Knight & Yorke, 2003). The risk of applying the employability concept in this way, is that focus will be put solely on the demand of the labour market and not on the abilities of the graduates. Although this could mean that the institutions would encourage and support the graduates in their search for jobs it would not guarantee that the graduates would find the transition process easier, or that they would acquire the competencies that the employers demand. Therefore the idea of incorporating employability into the curriculum as an underlying concept makes more sense benefitting both students, graduates, the programmes and the employers.

5.3 Methodological limitations and considerations

The aim of this thesis was to make a broad, explorative study on graduates' experience of the transition from education to the labour market. In order to obtain information and experiences of as many graduates as possible a questionnaire survey was chosen, since it has the advantage of easily collecting large amounts of data. The combination of quantitative and qualitative questions in the questionnaire made it possible to understand where the respondents were employed and explore what affected their experience of transition to the labour market. The results have provided insight into the transition process, and have raised a number of questions that would be relevant for further study. The quantitative nature of the results are useful as a feedback to the Master's programme.

The response rate to the questionnaire was 57% ± 6% which inferred that the results of the questionnaire should only carefully be generalized to the total population of selected graduates or graduates from the Master's programme. 72% ± 8% of the respondents completed the questionnaire and the results implied that the dropout was due to the contents of the questions, and to the length of the questionnaire. The results showed that there was no indications of differences in the composition of the respondents and the selected graduates which meant the respondents were representable of the selected population.

A low response rate is one of the major disadvantages of questionnaire surveys which this questionnaire is an example of. Seen in light of the contents of the questions and the length of questionnaire the response rate was though relatively high. The aim of the thesis was to understand the mechanisms at play in the transition of the selected graduates. Therefore a higher response rate could have been more optimal in

order to generalize the results to the total population. However, the results can be used as indicators of which factors that are at play for physics graduates in the transition to the labour market, and provide inspiration for further studies. Such studies could either be of a more quantitative nature or of a more qualitative nature. A quantitative study could be to carry out further extensive statistical analyses on the results. This would provide information on which factors that, with a high certainty, could be determined to have had an effect on the respondents' transition to the labour market.

A qualitative approach could be to interview a selected number of graduates. To get a more specific understanding of how the factors found in this survey played a role for the respondents, subgroups of the respondents could be selected (for example in regard to gender, qualification profile or employment type), and interviewed based on the results of the questionnaire.

The purpose of this study was to investigate the transition to the labour market from the graduates' perspective by using their experiences as research object. But this also meant that the transition has only been described from their point of view. Future studies could benefit from combining graduates' perspectives with other perspectives, for instance by interviewing educators and study programme managers. The transition process could also be approached by contacting the employers of the graduates to gain insight in their experience of the transition process of the graduates and their perspectives on graduate employability.

Another way could be to look at other study programmes than physics. This could include other STEM (Science, Technology, Engineering and Mathematics) higher education programmes. This would provide an understanding of whether or not the results of this questionnaire are unique to physics, or if there are tendencies which are valid for all STEM higher education study programmes.

Since such a high percentage of the respondents continued into a PhD position, a future study could also be to investigate the graduates' transition from the PhD programme to the labour market.

These are all aspects of the transition process which could be interesting to investigate if this project was to continue. This would provide a deeper understanding of the mechanisms which are at play in the transition process and shed light on a subject which we know little about today.

6 CONCLUSION

The aim of this thesis was to understand how graduates from the Master's programme in physics experience the transition to the labour market and what influence their experience. Graduates from the Master's programme in physics from the past five years were selected for the study. The study was carried out as an extensive questionnaire survey, containing both quantitative and qualitative questions regarding the graduates' strategies during the programme, their approach to future employment, their experience of their the first job, and their current job. The response rate to the questionnaire was 57% ± 6%.

The results of the questionnaire has provided an insight into the respondents strategies in regard to their approach to the study programme and their thoughts about future employment opportunities. The results implied that the respondents had been interest-driven students who did not especially put much importance into knowing what their employment opportunities were, even though they did not have any specific job opportunities in mind. The results indicated that respondents who had had a student job had found the transition to the labour market easier than the respondents who had not. Also, the respondents who had been employed in a PhD programme for their first job had found the transition easier than the respondents who had been employed in the labour market. The results suggested that within gender and qualification profile some respondents experienced more challenges than others. The results have provided information on where the respondents were employed, and the contents of their jobs. The results implied that the respondents were able to use the competencies which they felt they had acquired during the programme, in their jobs. But the results also implied that the respondents experienced that they to some degree were lacking the abilities to put their science competencies into other contexts than physics, to execute projects, to collaborate and to communicate with people with another backgrounds than physics.

Summing up, the results imply that the respondents overall experienced that they were well prepared for the labour market but that some graduates faced more challenges than others and that, in general, the graduates experienced challenges in regard to applying their competencies and engaging in other contexts than physics.

The results of this survey have shed light on the transition process of graduates from the Master's programme in physics, a process which has not been investigated before. The results call for further study of the challenges pointed out for a deeper understanding of what influences the transition process of graduates to the labour market and what can be done to increase graduate employability.

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8 APPENDIX

Appendix A, the questionnaire

Welcome the a questionnaire survey about the competencies of physicists

Dear physicist from the Niels Bohr Institute

Thank you for taking your time to participate in this questionnaire survey!

It takes about 30 minutes to fill in the questionnaire. Participation in the survey is entirely voluntary and your personal answers will be treated confidentially and appear absolutely anonymous in my thesis.

Please reply as honest and accurate as possible. Read all of the options to each question before you answer. If you feel that you are missing an option, you are asked to choose the option which is closest to what you wish to answer. The questions will address your experiences with your Master's programme in physics, your first job after graduation and your current job.

Your answers will be stored continuously, which means that you can pause and close down the window, without losing your answers. The questionnaire is resumed by clicking on the link in the mail again and then click your way to the question you have reached.

If you have comments or questions about the questionnaire or my Master's Thesis you are very welcome to contact me via e-mail: trinebroendt@hotmail.com.

In advance, thank you for your help!

Trine Brøndt Nielsen

Master Thesis student in physics at the Department of Science Education

1. Are you a graduate from the Master's programme in physics at the Niels Bohr Institute, University of Copenhagen?
(1) ❑ Yes
(2) ❑ No

2. Gender?
(1) ❑ Male
(2) ❑ Female

3. What is your age?
(1) ❑ 20-24
(2) ❑ 25-29
(3) ❑ 30-34
(4) ❑ 35-39
(5) ❑ 40-44
(6) ❑ 45-49
(7) ❑ 50-54
(8) ❑ 55-59
(9) ❑ 60-64
(10) ❑ 65-69
(11) ❑ 70 or older

4. Which year were you accepted to the Master's programme in Physics?
(1) ❑ Before 1995
(2) ❑ 1995
(3) ❑ 1996
(4) ❑ 1997
(5) ❑ 1998
(6) ❑ 1999
(7) ❑ 2000
(8) ❑ 2001
(9) ❑ 2002
(10) ❑ 2003
(11) ❑ 2004
(12) ❑ 2005
(13) ❑ 2006
(14) ❑ 2007
(15) ❑ 2008
(16) ❑ 2009
(17) ❑ 2010
(18) ❑ 2011
(19) ❑ 2012
(20) ❑ 2013

5. Which year did you graduate from the Master's programme in physics? (the year you defended your Master's thesis)
(1) ❑ Before 2007
(2) ❑ 2007
(3) ❑ 2008
(4) ❑ 2009
(5) ❑ 2010
(6) ❑ 2011
(7) ❑ 2012
(8) ❑ 2013

6. Which qualification profile did your Master's programme have?
(1) ❑ Astrophysics
(2) ❑ Biophysics
(3) ❑ Geophysics
(4) ❑ General profile (all sub-fields of physics as well as elective subjects)

7. Do you have an elective subject (taking a minor in another subject with the aim of becoming a teacher)?
(1) ❑ Yes
(2) ❑ No

8. What is your elective subject?
(1) ❑ Biology
(2) ❑ Computer sciences
(3) ❑ Geography
(4) ❑ Physical education
(5) ❑ Chemistry
(6) ❑ Mathematics

(7) ❏ Philosophy
(8) ❏ Language subjects
(9) ❏ Other, please write_____

9. Have you finished a PhD programme (if you are in a PhD programme at the moment please answer *No*)
(1) ❏ Yes
(2) ❏ No

10. Were your PhD programme an industrial PhD programme?
(1) ❏ Yes
(2) ❏ No

11. Which university did you collaborate with during your industrial PhD programme?
(1) ❏ University of Copenhagen, the Niels Bohr Institute
(2) ❏ University of Copenhagen, Faculty of Science (exclusive the Niels Bohr Institute)
(3) ❏ University of Copenhagen (exclusive the Niels Bohr Institute and the Faculty of Science)
(4) ❏ Aalborg University
(5) ❏ Aarhus University
(6) ❏ Copenhagen Business School
(7) ❏ Technical University of Denmark
(8) ❏ IT University of Copenhagen
(9) ❏ Roskilde University
(10) ❏ University of Southern Denmark
(11) ❏ Universities abroad, please write_____
(12) ❏ Other institutions, please write_____

12. At which university did you finish your PhD programme?
(1) ❏ University of Copenhagen, the Niels Bohr Institute
(2) ❏ University of Copenhagen, Faculty of Science (exclusive the Niels Bohr Institute)
(3) ❏ University of Copenhagen (exclusive the Niels Bohr Institute and the Faculty of Science)
(4) ❏ Aalborg University
(5) ❏ Aarhus University
(6) ❏ Copenhagen Business School
(7) ❏ Technical University of Denmark
(8) ❏ IT University of Copenhagen
(9) ❏ Roskilde University
(10) ❏ University of Southern Denmark
(11) ❏ Universities abroad_____
(12) ❏ Other institutions, please write_____

Now comes at couple of questions about your Master's programme in physics.

13. Which of the statements, listed below, describes your choice of qualification profile (astrophysics, bio-physics, geophysics and a general profile) during your Master's programme?
(1) ❏ I had a clear idea, about which qualification profile I wanted with my Master's programme
(2) ❏ I had a fairly good idea, about which qualification profile I wanted with my Master's programme
(3) ❏ I was in doubt, about which qualification profile I wanted with my Master's programme
(4) ❏ I did not know, which qualification profile I wanted with my Master's programme
(5) ❏ Other, please write_____

14. To how high a degree does the statements listed below describe your choices of courses during your Master's programme?

	To a high degree	To some degree	Neutral	Not especially	Not at all
I chose courses based on the type of assessment	❏	❏	❏	❏	❏
I chose courses based on which courses were offered	❏	❏	❏	❏	❏
I chose courses within a certain subject (courses offered for the qualification profile)	❏	❏	❏	❏	❏
I did not chose courses based on any system (To a high degree means that this statement is true)	❏	❏	❏	❏	❏
I chose courses based on what my classmates chose	❏	❏	❏	❏	❏
I chose courses based on the teacher	❏	❏	❏	❏	❏
I chose courses based on interest	❏	❏	❏	❏	❏
I chose the courses that I believed I needed for the job I wanted	❏	❏	❏	❏	❏
I chose courses that had practical exercises/field trips	❏	❏	❏	❏	❏
I chose courses that were directed towards the labour marked	❏	❏	❏	❏	❏
I chose general courses outside physics (communication, didactics, project management, entrepreneurship)	❏	❏	❏	❏	❏
I chose courses at other universities (in Denmark or abroad)	❏	❏	❏	❏	❏

15. Did you have a student job during your Master's programme?
(1) ❏ Yes
(2) ❏ No

16. How relevant was your student job to your Master's programme?
(1) ❏ Very relevant
(2) ❏ Rather relevant
(3) ❏ Relevant at times

(4) ❑ Not relevant

17. Which of the options below describes you best regarding how you saw your job opportunities during your Master's programme?
(1) ❑ I had an idea of the position I would be able to obtain
(2) ❑ I had an idea of the type of position I would be able to obtain
(3) ❑ I had an idea of the company I would be able to obtain a job in
(4) ❑ I had an idea of the industry I would be able to obtain a job in
(5) ❑ I had an idea that as a physicist I would be able to obtain a job with many different industries
(6) ❑ I had an idea about what my competencies as a physicist were but I did not know how I could apply them
(7) ❑ I had no idea what I could use my Master's degree for

18. How important was is to you, during your Master's programme, to know what job opportunities you had access to based on your Master's degree?
(1) ❑ Very important
(2) ❑ Important
(3) ❑ Neutral
(4) ❑ Not that important
(5) ❑ Not important at all

19. How aware are you of the competencies you have with you from your Master's programme in physics?
(1) ❑ I have a very clear idea about what my competencies are
(2) ❑ I have a good idea about what my competencies are
(3) ❑ I have an okay idea about what my competencies are
(4) ❑ I do not have a good idea about what my competencies are
(5) ❑ I have no idea what my competencies are

20. Which competencies do you especially experience having gained from the Master's programme in physics? Describe the three that are most important to you.

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Now a couple of questions regarding your experience of the labour market based on your first job
after graduation.
If you are currently in your first job, then please answer the questions based on this.
If you do not hold a job yet, you should still continue.

21. How many jobs have you had since you graduated from the Master's programme? (inclusive the job you hold now, a PhD programme is counted as a job)
(1) ❑ 0
(2) ❑ 1
(3) ❑ 2
(4) ❑ 3
(5) ❑ 4
(6) ❑ 5

(7) ❑ 6 or more

22. How long time went by from your graduation until you began your first job?
(1) ❑ 0 months (I began my job right after graduation)
(2) ❑ 0-3 months
(3) ❑ 3-6 months
(4) ❑ 6-9 months
(5) ❑ 9-12 months
(6) ❑ More than a year

23. How did you experience, trying to find a job which demanded your competencies?
(1) ❑ Very easy
(2) ❑ Easy
(3) ❑ Neutral
(4) ❑ Difficult
(5) ❑ Very difficult

24. How did you, in general , experience the transition from university to the labour market based on your first job? Choose the three words that describe the transition the best.
(1) ❑ Good
(2) ❑ Learning
(3) ❑ Easy
(4) ❑ Exciting
(5) ❑ Getting responsibility
(6) ❑ Unproblematic
(7) ❑ Surprising
(8) ❑ Eye-opening
(9) ❑ Mind-expanding
(10) ❑ Confidence-boosting
(11) ❑ Maturing
(12) ❑ Challenging
(13) ❑ Boring
(14) ❑ Confusing
(15) ❑ Troublesome
(16) ❑ Unmanageable
(17) ❑ Difficult
(18) ❑ Frustrating
(19) ❑ Heavy

25. How was the academic coherence between your Master's programme and your first job?
(1) ❑ The job was a direct extension of my Master's thesis
(2) ❑ The job was within the academic subjects of my Master's programme, but outside the subject of my Master's thesis
(3) ❑ The job was outside the traditional subjects of the Master's programme, but required competencies from the programme
(4) ❑ There was no academic coherence between my Master's programme and my first job

Now a couple of questions about your current job situation.
If you are under education/unemployed then please answer the questions based on your most recent job.

26. What is your current job situation?
(1) ❏ In work (including leave, maternity leave, løntilskud/wage subsidies, part time employment etc.)
(2) ❏ Independent
(3) ❏ Unemployed
(4) ❏ Enrolled in a PhD programme
(5) ❏ Enrolled in another programme/education
(6) ❏ Other, please write_____

27. What was your most recent job situation? The next questions you are asked to reply based on this, your most recent job.
(1) ❏ In work (including leave, maternity leave, løntilskud/wage subsidies, part time employment etc.)
(2) ❏ Independent
(3) ❏ PhD programme
(4) ❏ Other, please write_____

27. Is your PhD programme an industrial PhD programme?
(1) ❏ Yes
(2) ❏ No

29. With which university are you collaborating with during your industrial PhD?
(1) ❏ University of Copenhagen, Niels Bohr Institute
(2) ❏ University of Copenhagen, Faculty of Science (excluding the Niels Bohr Institute)
(3) ❏ University of Copenhagen (excluding the Niels Bohr Institute and the Faculty of Science)
(4) ❏ Aalborg University
(5) ❏ Aarhus University
(6) ❏ Copenhagen Business School
(7) ❏ Technical University of Denmark
(8) ❏ IT University of Copenhagen
(9) ❏ Roskilde University
(10) ❏ University of Southern Denmark
(11) ❏ Universities abroad
(12) ❏ Other institutions, please write_____

30. At which university are you finishing your PhD programme?
(1) ❏ University of Copenhagen, Niels Bohr Institute
(2) ❏ University of Copenhagen, Faculty of Science (excluding the Niels Bohr Institute)
(3) ❏ University of Copenhagen (excluding the Niels Bohr Institute and the Faculty of Science)
(4) ❏ Aalborg University
(5) ❏ Aarhus University
(6) ❏ Copenhagen Business School
(7) ❏ Technical University of Denmark
(8) ❏ IT University of Copenhagen
(9) ❏ Roskilde University
(10) ❏ University of Southern Denmark
(11) ❏ Universities abroad
(12) ❏ Other institutions, please write_____

31. What is your employment conditions at your current/most recent job?
(1) ❏ Permanent employee
(2) ❏ Project employee/ temporarily employed
(3) ❏ Employed as a substitute

(4) ❑ Employed with wage subsidies (løntilskud)
(5) ❑ Other, please write_____

32. How did you find your current/most recent job?
(1) ❑ Magazine from your trade union
(2) ❑ Daily newspaper
(3) ❑ The Internet
(4) ❑ A CV-bank
(5) ❑ Through my student job
(6) ❑ Through an internship I had during my Master's programme
(7) ❑ Recruitment and employment agencies
(8) ❑ Unsolicited approach from the employer
(9) ❑ Unsolicited approach to the employer
(10) ❑ A-kasse (an unemployment insurance fund. As a member you are guaranteed an amount of regular income if you become unemployed)
(11) ❑ Employment services/job centre
(12) ❑ Aktivering (job training, internship, courses etc.)
(13) ❑ Through contacts inside the university
(14) ❑ Through contact outside the university
(15) ❑ Through career-/ job fairs or alike
(16) ❑ Other, please write_____

33. How many years have you been employed in your current/most recent job?
(1) ❑ Under one year
(2) ❑ One to two years
(3) ❑ Two to three years
(4) ❑ Three to four years
(5) ❑ Four to five years
(6) ❑ More than five years

34. What is the location of your current/most recent workplace?
(1) ❑ Denmark
(2) ❑ Abroad

35. In which part of the world is your current/most recent workplace located?
(1) ❑ The North (Sweden, Norway, Iceland, the Faroe Islands, Greenland)
(2) ❑ Europe
(3) ❑ North America
(4) ❑ South America
(5) ❑ Asia
(6) ❑ Africa
(7) ❑ Other countries abroad

36. Where in Denmark is your current/most recent workplace located?
(1) ❑ Greater Copenhagen
(2) ❑ The rest of Zealand
(3) ❑ Lolland-Falster
(4) ❑ Funen
(5) ❑ Southern Jutland
(6) ❑ Western Jutland
(7) ❑ Middle Jutland

(8) ❑ Eastern Jutland (including Århus)
(9) ❑ Northern Jutland
(10) ❑ Bornholm

37. In which sector is your current/most recent job?
(1) ❑ Private (including NGO's)
(2) ❑ State
(3) ❑ Region
(4) ❑ Commune
(5) ❑ Other, please write_____

38. In which industry is your current/most recent job?
(1) ❑ Education (elementary school, high school, vocational school, secondary school, university without research, adult education)
(2) ❑ Knowledge services (scientific research, PhD, technical counselling, company counselling, consultants)
(3) ❑ The financial sector (banks, credit unions, insurance and pensions, financial services)
(4) ❑ Information and communication (IT and information services, publishers, TV and radio)
(5) ❑ Culture and free-time (museums, music, art, libraries, sports, amusement parks)
(6) ❑ Mining and quarrying (including extraction of oil, gas, gravel and stone)
(7) ❑ Manufacturing (including chemicals, pharmaceuticals, medical devices, electronics and machinery)
(8) ❑ Public administration (including educational administration, defence, police, justice)
(9) ❑ health and social work (hospitals, disease-fighting organizations, day care centres, youth clubs)
(10) ❑ International organizations (including embassies, EU, FN, WWF)
(11) ❑ Other, please write_____

39. What is your primary job functions in your current/most recent job?
Choose three options.
(1) ❑ Teaching
(2) ❑ Basic research
(3) ❑ Communication
(4) ❑ Product development
(5) ❑ Applied research
(6) ❑ IT-service functions
(7) ❑ Counselling
(8) ❑ Administration
(9) ❑ Documentation (quality assurance)
(10) ❑ Analysis and evaluation tasks
(11) ❑ Project management
(12) ❑ Corporate governance
(13) ❑ Production
(14) ❑ HR/personnel administration
(15) ❑ Sales/marketing/advertisement
(16) ❑ Customer-and citizen services
(17) ❑ Personnel management
(18) ❑ Finance and accounting functions
(19) ❑ Political work
(20) ❑ Other, please write_____

40. To how high a degree, have you experienced that you lack knowledge within the areas listed below, in your current/most recent job?

	To a high degree	To some degree	Neutral	Not espe-cially	No not at all
Physics (all sub-fields of physics)	❑	❑	❑	❑	❑
Science (excluding physics)	❑	❑	❑	❑	❑
IT	❑	❑	❑	❑	❑
Teaching	❑	❑	❑	❑	❑
Economy	❑	❑	❑	❑	❑
Leadership (project, personnel)	❑	❑	❑	❑	❑
Networking	❑	❑	❑	❑	❑
Organizational structure	❑	❑	❑	❑	❑
Sales	❑	❑	❑	❑	❑
Marketing	❑	❑	❑	❑	❑
Communication	❑	❑	❑	❑	❑
Statistics	❑	❑	❑	❑	❑
Human Resources	❑	❑	❑	❑	❑

41. Is there other areas that you also feel that you lack knowledge within?
(1) ❑ Yes, please write_____
(2) ❑ No

42. Which competencies do you especially experience using in your current/most recent job? Describe the three that are most important to you.

Now you have to concentrate! The next two questions are quite extensive but since they are central to my study I hope that you will use some time to answer them!

43. Below is a list of scientific competencies. For each competence you are asked to evaluate to which degree you:
1) have experienced to have the competence with you from the Master's programme
2) experience to use the competence in your current/most recent job

	Carry with you from the Master's programme					Use in current/most recent job				
	To a high degree	To some degree	Neutral	Not especially	Not at all	To a high degree	To some degree	Neutral	Not especially	Not at all
Identifying a problem	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Formulate a problem based on conditions, methods and theories	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Selecting relevant theories/methods to illustrate a problem	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
To connect the abstract with the concrete (e.g. integrating scientific knowledge in practical solutions)	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Planning longer projects	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Seeking out, sorting, evaluating and summarizing relevant information and the latest knowledge	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Setting up an experiment that can illustrate a problem	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Describe an experiment as a physical system consisting of parameters	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Extracting relevant information from an experiment	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Setting up a model which can illustrate a problem	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Applying a model to solve a problem	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Argue scientifically	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Evaluate pros and cons of a method	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏

Critically discuss theories/methods/models in relation to relevant knowledge in the area, applications and limitations	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Assess the credibility of results relative to the theories/methods which have been used	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Discussing the scientific problems which arise from a project	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Concluding clearly and scientifically relative to a problem description	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Concluding clearly and scientifically relative to relevant areas	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Presenting results objectively and precisely	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Making a connection between what a subject is all about and one's own values and worldview	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Discussing results in relation to related areas (public concerns e.g. ethics, environment, culture, history and in an industrial context)	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Working in accordance with the generally accepted standards in terms of scientific integrity and protection of the environment, animals, public interest, etc.	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Evaluating the relevance of theories/methods from physics in relation to other areas	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Applying methods/theories from physics at other areas than physics	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Using IT in the contexts where it is scientifically relevant e.g. as an informational and data processing tool	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Using IT in ones daily work	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Using foreign language as a working language	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏

	To a high degree	To some degree	Neutral	Not especially	Not at all	To a high degree	To some degree	Neutral	Not especially	Not at all
Communicating expert knowledge in English (in writing and orally)	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Communicating expert knowledge clearly in writing	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Communicating expert knowledge clearly orally	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Communicating expert knowledge on a scientific level	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Communicating expert knowledge to a layman	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑

44. Below is a list of general competencies. The concept is the same as before. For each competence you are asked to evaluate to which degree you:
1) have experienced to have the competence with you from the Master's programme
2) experience that the labour market demands these competencies based on your job search

	Carry with you from the Master's programme					The labour market demands				
	To a high degree	To some degree	Neutral	Not especially	Not at all	To a high degree	To some degree	Neutral	Not especially	Not at all
Setting goals	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Planning your own learning and progress independently	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Acquiring knowledge	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Adapting to varying situation	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Letting oneself be challenged	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Asking questions	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Be curious towards new knowledge and challenges	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Finding the purpose with an assignment	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
To commit oneself	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Taking responsibility	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
To prepare oneself	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Working towards a goal	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Focusing on every part of a project (interesting as well as boring)	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑

	Carry with you from the Master's programme					The labour market demands				
	To a high de-gree	To some de-gree	Neu-tral	Not espe-cially	Not at all	To a high de-gree	To some de-gree	Neu-tral	Not espe-cially	Not at all
Immersing oneself in a project over longer periods	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Recognizing that mistakes are an important part of a recognition process	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Recognizing that learning takes time	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Separating work from ones free-time	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Receiving critics with a positive spirit	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Having faith in one's own abili-ties	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Understanding ones part in the world	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Wanting to apply learned knowledge and skills	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Understanding the norms and ways of working of others	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Initiating a collaboration	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Understanding one's own role in a group in relation to what one can and have to contribute with	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Participate in group work with what in involves regarding divid-ing the workload, active partici-pation, criticisms and coopera-tion	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Engaging in a cooperation with participants from different backgrounds than one's own	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Learning from a cooperation	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Feeling safe when participating in social activities (lunch, Friday bar)	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑

45. Do you experience, that there is a difference between what you can and what you have to do in your current/most recent job?
(1) ❏ To a high degree
(2) ❏ To some degree
(3) ❏ Neutral
(4) ❏ Not especially
(5) ❏ No not at all

46. What differences, between what you can and have to do, in your current/most recent job, have you especially experienced?

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47. Have you experienced, that the fact that there is a difference between what you can and you have to do in your current/most recent job, as a pronounced problem?
(1) ❏ To a high degree
(2) ❏ To some degree
(3) ❏ Neutral
(4) ❏ Not especially
(5) ❏ Not at all

48. Do you feel, that you utilize your competencies from the Master's programme in your current/most recent job?
(1) ❏ Yes to a high degree
(2) ❏ To some degree
(3) ❏ Neutral
(4) ❏ Not especially
(5) ❏ No not at all

49. Do you feel, that your colleagues know what to expect from you as a physicist?
(1) ❏ Yes very much
(2) ❏ To some degree
(3) ❏ Neutral
(4) ❏ Not really
(5) ❏ Not at all
(6) ❏ Do not know

49. How big a percentage, of what you use in your job, have you acquired through you education in physics, relative to how big a percentage you have acquired in other places?
Choose how big a percentage, you have acquired through your physics education.
(1) ❏ 0 - 20 %
(2) ❏ 20 - 40 %
(3) ❏ 40 - 60 %
(4) ❏ 60 - 80 %
(5) ❏ 80 - 100 %

51. What is your current situation?
(1) ❑ Unemployed
(2) ❑ Under education
(3) ❑ Other, please write_____

52. For how long time have you been out of work, since you graduated?
(1) ❑ 0-3 months
(2) ❑ 3-6 months
(3) ❑ 6-9 months
(4) ❑ 9-12 months
(5) ❑ More than a year

53. How has your job search been since you graduated? (e.g. where and how you have applied for jobs, have you been in løntilskud, have you taken courses etc.)

54. How have you experienced being unemployed?(e.g. which reflections have you had about your competencies and your Master's degree, what kind of jobs you see yourself in, where you see yourself in five years etc.)

Now you have to concentrate! The next two questions are quite extensive but since they are central to my study I hope that you will use some time to answer them!

55. Below is a list of scientific competencies. For each competence you are asked to evaluate to which degree you:
1) have experienced to have the competence with you from the Master's programme
2) experience that the labour market demands these competencies based on your job-search

	Carry with you from the Master's programme					The labour market demands				
	To a high degree	To some degree	Neutral	Not especially	Not at all	To a high degree	To some degree	Neutral	Not especially	Not at all
Identifying a problem	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Formulate a problem based on conditions, methods and theories	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Selecting relevant theories/methods to illustrate a problem	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
To connect the abstract with the concrete (e.g. integrating scientific knowledge in practical solutions)	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Planning longer projects	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Seeking out, sorting, evaluating and summarizing relevant information and the latest knowledge	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Setting up an experiment that can illustrate a problem	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Describe an experiment as a physical system consisting of parameters	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Extracting relevant information from an experiment	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Setting up a model which can illustrate a problem	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Applying a model to solve a problem	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Argue scientifically	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Evaluate pros and cons of a method	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Critically discuss theories/methods/models in relation	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑

	Carry with you from the Master's programme					The labour market demands				
	To a high degree	To some degree	Neutral	Not especially	Not at all	To a high degree	To some degree	Neutral	Not especially	Not at all
to relevant knowledge in the area, applications and limitations										
Assess the credibility of results relative to the theories/methods which have been used	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Discussing the scientific problems which arise from a project	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Concluding clearly and scientifically relative to a problem description	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Concluding clearly and scientifically relative to relevant areas	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Presenting results objectively and precisely	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Making a connection between what a subject is all about and one's own values and worldview	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Discussing results in relation to related areas (public concerns e.g. ethics, environment, culture, history and in an industrial context)	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Working in accordance with the generally accepted standards in terms of scientific integrity and protection of the environment, animals, public interest, etc.	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Evaluating the relevance of theories/methods from physics in relation to other areas	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Applying methods/theories from physics at other areas than physics	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Using IT in the contexts where it is scientifically relevant e.g. as an informational and data proc-	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑

	Carry with you from the Master's programme					The labour market demands				
	To a high degree	To some degree	Neutral	Not especially	Not at all	To a high degree	To some degree	Neutral	Not especially	Not at all
essing tool										
Using IT in ones daily work	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Using foreign language as a working language	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Communicating expert knowledge in English (in writing and orally)	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Communicating expert knowledge clearly in writing	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Communicating expert knowledge clearly orally	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Communicating expert knowledge on a scientific level	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Communicating expert knowledge to a layman	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏

56. Below is a list of general competencies. For each competence you are asked to evaluate to which degree you:
1) have experienced to have the competence with you from the Master's programme
2) experience that the labour market demands these competencies based on your job search

	Carry with you from the Master's programme					The labour market demands				
	To a high degree	To some degree	Neutral	Not especially	Not at all	To a high degree	To some degree	Neutral	Not especially	Not at all
Setting goals	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Planning your own learning and progress independently	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Acquiring knowledge	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Adapting to varying situation	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Letting oneself be challenged	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Asking questions	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏
Be curious towards new knowledge and challenges	❏	❏	❏	❏	❏	❏	❏	❏	❏	❏

	Carry with you from the Master's programme					The labour market demands				
	To a high degree	To some degree	Neutral	Not especially	Not at all	To a high degree	To some degree	Neutral	Not especially	Not at all
Finding the purpose with an assignment	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
To commit oneself	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Taking responsibility	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
To prepare oneself	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Working towards a goal	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Focusing on every part of a project (interesting as well as boring)	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Immersing oneself in a project over longer periods	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Recognizing that mistakes are an important part of a recognition process	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Recognizing that learning takes time	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Separating work from ones free-time	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Receiving critics with a positive spirit	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Having faith in one's own abilities	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Understanding ones part in the world	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Wanting to apply learned knowledge and skills	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Understanding the norms and ways of working of others	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Initiating a collaboration	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Understanding one's own role in a group in relation to what one can and have to contribute with	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Participate in group work with what in involves regarding dividing the workload, active partici-	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑

	Carry with you from the Master's programme					The labour market demands				
	To a high de-gree	To some de-gree	Neu-tral	Not espe-cially	Not at all	To a high de-gree	To some de-gree	Neu-tral	Not espe-cially	Not at all
pation, criticisms and coopera-tion										
Engaging in a cooperation with participants from different backgrounds than one's own	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Learning from a cooperation	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Feeling safe when participating in social activities (lunch, Friday bar)	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑

Since this questionnaire primarily is focusing on the transition to the labour market, you will now be redirected to end of the survey, which regards possible improvements of the Master's programme in physics.

Finally a couple of questions about how the Master's programme can be improved.

57. How have you in general experienced, that your Master's programme have prepared your for the labour market?
(1) ❑ Very good
(2) ❑ Good
(3) ❑ Neutral
(4) ❑ Not so good
(5) ❑ Bad

58. How can the Master's programme be improved so that the students are better prepared for the demands that the labour market have? You can choose several options.
(1) ❑ A higher degree of interdisciplinarity
(2) ❑ More advertising for interdisciplinary courses
(3) ❑ Problem solving in collaboration with companies as an embedded part of the Master's programme
(4) ❑ More guest teachers form the industry community
(5) ❑ More company presentations at the university
(6) ❑ Better counselling about the needs of the labour market
(7) ❑ More courses more directly aiming at the labour market
(8) ❑ Vocationally oriented teaching
(31) ❑ Linking the contents of the courses to applications (both within physics but also greater perspectives)
(9) ❑ More theory in the Master's programme
(10) ❑ More method/tool courses
(11) ❑ More specific cases in the courses
(12) ❑ More practical courses
(13) ❑ More opportunities for internship during the Master's programme

(14) ❑ Better career counselling (about the possibilities at the labour market)
(15) ❑ More career fairs at the university
(16) ❑ Clarification of the purpose of the Master's programme
(17) ❑ A better introduction to the possibilities within the Master's programme
(18) ❑ A better introduction to the structure and content of the qualification profiles
(19) ❑ Presenting the goals of learning for the courses, in the courses
(20) ❑ Better counselling (about the choices during the Master's programme)
(21) ❑ Mandatory student counselling
(22) ❑ More advertising for the SPOT-events (Events offered by the SCIENCE Student Services with the purpose of preparing students for the education and the labour market after)
(23) ❑ More project oriented work in the Master's programme
(24) ❑ More group work during the Master's programme
(25) ❑ More possibilities for working with the roles in a group
(26) ❑ Higher demands on participation in the courses
(27) ❑ More focus on student involvement in the courses
(30) ❑ The possibility of a mentor whom can guide one through the Master's programme (not a thesis supervisor)
(28) ❑ No proposals
(29) ❑ Other, please write_____

59. With the experience and knowledge about the labour market you have now, is there anything that you especially feel must be improved with the Master's programme in physics?
If you do not answer this questions then please write:
1: I do not have time
2: I have nothing to write
3: other

60. To administrate who has filled out the survey it would be of great help if you would state your name. The questionnaire survey is anonymous and your name will not be used for anything else than administration.
If you do not wish to state your name, it is perfectly alright. In this case you are asked to write *Anonymous*.
If I may contact you in case of further questions you are very welcome to enter your e-mail address.
(1) ❑ Name_____
(2) ❑ E-mail_____

The questionnaire is now finished
Thank you for your participation!
If you have comments or question about the survey or my Master's Thesis you are welcome to contact me via e-mail: trinebroendt@hotmail.com.
If you are in contact with other graduates from the Master's programme in physics from the Niels Bohr Institute you are welcome to share the survey with them through this link:
https://www.survey-xact.dk/LinkCollector?key=PL4QNMQW121J
You can also refer them to the Facebook-event *'Velkommen til en spørgeskemaundersøgelse af fysikeres kompetencer'* at:

https://www.facebook.com/events/347077332062468/?fref=ts

or share the LinkedIn-group of the same name:

http://www.linkedin.com/groups/Velkommen-til-en-sp%C3%B8rgeskemaunders%C3%B8gelse-om-5067307?trk=myg_ugrp_ovr.

Thank you very much for the help.
With best regards
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