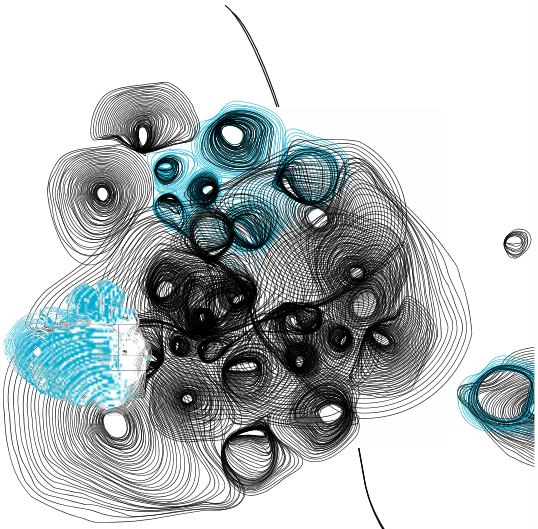

Master thesis

WHO AM I AS A TECHNICAL PHYSICIAN? THE PROFESSIONAL IDENTITY OF YOUNG PROFESSIONALS IN AN EMERGING FIELD

An exploratory study into professional identity as a predictor of intended career choice and career development

Laura van 't Hul
S1233203

Enschede, June 2017

FACULTY OF BEHAVIOURAL, MANAGEMENT AND SOCIAL SCIENCES
MASTER EDUCATIONAL SCIENCE AND TECHNOLOGY

EXAMINATION COMMITTEE
Dr. M.D. Endedijk
Dr. M. Groenier
University of Twente

UNIVERSITY OF TWENTE.

Contents

SUMMARY

In response to today's more complex and non-traditional problems, new professions emerge. One of such emerging professions is the Technical Physician (TP). In the study program Technical Medicine (TM), students are educated to become a TP who is the intermediary between physicians and engineers. For TM students it is potentially more difficult to develop a professional identity (PI) as there is no clear group information or stereotype to identify with. PI is the view individuals hold of who they are as professional which likely predicts persistence. Currently it is poorly understood how students learning for an emerging profession develop their PI and how this affects their perception on their career. Therefore, this study filled the literature gap by investigating what the PI of TM students in an emerging profession entails, how this varied across study phase and how PI affected students' intended career choice, career clarity, exploration and confidence.

In total 397 TM students (64% response) participated in the online survey, which consisted of validated scales on five domains of PI (interests, professional goals, values, competences and personality), strength of identification with the role of TP, intended career choice, career clarity, exploration and confidence in a successful career as a TP. Five profiles of PI were identified by means of cluster analysis: the *individualist, engineer, all-rounder, security seeker and status driven* TM student. The distribution of the profiles differed per study phase as there were more status driven students in the bachelor, and more engineers in the master. Furthermore, the profiles differed in their strength of identification with the role of TP, intended career choice, and career development. The all-rounder, who scored high on medical and technical competences, identified strongest with the profession, had the highest career clarity and was most confident. All profiles were most likely to work as medical specialist, however master students showed the lowest intention. Furthermore, identification and confidence was lower in the end of the bachelor and master, when they had to choose a master or experienced their first internships.

This study showed that TM students have different views of who they are as a TP. Furthermore, the more stereotypical students are most confident in their career and most likely to opt for a career as medical specialist or researcher. Acknowledging diversity amongst TM students and providing personalised support in development of self-clarity and –confidence will be beneficial. Especially during internships, students are less confident in their ability to become a successful professional which might be a result of the absence of TP in role models in clinical practice to identify with. Supporting students in these critical moments and providing students with role models, and also less-stereotypical ones, will facilitate the development of a fitting PI.

Keywords: professional identity • emerging profession • intended career choice • career development • technical medicine • higher education

CHAPTER 1 PROBLEM STATEMENT

As today's problems are of a more complex and non-traditional nature, new areas of expertise arise which are placed on the intersection of traditional fields of expertise (Palonen, Boshuizen, & Lehtinen, 2014). Especially within health care, bridging boundaries between professions can directly impact patient outcomes and decrease medical mistakes made due to a lack of interdisciplinary collaboration (Fewster-Thuente & Velsor-Friedrich, 2008). In response to this need, new specialised professions emerge from the integration of related fields that result into an entirely new research area and knowledge production (Palonen et al., 2014).

One of such new fields of expertise is Technical Medicine (TM). In 2003, the University of Twente (UT) started the study of TM in response to the growing need for interdisciplinary professionals who have the expertise to bridge the field of classic medicine and complex technology (University of Twente, 2016). Students are educated to become a Technical Physician (TP) who is the intermediary between the practice of physicians and the scientific world of the engineers (Miedema, 2015). The practice of TPs should be embedded in direct patient care (Miedema, 2015). According to Janssen, Wallenburg, and de Bont (2016) the emergence of new professions causes boundaries between professions to be fading and results in the need for redistribution of tasks and responsibilities. Carving out a position takes effort for new professionals in a healthcare setting where vested professionals with pre-existing identities will likely protect the boundary of their profession. Just like the physician-scientist, TM students must generate a professional niche in which values and skills from medicine and TM complement each other rather than compete with each other (Rosenblum, Kluijtmans, & ten Cate, 2016). From the beginning of their study program TM students are challenged with this highly demanding task of creating a niche, which is first experienced during internships. In the ideal situation, TM students persist their career as a TP and are confident to gain their position next to physicians and biomedical engineers.

Developing a realistic idea of the role expectations of an emerging profession is more difficult when there is no clear group information or stereotype to identify with (Van Veelen, Otten, & Hansen, 2013). The process of identification is important because it is the process through which individuals come to define themselves, also as professional (Ashforth, Harrison, & Corley, 2008). Professional identity (PI) is the view individuals hold of who they are as professional (Slay & Smith, 2011). Students who are confident in their ability to fulfil the expected identity features of a TP will likely be more successful in crafting a job (Cech, Rubineau, Silbey, & Seron, 2011). PI is commonly described a key predictor of career sustainability (Rosenblum et al., 2016) and workers' decision to leave the profession (e.g. Hong, 2010). Yet, PI development of emerging professional roles in healthcare is poorly understood (Rosenblum et al., 2016). Only few studies have attempted to broaden understanding of PI development amongst students being educated for new occupation that bridges two professions (e.g. Rosenblum et al., 2016). Current research has focused either on medical students (e.g. Adams et al., 2006) or technical students (e.g. Pierrakos et al., 2009) learning for long-established professions. Therefore, this study aims to understand PI development of TM students. By doing so, this study will provide new theoretical implications and key points for improving education and student counselling in emerging professions.

Persistence of TM students as a TP is dependent upon how they see themselves as

professional. The study program of TM outlines doing a PhD or fellowship as ideal career path for a graduated TM student to become a successful member of the profession (Miedema, 2015). However, we know that students who do not identify with stereotypical features of the profession are more likely to leave the profession (Cheryan, Siy, Vichayapai, Drury, & Kim, 2011). It is unclear how identification with the profession predicts the chosen career path in the context of an emerging field where stereotypical features of the profession are unclear.

To sum up, PI is an important predictor of one's career path while research also implicates that developing a PI in a new professional field is potentially more difficult. Building on this, the question then is *what* is the PI of students in an emerging field and *how* does it influence their career development? In this study, the multifaceted concept of career development is used to describe the ongoing process of outlining one's career goals (Simonsen, 1997, as cited in Mcdonald & Hite, 2005), which for instance concerns one's intended career choices or confidence in becoming a succesfull TP. To conclude, the goal of the current research is twofold: a) it aims to answer the question of 'What is the PI of TM students?' by identifying types of TM students, b) to understand how TM students' PI explains their career development.

CHAPTER 2 THEORETICAL FRAMEWORK

In this chapter, the understanding of professional identity (PI) of TM students will be broadened. First, the concept of PI will be discussed and how it can be approached from different theoretical perspectives. Second, the current understanding PI in an emerging professional field is outlined. Third, the importance of PI for the career choices and career development of students is discussed. Lastly, research questions and model are presented.

2.1 Professional identity

Individuals engage in developing a firm identity and finding their own place in society across their entire lifespan (Crocetti, Avanzi, Hawk, Franco, & Meeus, 2014). An individual's identity is a self-perception that provides answers to questions such as 'Who am I?' or 'Who are we?'(Ashforth et al., 2008). The answer to this question is complex, since an individual holds multiple self-definitions that are related to several domains of life (Crocetti et al., 2014). One way individuals can define themselves is in their professional role, which is used to understand their meaning and purpose in life (Caza & Creary, 2016). As a core domain of identity, professional identity (PI) is the view individuals hold of who they are as a professional (Slay & Smith, 2011). There are various disciplines studying identity that disagree if PI is a social or personal construct, or an integration both.

According to theorists from the social perspective, people categorise themselves and others to order their social environment and place themselves and others within it (Ashforth, 2001). Individuals develop a sense of who they are by assuming prototypical or exemplar characteristics of the group as their own (Ashforth, 2001). As such, theorists focusing on the social aspects of PI define it as "*the degree to which employees identify themselves with the profession that they practice and its typical characteristics*" (Bartels, Peters, Jong, Pruyn, & Molen, 2010; p. 211). From this perspective, PI is a rather unstable and complex unity that is developed over time and is determined by the context of the individual (Clarke, Hyde, & Drennan, 2013). Taken together, from a social perspective, people develop their PI through interactions with their social environment and integrate prototypical values and behaviours of the profession as their own, which differentiates them from other professions.

In contrast, theorists holding a personal perspective view on PI focus on how individuals see aspects of themselves as self-defining instead of defining oneself as belonging to a certain group (Crocetti et al., 2014). As such, they define PI as *"the relatively stable and enduring constellation of attributes, beliefs, values, motives, and experiences in terms of which people define themselves in a professional role"* (Schein, 1978, as cited in Ibarra et al., 1999). PI from a personal view is about someone's awareness of working within a certain profession and includes the attributes, such as professional values and skills, individuals use to define their unique professional capacity (Caza & Creary, 2016; Crocetti et al., 2014). While having a stable PI is beneficial as it enhances psychological well-being and creates direction in one's working life, it can constantly change due to new experiences (Crocetti et al., 2014). Such experiences will increase one's understanding of their intended role which helps them to redefine who they want to be as professional. A stable PI will be achieved again once new or adjusted aspects

have been incorporated into the former PI (Ibarra et al., 1999). Overall, from a personal perspective PI is one's relatively stable self-characterisation of who he or she is as professional.

Both theoretical approaches can be criticised for being incomplete since identities are inevitably both personal and social (Luyckx, 2011), which calls for the need to integrate both. Crocetti et al. (2014) clarify that from the social perspective, identity consists of the strength of identification with the profession, whereas the personal perspective refers to one's awareness and self-characterisation as professional. Overall, theorists from both perspectives agree that individuals are continuously defining themselves as professional as a result of social interaction and new experiences. In this study PI is defined as the "*continuous process of incorporating distinctive professional attitudes and values into the self-identity, according to which individuals will behave in their professional role*" (adapted from, Caza and Creary, 2016).

2.2 Professional identity in an emerging professional field

Today career prospects are not as clearly defined and predictable as before and professions are constantly subject to change. This makes it more difficult for people to develop a relatively stable PI (Savickas et al., 2009). Especially for students learning for an emerging profession it might be more difficult to identify with a profession that is unclearly defined. According to Van Veelen et al. (2013), students learning for more long-established professions, such as physician or psychologist, identify with their profession by integrating group prototypical features into their self-concept. Students learn to signal important professional traits and behaviours by observing successful role models in practice (Ibarra et al., 1999). For students in an emerging profession there are not yet many role models to derive prototypical features from. The question therefore is, how do students in an emerging field identify with a group that lacks a clear identity content? According to Van Veelen et al. (2013), individuals will identify with an unclear group by constructing a meaningful group identity themselves through the projection of personal self-attributes onto a group. In case of TM, students might consider themselves to be rational, ambitious and innovative, and will project this onto all their peers which will result into a perceived group unity to identify with. One way or another, students have attributes derived from the self or the group that define them as professional. However, what are these attributes in case of TM, that might serve as example of an emerging profession with an unclear identity content? This study will therefore investigate what the variations are in the PI of TM students.

To understand what the PI of TM students entails and how it is developed, it is important to understand what constitutes the construct of PI. However, this is not easily done as PI is a highly complex construct. Especially operationalising PI is difficult because a research design is needed that captures the various components of PI (Luyckx, 2011). In the first place, an important component of PI involves one's response to the question "Who am I as a professional?". However, in the opinion of Luyckx (2011), PI must also be seen as something broader rather than a range of possible characteristics that can be used to describe someone. All these characteristics only become part of someone's identity as these become self-defining. As a result of this rationale, the model of Ashforth et al. (2008) about organisational identification was adapted to capture the complexity of PI (see Figure 1). Ashforth et al. (2008) describe two important components of PI; *content* and *strength*. *Content* of identity is defined as the central, distinctive and enduring attitudes that compose PI and encompasses what it means to be *A*,

in this case TP. *Strength* of identity is the degree to which one has committed to these components of PI content and has accepted these as one's own. The following paragraphs are an elaboration of these concepts and a discussion of the PI of TM students.

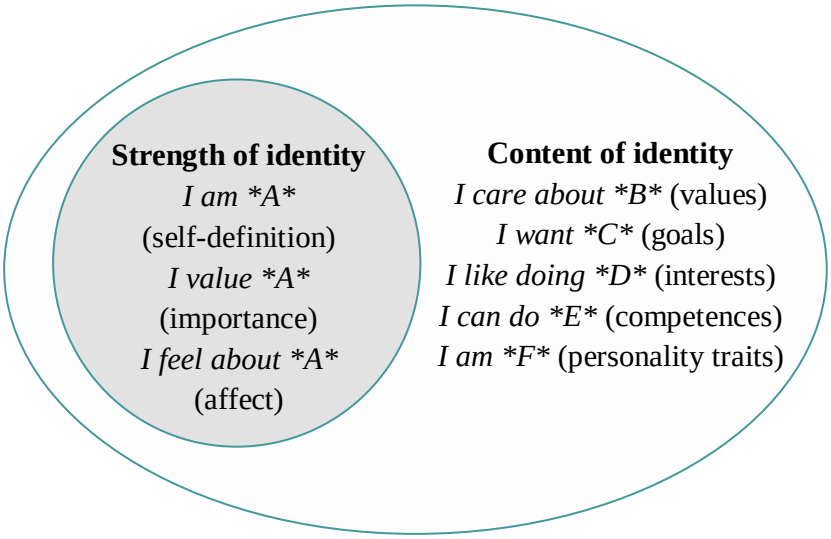

Figure 1. Model of professional identity (adapted from Ashforth et al., 2008).

2.2.1. Content of professional identity

The content of identity is composed of values, goals, beliefs, competences and stereotypical traits (Ashforth et al., 2008). In terms of PI content, TM strongly focuses on the development of competencies that need to be acquired in order to become a TP. Miedema (2015) describes expected competences ranging from research and design related competences to clinical competences such as patient contact, working in multidisciplinary teams and performing technical medical procedures. Students are taught to become aware of their own behaviour in relation to him- or herself, patients, colleagues and tasks. Through reflection students are expected to signal shortcomings in their knowledge and skills and as such become life-long learners (Miedema, 2015). This study provides insight into the variations in TM students' PI by examining the various components (values, goals, interests, competences and personality traits) of PI content.

The majority of current research has taken a qualitative approach to study PI content in the context of higher education (Trede, Macklin, & Bridges, 2011). Therefore, Möwes (2016) developed a quantitative instrument to measure the PI content of Science, Technology, Engineering and Mathematics (STEM) students. Five domains of PI (personality, values, goals, competencies, and interests) were measured which resulted into five profiles of STEM students (Möwes, Van Veelen, & Endedijk, 2017). First, the *nerd* STEM student is conscientious, rational, honest and values intellectual challenge. The nerd student is a is a highly skilled researcher and is very analytical. The *einzelgänger* is introvert, compliant, does not value status in life and shows low self-assessment of skills. The *security seeker* is conscientious, conservative, emotional and values structure and routine in life. The *all-rounder* is open-minded, passionate and has good design, team and management skills. They value contributing to a greater goal and value physical health and autonomy. Lastly, the *status seeker* is an extravert and rational STEM student who values money and power but not family life. They have strong management and communication skills, but are not a team player or researcher.

These results show that great variety exists in the PI content of young STEM professionals. In this study, the PI content of TM students will be examined which will also result into a classification of profiles. It is expected that among TM students there will be a *nerd* profile, representing the TM student that has more affinity with technology than medicine. Moreover, an *all-rounder* is expected that encompasses both technical and medical identity features and a *medical* type is expected that has more affinity with medicine than technology.

2.2.2. Strength of professional identity

The strength of identification is the extent to which an individual feels committed to the profession (Ellemers, Kortekaas, & Ouwerkerk, 1999). On the one hand, PI strength is a sense of emotional involvement with and attachment to the profession (Bergami & Bagozzi, 2000). On the other hand, PI strength also involves awareness of one's membership of a profession and viewing the professional role as self-defining (Ashforth et al., 2008, as cited in Bergami & Bagozzi, 2000). Based on previous research, it is expected that the further the student is in acquiring the knowledge and skills of the profession, the more likely one will identify with the future profession. For instance, students that are at the beginning of their study will identify less strongly as a result of limited meaningful exposure and experiences with their profession (Pierrakos et al., 2009). In the long-established professions, students find an appropriate identity as professional through interaction with role models at the actual working environment (Adams et al., 2006). In case of TM, only a few graduated students have achieved a prototypical position as clinician within a hospital who might serve as role models for students to identify with.

Content and strength are related, such that the more someone embodies the attributes of a profession as one's own, the more prototypical one is. Strongly identifying thus makes one become a prototype of the profession (Ashforth et al., 2008). Cheryan et al. (2011) explain that students who identify less with the profession will believe themselves to be less likely to possess traits that more stereotypical fellow students do have. Students may feel dissimilar and as a result get discouraged and feel less confident about succeeding in their professional field (Cheryan et al., 2011). Research of Möwes (2016) supported of this theoretical assumption. She found out that the more stereotypical STEM students (male and engineering study program) identified stronger with a profession in the technical sector and were more likely to pursue a technical career. To sum up, profiles high on strength are regarded as more prototypical. To conclude, this study investigates PI strength of TM students, and its relation with PI content to understand which PI profiles of TM students are more prototypical. In addition, this study will examine how the PI of TM students varies across study phase to understand how students learning for an emerging profession develop their PI.

2.3 Importance of professional identity for career choices and development

In the context of TM, students will tsideally get a job as technical medical specialist in a hospital where they can integrate the fields of medicine and technology (Miedema, 2015). Research has shown that the perceptions and attitudes students hold about their profession will predict persistence. Students who perceive a bad fit with the profession will opt for a different study program or career (Pierrakos et al., 2009). Students can also choose to switch to another sector, but not necessarily leave their profession (Chetkovich, 2003). This study expects students intended career choice to be influenced by an individuals' content and strength of PI.

Chetkovich (2003) showed that public policy students who have the desire to have impact will opt for a career in the public sector, whereas students that seek financial security and professional development will be attracted to the private sector. For example, TM students who value status and want to be a leader presumably will opt for a career as TP in a company instead of a hospital. Also with regard to PI strength, students that feel less committed to the profession of TP might opt for an alternative career context or job type but not necessarily leave the profession. This was confirmed by research of Möwes (2016) which showed that STEM students with high PI strength were more inclined to aim for a career in a technical context. Currently, little is known about how PI affects students intended career choices. Moreover, the importance of PI for career success and persistence has been researched for students learning for long-established professions, such as engineering (e.g. Cech et al., 2011) or teaching (e.g. Hong, 2010) but not yet for emerging professions as TM. Therefore, this study aims to increase understanding of how PI affects intended career choices, this is done by examining this relationship in an explorative manner.

PI can be used to predict concrete career choices, but is also likely related to students' degree of *career development*. Career development is the *"ongoing process of planning and directed action toward personal work and life goals"* (Simonsen, 1997, as cited in Mcdonald & Hite, 2005, p. 422). Significant career development takes place during adolescence which is characterised by developing awareness of vocational interests and engaging in career-related tasks, such as planning and reflecting on one's future career (Rogers & Creed, 2011). Students' engagement in career development processes will naturally increase as they progress through their study program. As students move closer to finishing their study, they will be more interested in and feel the necessity of exploring career options (Rogers, Creed, & Ian Glendon, 2008). In this study the multifaceted concept of career development is defined as an individuals' consideration of career options (exploration), self-knowledge about occupational goals and interests (clarity) and self-confidence in one's ability to become successful in the profession (professional role confidence). In the following paragraphs the importance of PI for career development is outlined, also the interrelatedness between concepts is discussed.

2.3.1. Career clarity

An important concept in career development literature is career clarity, which as concept is not widely used and poorly defined in current research. In this study career clarity is defined as one's stable awareness of his or her vocational goals and interests (Gupta, Chong, & Leong, 2015). As such, career clarity is rather about having a clear image of fitting job options and occupational interests, than one's self-image (i.e. competences and goals) as professional. This study examines how one's PI is related to the development of a clear career image. Developing career clarity can happen in two ways according to Dehing, Jochems, & Baartman (2013). Extrapolated to the case of TM, a student can either experience that his or her experiences with the professions matches their self-perception and as a result develop a clear career image as TP. Also students can develop a clearer image that is not in line with their expectations of being a TP, and decide to opt for another profession (Dehing et al., 2013). To conclude, this study expects that TM students with a strongly identify with the profession have greater career clarity. However, other mechanisms might explain how for instance TM students with lower identification can still obtain career clarity, which will be discussed in the following sections.

2.3.2. Career exploration

To start with, the relation between PI and career clarity is likely intertwined with *career exploration*. Dehing et al. (2013) argue that having a clear picture of one's career is the result of gathering information about a profession. It is especially important that students develop a clear image of their goals, values, interests and competences in order to make fitting career choices. Also exploring career options helps individuals to learn what different career paths imply or require (Werbel, 2000). Aschbacher, Li and Roth (2010) argue that part of career exploration is concerned with talking to others about different career options and an individuals' career interests. The interaction of students with people in their environment, such as family, peers, and teachers, plays a considerable role in boosting students' interests in the profession and eagerness to pursue a career in the field. In case of TM, students learn through such interactions what being a TP entails and if they are capable to, and want to, persist as a TP. So, students weigh their own identity as professional against the reaction of peers (Aschbacher et al., 2010). To sum up, it is expected that exploration of career options and discussing with others will increase clarity in students' career goals. As such, it is expected that exploration can explain the relation between students' PI and their career clarity. For example, students with a weak PI as TP might still develop career clarity through exploring alternative career options.

2.3.3. Professional role confidence

Lastly, the concept of *professional role confidence* is discussed as important element of career development. This concept was introduced by Cech et al. (2011; p. 642) referring to "*individuals' confidence in their ability to fulfil the expected roles, competencies, and identity features of a successful member of their profession*". Becoming a successful professional is not just about mastering a professions' intellectual skills, but also about developing confidence and commitment to the profession. A lack of this confidence contributes to students leaving their work field (Cech et al., 2011). Therefore, it is especially important that TM students develop the confidence that they can become successful in creating their position between the vested professionals. A strong and clear PI is necessary to become successful as professional because it will determine one's behaviour in the work place (Caza & Creary, 2016). Cech et al. (2011) argue that students with a strong PI have internalised self-defining attributes that correspond to the professional role of TP which will likely increase their confidence that the profession fits them. For this reason, it is expected that students with a strong PI are more confident that they possess the knowledge and master the competences required of a TP. Also students with a strong PI will be more confident that they can be successful in their career and actually get a satisfying job as TP. In turn, it is expected that students with more confidence will show higher levels of career clarity.

Overall, little is known of how PI is related to intended career choices and the career development variables. As a first step, this study explores how PI is related to intended career choice, career clarity, exploration and professional role confidence. Based on the above rationale, it is expected that career exploration and professional role confidence mediate the relationship between PI and career clarity. Therefore, a second step involves the testing of several models to explain how these career development variables are related to PI.

2.4 Research questions

This study aims to answer the following main question:

- What is the relationship between TM students' PI and their intended career choice and career development, and how is this influenced by study phase?

In order to answer the main question, the following sub questions were drawn (see Figure 2):

- RQ1 – What are variations in TM students' PI and how are these related to study phase?
  - RQ1a – What profiles can be deduced to describe variations in the PI content of TM students?
  - RQ1b –What is the relationship between TM students' PI content and strength?
  - RQ1c – What are differences in TM students' PI content across different study phases?
  - RQ1d – What is the relation between TM students' study phase and their PI strength?
- RQ2 – What is the relationship between TM students' study phase and their intended career choice and career development?
- RQ3 – How is the relationship between TM students' PI and their intended career choice and career development?
  - RQ3a – To what extent can differences in TM students' intended career choice and career development be explained by their PI content?
  - RQ3b – How is the relationship between TM students' PI strength and their intended career choice and career development?

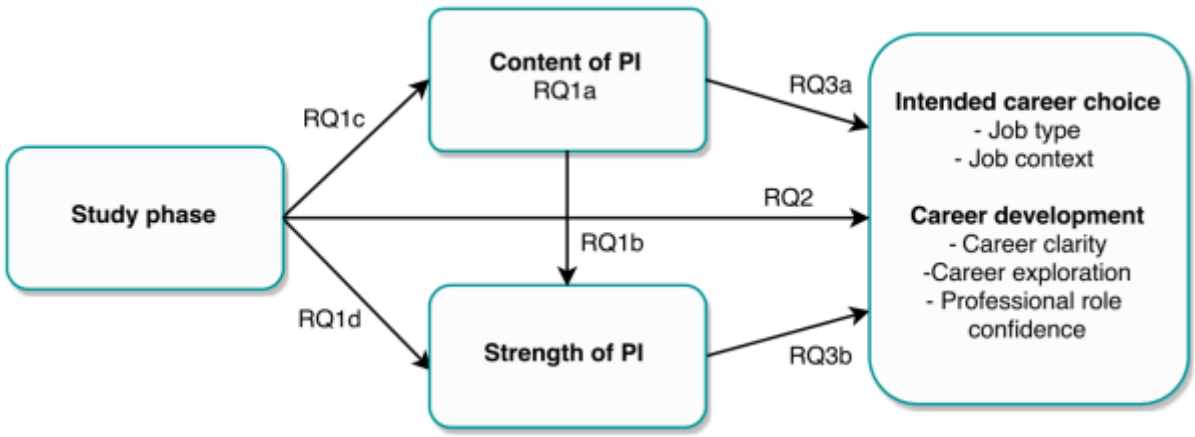

Figure 2. Research model and questions.

CHAPTER 3 METHOD

3.1 Research design

The nature of this study is explorative as the aim is to gain new insights into the underexposed topic of PI development of students in emerging professions. A cross-sectional design was used in the form of an online survey. This design fits the explorative nature of this study because cross-sectional research usually aims to describe a population with respect to a certain subject without necessarily having hypotheses beforehand (Levin, 2006). Also a major advantage of a cross-sectional approach is that data can be collected from a large population in a relatively short period of time (Babbie, 2013).

3.2 Sample

The population of this study were TM students enrolled in the three-year bachelor and three-year master program at the UT. The study of TM is currently only offered at the UT and Delft University of Technology (TU Delft). However, TM students of the TU Delft were excluded from participation as Delft only offers a bachelor and is still developing its master program. The respondents were thus purposively selected as this study is specifically interested in the PI of TM students studying at the UT (Babbie, 2013). The total sample size consisted of 580 students that were all invited to participate in this study. A total of 407 students started the survey of which 371 respondents completed the entire survey, with a total response rate of 64.0%. Nine respondents did not complete the entire survey, but did complete the first section of the survey measuring the five domains of PI content. These respondents were included in the Explanatory Factor Analysis (EFA) for the five domains. A total of 27 students did start the survey, however did not finish of which the majority was female (N = 17) and bachelor student (N = 20). These participants did not the finish all five domains of PI needed for EFA and were therefore deleted case wise. In Table 1, response rate per study phase can be found. The mean age of the respondents was 21.0 (SD = 2.39), ranging from 17 to 29. Of the respondents, 32.6% was male and 67.4% was female which is only a small deviation from the male/female distribution of the population which is estimated at 40/60%.

Table 1
Number of respondents and response percentage per study phase

	Estimation of population	*N* completed entire survey	Response %	*N* completed five domains PI	Response % five domains PI
Bachelor year 1 (B1)	130	86	66.2%	91	70.0%
Bachelor year 2 (B2)	120	53	44.2%	55	45.9%
Bachelor year 3 (B3)	110	77	70.0%	78	70.9%
Master year 1 (M1)	90	56	62.2%	57	63.3%
Master year 2 (M2)	80	58	72.5%	58	72.5%
Master year 3 (M3)	50	41	82.0%	41	82.0%
Total	580	371	64.0%	380	65.5%

3.3 Instrumentation

An instrument developed by Möwes (2016) was used for this study. This instrument, the Career Compass (CC), was developed to measure content and strength of STEM students PI.

Study phase. Participants were asked of in what phase of their bachelor (options: B1, B2, B3) or master (M1, M2, M3) they were. Students with study delay were asked to click the phase of which they attended the most study units.

Content of professional identity. The CC measures five domains of PI; interests, competences, values, personality and goals. These domains are literature based and have been validated amongst both STEM-students (Möwes, 2016) and employees in engineering (ten Berg, 2016). Since the CC was originally developed to measure PI of engineers, four steps were taken to adapt the domain of competences for the current study amongst TM students. First, specific TM competences were derived from the competence profile of the TM professional published by Miedema (2015). In the second step, all items of the original scale of Möwes (2016) measuring engineering competences were judged on their relevance for TM students. Third, items of the scale of Möwes (2016) were rewritten to fit the competences expected of TM students. Furthermore, based on Miedema (2015), items to measure specific TM competences were added to the scale. These items measured competences related to technical medical practice and professional behaviour. Having both aspects, engineering and medicine, was especially necessary to investigate the dualism students could experience between these two fields of expertise. As such, the scale had items both measuring engineering competences (e.g. *"designing or adapting treatments or diagnostic methods"*) and technical medical competences (e.g. *"assessing complaints of the patient").* In the fourth phase, this scale was thoroughly discussed with a teacher, researcher and a master TM student and items were rewritten where needed. Further validation of this scale was done by means of this study. Overall, 13 items were added and 3 items were adapted (see appendix A). The version of the CC that was used in this study had a total of 129 items. An overview of the items and underlying factors can be found in Table 2.

Table 2

Overview of scales, factors, n of items and example items used in the Career Compass to measure content of professional identity

Domain	Reference	Factors (number of items per factor in parentheses)	*n* items	Example item
Interests	Hansen and Scullard (2002)	community involvement (3); music (3); outdoors (5); screen time (3); fashion & beauty/social (4); sports (3)	21	I am interested in... "team sports"
Competences	Male, Bush, and Chapman (2011) Miedema (2015) Passow (2008)	engineering (6); international orientation (3); management (8); research (7); professional behaviour (7); team (5); technical medical practice (5)	41	I am good at…"motivating myself"
Values	Lyons, Higgins, and Duxbury (2010)	achievement & power (5); lifelong learning (4);	24	I find… "success" important

	Ros, Schwartz, and Surkiss (1999)	hedonism (4); tradition (4); security (3); universalism (3); family (1)		
Personality	Ashton et al. (2004) Ashton and Lee (2009)	honesty (4); emotionality (4); extraversion (5); agreeableness (4); conscientiousness (4); open-mindedness (4)	25	I am… "honest"
Goals	Roberts and Robins (2000) Sheldon, Elliot, Kim, and Kasser (2001)	comfort (3); economy & status (4); family (3); physical well-being (3); purpose (3); security (2)	18	In the future I want to… "know my purpose in life"

Strength of professional identity. To measure the degree of identification with the future profession of TP six items from Ellemers et al. (1999) were used (e.g. "I feel good about being technical physician"). Respondents could answer on a 7-point Likert scale (1 = strongly disagree; 7 = strongly agree). The initial scale consisted of 10 items of which six were selected that covered both affective and cognitive commitment. This was done to make sure participants would not need more than 20 minutes to finish the survey.

Career clarity and exploration. Items to measure career clarity and exploration were adapted from two articles (Gupta et al., 2015; Meeus, Iedema, Helsen, Vollebergh, & Meeus, 1999). These items had been used in research of Möwes (2016), however were not used in further analysis. Though, her research showed that both scales of career clarity and exploration were of sufficient reliability, respectively a Cronbach's Alpha of .853 and .801.

Professional role confidence. Professional role confidence was measured with seven items adjusted from Cech et al. (2011) on a 7-point Likert scale (1 = strongly disagree; 7 = strongly agree).

Table 3

Overview of scales, factors, n of items and example items used in the Career Compass to measure professional role confidence and career clarity and exploration

Construct	Reference	*n* items	Example item
Professional role confidence	Cech et al. (2011)	7	At the moment I am confident... "in my ability to be successful in my career as technical physician"
Career clarity and exploration	Gupta et al. (2015) Meeus et al. (1999)	6	I know what kind of work suits me best

Intended career choice. Finally, participants answered questions on concrete career choices on a 7-point Likert scale (1 = strongly disagree; 7 = strongly agree). First, students were asked for the context (hospital, company and university) they would prefer to work in five years after graduation (e.g. *"5 years after graduation, I would prefer to work in a hospital").* Second, five similar questions were asked about the job type students would prefer: researcher, designer, manager, consultant and medical specialist. These job types were adjusted from the roles of a TP described by Miedema (2015).

3.4 Procedure

Participants participated in an online survey in December 2016 and January 2017. Before the actual data collection took place, a pilot study was performed to detect possible problems of the survey. The survey was tested with four students before it was sent to the participants. All current bachelor and master students of TM received an invitation via e-mail to participate. In this e-mail participants were provided with information about the study, the importance of their participation for the study program of TM, and the possibility of receiving the results. In line with the ethical guidelines of the UT, participants were informed that the data will be treated anonymously. Also at the beginning of the survey students were informed that their participation is voluntary and that they can quit if they do not feel comfortable while participating. Lastly, students were asked to find a quiet space and take enough time to complete the survey. At the end of the survey, participants could enter their e-mail to receive a personal report and the general results of the research. To ensure anonymity, the personal e-mail addresses were encoded and stored separately from the data. In addition to the invitation via e-mail, the researcher promoted this study via lectures and via posters. For B1 and B3 students, participation for this study was scheduled directly after a lecture to guarantee response. This gave the students the opportunity to directly fill out the survey in the presence of the researcher who was available for questions. One week before the deadline of data collection, specific years with insufficient response rates were once more reminded via e-mail or talks in lectures to participate. All data was collected within a period of six weeks. Participants answered a total of 165 questions, which took them 16 minutes on average to complete.

3.5 Instrument validation

The CC has already been validated among STEM students and engineering employees, but has not yet been validated for TM students. For this reason, the factor structure of the content of PI was tested for its validity and reliability by means of Explanatory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). Researchers typically first asses an instrument by means of EFA, followed by CFA to asses if the factor structure produced by the EFA fits the data (Worthington & Whittaker, 2006). As such, EFA was first performed for each domain of PI content to examine the underlying dimensionality of the data. This was also done for strength of PI and the career development variables. Secondly, CFA was performed for all domains of PI content, PI strength and career development to confirm the validity of the scales. Once reliable factor structures had been established, mean scores were calculated for all factors. Based on these scores, clusters of TM students were made to understand their PI.

IBM's statistics program SPSS (24th version) was used to conduct exploratory factor analyses (EFA). To arrive at an EFA that would fit the research goal and data, decisions were made about the 1) type of analysis; 2) sample size; 3) number of factors and; 4) criteria for item removal.

1) To extract factors from the data, principal axis factoring (PAF) was selected as common-factor analyses (FA) method. This method was chosen since it is more closely aligned with the development of new scales in comparison to the other frequently used method of principal-components analysis (PCA) (Worthington & Whittaker, 2006). Based on the theoretical assumption that the factors within a construct may correlate, a

direct oblimin as oblique rotation method was chosen (Field, 2009).

2) Guidelines regarding the minimum sample size for valid EFA outcomes have received considerable discussion in literature. In general, larger sample sizes are better for EFA but two rules of thumb were followed. Following these rules, a minimum of 300 responses was necessary or approximately 390 responses when adopting the model participant-to-item ratio of 3:1 (Worthington & Whittaker, 2006). Therefore, the sample of 380 students who completed the survey is sufficient for conducting EFA. Moreover, Kaiser-Meyer-Olkin measures (KMO) were also performed for the EFA's of the domains of PI content to analyse whether the sample size is adequate. KMO values between .5 and .7 are considered to be mediocre, values between .7 and .8 as good, values higher than .8 as great (Hutcheson & Sofroniou, 1999, as cited in Field, 2009).
3) Eigenvalues (>1) were analysed to arrive at a definitive number of factors for each construct. Besides, scree plots were also taken into account when checking the number of factors. To arrive at internal factor structures, items were also judged on their content and how items theoretically connected as an overarching factor. When the final factors were extracted, Cronbach's alphas were calculated for all factors. According to DeVellis (2012) alphas lower than .60 are considered as poor, between .60 and .70 as mediocre, and greater than. 70 as acceptable. Spearman Brown was calculated for factors containing only two items, as this measure is more reliable for assessing the reliability of two-item factors (Eisinga, Te Grotenhuis, & Pelzer, 2012).
4) Item reduction took place based on the recommendations of Worthington and Whittaker (2006). An item was deleted from the pattern matrix when; the highest factor loading of an item was lower than .3, when an item loaded on several factors with both or more factor loadings higher than .3, and when the difference between the two highest factor loadings of an item was smaller than .15.

3.5.1. Exploratory factor analyses

EFA's were conducted for the domains of PI content separately. The domains of 'values' and goals' were taken together in the EFA because of the overlap between the items. KMO test was run to test if the sample size was large enough for performing EFA. Sample sizes showed to be large enough (KMO > .60) for all domains of PI content, PI strength and the career development variables (see Table 4). As such, EFA could be conducted to explore factor structures for all constructs separately which is discussed in the next sections.

Table 4

Kaiser-Meyer-Olkin values for the domains of professional identity content, professional identity strength and career development variables

Construct	KMO
Interests	.64
Competences	.84
Values & goals	.81
Personality	.77
Strength of PI	.84
Career clarity and exploration	.78
Professional role confidence	.84

Interests. EFA was executed to build an adequate factor structure for the interests of TM students. Initially, a six-factor structure was assumed (community involvement, music, outdoors, screen time, fashion & beauty/social, and sports) within a total of 21 items. After five rounds of step-wise item deletion, 16 items remained resulting in the six factors that were assumed. EFA was also performed setting the number of expected factors, which resulted in 17 remaining items (see appendix B). Two factors were renamed into fashion & beauty and societal involvement to cover the content after item deletion. Three of the factors of the interests' domain showed poor reliability (α = .47 – .56), whereas the other factors were mediocre (α = .60) and acceptable (α = .76 – 79). The factors music, societal involvement and screen time were of poor reliability and were checked for their correlation. The three items of music were mutually correlated ranging from r = .23 to r = .47 (p > .01). The two items of societal involvement were also significantly correlated (r = .43, p > .01), as well as the two items of screen time (r = .31, p < .01). Therefore, both factors were still included in further analysis. Together all factors explained 63.22% of the total variance.

Competences. Based on theory, seven factors were expected within the domain of competences (engineering, international orientation, management, research, professional behaviour, team, and technical medical practice). EFA was performed on the 41 items to build a factor structure for the competences of TM students. Eleven items were deleted because they did not meet the criteria, which resulted in an eight-factors structure after four rounds of item deletion (see appendix C). Only the factor of management remained as was initially assumed, all other new factors are combinations of factors or were newly formed in the EFA. The eight established factors are: technical practice, self-management, cognitive skills, collaboration, international orientation, medical practice and research. Firstly, the factor technical practice is a combination of former engineering items and items of technical medical practice that specifically focussed on working with technology within a medical context. The remaining items which were concerned with treating patients and medical practice together formed the factor medical practice. Likewise, the items that originally measured research competences fell apart into two new factors: cognitive and research skills. Furthermore, the factor of professional behaviour was renamed into self-management which better reflected the content of the factor. This was done because several items were deleted which had specifically been added to measure professional behaviour being a TM specific competence. Lastly, one item on international orientation loaded onto the factor of collaboration which could be theoretically substantiated. All factors had mediocre (α = .63 – 68) to acceptable (α = .73 – .82) reliability. The factors explained 61.66% of the total variance.

Values & goals. The domains of values and goals were taken together to build a factor structure through EFA. An 11-factor was expected: achievement & power, lifelong learning, hedonism, tradition, security, universalism, family, comfort, economy & status, physical well-being, and purpose. Nine rounds of item deletion were necessary to establish a valid factor structure for the domain of values and goals (see appendix D). Of the 32 items, 11 items needed to be removed to arrive at an eight-factor structure. All items of the factors universalism and comfort were deleted. Also the items of achievement & power and economy & status were combined forming a new factor called status & achievement. All factors were of sufficient reliability ranging from mediocre (α = .66 – .67) to acceptable (α = .74 – .85). Together the factors explained 62.92% of the total variance.

Personality. For the personality of TM students, a six-factor structure was assumed consisting of the following factors: honesty, emotionality, extraversion, agreeableness, conscientiousness, and open-mindedness. After two rounds of step-wise item deletion according to the criteria for item removal a six-factor structure remained. The initial factor structure remained with a total of 23 items (see appendix E). The factors had a reliability ranging from mediocre (α = .62 – .68) to acceptable (α = .77 – .83). Together the factors explained 61.43% of the total variance.

Strength of professional identity. A one-factor structure was expected for strength of PI which was also confirmed by EFA (see appendix F). The factor was of acceptable reliability (α = .85) and explained 59.41% of the variance.

Career clarity and exploration. EFA was performed and resulted in the assumed two-factor structure of career clarity and career exploration (see appendix F). The factors had acceptable Cronbach's Alphas of respectively .81 and .79 and together explained 72.19% of the total variance.

Professional role confidence. Professional role confidence was measured with seven items which were assumed to result into a one-factor structure (see appendix F). After EFA, all items remained and together formed one factor with a Cronbach's Alpha of .84 explaining 52.81% of the total variance.

3.5.2. Confirmatory factor analysis

Separate first order CFAs were conducted for all domains of PI and the career development scales to test their quality. The statistics program R and the package *lavaan* was used to perform the CFA. The Weighted Least Square Means and Variance adjusted (WLSMV) estimator was used, which is an estimator that is appropriate in the context of small samples and simple structure models (Beauducel & Herzberg, 2006). Fit indices were calculated to evaluate the fit and simplicity of the model. Following Kyndt and Onghena (2014), five model fit indicators were calculated and inspected; 1) ratio of the chi-square test statistic to the degrees of freedom; 2) Comparative Fit Index (CFI); 3) Tucker-Lewis Index (TLI); 4) Standardized Root Mean Square Residual (SRMR); and 5) Root Mean Square Error of Approximation (RMSEA). Critical values indicating sufficient model fit for each fit indicator can be found in Table 5.

Table 5 also shows the model fit for all the domains of PI content and the other constructs. The results of the CFA showed decent model fit for the domains of PI content. For all domains, the ratio of the chi-square and degrees of freedom were below 3 indicating sufficient model fit. Also the RMSEA and SRMR values were acceptable, as they were below .08. However, the values of CFI and TLI were insufficient indicating poor model fit (ranging from 0.813 to 0.875). While research acknowledges that CFI and TLI values lower than .90 unacceptable, values that are perfect (e.g., CFI = 1.0) are seldom encountered in practice (Cheung & Rensvold, 2002). These rules of thumb should however not be taken too seriously as it may always be possible that the model fits the data while the fit indices suggest otherwise (Schermelleh-Engel, Moosbrugger, & Müller, 2003). Overall, three of the five model fit indices showed sufficient model fit for the domains of PI content. With regard to strength of PI, only SRMR showed sufficient model fit. Career clarity and exploration was the only construct for which all model fit indices were sufficient, indicating a good model fit. Lastly, four model fit indices indicated insufficient model fit for the construct of professional role confidence. The

concepts of strength of PI and professional role confidence were further inspected to better understand the outcomes of the CFA, and possibly improve these values.

Table 5

Output from the CFA for all domains of professional identity, strength of PI, career, clarity, exploration and professional role confidence

Fit indices	Critical values indicating sufficient model fit	Interests	Competences	Values & goals	Personality	Strength of PI	Career clarity & exploration	Professional role confidence
Ratio X^2/df	<3	1.989	1.838	1.347	2.721	**7.002**	2.522	**6.389**
CFI	≥.90	**0.875**	**0.838**	**0.857**	**0.745**	**0.889**	0.977	**0.874**
TLI	≥.90	**0.837**	**0.813**	**0.836**	**0.700**	**0.815**	0.957	**0.810**
RMSEA	<.08	0.051	0.047	0.030	0.067	**0.126**	0.064	**0.120**
SRMR	<.08	0.053	0.062	0.056	0.074	0.046	0.028	0.055

Note. Bold indicates insufficient model fit. CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = root mean square error of approximation; SRMR = standardized root mean residual.

3.5.3. Inspecting strength of professional identity and professional role confidence

It was decided to further inspect the insufficient model fit for the constructs strength of PI and professional role confidence. EFA was performed with all items of the two constructs together because theoretical overlap was supposed. KMO test was run before performing EFA resulting in a value of .90, indicating the sample size was large enough to perform EFA. After one round of stepwise item deletion, a two-factor structure remained with a total of 12 items. The first factor, strength of PI consisted of all former items and two items from professional role confidence. The two added items showed a theoretical fit with the construct of PI strength, being concerned with the degree of commitment one has to his profession (*At this moment I am confident that.. "technical physician is the right profession for me" and "I am very committed to technical medicine").* With regard to the remaining items of professional role confidence, it was decided to delete one item (*At this moment I am confident that.. I am capable of developing useful skills")* because of a poor theoretical fit with the other remaining items and a negative impact on the reliability of the scale. As a result, the second factor was named career confidence being the confidence that one can be successful in becoming a member of the profession. Overall, a two-factor structure remained with a total of 11 items (see appendix G) of acceptable reliability (α = .78 – .90). Together the factors explained 63.20% of the total variance.

Table 6 shows the model fit for the new two-factor structure of PI strength and career confidence. The results of the CFA still show insufficient model fit for the new structure, however the model fit has increased in comparison to the model fit of the former constructs. While the ratio of the chi-square and degrees of freedom, CFI, TLI, RMSEA are still insufficient, they are close to acceptable. As the model fit has increased, it was decided to persist using the newly established factors in further analysis.

Table 6

Output from the CFA for the new two-factor structure of professional identity strength and career confidence

Fit indices	Critical Values indicating sufficient model fit	New values for the two-factor structure: PI strength & career confidence
Ratio X^2/df	<3	**3.897**
CFI	≥.90	**0.889**
TLI	≥.90	**0.858**
RMSEA	<.08	**0.088**
SRMR	<.08	0.052

Note. Bold indicates insufficient model fit. CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = root mean square error of approximation; SRMR = standardized root mean residual.

3.6 Data analysis

Assumptions were checked before the data analysis of which one was not met. Two univariate outliers (z = 3.44, x = 1) on the variable 'medical specialist' were found. The score that would be acceptable when assuming z = 3.29 was calculated to see how big of an outlier these two cases were. Calculation resulted in a score of x = 1.20, indicating that the score is not extremely unrepresentative and will likely not bias our statistical tests. For this reason, it was decided not to remove or change the outliers. In the following paragraphs used methods of analysis per question will be discussed.

RQ1a. The aim of the first research question is to determine if there are different profiles in the PI of TM students. Through k-means cluster analysis, participants who have the similar answer patterns were grouped together forming a cluster. A fixed number of clusters must be entered when performing the analysis. Therefore, the options of having three to seven clusters were examined. The cluster solution that fitted the data best was selected by inspecting the iteration history and ANOVA's. Lastly, the clusters were analysed with the help of theory to arrive at clusters that were both statistically and theoretically appropriate.

RQ1b. Moreover, the relationship between PI content and strength was examined. One-way ANOVA with Bonferroni post-hoc testing was run because Bonferroni guarantees control over Type I errors and it does not necessarily need equal sample sizes (Field, 2009).

RQ1c. Research question 1c investigated the differences in PI content between students differing in their study phase. To answer this research question, chi-square analysis was performed.

RQ1d. Fourth, the relationship between study phase and PI strength was examined. Spearman's correlation coefficient was conducted, which is a non-parametric test to examine correlation in non-normally distributed data when one or two of the variables is ordinal (Field, 2009). In addition, a one-way ANOVA was run. Levene's test showed significant results F (371) = 3.23, p = .007), therefore Games-Howell post-hoc testing was done because this test is robust to unequal variances (Field, 2009).

RQ2. Fifth, the relationship between study phase and intended career choice and career development was examined. MANOVA was conducted to answer this research question. Checking of assumptions revealed that the assumption of homogeneity of variance was not met for two variables. Levene's test showed significant results for career confidence (F (364) = 3.33, p = .006) and medical specialist (career choice) (F (364) = 8.40, p < .001). Post-hoc testing for these variables was done with Games-Howell instead of Bonferroni.

RQ3a. Another MANOVA was run to examine to what extent differences in the intended career choice and career development of TM students is depend upon their PI content.

RQ3b. Additionally, the relationship between TM students' PI strength and their intended career choice and career development was examined. To answer this research question, two different analyses were run. First, MANOVA was run to find answers on how PI strength and intended career choice are related. Again assumption of homogeneity of variance was not met for the variable medical specialist (F (365) = 4.03, p = .003). Games-Howell post-hoc testing was be done instead of Bonferroni. Second, a model was hypothesised about the relationship between PI strength and the three career development variables: career clarity, exploration, and confidence. This model was tested by means of moderation and mediation analysis using PROCESS macro in SPSS.

CHAPTER 4 RESULTS

4.1 Descriptive statistics

In Table 7 means, standard deviations and correlations between all continuous variables are depicted. Of the career development variables, TM students scored highest on career confidence (*M* = 4.67, *SD* = 1.14) and lowest on career clarity (*M* = 3.93, *SD* = 1.25). With regard to job context, students were most likely to work in a hospital (*M* = 5.50, *SD* = 1.41) five years after graduating and least likely to work at a university (*M* = 3.38, *SD* = 1.43). Students scored highest on working as medical specialist (*M* = 5.54, *SD* = 1.32) and lowest on working as a designer (*M* = 3.58, *SD* = 1.34).

In this section the most important significant correlations will be discussed (see Table 7 for significance values). First, study phase was significantly positively correlated with working at a company (*r* = .21) and career exploration (*r* = .21). Study phase was negatively correlated with PI strength (*r* = -.23), working as medical specialist (*r* = -.33), working at a hospital (*r* = -.16), and career confidence (*r* = -.22). PI strength was positively correlated with working as researcher (*r* = .28), medical specialist (*r* = .27), working at a hospital (*r* = .35), university (*r* = .14), career clarity (*r* = .25), and career confidence (*r* = .56). Second, strength was negatively correlated with working at a company (*r* = -.13) and career exploration (*r* = -.12). With regard to career development, career exploration was positively correlated with working as a consultant (*r* = .12), career clarity (*r* = .44), and negatively correlated with working as designer (*r* = -.11). Career clarity was positively correlated with working as medical specialist (*r* = .23), working at a hospital (*r* = .23), and career confidence (*r* = .40). It was negatively correlated with working at a company (*r* = -.13). Lastly, career confidence was positively correlated with working as a researcher (*r* = .19), medical specialist (*r* = .16), with working in a hospital (*r* = .16), and a company (*r* = .15). Overall, students with a high PI strength also have high confidence in their career as TP, high career clarity but low exploration. Students with low PI strength will likewise have higher career exploration However, correlations show that students high on exploration also have high career clarity. This can be explained by the fact that PI strength and career confidence are TM specific variables, whereas career clarity and exploration were not measured with regard to a profession.

It was decided that further analysis with the variable intended career choice was done with solely job type instead of both type and context. This was done because hospital and medical specialist (*r* = .51), university and researcher (*r* = .38), company and manager (*r* = .38)/consultant (*r* = .35) were moderately correlated.

Table 7
N, Means, SD and correlations for all continuous variables

				Correlations												
	N	*Mean*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Study phase	379	3.16	1.68	1												
2. PI strength	377	4.92	0.99	-.23**	1											
Job type																
3. Researcher	370	3.86	1.57	.08	.28**	1										
4. Designer	370	3.58	1.34	.03	.02	.21**	1									
5. Manager	370	3.89	1.47	-.06	-.04	-.12*	.04	1								
6. Consultant	370	4.03	1.50	.04	.05	-.10*	-.02	.53**	1							
7. Medical specialist	370	5.54	1.32	-.33**	.27**	-.14**	-.13*	.03	-.01	1						
Job context																
8. Hospital	370	5.50	1.41	-.16**	.35**	.01	-.17**	-.23**	-.17**	.51**	1					
9. University	370	3.38	1.43	-.02	.14**	.38**	.10*	.03	-.06	-.03	.07	1				
10. Company	370	4.00	1.60	.21**	-.13*	-.03	.20**	.38**	.35**	-.24**	-.48**	-.10*	1			
Career development																
12. Career clarity	375	3.93	1.25	-.09	.25**	-.02	-.07	-.05	-.07	.23**	.23**	-.03	-.13*	1		
11. Career exploration	375	4.52	1.27	.21**	-.12*	-.05	-.11*	.09	.12*	-.02	-.09	.02	.10	.44**	1	
13. Career confidence	376	4.67	1.14	-.22**	.56**	.19**	.05	-.02	-.01	.16**	.16**	.15**	.04	.40**	-.01	1

Note. ** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

4.2 RQ1 – What are variations in TM students' PI and how are these related to study phase?

To answer this question, first analysis of PI content of TM students resulted in several profiles of TM students. Secondly, the relationship between PI content and strength was examined. Third, differences in PI content across study phase were analysed. Lastly, the relation between study phase and PI strength was inspected.

4.2.1 RQ1a – What profiles can be deduced to describe variations in the PI content of TM students?

The goal was to establish profiles to describe variations in the PI content of TM students. The 28 factors on the four domains of PI were used to determine profiles of the various types of TM students by means of *k-means* clustering analysis. Based on theoretical considerations, solutions of three to seven clusters were examined. One participant was excluded from the data analysis because he formed a cluster on his own. This was due to his extremely negative answer pattern indicating he did not take participation seriously. Firstly, iteration history was inspected. When the algorithm converged, this means there is no further change in the assignment of instances to clusters indicating cluster stability (Wagstaff, Cardie, Rogers, & Schroedl, 2001). Secondly, ANOVA's were inspected from which was determined if all factors significantly contributed to the cluster formation. As a result, both the five- and six-cluster solution showed good fit. A five-cluster solution was chosen as this was the theoretically most logical solution.

The five established profiles were: individualist, engineer, all-rounder, security seeker and status driven. The *individualist* TM student is rational and has no problems living an unpredictable life and having weaker family relations. At the same time, this type is interested in society and would like to work in an international context. In comparison to the other students, the individualist is not (yet) good at competences and scores low on cognitive-, technical-, and medical skills. The *engineer* TM student enjoys being at his computer and is good at working with (medical) technology and designing diagnostic methods. The engineer likes working in an international context and values gaining status and influence within their job. They see themselves as introvert students who are self-centred and not good at managing themselves. The *all-rounder* students score positive on almost all factors, which makes them all-rounders amongst TM students. These students are interested in society and see themselves as being good at managing themselves and the people around them. At the same time, this type is also good at research, technical- and medical practice. In the future they want to be healthy, have good family relations and they value enjoying life. The *security seeker* has an emotional and modest character and values having a family life and stability in life. These TM students do not consider themselves to be good managers nor good at networking and are not keen on having a prestigious job in an international context. The last profile is the *status driven* TM student, who is extraverted and interested in fashion an beauty. These students consider themselves to be good at managing while they are not that good at doing research, working with (medical) technology and designing new diagnostic methods. They are open-minded but also indifferent and self-centred students who value being successful in life whilst fully enjoying it. The five profiles are shown in Figure 3.

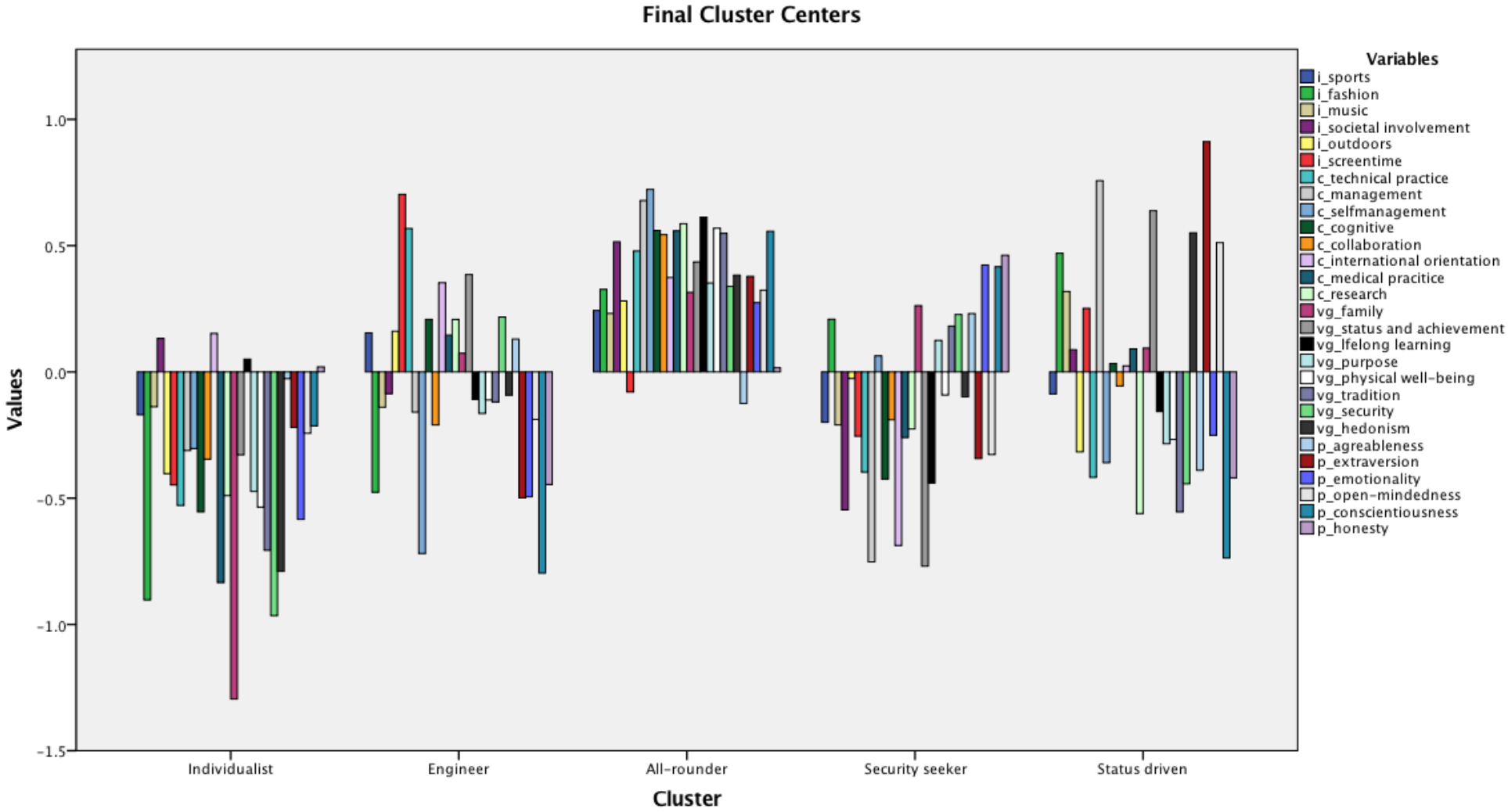

Figure 3. Overview of the five profiles and the standardized score per factor.

Distribution of profiles. Chi-square analysis showed that gender was not equally distributed across the profiles, X^2 (4) = 98.87, $p < .001$. Post-hoc analysis was performed by looking at the adjusted residuals and showed a significant unequal gender distribution within two profiles (see Table 8). Men were significantly overrepresented in the engineer profile ($z = 7.8$, $p < .001$), while women were overrepresented in the profile of the security seeker ($z = 7.7$, $p < .001$).

Table 8
Gender distribution within the profiles

Profile	Frequency	% of total	Female	% of total	Male	% of total
Individualist	53	14.0%	30	7.9%	23	6.1%
Engineer	67	17.7%	*18*	*4.7%*	**49**	**12.9%**
All-rounder	105	27.7%	76	20.1%	29	7.7%
Security seeker	107	28.2%	**104**	**27.4%**	*3*	*0.8%*
Status driven	47	12.4%	28	7.4%	19	5.0%
Total	379	100%	256	67.5%	123	32.5%

Note. **Bold** indicates significantly more than expected, *italic* indicates significantly less than expected.

4.2.2 RQ1b – What is the relationship between TM students' PI content and strength?

Inspection of Figure 4 shows the all-rounder had the highest strength of PI ($M = 5.26$, $SD = 0.96$) followed by the status driven ($M = 4.96$, $SD = 0.99$) and engineer ($M = 4.90$, $SD = 1.04$). The security seeker ($M = 4.76$, $SD = 0.92$) and individualist showed the lowest PI strength ($M = 4.57$, $SD = 0.93$).

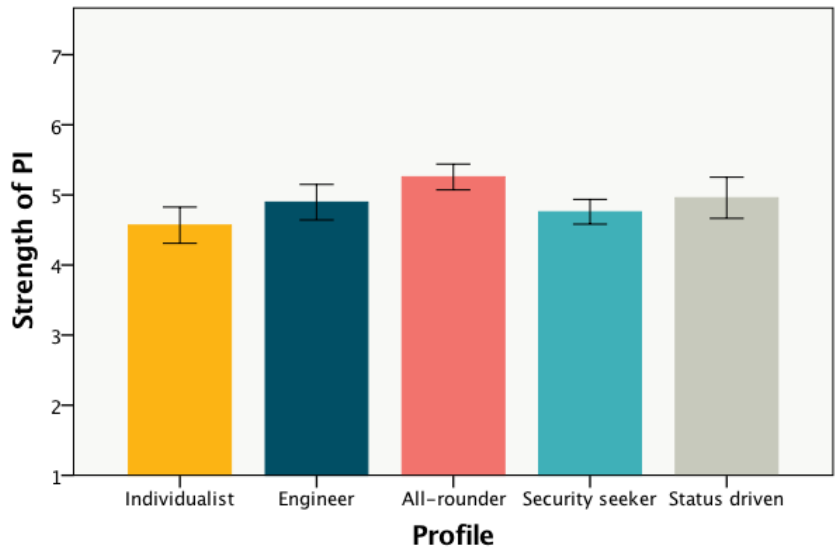

Figure 4. Means of strength of professional identity for the different profiles.

To examine the relationship between PI content and strength, one-way ANOVA with Bonferroni post-hoc test was performed. Results supported that PI content and strength were related as a significant difference between strength of PI of the five profiles was found, F(4, 372) = 5.729 $p < .001$ $\omega^2 = 0.048$, representing a medium effect (Kirk, 1996; as cited in Field, 2009). Bonferroni post-hoc testing showed that the PI strength of the all-rounder was significantly higher than the strength of identity of the individualist ($p < .001$) and the security seeker ($p = .002$). 5.8% of the variance among PI strength was explained by PI content.

4.2.3 RQ1c – What are differences in TM students' PI content across different study phases?

The goal was to investigate how students in different study phases differ in their PI content. Figures 5 shows the distribution of the profiles within each study phase. What is noticeable is that the engineer seems to become more present towards the last years of the study. Remarkably, the security seeker seems equally distributed across study phases. Lastly, it shows that the status driven profile is mostly represented in the bachelor and is underrepresented in the master. Chi-square analysis was performed and showed that the profiles were indeed unequally distributed across the different study phases, X^2 (20) = 40.95, p = .004.

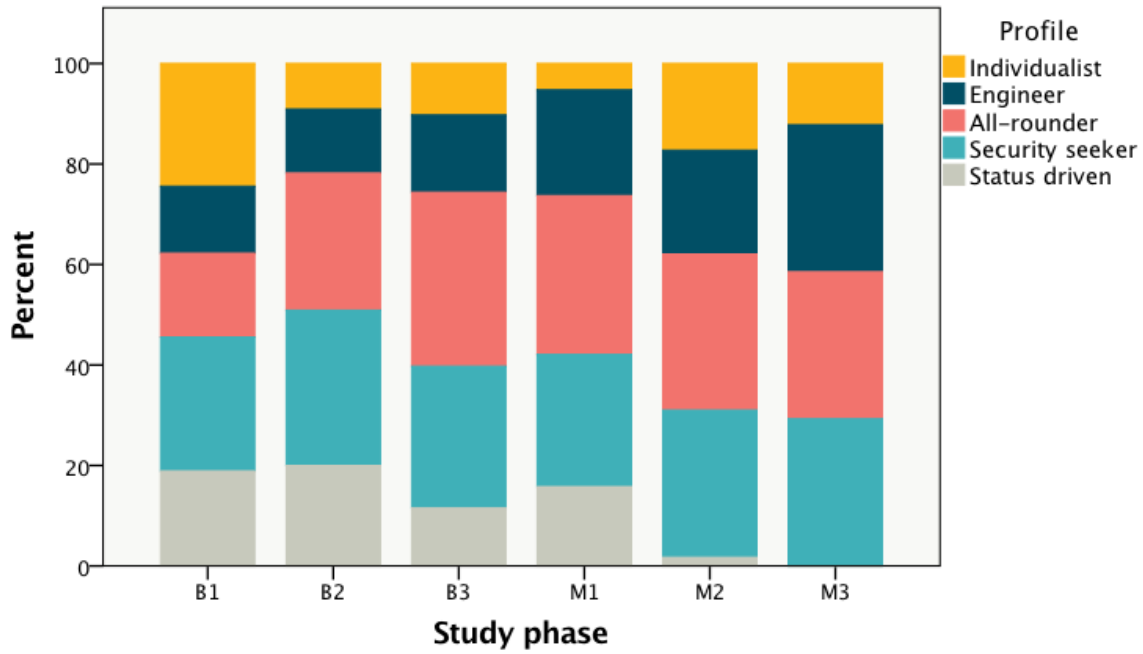

Figure 5. Stacked bar chart showing the percentages of the profiles within each study phase.

Post-hoc testing (interpreting adjusted residuals) showed a significantly different distribution of the profiles across several study phases (see Table 9). There were significantly more B1 students (z = 3.3, p < .001) and less M1 students (z = -2.1, p < .05) with an individualist profile than expected. Also there were more M3 students (z = 2.1, p < .05) with an engineer profile and less B1 students (z = -2.7, p < .01) with an all-rounder profile than expected. The security seeker was equally distributed across study phase as post-hoc showed no significant result. Lastly, there were more B1 students (z = 2.1, p < .05) but less M2 (z = -2.7, p < .01) and M3 students (z = -2.6, p < .01) with a status driven profile than expected. To compare bachelor and master-students, another Chi-square was performed and showed the profiles were unequally distributed across bachelor and master students, X^2 (4) = 14.08, p =. 007. Post-hoc analysis showed there were more engineers in the master than in the bachelor (z = 2.3, p < .05). At the same time, there were more status driven students in the bachelor than in the master (z = 3.0, p < .01). In conclusion, there indeed are differences in PI content across students from different study phases. Most notability is the underrepresentation of engineers in the bachelor, and underrepresentation of status driven TM students in the master.

Table 9
Distribution of profiles within study phase

Profile		B1	B2	B3	M1	M2	M3	Total
Individualist	Observed count	**22**	5	8	*3*	10	5	53
	Expected count	**12.6**	7.7	10.9	*8.0*	8.1	5.7	53.0
	%	**24.4%**	9.1%	10.3%	*5.3%*	17.2%	12.2%	14.0%
Engineer	Observed count	12	7	12	12	12	**12**	67
	Expected count	15.9	9.7	13.8	10.1	10.3	**7.2**	67.0
	%	13.3%	12.7%	15.4%	21.1%	20.7%	**29.3%**	17.7%
All-rounder	Observed count	15	15	27	18	18	12	105
	Expected count	24.9	15.2	21.6	15.8	16.1	11.4	105.0
	%	16.7%	27.3%	34.6%	31.6%	31.0%	29.3%	27.7%
Security seeker	Observed count	24	17	22	15	17	12	107
	Expected count	25.4	15.5	22.0	16.1	16.4	11.6	107.0
	%	26.7%	30.9%	28.2%	26.3%	29.3%	29.3%	28.2%
Status driven	Observed count	**17**	11	9	9	*1*	*0*	47
	Expected count	**11.2**	6.8	9.7	7.1	*7.2*	*5.1*	47.0
	%	**18.9%**	20.0%	11.5%	15.8%	*1.7%*	*0%*	12.4%
Total	Observed count	90	55	78	57	58	41	379
	Expected count	90	55	78	57	58	41	379
	%	23.7%	14.5%	20.6%	15.0%	15.3%	10.8%	100%

Note. **Bold** indicates significantly more than expected, *italic* indicates significantly less than expected.

4.2.4 RQ1d – What is the relationship between TM students' study phase and their PI strength?

Strength of PI was highest amongst B1 students (M = 5.30, SD = 0.74) followed by M1 students (MD = 5.14, SD = 0.91), and B2 students (M = 5.02, SD = 0.91). M2 students scored lowest on PI strength (M = 4.44, SD = 1.04), followed by B3 students (M = 4.70, SD = 1.07), and M3 students (M = 4.70, SD = 1.07). The scores per study phase were plotted (see Figure 6).

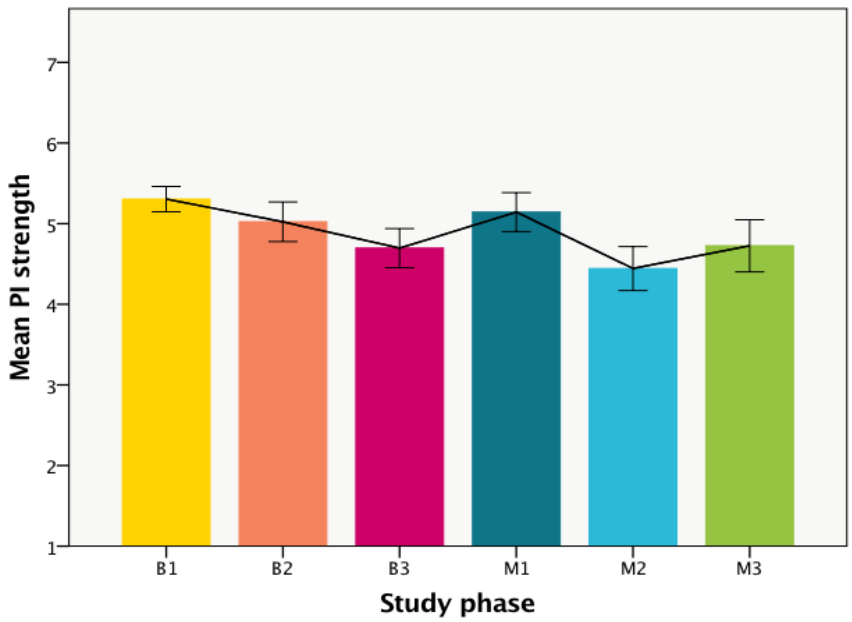

Figure 6. Means of strength of professional identity for each study phase.

Spearman's rank-order correlation was run to determine the relationship between students' study phase and their strength of PI. There was a weak negative correlation between study phase and strength of PI, which was statistically significant r_s = -.226, p < .001. In addition, one-way ANOVA with Games-Howell post-hoc was performed to examine differences between groups. A significant difference in PI strength between study phases was found (F(5, 371) = 7.032, p < .001). B1 students had significantly higher PI strength than B3 (p < .01), M2 (p < .001) and M3 students (p < .05). M2 students scored significantly lower than B2 (p < .001) and M1 students (p < .01).

4.3 RQ2 – What is the relationship between TM students' study phase and their intended career choice and career development?

Descriptive statistics of career choices were already inspected in section 4.1. MANOVA's were run to inspect the relationship between study phase and intended career choice and career development of TM students.

The first MANOVA was run to examine the relationship between study phase and intended career choice. Pillai's Trace test showed there was a significant effect of study phase on intended career choice, $V = .250$, $F(30, 1815) = 3.19$, $p = < .001$. The career choices of designer and medical specialist showed to be significantly different depending upon study phase. A second MANOVA was run to examine the relationship between study phase and the career development variables: career clarity, exploration and confidence. Pillai's Trace test showed there was a significant effect of study phase on these three variables, $V = .189$, $F(15, 1207) = 4.96$, $p < .001$. Career exploration and career confidence showed to be significantly different depending on study phase. Results of the MANOVA are shown in Table 10.

Scores on intended career choice and the career development variables were plotted for all study phases (Figure 7 and 8). To further explore the data for between-group differences, post-hoc analyses were run. Concerning intended career choice, Bonferroni post-hoc testing indicated students from B2 scored lower than B1 ($p < .05$), M1 ($p < .01$) and M3 ($p < .05$) students on the likelihood to work as a designer five years after graduation. Lastly, students from M2 were significantly less inclined to work as medical specialist than B1, B2 ($p < .001$), B3 ($p < .01$) and M1 ($p < .05$) students. This was also the case for M3 students ($p < .001$). No significant differences between study phase were found with regard to working as researcher, manager and consultant.

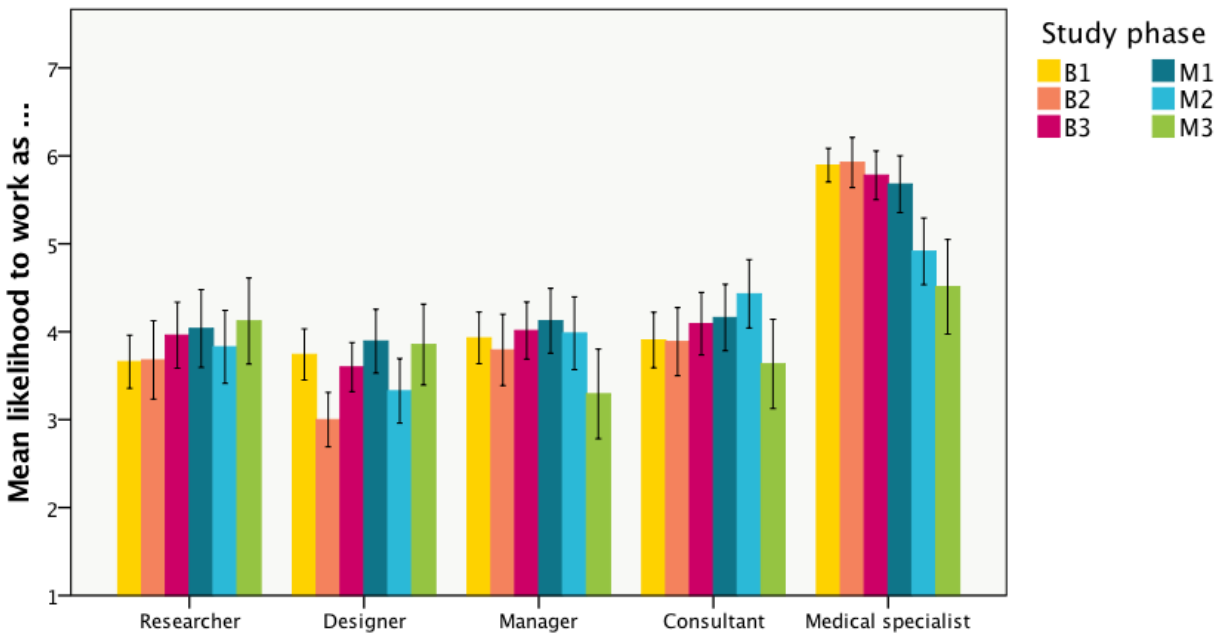

Figure 7. Means scores per study phase on the likelihood to work as researcher, designer, manager, consultant, and medical specialist five years after graduation.

Table 10
Means, SD, and results of MANOVA for intended career choice and career development per study phase

	Study phase									
	B1	B2	B3	M1	M2	M3	MANOVA			
Variable	Mean (*SD*)						Mean square	*F*	*df*	*p*
Intended career choice										
Researcher	3.66 (1.40)	3.68 (1.61)	3.96 (1.65)	4.04 (1.65)	3.83 (1.58)	4.12 (1.55)	2.11	0.86	5	.51
Designer	3.74 (1.35) B2	3.00 (1.13) B1, M1, M3	3.60 (1.23)	3.89 (1.36) B2	3.33 (1.39)	3.85 (1.46) B2	6.46	3.73	5	.00
Manager	3.93 (1.36)	3.79 (1.47)	4.01 (1.43)	4.13 (1.38)	3.98 (1.57)	3.29 (1.62)	4.00	1.89	5	.10
Consultant	3.91 (1.46)	3.89 (1.41)	4.09 (1.57)	4.16 (1.41)	4.43 (1.48)	3.63 (1.61)	3.88	1.75	5	.12
Medical specialist	5.89 (.89) M2, M3	5.92 (1.03) M2, M3	5.78 (1.22) M2, M3	5.68 (1.21) M2, M3	4.91 (1.44) B1, B2, B3, M1	4.51 (1.70) B1, B2, B3, M1	18.01	11.92	5	.00
Career development										
Career clarity	4.16 (1.12)	3.90 (1.33)	3.96 (1.20)	3.78 (1.23)	3.64 (1.34)	4.00 (1.38)	2.21	1.42	5	.22
Career exploration	4.15 (1.13) B3, M2, M3	4.13 (1.30) B3, M2, M3	4.90 (1.19) B1, B2	4.28 (1.22)	4.89 (1.42) B1, B2	4.92 (1.11) B1, B2	9.91	6.57	5	.00
Career confidence	5.13 (.93) B3, M2, M3	4.92 (1.29)	4.30 (1.07) B1	4.68 (1.06)	4.25 (1.27) B1	4.58 (.91) B1	7.18	8.56	5	.00

Note. B1Significantly different from B1. B2Significantly different from B2. B3Significantly different from B3. M1Significantly different from M1. M2Significantly different from M2. M3Significantly different from M3

With regard to career exploration, Bonferroni post-hoc testing showed that students in B3 scored significantly higher on career exploration than B1 ($p < .01$) and B2 ($p < .01$). Also M2 students scored significantly higher than B1 ($p < .01$) and B2 ($p < .05$). Lastly, M3 students showed significantly higher scores than B1 ($p < .05$) and B2 ($p < .05$). Games-Howell post-hoc testing showed that B1 students had significantly more career confidence than students from B3 ($p < .001$), M2 ($p < .001$) and M3 ($p < .05$). No significant differences were found between study phases with regard to career clarity.

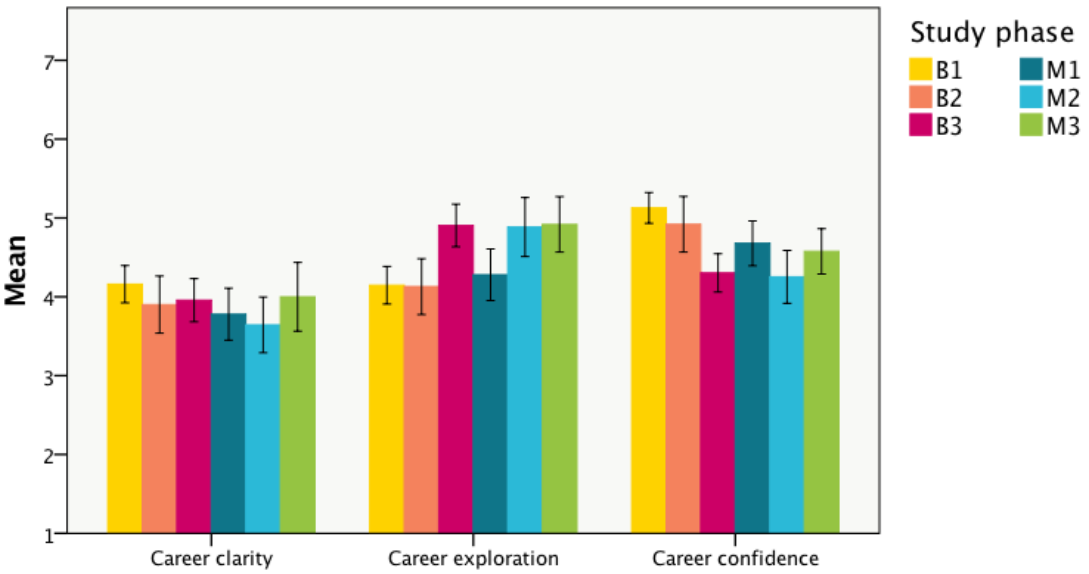

Figure 8. Mean scores per study phase on career clarity, exploration, and confidence.

To conclude, results indicate that differences in intended career choice and career development can be explained by study phase. Results show that career confidence is lower, while career exploration is higher towards the end of the study. Concerning intended career choice, likelihood to work as a designer is lowest at B2. Most importantly, results suggest that the likelihood to work as a medical specialist is lower in the master in comparison to the bachelor.

4.4 RQ3 – How is the relationship between TM students' PI and their intended career choice and career development?

To answer this question, it was inspected to what extent differences in TM students' intended career choice and career development could be explained by their PI content. Secondly, the relationship between PI strength and both intended career choice and career development was inspected.

4.4.1 RQ3a – To what extent can differences in TM students' intended career choice and career development be explained by their PI content?

Two separate MANOVA's were run to test the relationship between PI content and intended career choice, and the relationship between PI content and the career development variables. Analyses revealed that TM students' intended career choice and career development could indeed be explained by their PI content. Pillai's Trace test showed there was a significant effect of PI content on intended career choice (V = .169, F(20, 1456) = 3.22, p < .001) and on the three career development variables: career clarity, exploration and confidence (V = .174, F(12, 1110) = 5.69, p < .001). Results showed that the career choices of manager, consultant and medical specialist significantly differed depending on the content of PI. This was also the case for career clarity, exploration, and confidence. Results of MANOVA can be found in Table 11.

Scores on intended career choice and the career development variables were plotted for all profiles of PI (Figure 9 and 10). Again, post-hoc analysis were run to further explore the data for between-group differences. With regard to intended career choice, the individualist significantly less (p < .05) intended to work as a manager five years after graduating than the all-rounder. The security seeker also intended significantly less (p < .001) to work as a manager than the all-rounder and the status driven. The all-rounder scored significantly higher on the likelihood to work as a consultant than the security driven (p < .001). Post-hoc testing did not reveal significant differences between the profiles for working as a medical specialist.

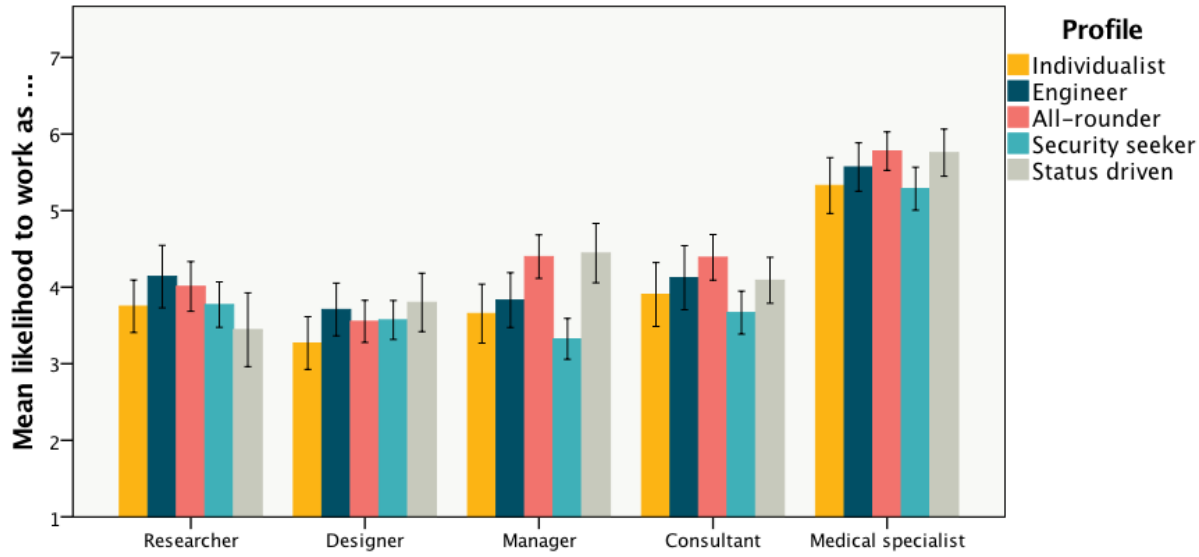

Figure 9. Mean scores on likelihood to work as researcher, designer, manager, consultant and medical specialist per profile of professional identity.

Table 11
Means, SD, and results of MANOVA for intended career choice and career development per profile of professional identity

	Profile of professional identity					MANOVA			
	Individualist	Engineer	All-rounder	Security seeker	Status driven				
Variable	*M* (*SD*)					Mean square	*F*	*df*	*p*
Intended career choice									
Researcher	3.75 (1.23)	4.14 (1.65)	4.01 (1.66)	3.77 (1.53)	3.44 (1.60)	4.14	1.70	4	.15
Designer	3.27 (1.24)	3.71 (1.39)	3.55 (1.41)	3.57 (1.31)	3.80 (1.27)	2.08	1.16	4	.33
Manager	3.65 (1.38) [c]	3.83 (1.44)	4.40 (1.45) [a, d]	3.32 (1.38) [c, e]	4.44 (1.29) [d]	19.30	9.84	4	.00
Consultant	3.90 (1.50)	4.12 (1.69)	4.39 (1.52) [d]	3.67 (1.45) [c]	4.09 (1.00)	7.16	3.28	4	.01
Medical specialist	5.33 (1.31)	5.57 (1.27)	5.78 (1.28)	5.29 (1.45)	5.76 (1.03)	4.27	2.50	4	.04
Career development									
Career clarity	3.44 (1.12) [b, c]	4.14 (1.33) [a]	4.36 (1.24) [a, d]	3.68 (1.18) [c]	3.78 (1.14)	10.53	7.14	4	.00
Career exploration	4.17 (1.31) [c]	4.36 (1.16) [c]	5.09 (1.17) [a, b, d, e]	4.34 (1.24) [c]	4.26 (1.33) [c]	12.09	8.02	4	.00
Career confidence	4.35 (1.00) [c]	4.86 (1.17) [d]	5.07 (1.19) [a, d]	4.29 (0.99) [b, c]	4.69 (1.09)	9.89	8.25	4	.00

Note. [a]Significantly different from individualist. [b]Significantly different from engineer. [c]Significantly different from all-rounder. [d]Significantly different from security seeker. [e]Significantly different from status driven.

Bonferroni post-hoc testing showed that the individualist scored significantly lower than the engineer ($p < .05$) and the all-rounder ($p < .001$) on career clarity. Also the security seeker scored significantly ($p < .001$) lower on career clarity than the all-rounder. With regard to career exploration, the all-rounder scored significantly higher than all profiles ($p < .01$). The all-rounder scored significantly higher ($p < .01$) on career confidence than the individualist and the security seeker. Furthermore, the engineer scored higher on career confidence than the security seeker ($p < .05$).

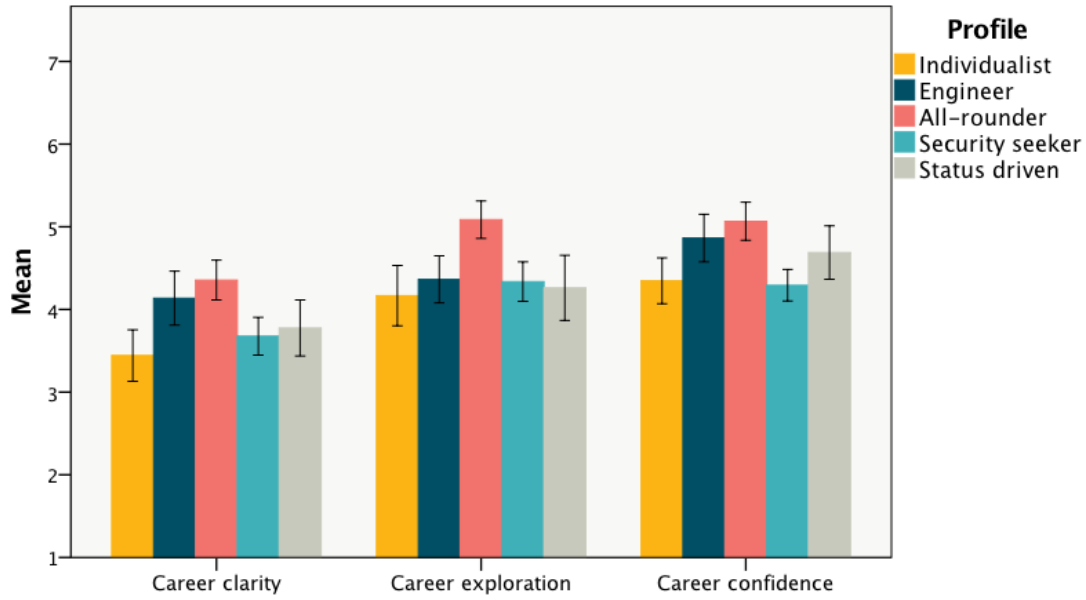

Figure 10. Mean scores per profile of professional identity on career, exploration and confidence.

In conclusion, the all-rounder scores highest on career clarity, exploration and confidence. The individualist and security seeker have the lowest career clarity, exploration and confidence of all profiles. All profiles had the highest intention to become a medical specialist. Working as a manager or consultant was least likely for the individualist and security seeker, and more likely for all-rounder or status driven TM students. Results suggest that intended career choices and career development indeed are dependent upon the content of PI.

4.4.2 RQ3b – How is the relationship between TM students' PI strength and their intended career choice and career development?

To answer this questions, two analyses were run. First, MANOVA was run to test the relationship between PI strength and intended career choice. Second, mediation analysis was run to establish the relation between strength of PI, career clarity, exploration and confidence.

PI strength and intended career choice. In order to examine this relationship, PI strength was transformed into an ordinal variable. Based on the mean ($M = 4.92$) and standard deviation ($SD = 0.99$), three new categories were formed (see Table 12).

Table 12
Strength of professional identity as ordinal variable

Category	Value range	*N*
Low	≤ 3.93	59
Average	> 3.93 and < 5.91	264
High	≥ 5.91	54

MANOVA was run and Pillai's Trace test resulted in a significant effect of PI strength on the intended career choice, $V = .131$, $F(10, 728) = 5.10$, $p < .01$. Results show that intended career choice was indeed dependent upon PI strength. MANOVA showed that researcher and medical specialist significantly differed depending upon the strength of PI. Results of MANOVA are shown in Table 13.

Table 13
Means, SD, and results of MANOVA for intended career choice per category of professional identity strength

	Category of professional identity strength						
	Low	Average	High				
				MANOVA			
Variable	*M* (*SD*)			Mean square	*F*	*df*	*p*
Researcher	3.17 (1.64) [bc]	3.84 (1.43) [ac]	4.73 (1.75) [ab]	33.82	14.79	2	.00
Designer	3.63 (1.45)	3.53 (1.26)	3.73 (1.57)	0.94	0.52	2	.59
Manager	4.02 (1.46)	3.87 (1.44)	3.88 (1.64)	0.53	0.25	2	.78
Consultant	4.00 (1.60)	4.04 (1.48)	4.02 (1.50)	0.05	0.02	2	.98
Medical specialist	5.02 (1.59) [b, c]	5.58 (1.22) [a]	5.88 (1.28) [a]	11.39	6.77	2	.00

Note. [a]Significantly different from low. [b]Significantly different from average. [c]Significantly different from high.

Scores on intended career choice were plotted for the categories of PI strength (Figure 11). Bonferroni post-hoc testing showed that all categories of PI strength significantly differed from each other with regard to intention to work as a researcher five years after graduation ($p < .05$). Students with low PI strength were less inclined to work as researcher, whereas students with high PI strength were most inclined to work as researcher. Games-Howell post-hoc testing showed that students with low PI strength were significantly less inclined to work as medical specialist than students with average ($p < .05$) or high PI strength ($p < .01$). Overall, the higher students' PI strength, the more likely they will want to work as researcher and medical specialist.

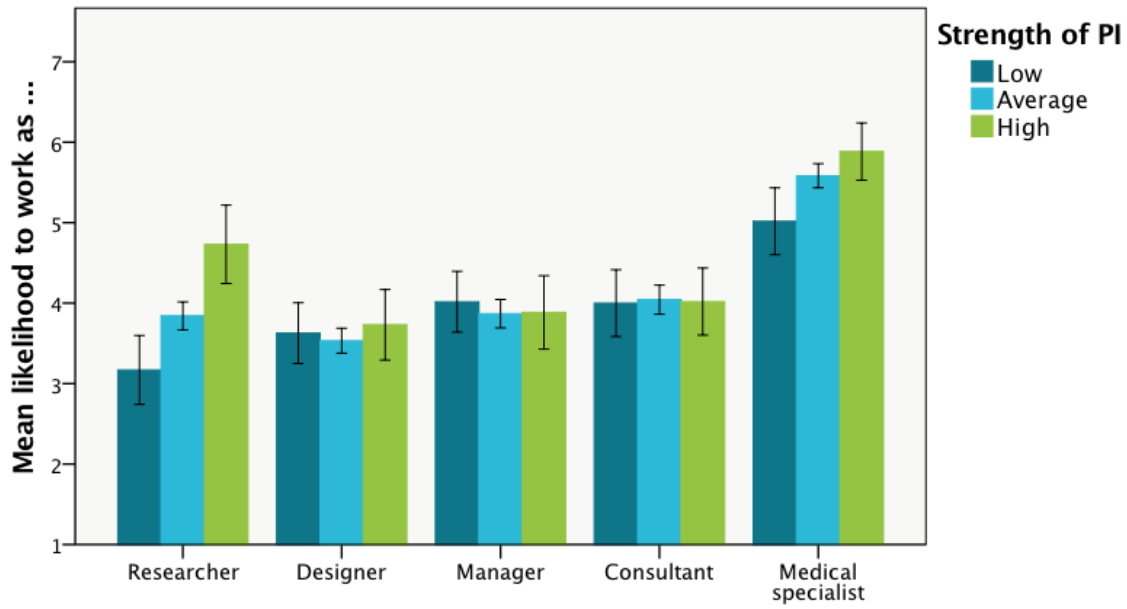

Figure 11. Mean scores on likelihood to work as researcher, designer, manager, consultant and medical specialist per category of professional identity strength.

PI strength and career development. To understand the relationship between PI strength and career clarity, exploration and confidence, a model was built. In this model, PI strength was the independent variable and career clarity the dependent variable. It was expected that career confidence would act as mediator, strengthening the relationship between PI strength and career confidence. It was expected that career exploration would act as a buffer for students with low PI strength as they can still gain career clarity through exploring career options and discussing career plans with others. As such, career exploration could either act as mediator, or act as moderator and thus directly influence the relationship between PI strength and career clarity. Since this is an exploratory study, both expectations were run using PROCESS macro for SPSS. Testing showed that career exploration was not a significant moderator explaining the relationship between strength and career clarity (b = .00, p = .90). A fitting model was established using career exploration as a mediator.

Mediation results are summarised in Figure 12, where the value in parentheses shows the effect of PI strength on career clarity prior to controlling for the effects of the mediator variables. In support of the first condition of mediation analysis, PI strength had a significant direct effect on career clarity, ignoring both mediators (b = .32, t(375) = 4.95, p = < .001). Secondly the model shows that the regression of PI strength on the mediators, career confidence (b = .65, t(375) = 13.15, p < .001) and career exploration (b = -.15, t(375) = -2.24, p < .05) was also significant. In addition, the relationship between the mediators career confidence (b = .38, t(375) = 6.94, p < .001) and career exploration and career clarity (b = .46, t(375) = 10.85, p < .001.) were significant. The third condition was not supported because inclusion of the mediators did not drop the relationship between PI strength and career clarity to a non-significant effect (b = .13, t(375) = 2.08, p < .05). This finding indicates that there is no full mediation as the direct effect *c'* is still significant.

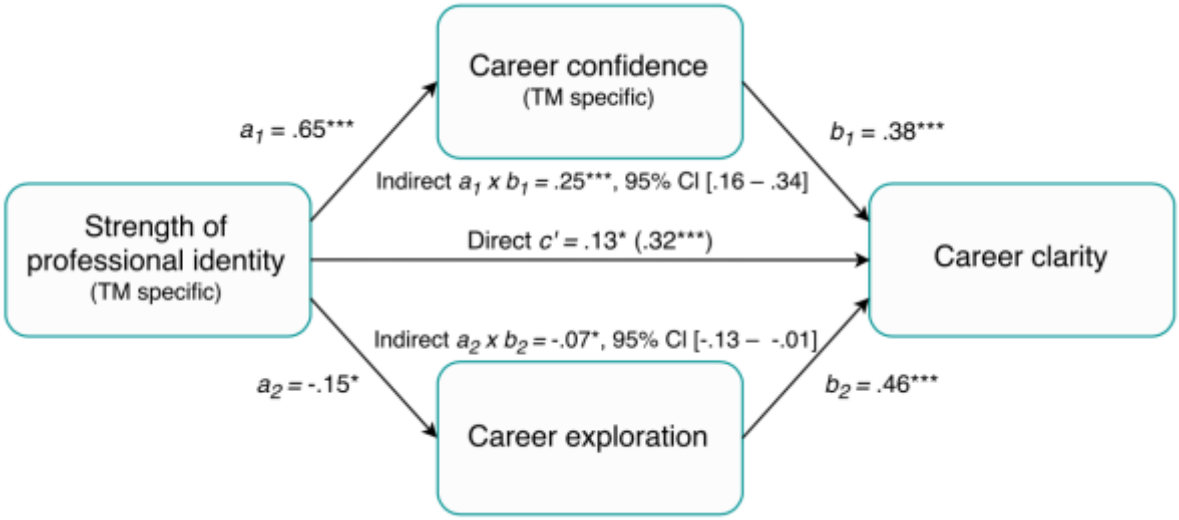

Figure 12. Mediation model with career confidence and exploration mediating the relationship between strength of professional identity and career clarity.
Note. b = unstandardized. Bootstrapping = 1000. *p < .05, **p < .01, ***p < .001.

To establish mediation, significant indirect effects are all that matter (Zhao, Lynch Jr., & Chen, 2010). An indirect effect of $a_1 \times b_1$ was found positive and significant (b = .25, z = 6.12, p < .001), with a 95% confidence interval excluding zero [.16 - .34]. In this path, when PI strength is held fixed, a unit increase in career confidence (0.65) will increase career clarity by 0.25 on a 1 to 7 scale. Since $a_1 \times b_1 \times c'$ is positive (0.03), it is a complementary mediation (Zhao et al., 2010). Also an indirect effect of $a_2 \times b_2$ was found negative and significant (b = -.07, z = -2.19, p < .05), with a 95% confidence interval excluding zero [-.13 - .01]. Likewise, when PI strength is held fixed, a unit increase in career exploration (-0.15) will decrease career clarity by 0.07 on a 1 to 7 scale. Since $a_2 \times b_2 \times c'$ is negative (-0.01), it is a competitive mediation (Zhao et al., 2010). Comparing both mediators, career confidence shows greatest added value in explaining the relationship between PI strength and career clarity.

In conclusion, the effect from PI strength on career clarity is partially mediated through career confidence and exploration. Results indicate high PI strength is associated with more career clarity. In addition, student with high PI strength, are also more confident to become a successful TP which in turn leads to more career clarity. Students with low PI strength, are engaging in more exploration behaviour and in turn develop more career clarity supporting our expectation.

CHAPTER 5 CONCLUSION

The main goal of this study was to understand the relation between PI of TM students and their intended career choice and career development, and how this is influenced by study phase. Firstly, this research shows that the group of TM students is diverse since five different profiles of PI are found, of which the engineer and all-rounder identified most strongly with being a TP. Secondly, this study shows in *what point in time* students differ in their career development from fellow students. For instance, the end of the bachelor and master are crucial moments in which students' identification and confidence are lowest and exploration is highest. Also students from all study phases are most inclined to become medical specialist, however this is lower amongst master students. Thirdly, PI as predictor shows *how* TM students differ from each other with regard to their intended career choice and career development. All-rounder students show greater career clarity, exploration and confidence, followed by engineers, than their individualist and security seeker fellow students. Furthermore, students with a status driven and all-rounder profile are more likely to work as manager or consultant. Students with a strong PI are more likely to work as medical specialist or researcher, being prototypical jobs for a TP. This study also revealed that students who highly identify with TP will experience more career clarity, which will be even more strengthened by one's confidence. For students that identify less, exploration of career options can act as a buffer to still gain career clarity. To sum up, this study shows that TM students have different views of who they are as TP and this varies across study phase. Furthermore, the more stereotypical students are more confident in their career as TP, and are more likely to opt for a career as medical specialist or researcher.

CHAPTER 6 DISCUSSION

This study had three goals. First, to understand the variations in PI content and strength of TM students in relation to their study phase. Second, to understand how TM students' study phase was related to their intended career choice and career development. Lastly, to relate TM students' PI content and strength to their intended career choice and career development. In the following paragraphs the outcomes of this study and its implications for theory will be discussed for each goal. Additionally, methodological strengths and weaknesses as well as the practical implications will be presented. This chapter ends with a final conclusion.

6.1 Goal 1 – understanding variations in PI content and strength of TM students in relation to study phase

The first aim of this study was to understand variations in the PI of TM students and how PI is developed, as this will likely differ from clearly defined professions. In contrast to more traditional fields of expertise, for TM students it might be more difficult to identify with their profession because clear group information and stereotypes are absent (Van Veelen et al., 2013). This study therefore aimed to uncover what constitutes the PI of TM students. As a result, five profiles of TM students were identified based on the content of their PI (RQ1a); the *individualist* TM student is rational and has no problems living an unpredictable life. The *engineer* TM student is introvert but does value status and is good at working with technology and designing new diagnostic methods. The *all-rounder* TM student likes everything and seems to be good at everything. All-rounders especially value social relationships and are good at doing research and medical and technical practice. The *security seeker* TM student is emotional, modest and, above all, values security and is therefore not keen on managing others or having a prestigious job. Lastly, the *status driven* TM student is an extravert and self-confident type who values becoming successful in his job. From this we can conclude that the group of TM students is not homogenous and that students view themselves differently as TP. These profiles amongst TM students show major overlap with these of STEM students found by Möwes et al. (2017). In both groups there are students with a status driven, security seeking and all-rounder profile. The TM engineer shows similarities with the nerd amongst STEM students. However in contrast with the nerd found by Möwes et al. (2017), the TM engineer does value status and power. Likewise, the STEM einzelgänger and TM individualist show overlap as they both show low self-assessment and a disvalue for security in life. The difference is that the TM individualist shows an interest in society and the world whereas the einzelgänger is not that interested in social contact. Overall, the profiles found in this study seem not that specific for TM. Furthermore, against expectations is that there is no profile that predominantly distinguishes a type of TM students based on medical characteristics, whereas the engineer is technically oriented and the all-rounder is both medical and technical. An explanation for this could be that it may have been hard for students to judge their medical competences because these are not addressed until end B3 and in the master. Hence, future research should delve into how medical facets of PI could be measured to better understand how the PI of TM students differs from their fellow STEM students.

Interestingly, there is a great difference in the gender distribution across the profiles. Male TM students are overrepresented within the profile of engineer, whereas security seeker TM students are almost exclusively female. This might be due to a lack of confidence as female engineering students tend to rate their engineering skills lower than men. Also, they have to prove they are skilled engineers because of the stereotypical masculine image of engineers (Cech et al., 2011). As such, it might explain why female students remain insecure as TP's and male students have less problems acknowledging their technical characteristics as self-defining. Another notable finding is the large group of security seekers (N = 107). One could argue that having a security seeker profile is not really convenient when you are expected to be a pioneer and carve the path for a new profession in health care. At the same time, it could also be that these students are especially aware of the insecurity this profession brings about, which makes it apparent that this is a central aspect in their PI. To conclude, the large representation of security seekers might be what characterizes PI development in an emerging field of expertise, in comparison to more traditional ones such as engineering.

In addition, this study aimed to understand how the types of TM students differed in their strength of identification with the profession (RQ1b). It was found that strength of PI significantly differed between the profiles, supporting our conceptualisation that PI content and strength were indeed related. The all-rounder scored highest followed by the engineer, whereas the security seeker and the individualist scored lowest. Interpretation of these results suggests that the all-rounders and engineers have embodied the attributes of the profession as their own, which makes them a prototype of the profession (Ashforth et al., 2008). In this line of reasoning, the security seeker and individualist are the least prototypical TM students. However, this interpretation is based upon a medium effect. Overall, it seems that all TM students to some degree perceive a fit between their PI and the expectations of the profession. Moreover, it should be considered that the all-rounder can also be a person that just scores high on everything. A self-report study such as this might suffer from self-serving attributional bias, meaning that students had the tendency to view themselves positively, and attribute negative aspects of the self to other causes (Mezulis, Abramson, Hyde, & Hankin, 2004).

Furthermore, the aim was to uncover the differences in students' PI content across different study phases (RQ1c). The profiles were unequally distributed across study phase since there were more status driven students in the bachelor than master, and more engineers in the master than bachelor. When looking on a more detailed level, there are significantly more individualist TM students in the B1 and less in M1. Moreover, engineers are overrepresented in the M3-cohort. In contrast, the status driven student is underrepresented in M2 and M3, but overrepresented in B1. An explanation could be that status driven TM students opt for another master, while engineer TM students come to value their technical competences in a medical context and stayed as a master student. The all-rounder is underrepresented amongst B1 students and is distributed equally across the other study phases. This seems logical because the all-rounder student is someone who has broadly developed himself, which is unlikely at the start of one's education. Striking is however that the security seeker is equally distributed across the study phases. In this case one would expect that students in their master would be more self-confident, or chose for another profession that has lower insecurity after their bachelor. To sum up, the profiles of PI are differently distributed across study phase. It seems that individualist and status driven TM students are more typical bachelor students, whereas engineer students

are more typical master students. However, the disadvantage of this cross-sectional research is that it remains unknown if people change in their profile over time or if the cohorts are made up of different people. Future longitudinal research is therefore needed, to investigate if students can change their profile of PI during their study and what are critical moments that cause such a change.

Lastly, the aim was to understand how PI strength develops during the study (RQ1d). This study found that identification with the profession decreased over the years of study, being highest amongst B1 and M1 students and lowest amongst B3 and M2 students. This finding is not in line with our expectation, namely that identification would increase due to meaningful experiences with the profession (Pierrakos et al., 2009). An explanation for high identification amongst first year bachelor and master students could be that they have just chosen their study program and as such highly identify with it, given their fresh choice. Also low identification amongst B3 and M2 students can be because of their first encounters with the practice of being TP during their internships. In comparison to medicine students, TM students will likely encounter less or no TP role models in practice with whom they can identify. When students have no role models to interact with, it will be more difficult to develop an image of who they want to be, which will cause them to start doubting if becoming a TP fits them (Ibarra et al., 1999). In conclusion, PI strength drops over the years which might be explained by increasing experiences with the profession and the lack of role models in practice. Qualitative follow-up research could investigate why PI decreases, to increase understanding of how students can be supported in their development throughout their study. In addition, future research should investigate if this drop in identification is distinctive for students in emerging professions, or if this is a natural course of PI development amongst young professionals in health care.

6.2 Goal 2 – relating TM students' study phase to their intended career choice and career development

This study's second goal was to investigate how TM students' intended career choice and career development could be explained by their study phase. To start with intended career choice, students of all study years are most inclined to work as medical specialist and least inclined to work as designer five years after graduation. Results show that these intentions to work as designer and medical specialist are different across study phase. B2 students score lowest on working as a designer in comparison to the more motivated students from B1, M2 and M3. Remarkable is that, compared to their fellow students from other years, M2 and M3 students show significantly lower preference to work as a medical specialist. For the other career choices of researcher, manager and consultant, no differences between study phases were found. Overall, it seems that the more prototypical job of medical specialist is less popular in the master, while intention to become a designer is higher in the master.

In addition, results show that career exploration differs per study phase, whereas career clarity does not. Students from B3, M2 and M3 score highest on career exploration. This is a logical finding as career exploration will likely increase when B3 students have to choose their master or when master students start thinking about their career path at the end of their studies. Interestingly, career clarity does not significantly differ per study phase, suggesting that students do not get a clearer image of their career aspirations and interests over time. However,

this was expected as other studies found that students develop a greater career clarity through interacting with role models and meaningful experiences in practice (Adams et al., 2006; Pierrakos et al., 2009). Following this, it would be more likely that both students who decide to persist or leave the profession, increase on career clarity. An explanation for the contrary might be that students are not yet ready to decide what kind of job suits them best and if this is a job as a TP or not. Lastly, B1 students have the highest career confidence, whereas B3 and M2 showed to have the lowest. Again, lower confidence in certain study phases can be explained by the difficulty of developing a clear PI in the absence of TP role models (Ibarra et al., 1999).

To sum up, study phase explains differences amongst students in their career exploration, confidence and career choice preferences. Exploration is highest at the end of one's bachelor and master, while career clarity is equal across study phase. These results show that M2 and M3 students are less confident about their career success and, compared to their fellow students, are less likely to work as medical specialist. At the same time B3 are also less confident with regard to a successful career as TP, but are still more likely than the M2 and M3 students to work as medical specialist.

6.3 Goal 3 – relating TM student's content and strength of PI to their intended career choice and career development

The third goal of this study was to understand how PI content (RQ3a) and strength (RQ3b) of TM students can explain how they picture their career as TP. To start with, this study showed that PI content and strength predicted the career choice of TM students. With regard to PI content, the status driven and all-rounder student are most likely to work as a manager five years after graduation, in comparison to the security seeker and individualist student. The all-rounder is also most likely to work as consultant, compared to the security seeker. This career choice can be explained by the content of their PI as the all-rounder and status driven TM students both are extravert, value status and are good at management tasks. This is in line with Chetkovich (2003), who found that students will opt for a job type or sector that fits their PI content. To sum up, how students view themselves as professional is a good measure to predict the type of job they prefer. A suggestion for future research would be to investigate PI of graduated TM students to uncover variations in their PI in relation to their actual career choice.

Second, PI strength is also related to intended career choices of TM students. Results show that preferring to work as researcher or medical specialist depends on strength of identification with the profession. TM students with stronger identification are more inclined to work as researcher and medical specialist. Students who perceive a greater fit between the self and being TP will more likely take the a role they are educated for, namely applying technology and research in a medical context (Miedema, 2015).

Third, TM students also differ in their career exploration, clarity and confidence depending on the content of their PI. For example, the all-rounder TM student scores higher on career exploration than the other profiles. In contrast to study phase, PI content does significantly predict career clarity. The all-rounder scores higher on career clarity and confidence than the individualist and security seeker, followed by the engineer. This is in line with previous research that showed that conscientious and self-confident persons, such as the all-rounder, are more likely to engage in exploration and developing a clear career image

(Rogers et al., 2008). Overall, the individualist and security seeker TM students score low on all these career development variables. An explanation for this might be that students who are dependent upon parents and feel the need for security, likely experience more career indecision as a way to maintain close relationships (Tokar, Withrow, Hall, & Moradi, 2003). However, this does not support the low career development of the individualist, who is not dependent on significant relations. In this case, it might be that the individualist is not that bothered with knowing what type of job fits him or talking with others about the future. Another explanation might be that the individualist and security seeker identify least with the profession and thus have not incorporated distinctive attributes of the profession into the self. Because they are less prototypical TM students, they might also feel less confident in getting a satisfactory job as TP.

Lastly, this study also showed PI strength and career development to be related. A mediation model was built to analyse the predictive value of PI strength for career exploration, clarity and confidence. Analysis revealed that career exploration and confidence partially mediate the positive relationship between PI strength and career clarity. Hence, students who highly identify with the profession of TP will have higher career clarity, which will be strengthened by their confidence in becoming a successful career. In addition, in line with our expectation, students who identify less can still gain career clarity through exploring career options and talking about it with others.

6.4 Methodological strengths and weaknesses

To begin with, a key strength of this study is the quantitative method since the majority of previously done research has taken a qualitative approach (Trede et al., 2011). Moreover, this is the first research to measure the PI of an emerging profession with a survey tool that is, according to Rosenblum et al. (2016), the next step in PI research. However, one disadvantage of the measurement is that many of the added items that were supposed to measure TM competences, were deleted in the process of factor analysis. Items regarding professional behaviour were deleted whereas items on technical and medical practice remained. While this study has made a first attempt to measure PI of TM students, future research should develop a more extended set of questions to specifically measure PI of TM students, instead of engineering students. Another point of consideration is that an adjusted version of the professional role confidence scale was used in this study. This was done because of conceptual overlap with PI strength and dissatisfying CFA results. Further analysis resulted in the construct of career confidence which was used to capture one's confidence in becoming a successful member of the profession. Future research should invest in developing a valid scale to measure this confidence, as it will likely be an important predictor for career persistence in emerging professions.

Furthermore, a strength of this study is the large sample of respondents and the high response rate of 64%. Such a high response rate indicates that the chances for nonresponse bias are smaller. However, nonresponse rate was highest amongst B2 students, who therefore might differ in other ways than just their unwillingness to participate (Babbie, 2013). Another limitation is that while much was done to obtain as much response as possible, this did result in different approaches towards data gathering. Some of the participants filled out the survey at home, while other students were asked to stay after their lecture to participate. When data was gathered in lectures, the researcher emphasised that it was important that the students answered

for themselves to prevent for invalid results. These different sampling methods may have caused differences in profile distribution amongst study years. Cohorts that filled out the survey after their lecture showed higher response rate, which might have caused an overrepresentation of conscientious persons in the other cohorts. Lastly, as mentioned before, B3 and M2 had just started their first internships. As these are often experienced as demanding and sometimes confusing for TM students, this could have influenced the results. Possibly students would have differently evaluated their confidence and fit with the profession later in their internship or when they look back upon their experiences after some time.

Another limitation is that the chance for Type I errors increases when doing exploratory research. Such errors occur when it is believed that there is an effect in our population, when in reality there is not (Field, 2009). In this study a great variety and amount of tests have been done to explore the concept of PI and how this is related to career choice and development. Every time such a test was done, the chance is 5% that we incorrectly found a statistical effect, on which subsequently conclusions were drawn. Acknowledging this, this study attempted whenever possible to use statistical tests that reduced the likelihood of Type I errors.

Lastly, this study has contributed by uncovering the PI of TM students. However, no inferences can be made about how students develop over time. While cross-sectional research is highly suitable method for gathering data of a large population and subgroups, measurements are taken only at one point in time (Levin, 2006). In the future, longitudinal research, quantitative or qualitative, would be suitable to study how TM students develop their PI over time (Babbie, 2013).

6.5 Practical implications

To start with, this study shows that TM students are not a homogeneous group because they show great diversity in how they see themselves as TP. For instance, this study showed that there are students that would like to work in a company as consultant and are less likely to follow the stereotypical path of becoming a technical medical specialist in a hospital which is desired by the study program. Moreover, there are also students, such as security seekers or individualists, that are less confident about their fit with the profession than their fellow students. While the TM study program is developed to educate students for a future as a TP in a hospital, diversity amongst students must also be recognized. Students continuously negotiate between what the standardized core essential of being a TP is, and what features make them unique relative to peers (Frost & Regehr, 2013). Therefore, the study program of TM must find a healthy balance between striving for uniformity in the role of TP and acknowledging diversity. Supporting students in the construction of their identity by allowing students to keep and take advantage of their individuality, while staying within the boundaries of the profession, can help less stereotypical students to become confident and persist as a TP (Frost & Regehr, 2013).

Moreover, this study shows that identification with the profession and career confidence is lowest amongst B3 and M2. An advice for the study program of TM is to provide students with more role models. By observing successful TP role models working in hospitals, students learn to signal important professional traits and behaviours (Ibarra et al., 1999). For instance, B3 students do a short internship in which they learn about the position of the specialist and the role of technology in medical practice. Instead of walking along with a specialist, students

might benefit from doing an internship in which they are connected to a graduated TP that could function as role model. Besides, the study program of TM might also benefit from providing students with role models that are less exemplarity to the intended image of a TP. When students interact with a greater variety of role models they have a greater opportunity of developing an image of who they want to be and what fits them best (Ibarra et al., 1999).

Lastly, the five types of TM students can be used for personalising support and counselling. For instance, types as the security seeker will benefit from personalised support in the bachelor already. Teachers and counsellors could shift from focusing on students struggles with independence and need for security, to supporting them in developing self-clarity and self-confidence about their career interests and competences (Tokar et al., 2003). Also, the individualist might benefit from being supported in reflecting on the relevant self-perceptions one holds as a young professional. Building on this, the options of using the CC as tool in education should be further explored. The CC could for instance be used to measure students' PI on a yearly basis, from which they can learn and reflect upon how they develop themselves as a professional. At the same time such implication of the tool as part of the curriculum will make data collection for a longitudinal study more convenient.

6.6 Final conclusion

TM students are learning for the emerging profession of TP which has not yet been fully acknowledged and implemented as profession in health care. Developing a clear and strong PI might be more difficult for students in the absence of successful TP role models to identify with. Therefore, this study aimed to provide insight in what the PI of TM students learning for an emerging profession is, and how this influences their intended career choice and career development. This study showed that TM students have different views of who they are as TP. Findings support previous research that more stereotypical students are more confident in their career as a TP and are more likely to opt for a career as medical specialist or researcher. This study has made a promising first step in uncovering what the PI of TM students is and with this has provided new insights into PI development in emerging professions. Furthermore, this study has resulted in valuable insights that can be used to support students in developing a clear image of who they are as TP.

References

Adams, K., Hean, S., Sturgis, P., & Clark, J. M. (2006). Investigating the factors influencing professional identity of first-year health and social care students. *Learning in Health and Social Care*, *5*(2), 55–68.

Aschbacher, P. R., Li, E., & Roth, E. J. (2010). Is science me? High school students' identities, participation and aspirations in science, engineering, and medicine. *Journal of Research in Science Teaching*, *47*(5), 564–582.

Ashforth, B. E. (2001). Role identities. In *Role transitions in organizational life: An identity-based perspective*. Mahwah, NJ: Erlbaum.

Ashforth, B. E., Harrison, S. H., & Corley, K. G. (2008). Identification in organizations: An examination of four fundamental questions. *Journal of Management*, *34*(3), 325–374.

Ashton, M. C., & Lee, K. (2009). The HEXACO-60: A short measure of the major dimensions of personality. *Journal of Personality Assessment*, *91*(4), 340–5.

Ashton, M. C., Lee, K., Perugini, M., Szarota, P., de Vries, R. E., Di Blas, L., … De Raad, B. (2004). A six-factor structure of personality-descriptive adjectives: solutions from psycholexical studies in seven languages. *Journal of Personality and Social Psychology*, *86*(2), 356–366.

Babbie, E. R. (2013). *The practice of social research*. Wadsworth: Cengage Learning.

Bartels, J., Peters, O., Jong, M. De, Pruyn, A., & Molen, M. Van Der. (2010). Horizontal and vertical communication as determinants of professional and organisational identification. *Personnel Review*, *39*(2), 210–226.

Beauducel, A., & Herzberg, P. Y. (2006). On the performance of maximum likelihood versus means and variance adjusted weighted least squares estimation in CFA. *Structural Equation Modeling*, *13*(2), 186–203.

Bergami, M., & Bagozzi, R. P. (2000). Self-categorization, affective commitment and group self-esteem as distinct aspects of social identity in the organization. *British Journal of Social Psychology*, *39*(4), 555–577.

Caza, B. B., & Creary, S. J. (2016). The construction of professional identity. In *Perspectives on contemporary professional work: Challenges and experiences* (pp. 259–285). Cheltenham, UK: Edward Elgar Publishing.

Cech, E., Rubineau, B., Silbey, S., & Seron, C. (2011). Professional role confidence and gendered persistence in engineering. *American Sociological Review*, *76*(5), 641–666.

Cheryan, S., Siy, J. O., Vichayapai, M., Drury, B. J., & Kim, S. (2011). Do female and male role models who embody STEM stereotypes hinder women's anticipated success in STEM? *Social Psychological and Personality Science*, *2*(6), 656–664.

Chetkovich, C. (2003). What's in a sector? The shifting career plans of public policy students. *Public Administration Review*, *63*(6), 660–674.

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling: A Multidisciplinary Journal*, *9*(2), 233–255.

Clarke, M., Hyde, A., & Drennan, J. (2013). Professional identity in higher education. In *The academic profession in Europe: New tasks and new challenges* (pp. 7–21). Netherlands: Springer.

Crocetti, E., Avanzi, L., Hawk, S. T., Franco, F., & Meeus, W. (2014). Personal and social facets of job identity: A person-centered approach. *Journal of Business and Psychology*, *29*(2), 281–300.

Dehing, A., Jochems, W., & Baartman, L. (2013). The development of engineering students professional identity during workplace learning in industry: A study in Dutch bachelor education. *Engineering Education*, *8*(1), 42–64.

DeVellis, R. F. (2012). *Scale development: Theory and applications* (2nd ed.). Thousand Oaks, CA: Sage publications.
Eisinga, R., Te Grotenhuis, M., & Pelzer, B. (2012). The reliability of a two-item scale: Pearson, Cronbach or Spearman-Brown? *International Journal of Public Health*, 1–11.
Ellemers, N., Kortekaas, P., & Ouwerkerk, J. W. (1999). Self-categorisation, commitment to the group and group self-esteem as related but disctinct aspects of social identity. *European Journal of Social Psychology*, *29*(23), 371–389.
Fewster-Thuente, L., & Velsor-Friedrich, B. (2008). Interdisciplinary collaboration for healthcare professionals. *Nursing Administration Quarterly*, *32*(1), 40–48.
Field, A. (2009). *Discovering statistics using SPSS* (3rd ed.). London: Sage publications.
Frost, H. D., & Regehr, G. (2013). "I AM a doctor": Negotiating the discourses of standardization and diversity in professional identity construction. *Academic Medicine*, *88*(10), 1570–1577.
Gupta, A., Chong, S., & Leong, F. T. L. (2015). Development and validation of the vocational identity measure. *Journal of Career Assessment*, *23*(1), 79–90.
Hansen, J.-I. C., & Scullard, M. G. (2002). Psychometric evidence for the Leisure Interest Questionnaire and analyses of the structure of leisure interests. *Journal of Counseling Psychology*, *49*(3), 331–341.
Hong, J. Y. (2010). Pre-service and beginning teachers' professional identity and its relation to dropping out of the profession. *Teaching and Teacher Education*, *26*(8), 1530–1543.
Ibarra, H., Ashford, S. J., Gersick, C., Dutton, J. E., Ely, R., Gabarro, J., … Weick, K. E. (1999). Provisional selves: Experimenting with image and identity in professional adaptation. *Administrative Science Quarterly*, *44*(4), 764–791.
Kyndt, E., & Onghena, P. (2014). The integration of work and learning: Tackling the complexity with Structural Equation Modelling. In *Discourses on professional learning: On the boundary between learning and working.* (pp. 255–291). Springer Netherlands.
Levin, K. A. (2006). Study design III: Cross-sectional studies. *Evidence-Based Dentistry*, *7*, 24–25.
Luyckx, K. (2011). *Handbook of Identity Theory and Research*. (S. J. Schwartz & V. L. Vignoles, Eds.). New York, NY: Springer.
Lyons, S. T., Higgins, C. A., & Duxbury, L. (2010). Work values: Development of a new three-dimensional structure based on confirmatory smallest space analysis. *Journal of Organizational Behavior*, *31*(7), 969–1002.
Male, S. A., Bush, M. B., & Chapman, E. S. (2011). An Australian study of generic competencies required by engineers. *European Journal of Engineering Education*, *36*(2), 151–163.
Mcdonald, K. S., & Hite, L. M. (2005). Reviving the relevance of career development in human resource development. *Human Resource Development Review*, *4*(4), 418–439.
Meeus, W., Iedema, J., Helsen, M., Vollebergh, W., & Meeus, W. (1999). Patterns of adolescent identity development: Review of literature and longitudinal analysis. *Developmental Review*, *19*(4), 419–461.
Mezulis, A. H., Abramson, L. Y., Hyde, J. S., & Hankin, B. L. (2004). Is there a universal positivity bias in attributions? A meta-analytic review of individual, developmental, and cultural differences in the self-serving attributional bias. *Psychological Bulletin*, *130*(5), 711–747.
Miedema, H. A. T. (2015). *Arts en ingenieur: And ever the twain shall meet: Analyse en ontwerp van de opleiding Technische Geneeskunde* (Doctoral dissertation). Retrieved from http://doc.utwente.nl/96952/
Möwes, R. A. (2016). *The career compass: Discovering diversity in STEM students ' professional identity and its effects on their intended career choice* (Master's thesis).

Retrieved from http://essay.utwente.nl/69306/
Möwes, R. A., Van Veelen, R., & Endedijk, M. D. (2017, June). Wie kiest voor de techniek? Professionele identiteit in relatie tot carrièrekeuzes van technische studenten. In *Onderwijs Research Dagen*. Antwerp: Universiteit Antwerpen.
Palonen, T., Boshuizen, H. P. A., & Lehtinen, E. (2014). How expertise is created in emerging professional fields. In *Promoting, assessing, recognizing and certifying lifelong learning: International perspectives and practices* (pp. 131–150). New York: Spinger.
Passow, H. (2007). What competencies should engineering programs emphasize? A meta-analysis of practitioners' opinions informs curricular design. In *Proceedings of the 3rd International CDIO Conference* (pp. 1–36).
Pierrakos, O., Beam, T. K., Constantz, J., Johri, A., & Anderson, R. (2009). On the development of a professional identity: Engineering persistors vs. engineering switchers. In *2009 39th IEEE Frontiers in Education Conference* (pp. 1–6).
Roberts, B. W., & Robins, R. W. (2000). Broad dispositions, broad aspirations: The intersection of personality traits and major life goals. *Personality and Social Psychology Bulletin*, *26*(10), 1284–1296.
Rogers, M. E., & Creed, P. A. (2011). A longitudinal examination of adolescent career planning and exploration using a social cognitive career theory framework. *Journal of Adolescence*, *34*(1), 163–172.
Rogers, M. E., Creed, P. A., & Ian Glendon, A. (2008). The role of personality in adolescent career planning and exploration: A social cognitive perspective. *Journal of Vocational Behavior*, *73*(1), 132–142.
Ros, M., Schwartz, S. H., & Surkiss, S. (1999). Basic individual values, work values, and the meaning of work. *Applied Psychology: An International Review*, *48*(1), 49–71.
Rosenblum, N. D., Kluijtmans, M., & ten Cate, O. (2016). Professional identity formation and the clinician–scientist. *Academic Medicine*, *91*(12), 1612–1617.
Savickas, M. L., Nota, L., Rossier, J., Dauwalder, J. P., Duarte, M. E., Guichard, J., … van Vianen, A. E. M. (2009). Life designing: A paradigm for career construction in the 21st century. *Journal of Vocational Behavior*, *75*(3), 239–250.
Schermelleh-Engel, K., Moosbrugger, H., & Müller, H. (2003). Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of-fit measures. *Methods of Psychological Research Online*, *8*(2), 23–74.
Schwartz, S. J., Luyckx, K., & Vignoles, V. L. (2011). *Handbook of identity theory and research*. New York, NY: Springer.
Sheldon, K. M., Elliot, A. J., Kim, Y., & Kasser, T. (2001). What is satisfying about satisfying events? Testing 10 candidate psychological needs. *Journal of Personality and Social Psychology*, *80*(2), 325–339.
Slay, H. S., & Smith, D. A. (2011). Professional identity construction: Using narrative to understand the negotiation of professional and stigmatized cultural identities. *Human Relations*, *64*(1), 85–107.
ten Berg, D. M. J. S. (2016). *Keeping the "older" engineer engaged at work* (Master's thesis). Retrieved from http://essay.utwente.nl/69789/
Tokar, D. M., Withrow, J. R., Hall, R. J., & Moradi, B. (2003). Psychological separation, attachment security, vocational self-concept crystallization, and career indecision: A structural equation analysis. *Journal of Counseling Psychology*, *50*(1), 3–19.
Trede, F., Macklin, R., & Bridges, D. (2011). Professional identity development: A review of the higher education literature. *Studies in Higher Education*, *37*(3), 1–20.
University of Twente. (2016). Technical Medicine: A unique descipline in health care. Retrieved September 8, 2016, from https://www.utwente.nl/tg/

Van Veelen, R., Otten, S., & Hansen, N. (2013). Social identification when an in-group identity is unclear: The role of self-anchoring and self-stereotyping. *British Journal of Social Psychology*, *52*(3), 543–562.
Wagstaff, K., Cardie, C., Rogers, S., & Schroedl, S. (2001). Constrained k-means clustering with background knowledge. In *International Conference on Machine Learning* (pp. 577–584).
Werbel, J. D. (2000). Relationships among career exploration, job search intensity, and job search effectiveness in graduating college students. *Journal of Vocational Behavior*, *57*(3), 379–394.
Worthington, R., & Whittaker, T. (2006). Scale development research: A content analysis and recommendations for best practices. *The Counseling Psychologist*, *34*(6), 806–838.
Zhao, X., Lynch Jr., J. G., & Chen, Q. (2010). Reconsidering Baron and Kenny: Myths and truths about mediation analysis. *Journal of Consumer Research*, *37*(2), 197–206.

Appendix A – Added items for Technical Medicine students

Factor	Item
Engineering	1. thinking creatively
	2. **adjusting or designing treatments/diagnostic methods**
	3. using computers to program or design
	4. using modern engineering techniques and tools
	5. *following developments in relevant disciplines**
	6. *applying scientific knowledge in practice**
International orientation	1. speaking a second language (e.g., Dutch, Chinese)
	2. working in an international context
	3. dealing with cultural differences
Management	1. convincing others
	2. chairing meetings
	3. negotiation
	4. conflict management
	5. leadership & management
	6. convincing others
	7. networking
	8. **giving presentations**
Research	1. analysing problems
	2. developing solutions to complex problems
	3. think analytically
	4. conducting (scientific) research
	5. statistics & data interpretation
	6. reading & writing (scientific) research reports
	7. **logical reasoning**
Professional behaviour	1. motivating myself
	2. time management
	3. organizing myself
	4. *critically reflecting upon myself*
	5. **pursuing my own learning goals**
	6. *solving ethical dilemma's*
	7. *keep a balance between my personal and professional role*
Team	1. project-based team work
	2. **collaborating with people from different disciplines***
	3. collaborating with peers
	4. *taking my own point of view*
	5. *showing my added value as TP within a team*
Technical medical practice	1. **working with medical equipment**
	2. *communicating with the patient and relatives*
	3. **assessing complaints of a patient**
	4. **developing a treatment plan for a patient**
	5. **assessing risks of a technical medical procedure**

Note. Items in **bold** were added or adapted items to measure competences of TM students that remained after EFA, items in *italic* were added or adapted items that were deleted. *Marks adapted items.

Appendix B – Factors within the domain of interests

	Rotated factor loadings					
Item	Sports	Fashion & beauty	Outdoors	Music	Societal involvement	Screen time
sport events (e.g. Olympic games or world cup football)	-.914					
sport news	-.811					
team sports	-.531					
shopping		.836			.106	
fashion & design		.674				
beauty & health		.655				
nature & outdoors			.797			
gardening			.500			
camping			.398			-.133
building & repair			.396			.162
listening to music				-.743		.250
going to concerts		.112		-.571		
making music				-.462		-.182
politics		-.159			-.804	
community involvement		.129			-.539	
surfing the web						.643
watching tv series/movies		.118				.453
Eigenvalues	2.53	2.31	1.91	1.61	1.27	1.16
% of variance	14.89%	13.57%	11.26%	9.48%	7.21%	6.82%
Cronbach's Alpha	.79	.76	.56	.55	.60[a]	.47[a]

[a] Spearman Brown was calculated to assess reliability in case of two-item factors instead of Cronbach's Alpha.

Appendix C – Factors within the domain of competences

	Rotated factor loadings							
Item	Technical practice	Management	Self-management	Cognitive	Collaboration	International orientation	Medical practice	Research
working with medical equipment	.654						.129	
using modern engineering techniques and tools	.645						.141	
using computers to program or design	.609			-.115		.166	-.141	
adjusting or designing treatments/diagnostic methods	.445			-.155			.207	-.125
leadership & management		-.863				-.110		
chairing meetings		-.747					-.163	
convincing others		-.578		-.217		.144		.101
negotiation		-.496			-.125	.136	.137	
networking		-.471			.133		.155	.149
giving presentations		-.462			.138		-.107	-.212
managing conflicts		-.413					.219	
organizing myself			-.799			-.111		-.140
time management			-.791		-.111			
motivating myself			-.724					
pursuing my own learning goals			-.604					
analysing problems				-.779			-.126	
think analytically		.118	-.140	-.746				
logical reasoning				-.553			.102	-.113
developing solutions to complex problems	.249	-.172		-.467				
collaborating in a diverse context (i.e., culture, gender, ethnicity)		.110			.711			
dealing with cultural differences					.648	.141		
collaborating with people of different disciplines	.183				.491			
collaborating with peers		-.247	-.211		.428	-.230		

speaking a second language (e.g., English, Chinese)			.101			.606		-.237
working in an international context	.219	-.124			.162	.599		
developing a treatment plan for a patient						.106	.684	.110
assessing complaints of a patient					.112	-.114	.637	
assessing risks of a technical medical procedure	.181						.420	-.239
reading & writing (scientific) research reports						.137		-.617
conducting (scientific) research	.152		-.103	-.134				-.535
Eigenvalues	5.94	2.80	2.38	2.10	1.78	1.34	1.11	1.06
% of variance	19.79%	9.34%	7.92%	6.99%	5.92%	4.45%	3.70%	3.53%
Cronbach's Alpha	.73	.80	.82	.76	.68	.63[a]	.67	.67[a]

[a] Spearman Brown was calculated to assess reliability in case of two-item factors instead of Cronbach's Alpha.

Appendix D – Factors within the domain of values & goals

	Rotated factor loadings							
Item	Family	Status & achievement	Lifelong learning	Purpose	Physical well-being	Tradition	Security	Hedonism
have children	.935							
family life	.805							
have a satisfying marriage/relationship	.548						.107	-.228
have a strong family relationship	.502					.184		
status		.775				.156		
authority		.689			.101			
be an authority in my field of work		.683				-.133	.105	
have a prestigious job		.673		-.112				
success		.618			-.108			-.106
influence		.600		.128				
be a leader		.595						
preserving my public image		.549						
intellectual stimulation			.802	-.123				
challenge		.107	.577				-.167	-.152
lifelong learning			.558					
understand my place in the universe				.803				
know my purpose in life				.801				
physical exercise					-.841			
be in a good physical condition					-.825			
eat healthy	.134		.107	.145	-.407			
honouring parents and elders						.809	-.121	
politeness						.616		
modesty	-.111	-.158	.156			.400	.244	
respect for tradition	.152					.341		-.107
have routine and structure in my life							.715	
lead a predictable life							.659	
stability in life						.110	.570	-.146
pleasure							.118	-.805
enjoying life								-.761
fun								-.703
freedom						.123	-.133	-.447
Eigenvalues	5.75	3.97	2.38	1.90	1.60	1.49	1.33	1.10
% of variance	18.50%	12.80%	7.67%	6.12%	5.15%	4.80%	4.28%	3.56%
Cronbach's Alpha	.83	.85	.67	.78[a]	.74	.66	.74	.78

[a] Spearman Brown was calculated to assess reliability in case of two-item factors instead of Cronbach's Alpha.

Appendix E – Factors within the domain of personality

	Rotated factor loadings					
Item	Agreeableness	Extraversion	Emotionality	Open-mindedness	Conscientiousness	Honesty
irritable	.813	-.100				.134
hot-tempered	.705					-.104
prickly	.566	.140	-.181			
stubborn	.322					
introvert		.822	-.102			
silent		.770	-.134			
reserved		.748				
spontaneous		.706		.111		.167
enthusiastic		.481	.255			
sensitive	.144		.887			
emotional	-.136		.777			-.103
vulnerable		-.134	.677			
imaginative				.763	-.118	
artistic				.542		
open-minded				.498		
philosophical				.461		
lazy					.783	
self-disciplined					.749	.157
slack	.113				.708	
irresponsible					.468	-.225
smug						-.624
self-centred		.223				-.591
arrogant	.164	-.151			.206	-.456
Eigenvalues	3.41	3.26	2.89	1.93	1.57	1.08
% of variance	14.82%	14.17%	12.55%	8.39%	6.81%	4.69%
Cronbach's Alpha	.68	.83	.83	.65	.77	.62

Appendix F – Factors within the construct of strength of PI, career clarity and exploration, and perceived role confidence

Strength of professional identity

Item	Rotated factor loadings
	Strength of PI
I feel good about my profession as a technical physician	.811
I am proud to be a technical physician	.790
I would like to continue working as a technical physician	.781
Being a technical physician is an important reflection of who I am	.638
I would rather be something different than technical physician	.638
I think I am a typical technical physician	.631
Eigenvalues	3.57
% of variance	59.41%
Cronbach's Alpha	.85

Career clarity and exploration

Item	Rotated factor loadings	
	Clarity	Exploration
I have a clear sense of my occupational interests	.841	
I know what kind of work suits me best	.808	
It is clear to me what I want to do for a living after I graduate	.660	
I often reflect on my career plans		.814
I try to find out a lot about my career		.741
I often talk with other people about my career plans	.131	.662
Eigenvalues	3.10	1.23
% of variance	51.73%	20.46%
Cronbach's Alpha	.81	.79

Professional role confidence

Item	Rotated factor loadings
	Professional role confidence
technical physician is the right profession for me	.796
that I can find a satisfying job as technical physician	.736
in my ability to be successful in my career as technical physician	.714
that I am very committed to technical medicine	.700
that I can continue to develop myself as technical physician	.653
I can select the field within technical medicine that is right for me	.608
I am able to develop useful skills	.411
Eigenvalues	3.65
% of variance	52.18%
Cronbach's Alpha	.84

Appendix G – New factors for the constructs of PI strength and professional role confidence

Item	Rotated factor loadings	
	Strength of professional identity	Career confidence
I would like to continue working as a technical physician	.845	
I am proud to be a technical physician	.777	
I feel good about my profession as a technical physician	.742	
Being a technical physician is an important reflection of who I am	.673	
I would rather be something different than technical physician	.671	
I think I am a typical technical physician	.638	
technical physician is the right profession for me	.637	.271
that I am very committed to technical medicine	.620	.234
in my ability to be successful in my career as technical physician	-.104	.896
that I can find a satisfying job as technical physician		.772
I can select the field within technical medicine that is right for me	.150	.480
Eigenvalues	5.65	1.30
% of variance	51.36%	11.84%
Cronbach's Alpha	.90	.78