Examining the effectiveness and impact of providing feedback to develop the Professional Identity of (future) STEM professionals.

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1. Abstract

Due to a shortage of STEM (science, technology, engineering & mathematics) professionals in the Netherlands and a significant drop-out rate of STEM students, a method must be searched to increase the retention in STEM. One such method is to develop the Professional Identity (PI) of students. PI development can be achieved by providing students with feedback on their PI using a digital feedback tool. However, feedback tools that provide feedback on the professional identity have not been researched for their effectiveness on elements of identity development. Within this research, we first perform a pilot study on the Career Compass which is a digital feedback tool that provides students with feedback on their PI. This pilot was conducted to gather information on the current career behaviours of students and the perceived effectiveness of the Career Compass. The pilot study, combined with literature research provided input for the main research. In this research, we examined the effects of the Career Compass feedback tool on intentions towards career behaviours. Additionally, we examined the distribution of identity statuses amongst students to examine if the identity status of students moderates the effectiveness of the digital feedback.

In this study, 103 participants completed a questionnaire that measured the current professional identity status (PISQ-5d), intentions towards career behaviours before and after receiving the Career Compass digital feedback, and their evaluation of the feedback. Through a pretest-posttest within-subjects design, we looked for a change in intentions towards career behaviours to draw conclusions on the effectiveness of the feedback tool.

Results showed a statistical increase in intentions towards the career behaviours of *learning about the self* and *making choices and committing*. The effectiveness of the CC feedback on career behaviour intentions was found not to be dependent on the identity status. Overall, students were content with the feedback they received and perceived the digital feedback as useful. Therefore, the Career Compass seems to be effective in raising the intentions of students towards certain career behaviours, without regarding the identity status of the student.

Keywords: Professional identity, professional identity development, career behaviour intentions, Career Compass

Contents

2. Introduction

In the Netherlands, there is a large shortage of STEM students and professionals. These professionals are needed as the technical sector is becoming increasingly more important for our global development and well-being. Already in 2013, the urgency for more students and professionals within STEM was acknowledged by the Dutch government (Ministerie van Onderwijs, 2016). Upon entering STEM education, technical students start to develop their Professional Identity (PI). Professional identity could be described as relevant traits, believes, and motives a person hold about themselves in a professional role (Ibarra, 1999). According to Trede, Macklin, and Bridges (2012), this concept of PI also influences the students' career choices. Moreover, it is believed that gaining insight into the PI of students and starting professionals can guide these starting professionals towards a long-lasting and stable career within STEM.

One major issue is that many students enter STEM education but drop out. Other students regard starting in STEM education but refrain to do so due to misconceptions about the field of STEM (Doerschuk et al., 2016). Additionally, research on the professional identity is now most executed within the medical or educational field (Pratt et al., 2006), whilst the evidence and research for STEM students' identity development are still lacking and deserves further attention. A well-developed PI is beneficial for retention in the sector, but this is not yet confirmed for students in the STEM sector. The development of the PI differs per student, and they can be in different phases of identity development as opposed to their classmates. Research also lacks on this front, where we are unsure what factors influence professional identity development.

To continue to aid students in the development of their PI, we are investigating the effectiveness of a feedback tool. We use the existing 'Career Compass', a feedback tool that was developed at the University of Twente to provide students with insight into their professional identity. In a pilot study, we gather information on the reactions of participants towards the Career Compass digital feedback and their current career behaviours. In the main research, we use a pretest-posttest within-subjects design to detect a change in intentions towards career behaviours, next to measuring the identity status of the participants. We combine changing career behaviour intentions with the identity status of the participants to identify if changing behaviour intentions are dependent on the identity status. With that information, we provide input for this specific feedback instrument, the Career Compass, to increase effectiveness in professional identity development.

3. Theoretical framework

In this theoretical framework, we will explain the topics of professional identity (PI), what makes up the PI in the form of identity content and how to develop PI. We explain how willingness to develop one's PI can be measured through career behaviour intentions. Additionally, we describe the identity status and what tools are available to foster PI development. Lastly, we set up several research questions that will later be answered in this research.

3.1 Professional Identity

Professional identity can be described in multiple ways. In general, it can be described as what it means for someone to be a professional in a certain profession (Krejsler, 2005). For example, in the field of medicine professional identity concerning physicians is described as: "A physician's [professional] identity is a representation of self, achieved in stages over time during which the characteristics, values, and norms of the medical profession are internalized, resulting in an individual thinking, acting, and feeling like a physician" (Cruess, 2014, p. 1447). Nadelson et al. (2015) define PI as "attributes, skills, knowledge, beliefs, practices, and principles, which are representative of professionals within a profession" (p. 705). They also argue that the level of internalization of professional elements mirror the level of professional identity development, making them non-separable. Combining these definitions, we conclude that PI describes the content of the identity of one's professional self. This is including (but not limited to) several artefacts such as how one represents, thinks, and sees him- or herself as being a professional in the sector he or she is a part of.

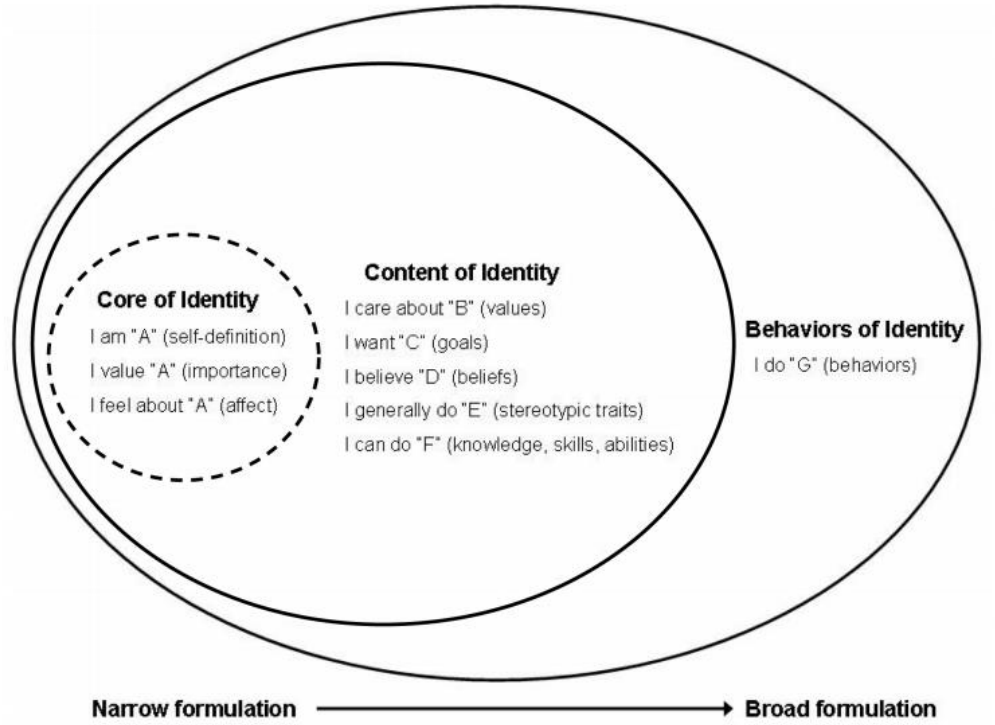
Professional identity (PI) is seen as an important aspect when looking at retention within the STEM field (Pratt et al., 2006; Graham 2013) for several reasons. The overview of Nadelson (2015) provides four reasons as evidence why a focus on students' PI and the development of PI in education are important: 1) the students' sense of professional identity influences their engagement in learning (Beijaard, Verloop & Vermunt, 2000), 2) the students' level of PI is associated with persistence in degree programs (Sweitzer, 2009), 3) PI is inextricably associated with a students' academic program achievement (Speirs, Neumeister and Rinker, 2006), and 4) the level of PI of the individual is related to her/his professional effectiveness. These four arguments combined connect professional identity with academic achievement and effectiveness of a student, next to retention in the program.

To further understand professional identity, we must also focus on the content that makes up someone's professional identity. Identity content can be described as the elements that build up the

total identity of an individual. Ashfort (2008) describes the main content of identity consists of values, beliefs, stereotypic traits and knowledge, skills, and abilities. Identity content flows from the 'core of identity' and results eventually in behaviours of identity.

Figure 1

Identity and identification from the core outwards toward behaviours.



From *Identification in Organizations: An examination of four fundamental questions* (p. 330) by Ashfort, 2008.

Identity content and behaviours of identity can be a signal for identity development. Ashfort states that "the stronger the identity, the more that identification involves not only the element in the first ring (I am, I value, I feel) but I care about, I want, I believe, I generally do, and I can do" (p. 331, 2008) (figure 1). Thus, when identity is developed, the more upfront the identity content is, and the more behaviours reflect the core and the content of the identity. Following the line of reasoning of Ashfort (2008), identity development becomes visible when a person has a better understanding of the identity content that follows from his core identity.

We conclude that a well-developed PI has advantages for students in the field and for retention in STEM. Additionally, Hall (2002, in Hirschi et al., 2014) describes that "proactive engagement in developing one's career is pivotal to achieve subjective career success", attributing to the fact that a

positive stance towards identity development is helpful for students themselves. The importance of engineers developing their PI is more often confirmed but especially for the STEM sector, this development is researched too little to recognize the true importance. As professional identity can develop similarly to other aspects of identity, we discuss how the development of PI takes place and what fosters professional identity development.

3.2 Professional identity development

Professional identity is not static but develops over time. Professional identity development starts as soon as a student enters an educational program and begins to internalize new techniques and professional skills and values that make the student ready to enter the professional domain (Pittman & Foubert, 2016). The development of PI is not limited to the period during education when preparing for a career but continues to develop when starting a career up until halfway through a person's career (Bebeau & Monson, 2012; Forsythe et al., 2002). Every student has a different trajectory and pace in developing their PI. Next to PI development that tacitly takes place through experience and social interactions, PI can also be developed directly. According to Kaufman's (2006) model on professional identity construction the content of work, work-identity, identity customization and social validation are intertwined and influence each other. In this interplay of work and identity learning, social validation plays a crucial role in the form of feedback and role models. Cruess et al. (2015) mapped the activities that impact the development of both personal and professional identity, on which he found that *socialization* had the most significant impact. This socialization consists of interactions with role models and mentors, experiences in the field, formal teaching, and self-assessment as well as the person's already existing personal identity, and other environmental factors. Self-assessment is a form of reflection that can be of great use as a formative event that is focused on the identity as a person. It can help that person to shape how they look at themselves in terms of their (professional) identity and what actions to take to develop their identity (Peel, 2005).

Nadelson et al. (2015) have also recognized and researched the topic of professional identity development. They mention that the development itself is insufficiently understood as little is known about what influences and facilitates this development and that there is a need to understand the different phases that developing (STEM) professionals go through.

3.2 Career Behaviour Intentions

To try and measure or witness growth in professional identity, we can look at someone's willingness in developing their PI. In the research of Savickas et al. (2018), willingness to develop is referred to as *adaptability*. Within adaptability, a subset of elements was distinguished by Savickas (2018), including *adaptive readiness* ("willingness and readiness to change", p.139), *adaptability resources* ("self-regulation resources for dealing with change", p.139), *adapting responses* ("performance of actual behaviours that address changing career conditions and making occupational choices", p.139) and *adaption results* ("outcome of adapting responses in terms of goodness of fit between the individual and occupational position indicated by success, satisfaction and stability", p.139). Based on this research, we can identify necessary ingredients of willingness to develop. Without the proper amount of *adaptive readiness* and *adaptability resources*, it becomes increasingly more difficult to produce *adaption results*.

In earlier research by Savickas (2018), a link was made between *adapting responses* and professional identity development. He posed a set of career construction items (CCI) that are closely connected to the adaptability response, and which describe the actions one is currently taking in career construction. These CCIs consisted of five categories: learning about the self (gaining knowledge about your personality, abilities, what you find important), discovering jobs (discussing your future career, learning/reading up on jobs), making choices and committing (deciding what you want to do in life and making plans on how to get there), choosing relevant training or education (finding opportunities for training, beginning the training), and finding a job (planning for job searches and getting a job once the training is complete). A similar study to that of Savickas (2018) was conducted with the Vocational Identity Scale (Holland, Daiger & Power, 1980 in Savickas 2018) where the content of the identity is described by looking at the "possession of a clear and stable picture of one's talents, interests, and goals" (Savickas 2018, p. 140).

The CCI can be useful in determining the *adapting response* of the professional identity, as the items within the CCI reveal the actions of the students towards certain career behaviours. Within professional identity development, we believe that the actions of a student may change over time, but that intentions to develop can change when presented with opportunities to build and reflect on the current professional identity (Morelock, 2017). This refers to the change in *adaptive readiness*. We refer to this as career behaviour intentions (CBI). Adaptability, next to CBIs, might differ for students, but could also depend on the status of professional identity.

3.3 Professional identity status

We have concluded that PI is not static and can change. PI is also not tied to a specific age or gender but is constructed through several internal processes (Mancini, 2015). Mancini identified two indicators for the status of these processes: *exploration* of the identity and *commitment* to the identity. A different identity status can be identified and analysed to measure development. One example is the Professional Identity Status Questionnaire (PISQ-5d) that was developed by Mancini et al. 2015. This questionnaire gives insight into the identity status of the participant that fills in the questionnaire. The outcomes of this questionnaire which make up the identity status are built up by five separate categories as described in table 1. The five categories are made up of having a high or low commitment, combined with a high or low exploration.

Table 1: five categories of the professional identity questionnaire

Category	Description according to Mancini et al. (2015)
Affirmation	"…captures the importance one attributes to the professional category to which one belongs and the sense of pride one feels as a member of that category" p.142
In-depth exploration	"… represents the extent to which individuals reflect on their current commitments while searching for new information" p. 141
Practices	"[practices] measure the probability of engaging in actions directly relevant to a professional category" p. 142
(Identification with) commitment	"… refers to the choices made in the central domains of the identity and to the self-confidence that individuals derive from these choices" p. 141
(Reconsideration of) commitment	"…refers to the comparison of present commitments with alternative commitments with alternative commitments because the current ones are no longer satisfactory" p. 141

When we determine the professional identity status, we do *not* learn which career behaviours students are undertaking to develop themselves in their PI, and merely shows the current status of the student including his or her state of commitment and exploration. The category of *practices* comes closest to the career behaviours of a student, but as this section is defined as "[practices] measure the

probability of engaging in actions directly relevant to a professional category" (Mancini et al., 2015; p. 142) no conclusions can be made regarding actual career behaviours.

Additionally, Mancini et al. (2015) connected the scores within the categories of the identity status questionnaire to a separate subset of *identity phases*. These phases, consisting of achievement, foreclosure, moratorium, searching moratorium and diffusion describe the status of the participant in finding out who he or she is on a professional level. The original creator of this identity phases model, Marcia (1966), researched ego-identity and distinguished the *achievement* ("has experienced a crisis period and is committed to an occupation and ideology.", p. 551), *foreclosure* ("not having experienced a crisis, yet expressing commitment", p. 552), *moratorium* ("is *in* the crisis period with commitments rather vague", p. 552) and *diffusion* ("may or may not have experienced a crisis period; his hallmark is a lack of commitment. He has neither decided upon an occupation nor is much concerned about it", p. 552) phases. In the research of Mancini et al. (2015), he added upon this existing model with a separate phase known as *searching moratorium* which he describes stands for people who have high levels of commitment, in-depth exploration and reconsideration of commitment as opposed to people in the *moratorium* stage who have similar characteristics but a low score of commitment and medium score on exploration.

Interestingly, in earlier research, Meeus et al. (2011) called the phase of 'searching moratorium' a positive view towards moratorium. He states that these participants are not struck by indecisiveness because they have high levels of commitment, but they are actively considering alternatives for the commitments they have already made. Meeus (2011) claims that these students are "on the way to making final choices from a set of alternative, well-defined commitments" (*p.*1018) and that people in 'searching moratorium' are no longer present in middle-to-lade adolescence but rather in early-to-middle adolescence.

Because not everyone develops their PI in the same way, it is necessary to understand the different needs and wishes of those different stages to properly foster PI development. However, research on the topic of professional identity development and assessment where differentiation is made between different phases of identity is lacking. Research of Mancini et al. (2015) suggests the existence of different phases within the development of one's professional identity, but no research suggests a different approach in PI development tools that are tailored for the different phases of (identity) development.

When looking for a connection between career behaviour intentions and identity status, we can explain the CBI as the active development in which we measure student behaviour that connects to the actions, whilst the identity status can be described as the cognitive development. At the

cognitive development, beliefs and opinions are formed regarding commitment and exploration. Currently, research on professional identity development has often focused on cognitive development (such as the identity status of Mancini) and requires more research in the active development of behaviours and intentions.

3.4 Stimulating professional identity development

However, the question remains how professional identity development can be stimulated to enhance the active development of career behaviours. One method to achieve this is through the use of feedback. As mentioned earlier, giving feedback can positively influence the development of PI (Kaufmann, 2006; Cruess et al, 2015). Furthermore, by helping a person to define themselves as an engineer through feedback on professional identity, an increase in self-efficacy is possible. Self-efficacy resembles the beliefs of a person regarding his or her capabilities, and how this person feels he or she is able to influence events that affect them (Bandura, 1994). An increased level of self-efficacy can in turn influence well-being of the person, helping them to challenge themselves and approaching difficult situations with confidence. Eliot and Turns (2011) found that after receiving feedback, participants kept reporting a positive view towards their skills in their transition from school to a new job and within applying for a job. They reiterate that building on the internal frame of reference of a student can help them make sense of themselves in the form of an engineer and construct their viewpoint on the engineering domain. This stresses the importance of PI development. One example of helping participants to define themselves as an engineer through feedback is the Career Compass. This is a digital feedback tool that provides students with feedback on their professional identity. Such feedback tools are a method to provide feedback in a structured way and are used to aid professional identity development. We dive more into feedback tools in chapter 3.6.

Additionally, Eliot and Turns (2011) state that PI development, and specifically 'defining self as an engineer', is assumed to happen automatically through working with peer students or by working in project groups. This assumption was refuted through an activity in which participants were asked to create a 'professional portfolio' which proved to be helpful by allowing participants to reflect on their identity in a structured way. Eliot and Turns (2011) state that these activities (internal frame sense-making activities) are not yet supported enough and should be integral in the PI development of students. In a systematic literature overview of Morelock (2017), he advises to not only facilitate 'engineering-related experiences' in identity construction interventions but to also foster moments for students to reflect on the personal connection they have with those experiences. Merely the experiences themselves do not provide the opportunity to learn optimally from those artefacts.

3.5 Feedback tools for developing professional identity

A method of executing assessment and providing the participant with feedback is through the use of feedback tools. Thus far, few examples of such feedback tools exist. One example of such a feedback tool is the website carrieretijger.nl, where a user can look for and select personal traits as a participant, to consequently receive tips or help based on the given input. When combining this knowledge with the outcome of Nadelson et al. (2015) that students often disproportionately enlarge their development, it is not the most fitting tool to provide students with feedback on their professional identity.

To aid conscious choices for career options and increase study and work performance, TechYourFuture together with Saxion University of Applied Sciences, the University of Twente and Windesheim created the Career Compass (CC) (Tech Your Future, n.d.). The first step towards making the technical profession attractive for a more diverse group of beta professionals is to aid students in making a well-thought-out decision. This begins with providing insight into the self-image where the CC contributes (van Veelen et al., 2018). The definition for PI that was used for the Career Compass connected to the question: 'Who am I as a technical professional?' which includes the following items: interests, competencies, values, personality, and goals. These items can be seen as identity content. The Career Compass consists of a digital questionnaire and a digital feedback tool. The digital questionnaire consists of roughly 100 short statements to which the participant must reply. The statements are based on the five items of identity content. The participant is offered feedback after completion of the questionnaire. In this feedback, the participant gets insight into his/her professional profile. The different personality types are divided into five profiles: Analyst, Individualist, Team-player, All-rounder, Innovator. A participant can relate closely to a profile but will never totally fit the description of one profile as the profiles overlap each other. Next to the aim of measuring the content of the professional image which answers the question: 'Who am I as a professional?', the tool aims to measure the connectedness with the profession (van Veelen et al., 2018). Additionally, participants receive their scores on subscales of the items that cover the identity content, which they can compare with their peers. Lastly, participants are provided with steps on how to continue with the feedback, including websites with information and university facilities for development.

The Career Compass has previously been a tool in research, to more closely investigate the dropout rate and retention rate in the sector. However, the effectiveness of the tool itself regarding identity development has not been investigated. Earlier research has been conducted with the use of the Career Compass in which the following question was answered: "Who of the beta-professionals has chosen for a job in the technical sector and why?" Using the Career Compass gave them insight

into the retention rates of young professionals and gave implications for future research. In these implications, it is mentioned that the role of the feedback tool could become more apparent, but so far, no research seems to have been conducted on the impact on career behaviours caused by the CC, nor on the perceived effect of the tool.

Evaluating the Career Compass feedback tool

To investigate the perceived effectiveness of the Career Compass feedback, we use an existing framework from Kirkpatrick (1996) that was designed around the evaluation of interventions and training programs. This framework consists of four levels of evaluation: reaction, learning, behaviours, and results, and is described as a 'simple and practical' (p.55) model by Kirkpatrick himself. The different levels of the Kirkpatrick model are built up according to the following definitions as described in table 2.

Table 2: Four levels of the Kirkpatrick model (1996)

Level 1: Reaction	A measure to gather information on how participants feel about the components of the intervention, which includes the topic, how the intervention is constructed and all variables. This level indicates if participants find the intervention helpful and worthwhile.
Level 2: Learning	This measures the knowledge, improved skills and/or attitudes on the topic due to the intervention. The improved knowledge contains concepts, techniques, and principles
Level 3: Behaviours	The extent to which the participant changes the behaviour due to the intervention. This is also referred to as the 'transfer of training'.
Level 4: Results	A measure of the final results can include increased sales, productivity change, profit or improved quality.

This model can be used to evaluate existing interventions. It gathers information on where participants think the intervention can be improved (level 1), on how participants gather skills and if they have learned anything (level 2), on how the participant changes in their behaviour when applying the skills (level 3) and the final return of investment that is especially interesting for the company or trainer who is looking for the fruits of his work (level 4).

For this research, we are especially interested in finding out the reaction of participants towards feedback on their professional identity (level 1) and if participants change in intentions towards career behaviours (level 2). We do this because the reaction of participants (level 1) is so important. After all, it tells if the participant is both motivated and interested in the material that is provided to them (Kirkpatrick,1996). With the background of professional identity described, as well as techniques to measure PI development and an assessment tool, we take a look at the research questions that make up this research.

3.6 Research questions and model

We have looked at evidence that feedback helps to stimulate the development in PI for university students and learned that more research is needed to identify the significance of giving feedback to students on their professional identity development. We identified career behaviour intentions (CBI) as signals for PI development. The Career Compass feedback tool lends itself to giving feedback to students, and we will use that CC feedback to determine the effectivity on CBIs whilst having the professional identity statuses to compare between different phases of identity formation. A conceptual model is displayed below the research questions in figure 2.

In short, this research measures the effect of the Career Compass on career behaviour intentions to measure the effectiveness of the Career Compass. This is done through the comparison between students before they have received their feedback and after they have received their feedback. This leads us to our first research question:

1. ***Does the digital feedback on the professional profile and other elements of identity content influence higher education students' career behaviour intentions?***

Then, we would want to determine if a differentiation in identity status affects intentions towards career behaviours:

2. ***Does the effect of the digital feedback on career behaviour intentions, depend on the identity status of higher education students?***

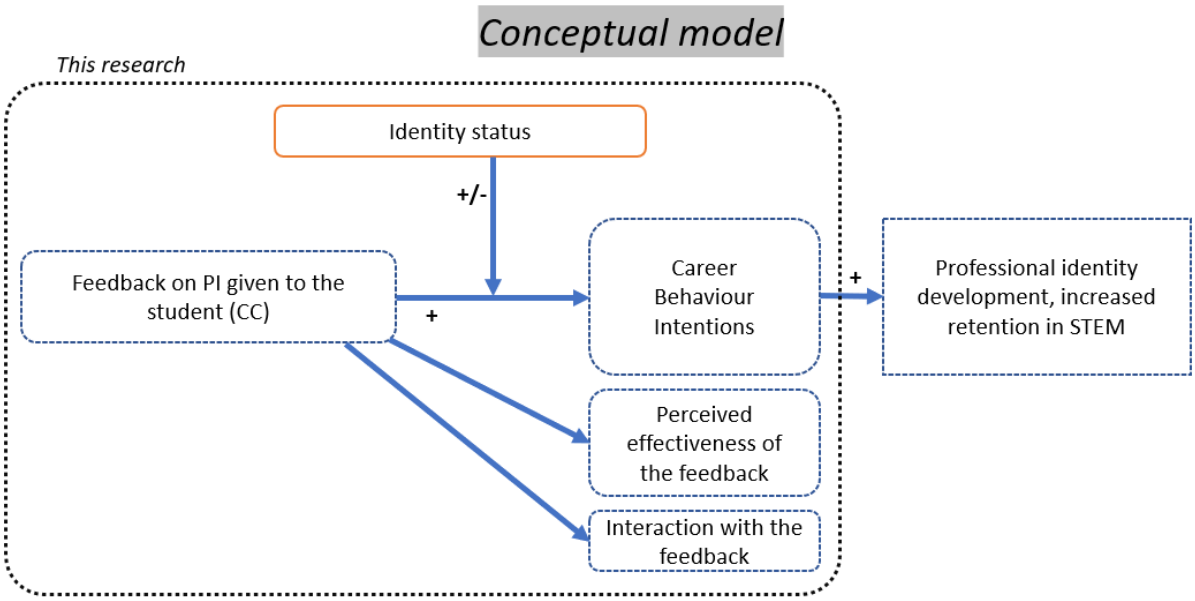
Finally, we would want to determine what improvements can be made and suggested towards the development of the Career Compass feedback tool to increase the effectiveness:

3. ***What improvements in the feedback of the Career Compass can be made to support higher education students more optimally in the development of their PI?***

Figure 2 describes the research questions and the expected relationships between variables in this research in a graphical manner.

Figure 2

Conceptual model of research questions and their interconnectedness in this research



The current study

To begin, we conducted a pilot study in the form of interviews. In this pilot study, we confronted eight participants with the Career Compass digital feedback and asked several questions to receive an indication of the effectiveness. Thereafter, the main study was conducted to investigate the effect of the Career Compass feedback on career behaviour intentions. Additionally, we measured the identity statuses of the sample, which were later used to look for a moderation effect of the identity status on the career behaviour intentions. The perceived effectiveness was also measured, next to the interactions with the CC.

4 Pilot study

The CC as a feedback tool has never been subjected to user research on perceived effectiveness. The objective of this pilot study was to gather information on the perceived effectiveness of the Career Compass feedback tool before setting up an effect measurement on more specified topics. This potential effectiveness was measured by using questions based on the levels of the Kirkpatrick model. We conducted semi-structured interview to allow participants to elaborate on their responses for the interview questions. Additionally, we asked about current developmental activities and intentions towards developmental activities. This would provide input to the main research and would help to decide on factors that could help to find the effect of the digital feedback.

4.1 Method

To conduct this pilot, we describe the following method of gathering participants, describing the procedure, and presenting the results.

Participants

First, we needed a representative group of the student population. Eligibility criteria for participating were being a student at the University of Twente or Saxion University of applied sciences and following a (semi) technical program (list of (semi) technical programs and the division used in this research available in Appendix E). This was done to include students from both STEM education and on the border of STEM in semi technical programs. The sample size selection was determined based on preferably having two participants from each year in university (first year until the fifth year). A semi-random selection of two participants per university year was asked to engage in a semi-structured interview regarding PI development, meaning ten students in total from the first year to the fifth year of university. Two participants could not be included as one student did not show up for the interview. The other participant had been studying at the University of Twente but recently started studying at another university – therefore not meeting the eligibility criteria. Thus, the final sample consisted of eight participants. The average age of the participants in the pilot study was 20.75 (*SD*=1.64), of whom six were male and two were female.

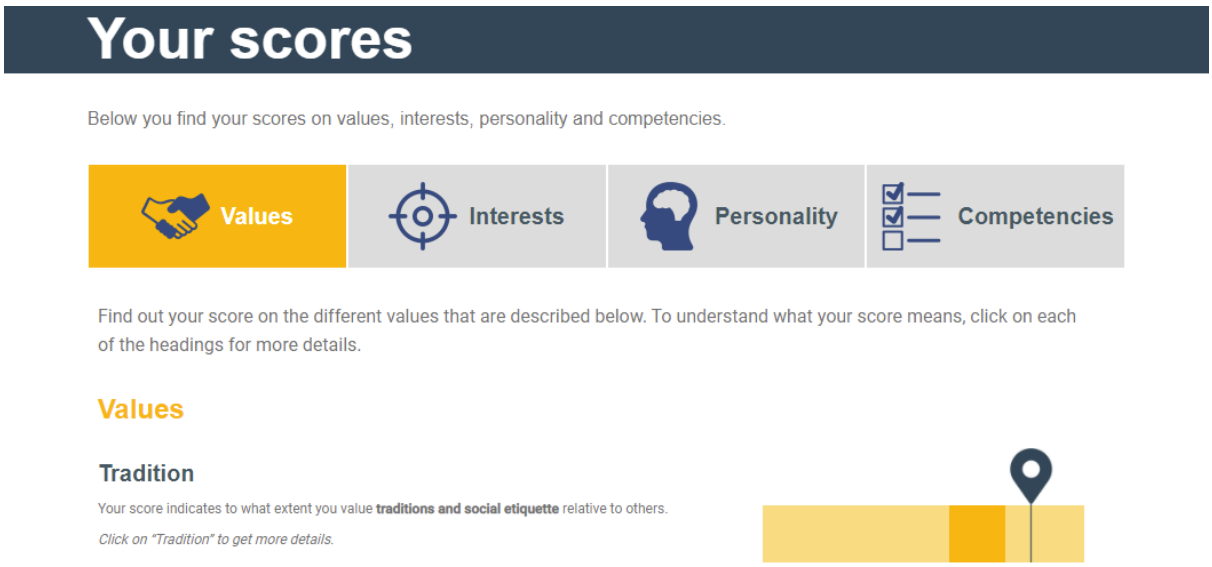
Procedure

The pilot study was conducted online in the form of interviews that were held on Zoom. This pilot study received ethical approval from the ethical committee of the University of Twente. Before the start of the interview, participants were given a consent form and asked to read through and sign it if they gave consent to the research. By signing, they provided consent to record their answers for the research in video form, which were afterwards transcribed and discarded. The consent form can be found in appendix H.

Participants were briefed on what professional identity is and on the significance of professional identity development. Then, participants would be given a mock-up version of the Career Compass digital feedback (figure 3).

Figure 3

Snippet from the Career Compass digital feedback (mock-up)

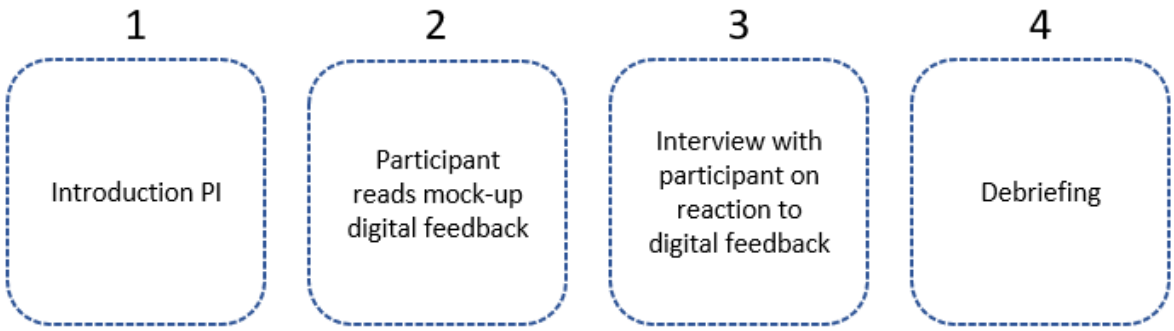


This feedback did not show personal outcomes based on the digital questionnaire that normally takes place before receiving the feedback. This was done as at the time of the research, the functionality for generating feedback was not working. When participants would have had enough time to examine the feedback on the webpage, they were asked several questions based on level one of the Kirkpatrick model (reaction). Here, the participant describes the effectiveness that they expect when looking at the feedback in terms of what they can learn from the feedback, if the feedback makes sense to them, and what to do with the information given. This included questions on the general reaction towards the CC ('Did you like reading the CC feedback?'), expected learning because of the CC feedback ('what new insights did / could you gain from this feedback?') and expected change

because of the CC feedback (‘what activities could you undertake after reading the CC feedback to develop your PI further?’). The procedure on the pilot study is visualized in figure 4.

Figure 4

Procedure of the pilot study in four steps.



After the questions were answered, participants would be shortly debriefed on how their answers would be used and that they would have a chance to win a €25,00 voucher. After the interviews were complete, a total amount of three vouchers was raffled amongst all participating participants of the pilot study and the main research combined.

4.2 Results

After conducting the interview, the outcomes of the pilot were divided into the three different levels of the measure of effectiveness (general reaction towards the CC, expected learning, expected change). The fourth level of expected results/outcome did not give any response from participants as they would not have had any time to process their feedback and put it to action. Therefore, no results are present for this final level. Reoccurring answers within the categories were grouped and posed more significance than answers that would only occur once. Considering all the outcomes of the questions based on the three levels (reaction, expected learning, expected change), the interviews produced several outcomes:

1. The feedback tool does not necessarily give insight into who you are as a technical professional *in your profession* but more on who you are as a technical professional *in the current situation*.

2. From the standpoint of multiple interviewees, action on the feedback is required to induce and generate change.

3. Responses from the interviews are most often recorded in the reaction phase (level 1 of Kirkpatrick's model), some expected knowledge/attitudes (level 2) change due to the feedback. Change and result are very hard to articulate and can only be detected after *working with* the feedback.

Additionally, it was found that there are a lot of minor improvements that can be made to the visual aspect of the CC, which are described in appendix F. As an implication, participants themselves pointed out that working with the feedback and examining the results closely and e.g., talking about it with peers could be of serious impact rather than only reading the feedback by themselves.

4.3 Discussion

The objective of this pilot study was to gather information on the perceived effectiveness of the Career Compass feedback tool. In terms of the perceived effectiveness, we suspect that the Career Compass feedback can be useful for students in finding out what your professional identity is *right now*, but not as much as what it will be later in your profession. Additionally, we find that participants think that action on the feedback (discussion with peers, putting advice into practice) is required to induce and generate change. This provides arguments to divert the main research away from identity change in the form of measuring a difference in identity status before and after receiving the feedback. More likely, the intentions of the students towards these career behavioural actions might be affected through the Career Compass feedback.

The questions about current developmental activities and intentions towards career behaviours produced little results. Most of the students indicated that they were not engaged in any or little developmental activities. They did indicate that they did find the feedback useful to learn about the self, indicating that there is an interest in developmental activities. Additionally, they posed that the Career Compass is a good starting point on the development of the professional identity, especially if action is taken after receiving the feedback to foster change.

We examined expected learning and expected behavioural change due to the feedback of the Career Compass, instead of directly assessing level two of the Kirkpatrick model (learning). This could potentially lead to reduced credibility of the data and should therefore be considered when reading these results and drawing conclusions. The use of the Kirkpatrick model with participants 'interpreting' their learned skills and potential change is not a complete use of the model – with this model the learned skills and change are ideally measured with the proper measuring tools to ensure an impactful intervention.

5 Main study

The goal of the main is study is to measure the effectiveness of the Career Compass feedback by performing a repeated measure analysis before and after participants have filled in and seen their feedback. We hope to find results for a change in intentions towards career behaviour intentions. Additionally, we wish to find out how effective students perceive the feedback and their interaction with the feedback. This information will help to answer the three research questions.

5.1 Method

After the pilot study, we now determine the method of executing this study by looking at the research design, the participants in this research, the instrumentation used and the procedure.

Research design

To answer if the digital feedback of the Career Compass influences career behaviour intentions (CBIs; RQ1), we measured the CBIs of students before and after they had received their feedback. As we are interested in the personal development per participant, we conducted a repeated measure within-subjects analysis on the scores of the CBIs.

To answer if the effect of the digital feedback on CBIs is influenced by the identity status (RQ2), we determined the identity status of all participants by using the identity status questionnaire. We then examine to what extent CBIs are dependent on identity status using a moderation analysis.

Finally, to answer how students could be supported more optimally by the Career Compass feedback in the development of their PI (RQ3), we measured the perceived effectiveness of the CC feedback and interactions with the CC feedback. In addition, we determined if participants with a different identity status perceive the feedback as more useful than other participants. To conclude, we provide advice for the improvement of the CC feedback using results from the pilot test, our literature research and the analyses performed in this research.

Participants

Firstly, we determined our needed participants for this research. Because we did not want to examine only the identities and intentions towards career behaviours of prototypical STEM students but also those who are close to the border of STEM education, all students from the University of Twente and Saxion University of Applied sciences were asked to partake. We used purposive sampling to select participants from all years in university, and we reached them through posting the request to fill in a questionnaire on LinkedIn. Also, we asked students through WhatsApp groups and personally approached them (online) to fill out the questionnaire and participate in the research. An a priori estimation was made for the number of participants using the application *G*power*. This

application produces an a priori estimation of the needed number of participants to reach sufficient power. Power, in this case, means a rightful rejection of the null hypothesis and is used to prevent type I statistical error. We used a partial n^2 of 0.06 and an alpha error probability of 0.05. The correlation amongst repeated measures was set to 0.6. Subsequently, an estimate of 44 participants would be needed to reach a power of 0.95 for finding sufficient differences between measures. The Saxion University of Applied sciences in Enschede provided the opportunity to conduct our research in five of their classes with first-year Mechanical Engineering students. These five classes all took part in a live session in which all students from that class would be given the time to fill in the survey and look at their Career Compass feedback.

A differentiation was made between two sets of participants using 'group A' and 'group B' (see figure 5). In group A, 103 responses were recorded. Group A filled in the questionnaire at least until the identity status questions but did not receive personal feedback. We used the responses from group A to determine professional identity statuses in the sample used as descriptive data in this research. From this set, 12.9% was female, 85.1% was male and 2% rather wouldn't say. In group A, 68% were first-year students and 32% were second-year students or higher. In total, 72.3% was studying at Saxion University of Applied Sciences and 27.7% was studying at the University of Twente. The mean age of the group was 21 years old (*SD = 3.52*). Most of the participants followed the program Mechanical Engineering (*n*=68), whilst the second largest group contain seven participants from Educational Science and Technology. The remaining participants all came from different study programs.

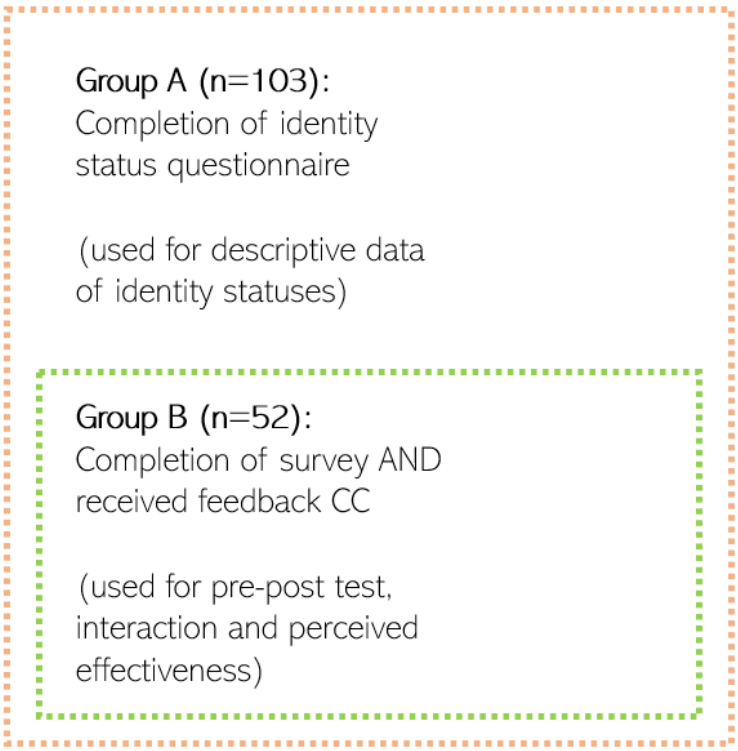
Out of the 103 participants (Group A), we selected a subset of participants who had a 100% completion rate of the questionnaire AND who had received the feedback (group B, *n*=52). In group B, 19.2% was female, 78.8% was male and 1.4% rather wouldn't say. 63.5% were first-year students and 36.5% were second-year students or higher. 55.8% studied at Saxion University and 44.2% at the University of Twente. The mean age of this group was 22 years old (*SD* = 4.30). For an overview, please see figure 5. Group B had a similar division in study programs; the majority were Mechanical Engineering students (*n*=27), and the second-largest group were Educational Science and Technology students (*n*=6). Having a completion rate of 100% in combination with that the participant would have received his or her feedback was regarded as an inclusion criterion for taking up the participant in the repeated measure analysis of the CBI values.

A differentiation in group A and group B was used because group A was eligible to be used for descriptive data of professional identity statuses. Group B was used for the pre-test and post-test and

the measurement of interaction with the feedback, as well as the perceived effectiveness of the feedback.

Figure 5

Visual representation of group A and group B



Instrumentation

In this section, we will describe the instruments used in this research by describing the career compass digital questionnaire, the professional identity status questionnaire, the career behaviour intentions questions, the interaction with the CC feedback questions, and the perceived effectiveness of the feedback. Afterwards, we describe the sequence of using these instruments in the procedure.

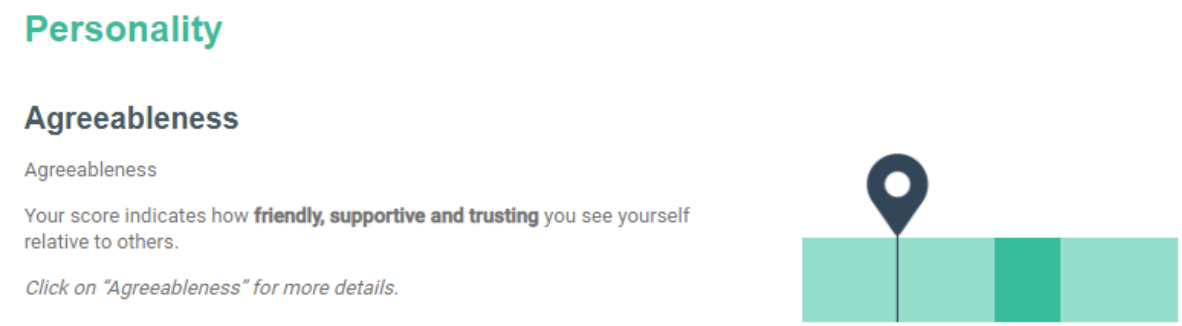
The Career Compass feedback tool

The Career Compass is a digital feedback tool that uses the input of the student from a digital questionnaire to provide feedback on elements of his or her professional identity. The questionnaire consists of four dimensions, namely personality, interests, values, and competencies. The dimension 'personality' was measured with 18 items (e.g., I am stubborn), reflecting five personality traits (e.g.,

agreeableness, extraversion). Interests were measured with 18 items reflecting seven interests (e.g., socializing, community). The dimension 'values' was measured through 32 items (e.g., I find stability important) reflecting eight values (e.g., tradition, family). The last dimension, 'competencies', was measured through 27 items (e.g., managing my time, mentoring others) and reflected nine competencies (e.g., research, analytical). Participants could respond to what extent a statement applied to them on a 7-point Likert scale ranging from 'not at all' to 'very much'. In total, the Career Compass consists of 90 statement questions. An example of a statement question is given in figure 7. The responses on the 90 items are then used to calculate the consequent personality traits, interests, values, and competencies. These are then used by the Career Compass to automatically generate 1) personalised feedback in the form of a profile that fits the student the best (e.g., analyst, individualist, team-player, all-rounder, innovator), 2) a list of personal scores on the four dimensions (figure 6) and 3) information on the next steps[1].

Figure 6

Example item of individual score shown to participants.



The feedback compares the outcomes of the student with 1000 technical professionals and shows the participant their score as compared to these norms. The profile (1) that is usually automatically generated was not functional when this feedback tool was used within this research. The scores on the individual items were not used in the analyses of this research. Therefore, no reliability or factor analyses were performed on the items of the Career Compass survey itself. The focus of this research was the effect of filling in the CC questionnaire and receiving feedback.

[1] Example available here: https://cc-feedback.tech4people-apps.bms.utwente.nl/fOnXw/user/o3vcX

Figure 6

Example question of the Career Compass questionnaire

Career behaviour intentions

To measure the intentions towards career behaviours, 18 questions were asked on all five categories of career behaviour intentions, namely learning about the self, exploring occupations, making decisions and committing to a choice, seeking relevant education or training, and finding a position (Appendix B). For each of the items, the participants were asked about their intentions and current plans around these career behaviour intentions. The category learning about the self contained six items (α_{pre}= .792; α_{post}= .904) with statements such as 'reflecting on who I am as a technical professional'. For this category, the first two items were altered from 'forming a clear picture of my personality' to 'reflecting on who I am as a person', and 'recognizing my interests and values' to 'reflecting on who I am as a technical professional'. This was done as both 'forming a picture' and 'recognizing interests and values' were found too difficult to answer with the response scale used, and we were interested in the intentions of the participants. Exploring occupations contained three items (α_{pre}= .792; α_{post}= .864) with statements such as 'learning about different types of jobs'. Making decisions and committing to a choice contained five items (α_{pre}= .916; α_{post}= .895) with statements such as 'finding a line of work that suits me'. Seeking relevant education or training contained three items (α_{pre}= .687; α_{post}= .702) with statements such as 'beginning the training I need for my preferred job'. For finding a position, reliability could not be assessed as this category only contained one question. This item contained the question: 'Getting a job once I complete my education or training'.

Table 3. *The original and adapted response scale for career behaviour intention questions:*

Adapted response options used in current study	Original response options (SCCI-RF; Student Career Construction items – Research form)
- I have not yet thought about it (1) - I have thought about it, but I do not yet know what I want to do with it - I have thought about it and know what to do with it - I know what to do with it and am actively planning on doing it - I am currently working on this - I have already finished/done this (6)	- I have not yet thought much about it (1) - I have thought about it but do not yet know what to do about it - I know what to do about it - I am now doing what needs to be done - I have already done this (5)

To measure the intentions towards the career behaviours, we used an adapted version (table 3) of the original response scale that was used in the research of Savickas (2018). A response option was added to distinguish between *knowing what to do with it* and *actively planning on doing it*. This was done as in the pilot study, one of the outcomes was that only reading the feedback did not seem to motivate participants to act, hence we wanted to distinguish between being aware of possible action and actively planning on acting.

Professional identity status questionnaire

To measure the identity status of the participants, the professional identity status questionnaire from Mancini et al. (2015) was used. This questionnaire, more often used in similar research towards professional identity, provides insight several components that make up the identity status. The validated questionnaire included 19 items, reflecting five dimensions, namely *affirmation, in-depth exploration, practices, reconsideration of commitment and identification with commitment* (see appendix B). A couple of additions and alterations were made to make the questions useable in this research. Whilst the original identity status questionnaire from Mancini (2015) contained twenty items, we removed one question from 'Affirmation' ('I am looking forward to becoming a technical professional') because it overlapped the three other statements from the category *affirmation* too much (e.g., I feel good to become a technical professional). Additionally, the original questionnaire from Mancini et al. (2015) contained the word 'psychologist' – in our case we replaced this with the

word ‘technical professional’ to adapt it to the aim of this research as was also done in previous research by Kostermans (2019) which did not seem to affect the reliability in that study.

To prepare the participants on the topic, a short statement was added beforehand: ‘The following questions are about you, becoming a technical professional. With technical professionals, we mean people who have – just like you will – completed a technical degree. For the next statements, fill in the answers that fit you the best’. The response scale used for in-depth exploration and practices was altered to clarify that the statements were focused on actions taken by participants. Hence, we changed the responses given in-depth exploration and practices to range from ‘never’ to ‘always’ to measure the frequency of actions. The remaining statements were answered using a five-point scale ranging from ‘Strongly disagree’ to ‘Strongly agree’.

Factor analysis on the identity status questionnaire outcomes

Factor loadings were compared to each other to find underlying factors within the question responses of the identity status questions. This was done to conclude a suitable number of factors fitting this research. The method chosen to execute this factor analysis was through a principal component analysis (PCA) by using IBM SPSS (version 26) using Kaiser normalization. We chose the oblique (or Oblimin) rotation as factors in the analysis were likely to be correlated. The criterion for factor loadings to be included was a minimal value of .55 based on 100 participants (Hair et al., 2009) and a difference between factor loadings of one component being large enough (>.15; Worthington & Whittaker, 2006). All 19 items were analysed for underlying factors. The following criteria were adopted to analyse the data: 1) The number of extracted factors could not surpass five, as this would be more than the number of factors introduced by Mancini (2015), and 2) the eigenvalues of the factors must be sufficient (>1) to be considered a factor. The number of factors was not pre-determined. The results from the first factor analysis revealed that items of affirmation loaded negatively on the same factor as reconsideration of commitment, and not on a separate factor. Therefore, it was decided that the items of affirmation would be recoded and combined with the items of reconsideration of commitment, forming a new scale ‘reconsideration/rejection of commitment’.

In addition, the items from the practices section were found to load on two separate factors. Even when pre-setting the extracted factors from the analysis to five in additional factor analysis, the four questions from practices would still load on two different factors. This shows that an underlying component was present within the practices questions. Both factors also showed insufficient internal coherence (α <.50). Hence, the category of practices was removed.

After the elimination of the practices section, a second factor analysis was performed. The first question from affirmation; ‘It is important for me to become a technical professional’, loaded

significantly on the second factor *identification with commitment* (.34) whilst it theoretically belonged to the factor *affirmation*. Additionally, the loading of this question was too low to be included in the pattern matrix. Therefore, in the final factor analysis, question one was removed.

The final factor analysis (table 4) presented three total factors to describe our dataset with: *reconsideration/rejection of commitment, identification with commitment, and in-depth exploration*. This factor analysis, with the three factors, explained 62.5% of the variance in the dataset. After the PCA was complete, all subscales were subjected to a reliability test. The internal reliability of the subscale reconsideration/rejection of commitment was high (α = .846) as expected from the factor analysis, which now consisted of seven items. The identification with commitment subscale consisting of four items (α= .844) also had high reliability. The in-depth exploration subsection consisted of four items (α= .744) and had good reliability as well.

Table 4: *Results final factor-analysis identity status questions*

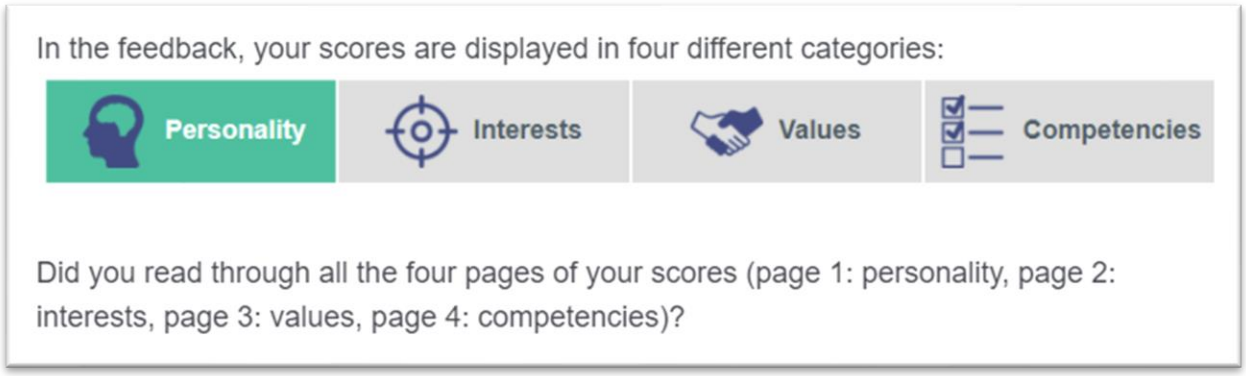
Item	Final factor loadings		
	Reconsideration/rejection of commitment'	Identification with commitment	In-depth exploration
I feel good about becoming a technical professional	-.619		
I am proud to become a technical professional	-.603		
Thinking about myself as a professional in this field helps me to understand who I am		.716	
Thinking of myself as a technical professional makes me feel secure in life		.891	
Thinking of myself as a technical professional makes me feel self-confident		.795	
Thinking of myself as a technical professional makes me feel confident about the future		.792	
If I could change my choice of becoming a technical professional, I would do it	.836		
Choosing a different professional would make my life more interesting	.729		
It would be better to prepare myself for another profession	.850		
I am considering the possibility of changing my study program to be able to practice another profession in the future	.715		
Do you ever wonder whether a technical profession is the most suitable for you?			-.679
Are you ever concerned about becoming a technical professional?			-.718
Do you ever think about the advantages and disadvantages associated with becoming a technical professional?			-.703
Do you pay attention to what other people think or say about technical professionals?			-.731
Eigenvalues	*4.391*	*2.840*	*1.367*
% of variance	*31.4%*	*20.3%*	*9.8%*
Chronbachs α	*.84*	*.82*	*.71*

Interaction with Career Compass feedback

To measure interaction with the career compass feedback, three questions were asked. First, interaction with the four tabs/pages (personality, interests, values, and competencies) that participants could click on in the feedback was measured (figure 7). Participants were asked if they had read through all the four pages of the feedback, in which they could answer 1) no, 2) I read one page, 3) I read two pages, 4) I read three pages, 5) I read four pages, 6) I did not know I could click on the other pages.

Figure 7

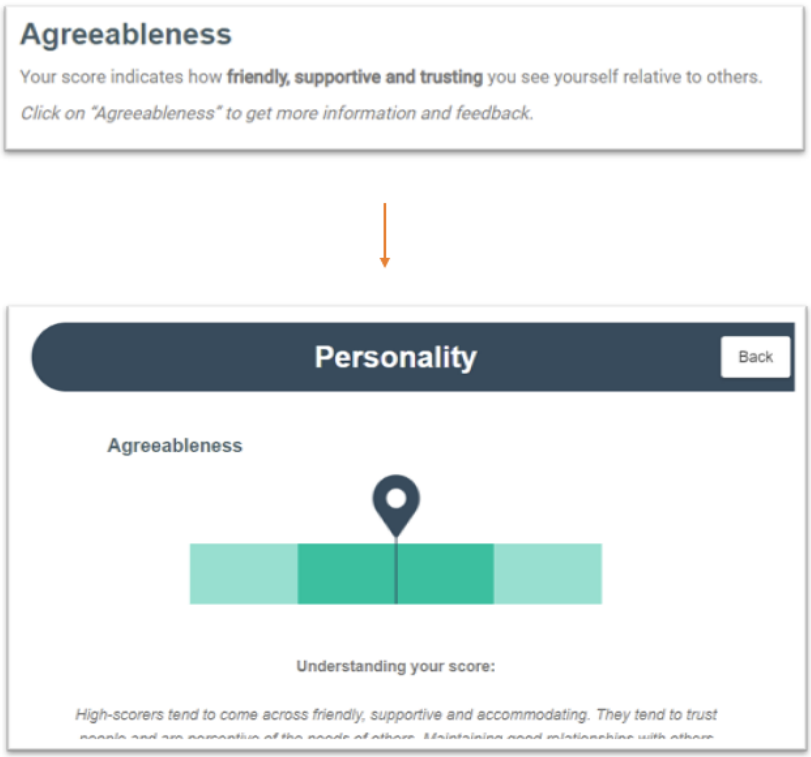
Question on interaction with the four different feedback pages



For the second question, participants were asked about their interaction with the individual scores. The purpose of interacting with the individual scores is that participants can click on the separate scores and read about it more, next to what it means to score above or below the average. The question 'Did you click on the items in the descriptive text of your individual scores' could be answered with 1) No, 2) I clicked on one item, 3) I looked through multiple items that interested me, 4) I did not know that I could click on the items. For clarification, a picture was used in the question that can be seen in figure 8 that shows what happens when a participant would click on the individual item.

Figure 8

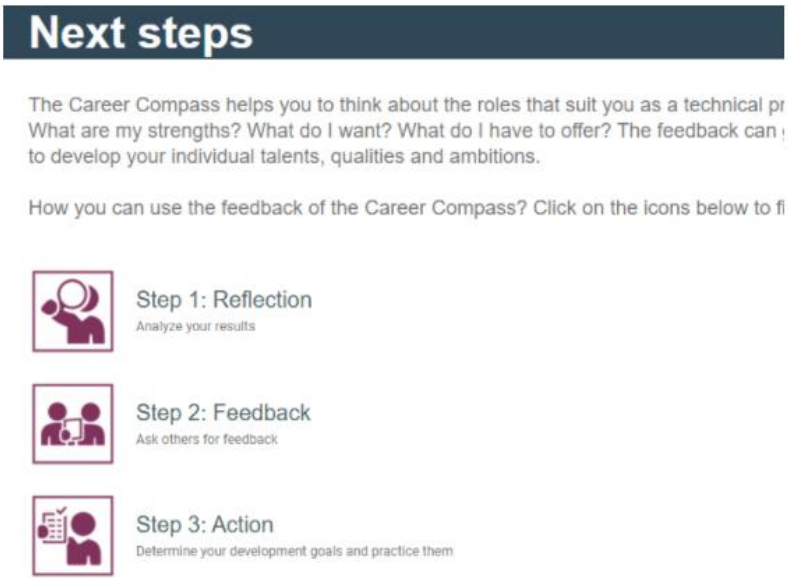
Description picture for question two showing the effect of clicking on an individual item.



The third question covered the interaction with the 'next steps' page at the bottom of the digital feedback website (figure 9). The purpose of this page was to inform students about the next steps that they could take with their feedback and how to proceed and develop further. The question 'Did you look at the 'Next steps' page at the bottom of the page' could be answered with 1) No, 2) I have briefly seen it but not read the text, 3) I have seen it and read the text but did not click any links, 4) I have seen it and clicked at least one link, 5) I have seen it, but I didn't know you could click on any links.

Figure 9

Picture used for the third question on 'how to continue' to help participants recognize the section



The responses on the interaction questions (reading the separate pages of the feedback, clicking on individual items) on the Career Compass feedback were categorized as 'having an interaction' or 'not having an interaction' to make the responses eligible for use in the correlation analysis. Having had an interaction meant that the participant would at least have clicked one or more items or read one or more pages of the feedback. Not having had an interaction meant that the participant filled in they did not know they could click the items or did not click on anything.

Perceived effectiveness of the CC feedback

To measure the perceived effectiveness of the CC feedback, participants were asked 11 questions based on level one (reaction) of the model of Kirkpatrick (1996) in the questionnaire. With perceived effectiveness, we describe 1) the potential that the participant perceives when looking at the feedback in terms of what they can learn, 2) if it makes sense to them, and 3) what to do with the information given. The questions were answered using a five-point Likert scale, ranging from totally disagree to totally agree. Four questions covered measuring the primary reaction of the participants on how useful and enjoyable they found the feedback to be (e.g., 'I found the results from the career compass useful' and 'I liked reading the career compass feedback'). The remaining seven questions

covered what participants expected to have learned from reading the feedback (e.g., I have gained knowledge about who I am as a technical professional' and 'I have gained knowledge about my competencies'). The latter seven questions could not contribute to level two of the Kirkpatrick model (Learning) as no objective learning benefits were measured – merely the reaction of the participant. We did not measure for or expect results in Level three (behaviour measures) or Level four (results).

We performed a PCA on the questions to examine if there was a difference in response between the first four questions on the primary reaction, and the seven questions based on expected learning. However, all items loaded on one factor. The reliability of all 11 questions was good (a = .890). Hence, all responses to the 11 questions on perceived effectiveness were combined into one category: 'Reaction'. Additionally, a one-way ANOVA and variance analysis was performed to detect the effect of the participants' identity phase on the perceived effectiveness.

Procedure

Participation in this research consisted of filling in the first part of the online questionnaire containing the pre-test, filling in the Career Compass questionnaire, reading the personal feedback from the Career Compass. Lastly, participants filled in the second part of the online questionnaire with the post-test. The first part of the questionnaire started contained a short introduction to the research, how the different data was stored and a set of inclusion criteria for participating in the research. Next, the altered questions from the identity status questionnaire were asked. After these, participants completed the pre-test containing the career behaviour intention questions.

Then participants were asked to fill out the Career Compass questionnaire in a separate window, to then go back and then fill in their data for the demographic section of this research. This would leave some time for the personal feedback of the Career Compass to be sent out to the participants.

After completing the demographic questions, participants could read their feedback. There was no indication of how long the participant should look at their feedback. To still be able to record how much time a participant would spend on the feedback page, one section of the questionnaire was designed to trace the time participants spent on the personal feedback page. However, this timing mechanism did not consider any breaks or other disruptions that the participant could potentially have. To combat this, it was made clear to the participant that the amount of time spent on the feedback page would be recorded for the research. In the end, the results for the time spent on the feedback page were unreliable and were discarded.

The second part of the questionnaire contained the post-test of the career behaviour intentions, followed by a set of questions on interaction with the feedback to see how many sections participants had clicked on. In the case that participants would not have received their feedback, an option was given to review an existing template of feedback that the participant could look through to form an image. They too were given the same post-test questions and proceeded with the research as normal. An additional question asked if they had received their feedback or if they had looked at the template for further analysis. Several questions were then asked based on the model of Kirkpatrick (1996) to measure perceived effectiveness.

Afterwards, a small debriefing in the form of a written text was given to the participant. In this debriefing, participants could read what would be done with the results of the questionnaire, and they were instructed to email the address of the researcher to find out about the results if interested. Lastly, participants could leave their e-mail addresses to have a chance to win one of three vouchers worth €25 for partaking in the research.

With all the participants, instruments and the whole procedure described, we can dive into the analytic strategy and the results of the analyses to answer the research questions.

5.2 Results

In this section, we will present the results following from the analyses on the topics of a correlation analysis, the career behaviour intentions, the professional identity statuses, the participants' interaction with the feedback and the perceived effectiveness questions on the CC feedback. We relate the results to the research questions.

Analytic strategy

The analysis of the elements within this research contained five steps. All analyses were performed on group B of our sample, unless stated otherwise. **The first step** was to explore potential correlations between the demographic variables and all variables of the research model.

The second step was to compare answers of the pre-test and post-test on CBIs, which would reveal the effectiveness of the digital feedback of the Career Compass on career behaviour intentions (RQ1). Differences between the pre-test and the post-test were examined using a Repeated Measure ANOVA (or within-subjects ANOVA) to test for overall differences in means for all five categories of CBIs (*learning about the self, exploring occupations, making decisions and committing to a choice, seeking relevant education or training, finding a position)*. For all categories, we looked at the Greenhouse-Geisser correction. Sphericity of the data could not be assumed as this requires a minimum of three measures in a repeated measures ANOVA. Therefore, the Greenhouse-Geisser correction was interpreted with a 95% confidence interval. Due to the lack of sphericity, Greenhouse-Geisser and Huynh-Feldt corrections produced identical results. The effect size was determined using the partial eta squared and the rule of thumb of Cohen (1988, as cited from University of Cambridge, 2021).

The third step was to look for a moderation effect in the effectiveness of the CC feedback on CBIs, regarding the impact of the identity status (RQ2). To examine this research question, we first performed a k-means cluster analysis to the identity status questions to determine identity 'phases' which would be used to describe the sample of group A. Combined with their perceived effectivity and interaction; we can suggest improvements for the effectivity of the Career Compass feedback tool (RQ3). Z-scores of the identity status scores were calculated in the form of standardized scores. To conclude which phases our subset could be divided in, we visually compared the z-scores per cluster with those of Mancini et al. (2015; Appendix G) and logically deducted the phases that our participants were in. Here, we performed another repeated measures ANOVA with the identity status dimensions as between-subjects factors. This would show the moderation effect of identity status on CBIs.

Step four and five that cover the interaction and perceived effectiveness answer how the digital feedback can be improved to more optimally stimulate students to develop in their PI (RQ3).

The fourth step was to measure the interaction with the Career Compass feedback using three separate questions. The answers to these questions were categorized in 'interaction' and 'no interaction' per participant. In addition, the answers generally describe the interaction between participants and the different components of the CC feedback. A chi-square test to test independence was conducted to detect a difference in samples between those who did have an interaction and those who did not have an interaction in terms of the identity status.

For **the fifth step**, responses for the questions regarding the perceived effectiveness of the digital feedback were shown per question in a horizontally stacked bar graph to inspect the separate responses and to identify high and low scoring items visually. Mean scores and standard deviations were calculated. These scores were used in an independent sample t-test to test for different means in different categories of the phases of identity statuses in combination with the reaction scores, as described in the next section of this research.

Correlation results

The exploratory correlation analysis yielded the following results (see table 5). For the demographic items such as age and gender, we find no correlation with career behaviour intentions (CBI). We did find a positive correlation between the identity status dimensions of reconsideration/rejection of commitment and age ($r(50) = .312$, $p<0.05$), whilst the identity status dimension identification with commitment negatively correlated with age ($r(50) = -.350$, $p<0.05$). We also found that being in a technical program is related to an elevated score of identification with commitment ($r(50)=.297$, $p<0.05$), and reduced scores of reconsideration/rejection of commitment ($r(50)=-.386$, $p<0.01$) and in-depth exploration ($r(50) = -.277$, $p<0.05$). We did not find any correlations between demographic items and students' perceived effectiveness of the feedback, nor the interaction with the feedback. The difference in career behaviour intentions between the pre-test and the post-test did not correlate to any items within this research.

Within the identity status dimensions, participants who claimed to have a higher reconsideration/rejection of commitment also showed a higher in-depth exploration ($r(50) = .449$, $p< 0.01$). Further, the identity status dimensions were not found to correlate with each other.

For the interaction items, we see mixed results. We find a correlation between the perceived usefulness Career Compass useful and interaction with clicking on more individual items in the Career Compass feedback (*r(50)*=.298*, p* < 0.05), indicating that participants who mentioned that they found the career compass feedback useful also tend to have an interaction with the individual items from the CC. However, no correlation appeared for reading the 'how to continue' page within the CC feedback and the perceived usefulness. No further correlations were found for both the students' perceived effectiveness and the interactions with the feedback and other elements within this research.

Based on the correlations found in this research, we chose to include being in a technical program or not, gender, as well as age as covariates in the repeated measure ANOVA for the CBIs. This was done as being a first or a higher year student correlated strongly with year of starting in university. Additionally, being a member of Saxion or the University of Twente highly correlated with other demographic factors, meaning that not all factors were needed to include as covariates to detect their influence.

Table 5: *Final Correlation table*

		M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Years since starting University	2.96	1.73	1.00																
2	First or higher year student[a]	1.37	.49	-.741**	1.00															
3	Technical program or not[b]	.85	.36	.07	-.341*	1.00														
4	Saxion/UT[c]	1.44	.50	-.586**	.691**	-.479**	1.00													
5	Gender[d]	1.83	.43	.326*	-.348*	.452**	-.365**	1.00												
6	Age	22.00	4.30	-.21	.394**	-.575**	.454**	-.413**	1.00											
7	Read 'how to continue' CC[e]	.48	.50	-.25	.23	-.02	.23	-.06	.23	1.00										
8	Clicked individual items CC[f]	.54	.50	.13	-.18	.03	-.11	.08	-.11	-.11	1.00									
9	Perceived effectiveness CC	3.14	.66	.09	-.26	.15	-.24	-.13	-.03	.02	.298*	1.00								
10	CBI: Change in 'Finding a job'	.29	1.05	.07	-.09	.07	-.17	.03	-.10	.18	.11	.18	1.00							
11	CBI: Change in 'Seeking relevant training/Education'	.10	.67	.11	-.16	.17	-.27	.22	-.25	.12	.20	.09	.500**	1.00						
12	CBI: Change in 'Making choices and committing'	.33	.56	.13	-.04	.05	-.01	-.02	-.01	.22	-.18	.10	-.07	.17	1.00					
13	CBI: Change in 'Discovering jobs'	.06	.84	.00	-.05	-.08	-.06	-.06	.05	-.08	.20	.20	.14	.14	.07	1.00				
14	CBI: Change in 'Learning about the self'	.18	.61	.11	-.06	.01	-.01	-.03	-.12	.10	.23	.19	.293*	.456**	.13	.441**	1.00			
15	IS: In-depth exploration	2.45	.71	.05	-.09	-.277*	.20	-.319*	.16	.27	.07	.08	.17	.03	.04	-.01	.23	1.00		
16	IS: Identification w/ commitment	3.39	.70	.25	-.24	.297*	-.290*	.293*	-.350*	-.08	.19	.16	.10	.03	.08	.01	-.16	-.03	1.00	
17	IS: Reconsideration/rejection of commitment	1.88	.62	.15	-.02	-.386**	.15	-.17	.312*	.20	-.25	-.03	.11	.08	.16	-.15	-.01	.449**	-.04	1.00

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

[a]For first or higher year student; 1 = first year student, 2 = higher year student; [b]For technical program or not; 0 = not in a technical program, 1 = technical program; [c]For Saxion/UT; 1 = Saxion, 2 = UT; [d]For gender; 1 = female, 2 = male; [e]For clicked individual items CC & [f]read 'how to continue' CC; 0 = no interaction, 1 = interaction ; CBI = career behaviour intentions, IS = identity status

Impact of the CC feedback on career behaviour intentions

The following results show the effect of the CC feedback on students' career behaviour intentions (RQ1).

For **learning about the self**, the impact of receiving feedback was found significant ($F(1,51) = 4{,}501$, $p=0.041$), with a medium effect size ($\eta_p^2 = 0.080$; $M_{pre}= 4.59$, $M_{post}= 4.77$).

For **discovering jobs**, the impact of receiving feedback was not found significant ($F(1,51) = 0.042$, $p = 0.839$) with a small effect size ($\eta_p^2 = 0.005$; $M_{pre}= 4.49$, $M_{post}= 4.55$).

For **making choices and committing**, the impact of receiving feedback was found significant ($F(1,51) = 18{,}400$, $p < 0.01$), with a large effect size ($\eta_p^2 = 0.265$; $M_{pre}= 4.15$, $M_{post}= 4.49$).

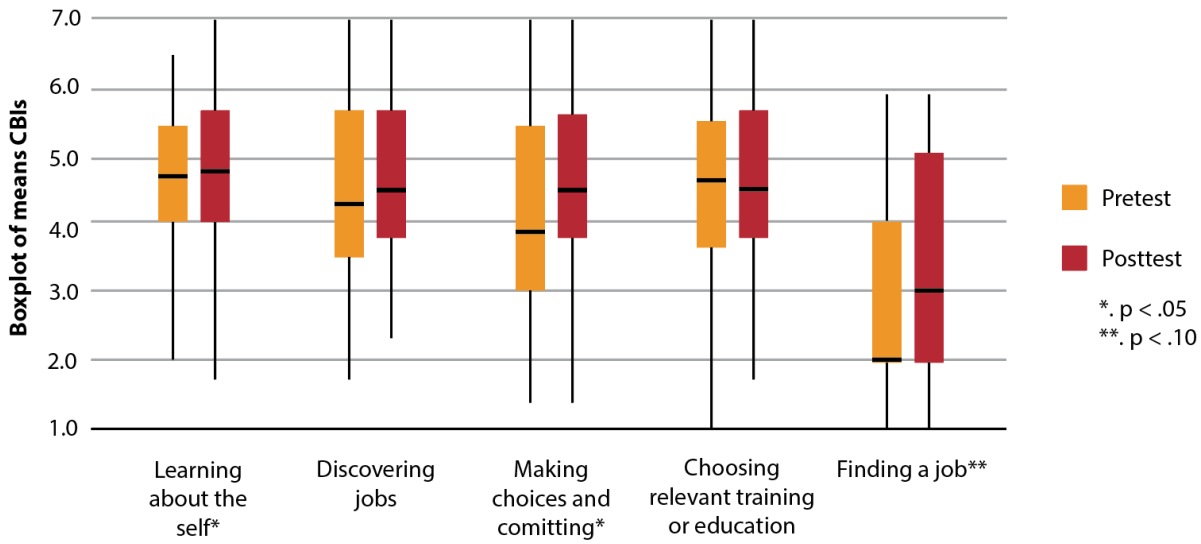
For **choosing relevant training or education**, the impact of receiving feedback was not found significant ($F(1,51) = 1{,}201$, $p = .278$) with a small effect size ($\eta_p^2 = 0.023$; $M_{pre}= 4.46$, $M_{post}= 4.57$).

The single question regarding **finding a job** also did not seem to be influenced significantly by receiving feedback ($F(1,51) = 3.894$, $p = 0.054$) with a medium effect size ($\eta_p^2 = 0.071$; $M_{pre}= 2.96$, $M_{post}= 3.25$). However, a noticeable difference in means before and after the measurement is detected (figure 10).

The between-subjects variables technical program or not and gender, as well as the covariate age, did not yield a significant impact (*ps.* > .10) for all five CBIs. The means and spread of the data from the CBIs are presented visually in figure 10, where we can witness a difference between the pre-test data (yellow) and post-test data(red).

Figure 10

Mean scores of the pre and post-test results of CBIs, presented in a boxplot



To identify the impact of receiving personal feedback and because a number of students did not receive their feedback, we performed an additional analysis. Here, we compared students in the dataset who had finished the questionnaire and received their feedback with students who had finished the questionnaire but who did NOT receive their feedback[2]. This was done by performing the repeated measure ANOVA analysis again on the participants who did not receive personal feedback for all items of the CBIs. Within this analysis, we again perceived a positive difference for the category of making choices and committing ($F(1,19) = 4.607$, $p=0.045$).

To investigate this result, we decided to include all 103 participants in the pre-post-test analysis and perform the repeated measure ANOVA on all items of the career behaviour intentions, with 'having received feedback' as a between-subjects factor. The result of this analysis showed that the group who did receive feedback and the group who did not receive feedback did not significantly differ from each other ($ps > .210$).

[2] We also performed the repeated measures ANOVA on the sample of this research that *did* fill in the career compass questionnaire but who did *not* receive their personal feedback (and that did finish the entire questionnaire). This sample was provided with a mock-up version of the feedback that was not filled with their personal scores, but which was meant to give an impression of the CC feedback. Even though this sample was relatively small ($n=20$), we performed a repeated measure ANOVA on the five categories of the career construction item intentions. We found that there still was a significant positive difference in the mean for making choices and committing ($F(1,19) = 4.607$, $p=0.045$). For the other categories, no significant effect was found. This finding is surprising, as this participant sample did not receive personal feedback. The validity of this ANOVA is, however, questionable due to the low sample size ($n=20$) as our prior number for a valid repeated measure ANOVA was set on 44 (see chapter 4.2).

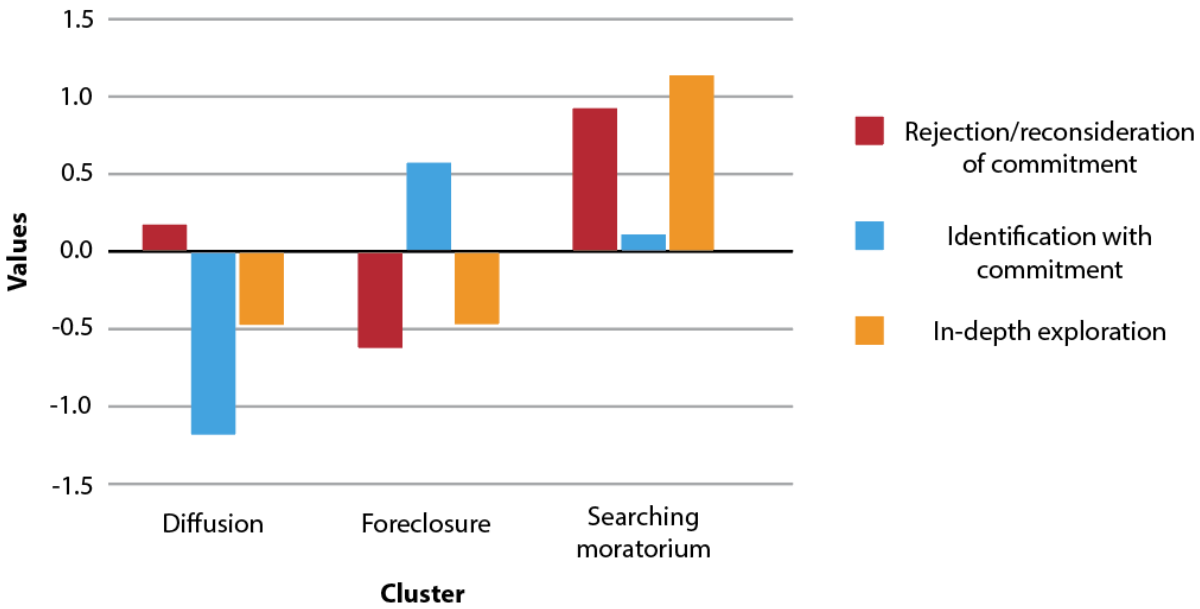
Professional identity status results and the impact on CBIs

To find if the effect of the digital feedback on CBIs depends on the identity status (RQ2), we conducted another repeated measure ANOVA on all five CBIs with the three identity status dimensions as covariates. In this analysis, the demographic covariates were not considered. This did not yield any significant results (*ps.* > .065). The moderation effect closest to being significant was the impact of in-depth exploration on learning about the self (p = 0.065).

Additionally, by performing a k-means non-hierarchical cluster analysis, clusters were generated from the scores of the questionnaire. We noticed that in our subset, not all identity phases were significantly present – as only three factors were found within the factor analysis and the results of our z-scores matched to three clusters within the research of Mancini (2015). We tried computing five clusters out of our three variables, but this gave clusters that were both too indifferent from each other and which we could not identify clusters comparable with those of Mancini (2015). Comparable clusters became apparent at three clusters (figure 11).

Figure 11

Final results from k-means cluster analysis with pre-set of three clusters



Based on this division of the clusters, we can then determine a cluster membership for every participant in the dataset. The number of iterations was 10, which is within the specifications of 10 iterations. From all participants (*n=102*), 25 were part of the cluster Diffusion, 48 were part of the

cluster Foreclosure, and 29 were part of the cluster Searching moratorium. The statuses moratorium and achievement were not detected significantly.

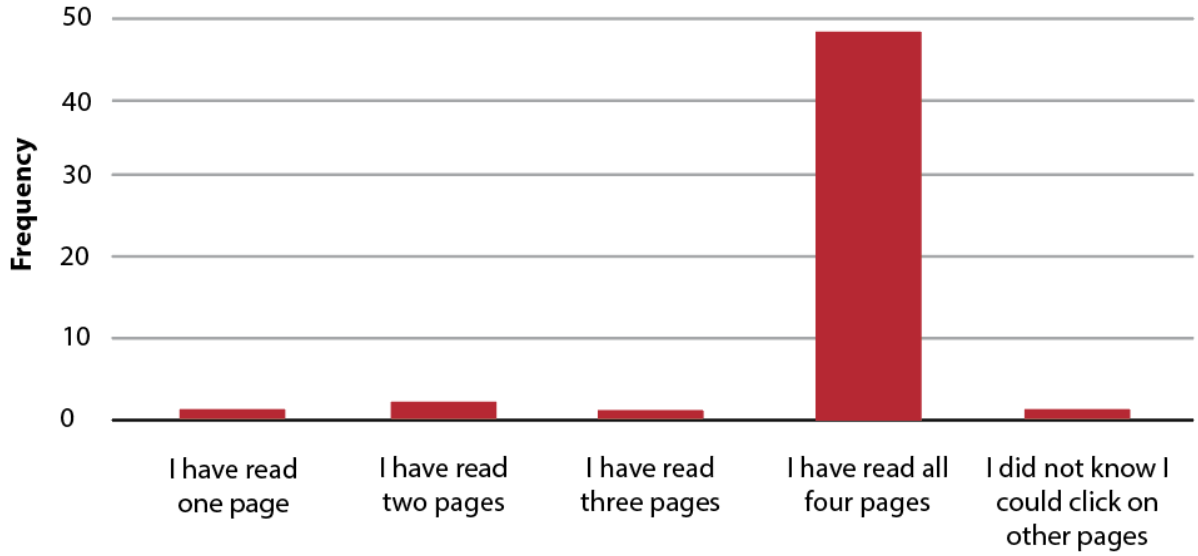
The results from the repeated measure ANOVA with the identity status as between-subject factors show no significant results for all five CBIs on the different identity statuses ($p > .223$).

Interaction with Career Compass feedback results

Now we examine the results of the questions on the interaction of the participant with the digital feedback of the Career Compass, to answer how the Career Compass could be improved (RQ3). The interaction was measured using three questions. The first question covered how many of the four separate dimension pages (i.e., personality, values, competencies, interests) students read or if they were not aware of the separate pages (figure 12).

Figure 12

Question covering how many pages the participant had read of the dimension score pages.

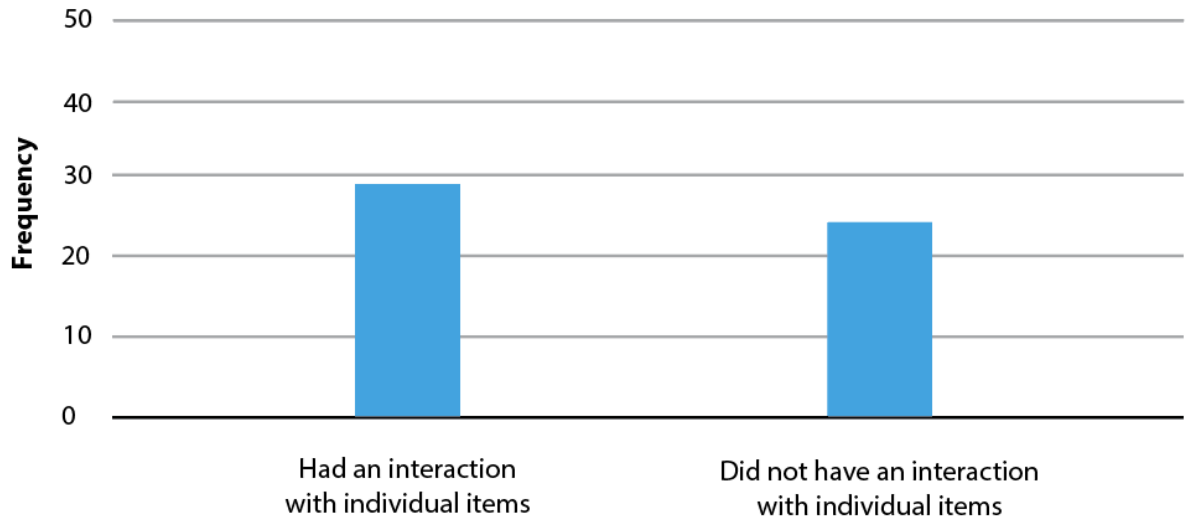


From the total subset (*n*=52), most students (*n* = 47; 90,3%) read all four pages of the dimension scores. Only a minority read through less than the four pages (*n* = 4; 7,7%) or did not know that the other pages were clickable (*n* = 1; 1,9%). From this result, we can assume that most participants read all four pages with their feedback on the dimension scores.

The second question covered whether participants had read the information that was available when clicking on the individual items in the feedback. This meant, for example, reading under 'personality' which separate scores the participant had received and clicking on the name of the separate items to read more information. The responses are displayed in figure 13.

Figure 13

Graph displaying if participants clicked on items at individual scores.

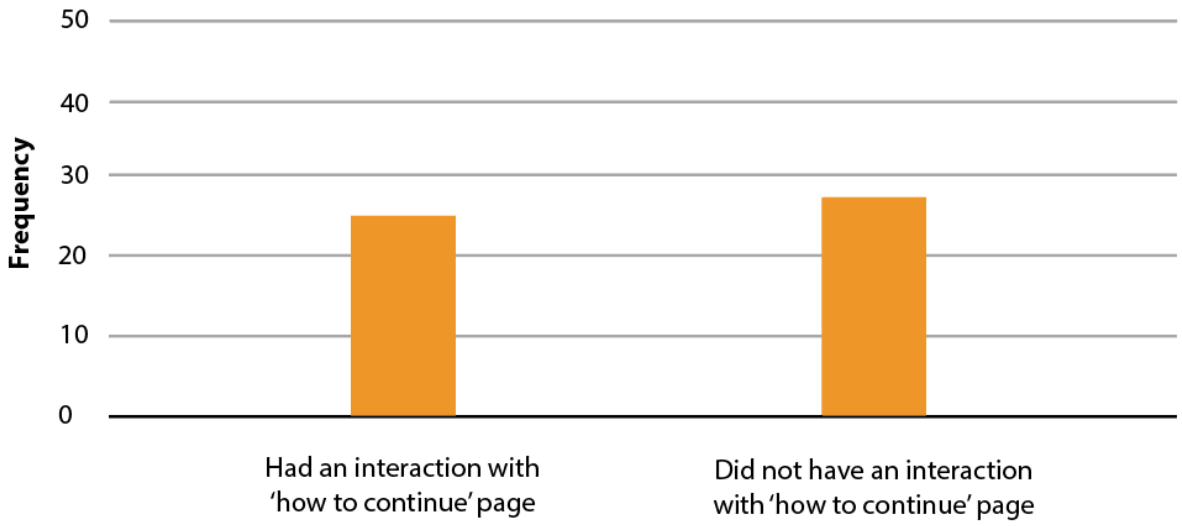


A slight majority (*n*=19) claim not to have clicked on the items for the individual scores, and a minority (*n*=5) mention they did not know the items were clickable. To include this question in further analyses, the response options were combined. The responses 'No' and 'I did not know you could click on the items' were flagged as **not** having an interaction with the feedback. The responses 'I clicked one item' or 'I clicked multiple items' were flagged as having an interaction. Based on this division, we find that 53.8% of the participants (*n*=28) had an interaction with the individual items and that 46.2% (*n*=24) did not have an interaction with the individual items.

The last question regarded if students had seen and interacted with the last page in the career compass feedback that gave tips on 'how to continue', in which participants can read on the next steps they could take with their feedback. The responses can be seen in figure 14.

Figure 14

Graph displaying responses to 'how to continue' page at the bottom of CC feedback



For this question, we again divide the responses into two categories. The responses 'no', 'I shortly have seen it but did not read the text' and 'I saw it, but I did not know you could click on the links' are marked as not having had any interaction with the section from the feedback. The responses 'I seen and read the text but did not click the links' and 'I have seen and read the text and clicked on at least one link' were marked as having had an interaction with the section. Based on this division, we find that 52% of the participants (*n*=27) did not have interaction, whilst 48% did have an interaction (*n*=25).

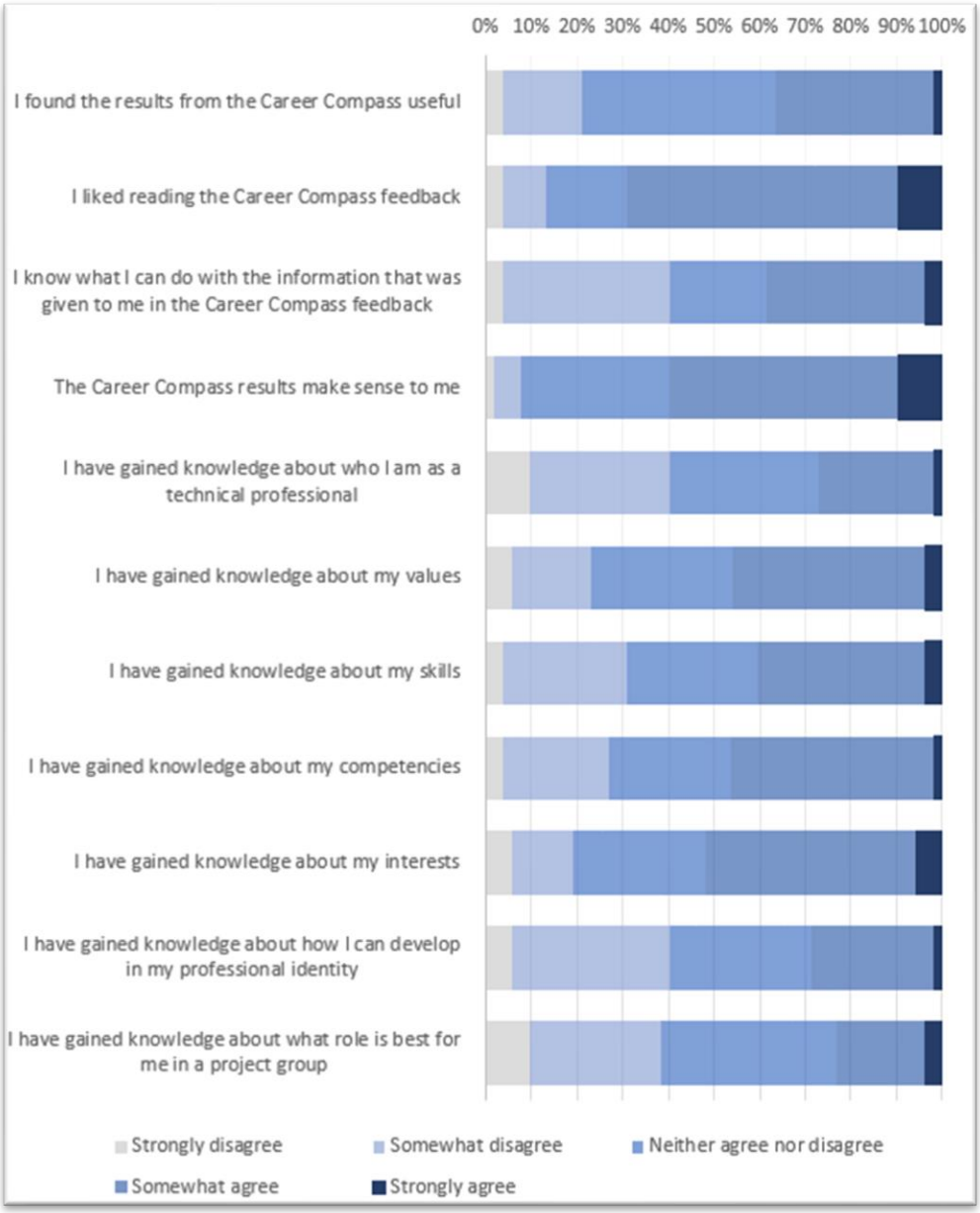
A chi-square for independence sought differences in means between different clusters of the identity status analysis and the interaction of participants with the Career Compass feedback. However, no statistically significant differences were found between these groups for both interaction with the individual items, X^2 (2, n = 52) = .39, p > .05, nor for the interaction with the 'how to continue' page, X^2 (2, n = 52) = 2.85, p > .05.

Perceived effectiveness of the CC feedback results

In this section, we examine the results from the reactions of the participants towards the digital feedback. This, in addition to the CBIs could also indicate further improvements that can be made to the Career Compass feedback (RQ3). First, we want to take a look at the separate responses per question (figure 15) to get an insight into the responses from our participants.

Figure 15

Separate question responses for the Reaction category



The graph showing the separate responses aids to identify the strongest and weakest points in the feedback to gain insight into the potential improvements for the Career Compass feedback

(RQ3). From this, we can see that the majority (>90%) at least answered the question 'The Career Compass results make sense to me' with 'Neither disagree nor agree'. Around 60% agrees with that statement. Following these results is the question 'I liked reading the Career Compass feedback', which is answered by over 85% with 'Neither disagree nor agree' and around 75% who agrees with that statement. Questions that were answered most negatively were those that covered knowing what to do with the information from the CC feedback, gaining knowledge about the professional identity, gaining knowledge about how one can develop in their professional identity and gaining knowledge about what role in a project group fits the participant the best. Within these last four questions, around 40% of the participants somewhat disagreed with the statements.

For the eleven combined questions, (*M*=3.14*, SD*=.66) the average came out between 'neither agree nor disagree' and 'slightly agree'.

A one-way ANOVA was performed to compare the effect of the participants' identity phase on perceived effectiveness. A one-way ANOVA revealed that there was not a statistically significant difference in perceived effectiveness between at least two groups of identity phases. One moderate significance was found for question 10 regarding 'having gained knowledge about how participants could develop their professional identity' ($F(2, 49) = 2.883$, $p = 0.065$).

An univariate analysis of variance on the result of question 10 revealed a moderate to high effect size ($F(2, 49) = 2.883$, $p = .065$, $\eta 2 = .105$). Even though the result is not significant, it still indicates an influence of cluster membership on how a participant perceives the effectiveness and usefulness of the CC feedback.

6 Discussion

This research aimed at examining the effect of providing students with digital feedback on their professional identity on career behaviour intentions (CBIs). Additionally, we wanted to find out if the effect of the feedback on these intentions were dependent on the students' identity status. Simultaneously, we collected data on the interaction with the feedback and the perceived usefulness of the digital feedback. In the current section, we discuss the results of the research questions, their validity, limitations and implications for future research.

Impact of the Career Compass feedback on intentions towards career behaviour intentions

Through the pre-test and post-test, we found significant effects of the digital feedback of the Career Compass on CBIs, namely for *learning about the self* and *making choices and committing*. No significant effects were found for the CBIs *exploring occupations*, *seeking relevant education or training*, and *searching for a position*. A possible explanation for this result is that the majority of participants were first-year students (63.5%). As expected, first-year students are not likely to be encouraged by the CC feedback to look for a job and what training or education is required.

Results of this research suggest that the CC feedback is most beneficial for helping students to learn about themselves at their current stage and in making choices for their careers. We can answer the question of whether digital feedback influences career behaviour intentions (RQ1) with the fact that the feedback partially influences these intentions and that the effect is measurable.

One factor that influences the credibility of the impact of receiving personal feedback on the professional identity, is that in this research the effectiveness was not found to be statistically dependent on whether the participant had received personalised feedback or reviewed an example template of the feedback. To investigate this, specified research should be conducted on comparative samples of identical sample size who either receive feedback or do not receive feedback with similar pre-tests and post-tests.

Career behaviour intentions and the influence of the identity status

Since Savickas (2018) found that career behaviours correlate with adaptability, we expected a difference between career behaviour intentions for differing identity statuses found in this research. Within the research of Savickas and other research (e.g.: Porfelli, 2011), it was stated that adaptability resources (self-regulation resources for dealing with change) condition the responses on career

behaviours. Despite this expectation, we could not identify differences in adaptability resources as no differences in responses on career behaviours for different identity statuses were found.

An explanation for this result is due to the relatively small sample size and over-representation of first-year students. First-year students are likely to share career construction behaviours because they are members of the same class and follow similar structured developmental activities. First-year students might not have been through the described 'crisis' (Marcia, 1966) and might not have a complete picture of their identity. This incomplete picture of identity in line with Hirschi et al. (2014) who also claim that students at university are less engaged in the matter of self-directed career development and that this becomes more significant after a student is graduated.

Another explanation for not finding this result is the lack of all five original identity phases within our participant group. Three out of five identity phases were detected. Not having found all identity phases within this research could point towards a lack of diversity and different attitudes towards CBIs.

Additionally, a possible explanation is that students overestimate their own identity and that the actions that they are undertaking in the career behaviours do not necessarily match their identity status. Nadelson et al. (2015) claim that when students early in their professional identity development report on their level of development (and their career behaviours), they consider themselves to be further in their development than their actions would imply. This was combatted in this research by closed questions on concrete actions when looking at the career behaviours. However, for the current research, this was not done as the identity status questionnaire was an existing validated questionnaire.

Interaction, perceived effectiveness, and implications for the improvement of the Career Compass feedback

From our results of the interaction with the Career Compass, we find that half of our sample has an interaction with the individual scores and the 'how to continue' that were part of their personal feedback. As the majority of our sample are categorized in the foreclosure and diffusion identity phases which are characterized by low exploration, we find this result positively surprising. We expected to find a connection between the interaction with the Career Compass feedback and identity status, as some identity phases have an increased level of in-depth exploration (taking the chance to reflect on current commitments) such as those in the searching moratorium phase. However, results

in this research do not support this expectation by not showing a statistical difference in the interaction between identity statuses.

One possible explanation between not finding differences in interaction with the CC and the identity status is through the method of measuring the interaction. This was measured using several response options that were later categorized as 'having an interaction' or 'not having interaction', which makes it more difficult to measure an intermediate difference in interaction and find more nuanced differences. Furthermore, measuring the interaction and having clicked the results also does not represent the actual interest from the student towards the feedback. A student might not read the text but could have thoroughly inspected the dimension scores that were presented to him; meaning that an item could have been flagged as 'not having interaction' whilst the student did find the information useful. It is difficult to compare interactions in digital feedback with examples from existing literature, as no comparable research on this subject with the Career Compass or a comparable tool has been executed and reported.

Perceived usefulness of the Career Compass

The general reaction of students in this research on the perceived usefulness of this feedback was positive. Students mentioned for example that they liked reading the feedback, the results made sense to them and that they gained knowledge about their interests. In the pilot study, several participants also mentioned that they liked reading about themselves in the feedback. On the other hand, students responded less positively on knowing what to do with the information from the feedback, gaining knowledge about who the student is as a technical professional and how to gain knowledge about how to develop in the professional identity.

These less positive responses oppose the goal of the Career Compass feedback, which is to provide the student with feedback so that they will gain knowledge about who they are as a technical professional. The fact that participants answered the question regarding the development of PI negatively can be explained by the fact that the matter of the Career Compass feedback does not specify on these topics. Additionally, the professional profile section of the Career Compass feedback was not functional during this research, which might have impacted scores of the question on who the participants were as a technical professional. Research of Peel (2005) stated that self-assessment could help a student to define what actions to take to develop their professional identity, but we did not find the CC feedback to foster this effect. The Career Compass feedback aids participants in defining such actions to take in their development, as they could read more on the bottom of the page (figure 9). However, not many students chose to make use of this as 52% did not have an interaction with this section. Therefore, the results suggest that participants neither wanted to learn a lot about themselves nor found reading about further development engaging enough. This suggestion is in line

with the characteristics of the diffusion and foreclosure identity phases, which have a reduced amount of in-depth exploration (Mancini, 2015).

One correlation between the questions on perceived effectiveness of the feedback and the interaction between the participant and the feedback was found, for the category of 'clicking individual items within the CC digital feedback'. This is not unexpected, as students who perceive the feedback as effective and who are more open to exploration (Mancini et al., 2015) tend to click on more individual items of the Career Compass to learn more about themselves. The students' perceived effectiveness of the feedback has no further correlations to other variables in this research. This shows us that finding the feedback useful or insightful is not connected to age, education or gender, nor connected to career behaviour intentions.

Contrary to our expectation, we did not find support in the results that different clusters of professional identity perceive the feedback as more useful or interact more. This could potentially be explained by the fact that the intervention is suitable for a broad audience and has an impact on all levels of identity development already. Results in this section do support the fact that the Career Compass feedback is useful and provides participants with insights into their identity. As this insight in identity can be positive and aid students in their growth of identity, the usefulness and learning are underlined by participants which proves a sense of the effectiveness of the Career Compass results.

Description of identity statuses determined in our sample:

For the primary investigation of the identity status of our participants, we found that the occurring identity phases within our set are diffusion, foreclosure and searching moratorium (Marcia, 1966; Mancini, 2015). The phases 'moratorium' and 'achievement' are not detected in our subset. These findings are in line with those of Kostermans (2019) with the three largest groups being connected to diffusion, foreclosure and searching moratorium. This confirms the measurement of our sample in finding a similar result. For future research, finding information and gaining insight of students in the 'moratorium' and 'achievement' may provide a different approach for students in those phases of identity development.

Limitations and implications for future research

We encountered several limitations in this research. During the data collection, the profile section of the Career Compass feedback tool was not working due to software issues. The impact of the profile section is unknown, but the addition of a profile section could have influenced the

connectedness participants felt who they are as a technical professional. We doubt that this would have influenced the career behaviour values, as the profile does not describe future actions or intentions towards career behaviours. Additionally, how the Career Compass was conducted and in what conditions participants filled in this survey was not monitored during this research and could have impacted the results.

Another limitation is that Mancini et al. (2015), who developed and reviewed the identity status questionnaire in their research, remarked that the questionnaire should also be tested in more diverse environments than psychology subjects. Adding to the fact, the validation and creation of the questionnaire were done by the same researcher, leaving room for biased findings. Within the identity status questionnaire, we found the category of 'practices' to disappear within this research. Perhaps the activities that were part of the practices section did not apply for our participants, or the activities from the practices section were still too much attached to the original 'psychology' subjects instead of the STEM sector.

Our participant group contained a mixed number of STEM and non-STEM subjects. Even though it was indicated in the theoretical framework that non-prototypical students are an interesting group that should be attracted to persuading a career in STEM, the Career Compass feedback tool and other questions might still have been too much focused on being a (prototypical) STEM professional. This possible difference could be measured in future research by comparing prototypical STEM students to non-prototypical STEM students and analysing a different impact on career behaviour intentions. We did not find a mixed number of STEM and non-STEM subjects to be an issue in analysing our data, as we still could detect a difference in intentions towards career behaviours that were not connected to following a STEM program.

An additional limitation of this research was the time it took to finish the questionnaire, including the Career Compass survey, which was often around 35 minutes. Some participants did not manage to complete their questionnaire in time before the class ended during the live sessions. Therefore, the number of participants was reduced. Additionally, instructions given by the questionnaire in Qualtrics were sometimes perceived as unclear and not all participants knew that they would have to continue with the questionnaire after receiving the feedback of the Career Compass. The post-test also featured similar questions to the pre-test, which led some participants to believe that 'something went wrong' and that they did not have to fill that section in again.

The generalizability of the outcomes of this research was impacted by not having a control group within the pre and post-test design. Now, all participants would receive their feedback and fill

out the identity status questionnaire at the same time. This makes it difficult to eliminate the interaction effects of filling out the questionnaire for the Career Compass feedback and could potentially be repeated with a different sequence of the questions to eliminate those factors. Additionally, receiving feedback was not found to be a moderating factor in CBIs, which suggests that only taking the questionnaire and thinking about the responses or talking about the questionnaire with peers can have a positive impact on CBIs. We know that reflection on the self has an impact and can already aid in building the professional profile, so this effect should be further researched to pinpoint where the growth takes place and what activities are the most effective for PI development.

One limiting factor that is beyond the scope of this study is the fact that this research was conducted during the COVID-19 global pandemic. Students have been found to have reduced amounts of security in their careers (diploma losing value, worries about finding a job) and a less enjoyable study period (Kuipers, 2021). The effect of this pandemic extends this research but cannot be ignored, as it could lead to reduced trust in the working sector or the (professional) future of participants.

The first level (reaction) of the framework of Kirkpatrick (1996) used in both the pilot study and the main research also knows its limitations. Weaknesses from this framework are that the reaction of trainees is sometimes overemphasized and that there might be a low correlation existing between the reactions of participants and actual output. Additionally, the optimal use of this framework is after the training or intervention. For the full use of this model, the research design should be elongated and expanded by including concrete measurements of what the participant has learned and how the behaviour has changed overtime through multiple measurements.

In a broader sense, we question the credibility of measuring interaction and intentions in cross-sectional research when the goal is long-term development. Perhaps the career behaviour intentions are influenced and can be measured, but we cannot say for sure that these intentions will lead to action. Such action could be measured in a more longitudinal study, which is needed to measure growth and development of professional identity. In addition, the trajectories and 'growth paths' of the student within PI are not known and are merely described in smaller research where the number of participants is often relatively low. As an implication for further research, we would suggest building up a dataset and performing a longitudinal study that follows a large number of students in STEM over a longer period to follow the development of their PI, measuring their career behaviour intentions and professional identity status.

For future research, it could be interesting to create a more complete image of the professional identity phases. This includes the difference between identity phases between STEM and other professions and the differences between universities, to get a sense of the identity development

that is occurring. To do this, the same intervention from this research could be conducted, and multiple post-tests could be conducted over time to gain insight in the long-term effects of the Career Compass on different identities.

Alternatively, the professional identity status questionnaire could be conducted yearly at either the start or end of the year. When gaining more insight into students of every year of membership at the university, improvements on professional identity development can be made.

Another indication for future work is the indication that participants gave themselves on actions on the feedback that should be taken. In the pilot study, participants mentioned that they would want to discuss and work with the feedback in order to find it effective for themselves. During the live sessions where this research was conducted at Saxion, students already started to talk amongst themselves and actively review their feedback. Comparing the feedback with peers may help to distinguish and define oneself as an engineer, which aids in PI development (Eliot & Turns, 2011). Whilst this may be a limitation for the credibility of this research, we believe this active engagement can be a method to make this feedback more effective. It is beyond the scope of this study to understand the effect of discussing answers with a peer student as opposed to reading the Career Compass results alone, but we cannot deny the possible impact on the overall effectiveness.

As action to develop identity can be obtained through self-assessment exercises (Peel, 2005) and many participants from this research claiming they did not know what developmental actions to take, there is room for improvement. Lastly, participants mentioned a number of visual aspects of the feedback tool that were good or that could use improvement. These aspects are mentioned in appendix F.

Finally, a body of research has been conducted on increasing persistence in STEM (e.g., Graham, 2013). These elements, next to providing the students with feedback, could potentially be integrated into the CC feedback to make the tool more complete. Elements from, for example, the self-authorship framework posed by Nadelson (2015) could provide steps per identity phase on how to continue and what actions to undertake to foster development. In that case, the Career Compass would gain a new purpose of being a prescribing tool, rather than just a descriptive one. A recent study conducted by Engelbertink et al. (2021) suggests that it could be meaningful to invest in reflection on emotion, which supposedly goes along with critical reflection. In their research, they advise to “build reflection education per study year, to gradually improve the students’ critical reflection level” (p. 81) to help students in the development of their PI. This could be taken up as a suggestion on how to tailor the Career Compass feedback for example per academic year to increase the overall impact and effectiveness.

The impact of the Career Compass feedback is noticeable, and the effects are not yet fully discovered, but more effort should go into helping students figuring out what they want to do in their career and to give them a stronger professional identity.

7 Final conclusion

The results of this study indicate that a positive influence of the career compass feedback on the intentions for learning about the self and making choices and committing is connected to career behaviour intentions. The students that participated in this research were divided over three categories or phases according to the prior research of Mancini (2015) into the phases: diffusion, foreclosure and searching moratorium. No correlation or moderation was found between the phases students were in and the intentions for the career behaviours.

When looking at the research questions and the title of this research ("examining the effectiveness and impact of providing feedback to develop the professional identity of (future) STEM professionals"), we can conclude that the Career Compass as an example of providing feedback is effective in raising the intentions of students that engage with the Career Compass questionnaire. The identity status of the students does not seem to have an impact on how effective the digital feedback is. We could not find any evidence of groups of students who seemed to be aided more by the results of the Career Compass feedback and found that the overall response and reaction of students towards the feedback was positive. Therefore, we can conclude that providing students with digital feedback is successful in raising the intentions of career construction items. This conclusion does not promise development in the professional identity, but we have theoretical implications to suspect a positive contribution towards PI development. We also found that many students do not yet know what they want to become in their professional careers, or what steps to take to get there. We see this as an opportunity for tools and interventions to be adjusted to further support students in their journey of becoming a STEM professional. This finding also does not make the Career Compass and other feedback tools obsolete and confirms that tools like this are not being developed without reason.

Future research is encouraged to look at the long-time effects of digital feedback and the growth and development of students, as much of this remains unknown. Gaining insight in this development can further down the road potentially aid students to be guided better in their professional identity and could help us bridge the gap in the STEM sector.

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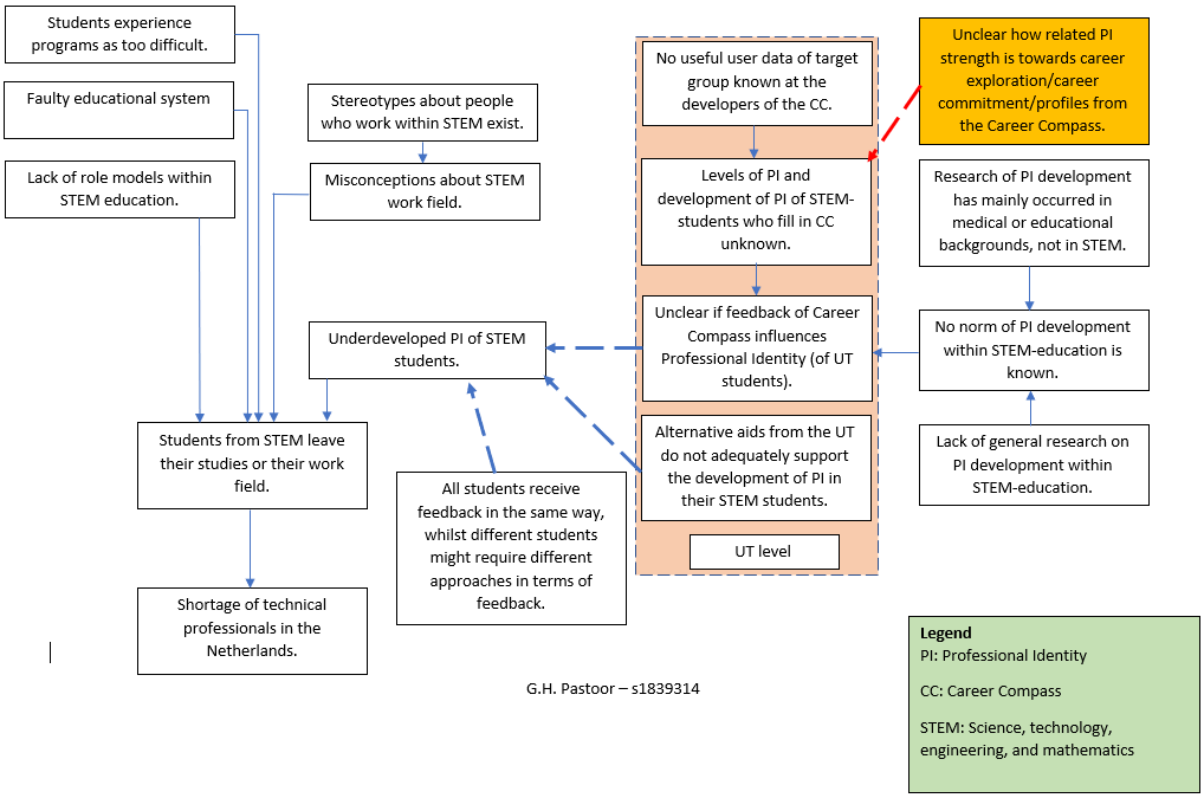
Appendix A: Problem analysis



G.H. Pastoor – s1839314

Appendix B: Full identity status questionnaire according to Mancini (2015)

Table 1 Professional STEM Identity survey items based on the Professional Identity Status Questionnaire (Mancini et al. 2015)

Professional STEM identity survey items and related categories
Affirmation
1. How important is it for you to become a STEM Professional?
4. How do you feel at this moment in time as a future STEM Professional?
7. Are you looking forward to becoming a STEM Professional?
11. Are you proud of becoming a STEM Professional?
In-depth exploration
2. To what extent is becoming a STEM Professional a concern for you?
15. Do you ever think about the advantages and disadvantages associated with becoming a STEM Professional?
17. Do you pay attention to what other people think or say about STEM Professionals?
19. Do you ever wonder whether the profession of STEM you choose is the most suitable for you?
Practices
6. Do you ever read books and / or articles written by STEM Professionals?
9. Do you ever seek information about the different job options that a degree in STEM may offer?
13. Do you ever seek information about the regulations of the STEM practice? (requirements for practicing this profession in your country, etc.)
20. Do you ever participate in meetings and /or conferences where STEM Professionals speak?
Identification with commitment
5. Does thinking of yourself as a STEM Professional help you to understand who you are?
10. Does thinking of yourself as a STEM Professional make you feel secure in your life?
14. Does thinking of yourself as a STEM Professional make you feel self-confident?
18. Does thinking of yourself as a STEM Professional make you feel confident about the future?
Reconsideration of commitment
3. If you could change your choice of becoming a STEM Professional, would you do it?
8. Do you ever think that choosing a different profession would make your life more interesting?
12. Do you ever think that it would be better to prepare yourself for another profession?
16. Are you considering the possibility of changing your major in order to be able to practice another profession in the future?

Appendix C: Main research Hermen Pastoor [ENG]

Start of Block: Welkom - intro

Q1 Prefer Dutch/Liever de Nederlandse versie? Klik hier: tinyurl.com/CC2021nederlands You are participating in a research study from the University of Twente. The goal of this research is to see if the Career Compass, an online tool built by the University of Twente that focuses on giving insight in professional identity, is reaching its potential. This means that you will first fill out some questions, fill out the Career Compass questionnaire, receive your personal feedback from the Career Compass and then answer some questions here. To receive the answers to the Career Compass and to correctly match your answers from the Compass and this survey, it is necessary to fill **the same valid e-mail address** in this and the subsequent survey. Based on the answers you will fill in for the Career Compass, you will receive personal feedback on your competencies, skills, professional profile and more. That data is stored by the University of Twente according to the certifications of the ISO/IEC 27001 and NEN 7510-norms. Participating in this study is fully voluntary, and you have the right to, at all times, quit this study without reason. We will delete your responses upon request. The entire research will **roughly take 30 minutes**. Please note that for this study, **it is necessary you are either a student at the University of Twente or Saxion**. Participating in this research can earn you **one of three vouchers worth €25,00 each**. At the end of this survey, you will be asked if we can use your email address for this. By pressing 'START' (the arrow) below, you agree that you have read this information page and that you give consent in participating within this research and giving your answers. If you have any questions about this research, please contact the researcher via g.h.pastoor@student.utwente.nl.
It is advised to fill out this survey on a laptop or desktop PC!

Q34 Please write your valid email address to continue

_____

End of Block: Welkom - intro

Start of Block: PISQ-5d questionnaire + additional

Q5 The following questions are about you becoming a technical professional. With technical professionals, we mean people who have - just like you will - completed a technical degree.

For the next statements, fill in the answer that fits you the best.

	Strongly disagree (6)	Somewhat disagree (7)	Neither agree nor disagree (8)	Somewhat agree (9)	Strongly agree (10)
It is important for me to become a technical professional (1)	○	○	○	○	○
I feel good about becoming a technical professional (2)	○	○	○	○	○
I am proud to become a technical professional (3)	○	○	○	○	○
Thinking about myself as a professional in this field helps me understand who I am (4)	○	○	○	○	○
Thinking of myself as a technical professional makes me feel secure in life (5)	○	○	○	○	○
Thinking of myself as a technical professional makes me feel self-confident (6)	○	○	○	○	○
Thinking of myself as a technical professional makes me feel confident about the future (7)	○	○	○	○	○
If I could change my choice of becoming a technical professional, I would do it (8)	○	○	○	○	○

Choosing a different profession would make my life more interesting (9)	○	○	○	○	○
It would be better to prepare myself for another profession (10)	○	○	○	○	○
I am considering the possibility of changing my study program in order to be able to practice another profession in the future (11)	○	○	○	○	○

Q6 For the next statements, fill in the answer that fits you the best.

	Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Always (5)
Do you ever wonder whether a technical profession is the most suitable for you? (1)	○	○	○	○	○
Are you ever concerned about becoming a technical professional? (2)	○	○	○	○	○
Do you ever think about the advantages and disadvantages associated with becoming a technical professional? (3)	○	○	○	○	○
Do you pay attention to what other people think or say about technical professionals? (4)	○	○	○	○	○
Do you ever read books and/or articles written by technical professionals? (5)	○	○	○	○	○
Do you ever seek information about the different job options that a degree in a technical profession may offer? (6)	○	○	○	○	○

Do you ever seek information about the regulations of being a technical professional? (e.g. requirements for practicing this profession in your country) (7)	○	○	○	○	○
Do you ever participate in meetings and/or conferences where technical professionals speak? (excluding regular classes from your teachers) (8)	○	○	○	○	○

End of Block: PISQ-5d questionnaire + additional

Start of Block: Pre-test

Q9

To prepare for your future career and to make a decision in what profession would suit you, there are many activities you could undertake to gain more knowledge in these choices. We are curious if you have thought about, considered or already done the following activities.

Q11 Learning about the self - To what extent have you thought about or done the following activities?

	I have not yet thought about it (1)	I have thought about it, but I do not yet know what I want to do with it (3)	I have thought about it and know what to do with it (4)	I know what to do with it and am actively planning on doing it (5)	I am currently working on this (6)	I have already finished/done this (7)
Reflecting on who I am as a person (1)	○	○	○	○	○	○
Reflecting on who I am as a technical professional (2)	○	○	○	○	○	○
Determining what values are important to me (4)	○	○	○	○	○	○
Knowing how other people view me (5)	○	○	○	○	○	○
Identifying people that I want to be like (6)	○	○	○	○	○	○
Finding out what my interests are (7)	○	○	○	○	○	○

Q12 Exploring occupations - To what extent have you thought about or done the following activities?

	I have not yet thought about it (1)	I have thought about it, but I do not yet know what I want to do with it (3)	I have thought about it and know what to do with it (4)	I know what to do with it and am actively planning on doing it (5)	I am currently working on this (6)	I have already finished/done this (7)
Learning about different types of jobs (3)	○	○	○	○	○	○
Reading about occupations (both online and in a magazine or book) (4)	○	○	○	○	○	○
Investigating occupations that might suit me (5)	○	○	○	○	○	○

Q13 Making decisions and committing to a choice - To what extent have you thought about or done the following activities?

	I have not yet thought about it (1)	I have thought about it, but I do not yet know what I want to do with it (3)	I have thought about it and know what to do with it (4)	I know what to do with it and am actively planning on doing it (5)	I am currently working on this (6)	I have already finished/done this (7)
Deciding what I really want to do for a living (1)	○	○	○	○	○	○
Finding a line of work that suits me (2)	○	○	○	○	○	○
Selecting an occupation that will satisfy me (3)	○	○	○	○	○	○
Planning how to get into the occupation I choose (4)	○	○	○	○	○	○
Reassuring myself that I made a good occupational choice (5)	○	○	○	○	○	○

Q14 Seeking relevant education or training - To what extent have you thought about or done the following activities?

	I have not yet thought about it (1)	I have thought about it, but I do not yet know what I want to do with it (3)	I have thought about it and know what to do with it (4)	I know what to do with it and am actively planning on doing it (5)	I am currently working on this (6)	I have already finished/done this (7)
Finding opportunities to get the training and experience I need (2)	○	○	○	○	○	○
Beginning the training I need for my preferred job (3)	○	○	○	○	○	○
Qualifying for the job that I like best (4)	○	○	○	○	○	○

Q15 Searching for a position - To what extent have you thought about or done the following activities?

	I have not yet thought about it (1)	I have thought about it, but I do not yet know what I want to do with it (3)	I have thought about it and know what to do with it (4)	I know what to do with it and am actively planning on doing it (5)	I am currently working on this (6)	I have already finished/done this (7)
Getting a job once I complete my education or training (2)	○	○	○	○	○	○

End of Block: Pre-test

Start of Block: Filling in CC

Q7 Now, you will visit the Career Compass for the first time and fill in the questionnaire.

Please:

1. Leave this window with the Qualtrics Survey open (**don't close it**)
2. Fill in the survey from the Career Compass with your own (valid) email address and return to this window. Use the following link:

https://cc.tech4people-apps.bms.utwente.nl/#/DK4FC

Did you finish the Career Compass survey? This is necessary to continue with this research.

- ○ Yes, I finished the Career Compass survey on my mobile phone (4)
- ○ Yes, I finished the Career Compass survey on my PC (5)
- ○ No, I did not finish the Career Compass survey (6)

End of Block: Filling in CC

Start of Block: Demographic data

Q42 Now that you have filled in the survey for the Career Compass, please fill in the following questions.

Q35
What is your age?

▼ 16 (4) ... 67 (56)

Q36 What is your gender?

- ○ Female (1)
- ○ Male (2)
- ○ Other (3)
- ○ Prefer not say (5)

Q37 Where do you currently follow a study program?

- ○ Saxion University of Applied Sciences (Enschede) (1)
- ○ University of Twente (Enschede) (2)

Q40 What is/are the name(s) of your current study program(mes)?

_____

Q38 In which year did you **start with your current studies** in higher education (HBO/WO)?

- ○ 2013 (1)
- ○ 2014 (2)
- ○ 2015 (3)
- ○ 2016 (4)
- ○ 2017 (5)
- ○ 2018 (6)
- ○ 2019 (7)
- ○ 2020 (8)
- ○ 2021 (9)

Q39 What is your nationality?

- ○ Dutch (1)
- ○ Other, namely: (2) _____

End of Block: Demographic data

Start of Block: Results check

Q43 Now you will look at the personal feedback you received from the Career Compass. Please take the following steps:

1. Check your e-mail if you have received your feedback (you might have to check your spam!) and don't yet open the feedback!

2. If you have NOT received your feedback yet, please hold on for a couple of minutes - it might take a little while (usually 5 minutes). If after 20 minutes you have not received any feedback, please contact the researcher (g.h.pastoor@student.utwente.nl).

Did you receive your feedback in your e-mail inbox? (please wait to open your feedback if you did!)

- ○ Yes, I received my feedback (1)
- ○ No, I did not receive my feedback (2)

End of Block: Results check

Start of Block: No feedback section

Display This Question:

If Now you will look at the personal feedback you received from the Career Compass. Please take the... = No, I did not receive my feedback

Q45 Timing

First Click (1)
Last Click (2)
Page Submit (3)
Click Count (4)

Display This Question:

If Now you will look at the personal feedback you received from the Career Compass. Please take the... = No, I did not receive my feedback

Q44 If already 20 minutes have passed, perhaps something went wrong with filling in your email address in the Career Compass or the system does not respond.

We're sorry you have not received your feedback yet. We will get back to you via email and hopefully will be able to send you your personal feedback at a later stage. To get an idea what the feedback looks like and to get your opinion about the feedback website we would like to ask you to continue with the research.
You can view an example feedback report here: https://cc-feedback.tech4people-apps.bms.utwente.nl/fOnXw/user/o3vcX

Please read through the example feedback report carefully to get an impression of the feedback website. As soon as you are done reading the example feedback, close the page and return to this page and click 'next'.

End of Block: No feedback section

Start of Block: Result timer

Display This Question:

If Now you will look at the personal feedback you received from the Career Compass. Please take the... = Yes, I received my feedback

Q17 Timing

First Click (1)
Last Click (2)
Page Submit (3)
Click Count (4)

Display This Question:

If Now you will look at the personal feedback you received from the Career Compass. Please take the... = Yes, I received my feedback

Q18
Now, you may open your feedback. Please read it carefully. Remember that these results are personal and especially for you! Take in the information, and return to this page.
For this research, we are curious how much time people spend on their feedback page. There is no time pressure and you can spend as long as you want. As soon as you hit the 'next' button (the arrow) below, the timer stops.

As soon as you are done reading your feedback, close the page and return to this page and click 'next'.

The button to continue to the next page is unavailable for 30 seconds to avoid accidentally continuing.

End of Block: Result timer

Start of Block: Post-test

Q50 To prepare for your future career and to make a decision in what profession would suit you, there are many activities you could undertake to gain more knowledge in these choices. The feedback results may help you with this. After reading your feedback, we are curious if you have thought about or considered or do the following activities.

Q51 Learning about the self - To what extent have you thought about or done the following activities?

	I have not yet thought about it (1)	I have thought about it, but I do not yet know what I want to do with it (3)	I have thought about it and know what to do with it (4)	I know what to do with it and am actively planning on doing it (5)	I am currently working on this (6)	I have already finished/done this (7)
Reflecting on who I am as a person (1)	○	○	○	○	○	○
Reflecting on who I am as a technical professional (2)	○	○	○	○	○	○
Determining what values are important to me (4)	○	○	○	○	○	○
Knowing how other people view me (5)	○	○	○	○	○	○
Identifying people that I want to be like (6)	○	○	○	○	○	○
Finding out what my interests are (7)	○	○	○	○	○	○

Q52 Exploring occupations - To what extent have you thought about or done the following activities?

	I have not yet thought about it (1)	I have thought about it, but I do not yet know what I want to do with it (3)	I have thought about it and know what to do with it (4)	I know what to do with it and am actively planning on doing it (5)	I am currently working on this (6)	I have already finished/done this (7)
Learning about different types of jobs (3)	○	○	○	○	○	○
Reading about occupations (both online and in a magazine or book) (4)	○	○	○	○	○	○
Investigating occupations that might suit me (5)	○	○	○	○	○	○

Q53 Making decisions and committing to a choice - To what extent have you thought about or done the following activities?

	I have not yet thought about it (1)	I have thought about it, but I do not yet know what I want to do with it (3)	I have thought about it and know what to do with it (4)	I know what to do with it and am actively planning on doing it (5)	I am currently working on this (6)	I have already finished/done this (7)
Deciding what I really want to do for a living (1)	○	○	○	○	○	○
Finding a line of work that suits me (2)	○	○	○	○	○	○
Selecting an occupation that will satisfy me (3)	○	○	○	○	○	○
Planning how to get into the occupation I choose (4)	○	○	○	○	○	○
Reassuring myself that I made a good occupational choice (5)	○	○	○	○	○	○

Q54 Seeking relevant education or training - To what extent have you thought about or done the following activities?

	I have not yet thought about it (1)	I have thought about it, but I do not yet know what I want to do with it (3)	I have thought about it and know what to do with it (4)	I know what to do with it and am actively planning on doing it (5)	I am currently working on this (6)	I have already finished/done this (7)
Finding opportunities to get the training and experience I need (2)	○	○	○	○	○	○
Beginning the training I need for my preferred job (3)	○	○	○	○	○	○
Qualifying for the job that I like best (4)	○	○	○	○	○	○

Q55 Searching for a position - To what extent have you thought about or done the following activities?

	I have not yet thought about it (1)	I have thought about it, but I do not yet know what I want to do with it (3)	I have thought about it and know what to do with it (4)	I know what to do with it and am actively planning on doing it (5)	I am currently working on this (6)	I have already finished/done this (7)
Getting a job once I complete my education or training (2)	○	○	○	○	○	○

End of Block: Post-test

Start of Block: Post-test objective

Q17 If everything is correct, you have filled in the Career Compass and read through your (personal) results. We now want to ask you some questions on the results that you have received. If you want, it is okay to take a break at this point.

Q20 In the feedback, your scores are displayed in four different categories:

Did you read through all the four pages of your scores (page 1: personality, page 2: interests, page 3: values, page 4: competencies)?

- ○ No (1)
- ○ I read one page (2)
- ○ I read two pages (5)
- ○ I read three pages (6)
- ○ I read all 4 pages (3)
- ○ I did not know I could click on the other pages (4)

Page Break

Q22 The next question is about the text and the individual scores under either the Personality, Interests, Values or Competencies page. In the feedback, each of the individual scores was accompanied by a short definition (see picture below).

Did you click on the items in the descriptive text of your individual scores?

- ○ No (1)
- ○ I clicked on one item (2)
- ○ I looked through multiple items that interested me (3)
- ○ I did not know that I could click on the items (4)

Q24 The next question is about the 'Next steps' page at the bottom of the page

Did you look at the 'Next steps' page at the bottom of the page?

- ○ No (1)
- ○ I have briefly seen it but did not read the text (2)
- ○ I have seen it and read the text, but did not click any links (3)
- ○ I have seen it and clicked at least on one link (4)
- ○ I have seen it but I did not know you could click on any links (5)

End of Block: Post-test objective

Start of Block: Post-test Kirkpatrick model

Q25 The following questions focus on your general reaction towards the feedback you have received. These questions are about your opinion and feeling towards the feedback you have read through for this research.

Q26 Please choose the answer that fits you the best.

	Strongly disagree (27)	Somewhat disagree (28)	Neither agree nor disagree (29)	Somewhat agree (30)	Strongly agree (31)
I found the results from the Career Compass useful (1)	○	○	○	○	○
I liked reading the Career Compass feedback (2)	○	○	○	○	○
I know what I can do with the information that was given to me in the Career Compass feedback (3)	○	○	○	○	○
The Career Compass results make sense to me (4)	○	○	○	○	○
I have gained knowledge about who I am as a technical professional (6)	○	○	○	○	○
I have gained knowledge about my values (7)	○	○	○	○	○
I have gained knowledge about my skills (8)	○	○	○	○	○
I have gained knowledge about my competencies (9)	○	○	○	○	○
I have gained knowledge about my interests (10)	○	○	○	○	○
I have gained knowledge about how I can develop in my professional identity (12)	○	○	○	○	○

I have gained knowledge about what role is best for me in a project group (13)	○	○	○	○	○

End of Block: Post-test Kirkpatrick model

Start of Block: Thank you/debriefing

Q27 Thank you for filling in this survey!

The results of this survey will be used to find out the effectiveness of the Career Compass as a tool for university students and to find out how helpful students perceive this tool. You have helped with this tremendously, so thank you for that!

There will be a raffle under all participants in this study in the form of three vouchers worth €25,00 each. If you want to have a chance of winning one of these, please mention this below.

If you want to know the results of this study, you can e-mail the researcher to find out more. Please send your email to g.h.pastoor@student.utwente.nl.

Q39 Please select one option:

- ○ I wish to have a chance to win a voucher by enrolling with my email address (1)
- ○ I do not wish to have a chance to win a voucher (2)

Q41 Is there anything that you would like to share or comment?

_____

_____

_____

_____

_____

End of Block: Thank you/debriefing

Appendix D: Career Compass feedback template

Bridge the Gap!

areer Compass Feedback en Download

Who are you as a professional?

The Career Compass provides insight into who you are as a (future) professional. It is important to know what kind of professional you are. This helps you to make study and career choices that are right for you.

The data from the Career Compass generates the average scores of technical professionals on different characteristics. In this way you can see how you score in comparison to other technical professionals. Scroll down to get more information on how to interpret your scores. Click on the 'Your scores' button to find out your scores.

Your scores

How to interpret your score?

The Career Compass shows your score on four dimensions: your values (what do I find important), interests (what do I like to do), personality (what are my core characteristics), and competencies (what am I good at).

The graphs below show your score on each of these four dimensions in comparison to the average score of more than a 1000 technical students and professionals that participated in our research (the norm group).

Your scores

Below you find your scores on values, interests, personality and competencies.

Values | Interests | Personality | Competenci

Find out your score on the different values that are described below. To understand what your score means, click on each of the headings for more details.

Values

Tradition

Your score indicates to what extent you value **traditions and social etiquette** relative to others.

Click on "Tradition" to get more details.

Hedonism

Your score indicates how important it is for you to **enjoy yourself and have pleasure** in life relative to others.

Click on "Hedonism" to get more details.

Family

Your score indicates how important **family** is to you relative to others

Click on "Family" to get more details.

Benevolence

Your score indicates how important it is to you to create a **better and just society** relative to others.

Click on "Benevolence" for more details.

Next steps

The Career Compass helps you to think about the roles that suit you as a technical professional: What are my strengths? What do I want? What do I have to offer? The feedback can give you input to develop your individual talents, qualities and ambitions.

How you can use the feedback of the Career Compass? Click on the icons below to find out more.

Step 1: Reflection

Analyze your results

Step 2: Feedback

Ask others for feedback

Step 3: Action

Determine your development goals and practice them

More info: Support UT/Saxion

Find out which study and career support is available at the UT/Saxion

More info: About CC

Find out more about the Career Compass

Appendix E: Division of technical students vs. non-technical students

Programs below are regarded as 'technical', other programs are not regarded as technical.

Chemical Science and Engineering/Chemie/Chemische Technologie
Civiele Techniek/Civil engineering/Civil Engineering
Applied Computer Science / Technische Informatica/ Computer Science and Engineering Technische informatica
Software Engineering HBO-ICT/Technical Computer Science/ Computer Science/ Data Science in Engineering
Data science in engineering/Data Science and Engineering /Data Science and Entrepreneurship Tru/e-security / Information Security Technology
Electrical Engineering /Electrical engineering
Electrical & Electronic Engineering / Elektrotechniek/ Elektrotechniek
Industrial Design/ Industrieel Product Ontwerpen/Industrial Design Engineering/Industrieel Product Ontwerpen/Industrial design
Industrial engineering /Industrial Engineering and Management
Werktuigbouwkunde/Mechanical engineering/Mechanical Engineering/Mechanical Engineering /Werktuigbouwkunde
Applied Mathematics/Mathematics
Physics Technische Natuurkunde/Technische Natuurkunde Applied Physics
Applied Physics Technische Natuurkunde/Applied Physics
Advanced Technology
Biomedical Engineering
Applied Physics, Applied Mathematics
Applied Mathematics, and Technische Natuurkunde
Computer sicence and Apllied mathematics
Applied Mathematics, Technical Computer Science
Technische natuurkunde/technische wiskunde
Technical Computer Science and Applied Mathematics
Tecnische Natuurkunde & Applied Mathematics
Computer Science and Applied Maths
EE en IEM
Chemical Engineering, Industrial Design
Applied physics en applied mathematics
TCS/AM
Electrical Engineering and Nanotechnology
Applied Mathematics Technical Computer Science
Data Science in Engineering / Operations Management & Logistics
Computer Science and Engineering, Industrial and Applied Mathematics
Big Data Management and Analytics
Expressive Arts of Social Transformation
Systems and Control
Environmental and Energy Management
Master of Environment and Energy Management

Appendix F: Responses participants improvements CC

Visual feedback:

Participant 1:

-The text should not be page-wide but a maximum of 900px, more white room makes it easier on the eyes
-The space between the dimension score title and the graph showing the score are too far apart
-Icons and subtitles are very clear!
-When clicking on the pop-up, participant mentioned the pop-up was too big and invasive. A dropdown with the extra text could be better.
-Formulation of text in the 'what's next' section could be more activating. It now looks like a place where the sources are stored and that is not really useful to read.
-Answer to 'who are you as a professional' is not the first thing that you see when clicking the link in the e-mail, that could make it nicer.

Participant 2:

-Use of icons is good
-Use of colors is good and calm

Participant 3:

-Participant found the circles with the professional profile difficult to understand, but also didn't read 'more details' and associated it with a pie-chart
-The layout does not seem to be correct, participant had to scroll too much they thought.
-Possible improvement: make it so you can click to go to the next page instead of scrolling

Participant 4:

-Participant found the dimension score graphs difficult to understand at first,
-Your profile button was not working (it was not functional during the interview)

Participant 5:

-The color blue fits the theme, is calm and professional
-Intuitive because of the symbols and icons

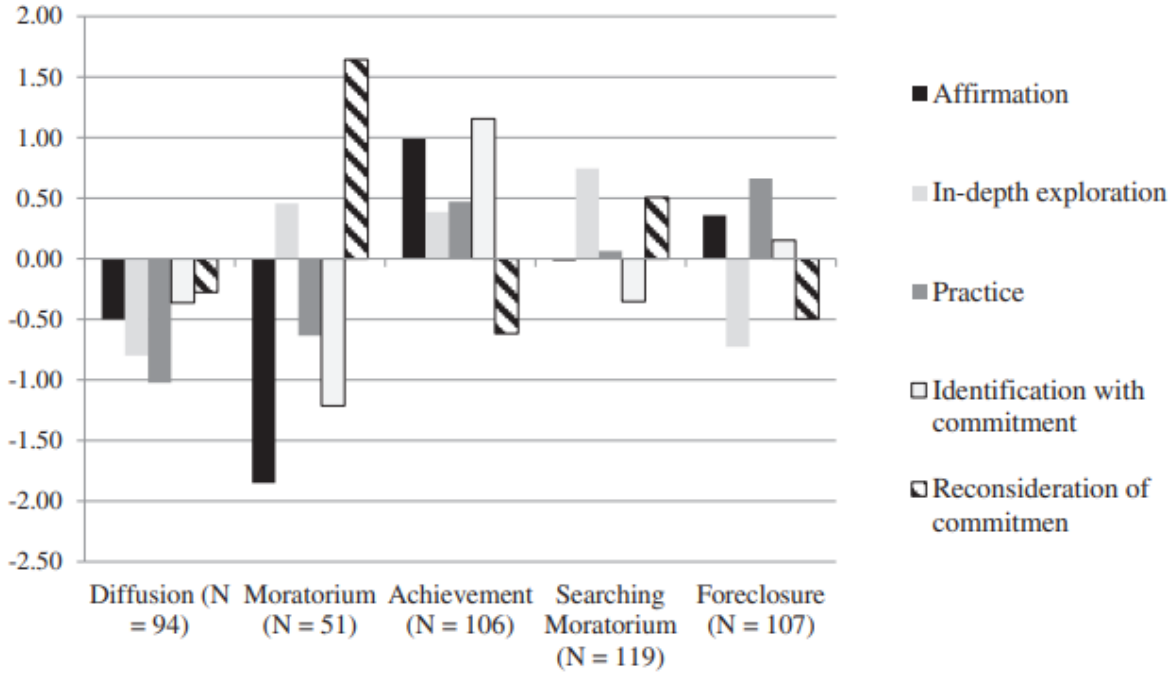
Participant 6:

-It looks like something that was designed for mobile use, it is too wide for a webpage, and everything is way too big.
-Unclear what the 'download' button does in the right top corner at first
-Additions to the dimension scores could be improved by a dropdown section under the text, not as an overlay
-Would like the information to be a little more dense, compact message.

Participant 8:

-Couldn't figure out if the dimension scores meant something positive or negative (judgement)
-It works well and it looks good/professional
-Participant was worried about the effect of the arrow above the individual scores; might give the implication when scoring too low or too high that something might be wrong.

Appendix G: Mancini cluster analysis outcome



Retrieved from Mancini (2015)

Appendix H: Consentform pilot study

Dear Participant,

You are participating in a study for a master thesis project at the University of Twente which makes use of the “Career Compass”. This study will look at your reaction towards the feedback that is part of this Career Compass. You can benefit from receiving this feedback on your own professional identity, no known risks are associated with this study.

For this research, we will record this interview with audio and video. At all times you have the right to request access to and rectification or erasure of personal data used in this research.

As soon as the interview has been transcribed into text, the data will not be able to be tracked back to you as a participant – therefore being anonymized. After transcription, the audio and video material will be destroyed.

If, at any point in time, you wish to withdraw from this research, you are free to do so without giving a reason, and all of your data collected up until that point will be destroyed.

The next paragraph covers the data that you submit to the Career Compass:

There are no known risks associated with this study. Your answers in this study will remain completely confidential and personal details that you may provide (email address) will be encrypted and saved separately from your answers. The University Twente has certified its data storage and the associated processes according to the ISO/IEC 27001 and NEN 7510-standards. If you have any questions about the research, then please get in touch with the research team, who will be happy to answer any queries (bridgethegap@utwente.nl).

Kind regards,

Hermen Pastoor

g.h.pastoor@student.utwente.nl

Consent Form for master thesis research on reviewing the effectiveness of the Career Compass feedback

YOU WILL BE GIVEN A COPY OF THIS INFORMED CONSENT FOR

Please tick the appropriate boxes	**Yes**	**No**
Taking part in the study		
I have read and understood the study information dated [**28 / 04 / 2021**], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	○	○
I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	○	○
I understand that taking part in the study involves recording of my personal answers and the recording audio/video which will be removed as soon as the interview has been transcribed and the data is anonymized.	○	○
Use of the information in the study		
I understand that information I provide will be used for validating the effectiveness of the Career Compass feedback tool.	○	○
I understand that personal information collected about me that can identify me, such as my audio/video recording, will not be shared beyond the study team.	○	○
Future use and reuse of the information by others		
I give permission for the anonymized answers that I provide to be archived in the personal archive of the researcher so it can be used for future research and learning.	○	○

Signatures

_____	_____	_____
Name of participant [printed]	Signature	Date

I have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

Hermen Pastoor		**28/04/2021**
_____	_____	_____
Researcher name [printed]	Signature	Date

Study contact details for further information:

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Contact Information for Questions about Your Rights as a Research Participant

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Secretary of the Ethics Committee of the Faculty of Behavioural, Management and Social Sciences at the University of Twente by ethicscommittee-bms@utwente.nl