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CAREDUCATION

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Esteemed Rector Magnificus,
Members of the Board of Directors of Utrecht University,
Members of the Board of Directors of UMC Utrecht,
Respected students,
Dear family, friends and colleagues,

Education and training are essential for progress in healthcare

Social and technological developments provide new opportunities and challenges to healthcare professionals (Susskind & Susskind, 2015; Raad voor de Volksgezondheid en Samenleving, 2019a). Some examples are the use of robots in healthcare, 3D printers, the possibility to record personal health data, and big data for global research (Ottes, 2016). People are getting older, becoming more independent with health services at home, and care is increasingly focused on the prevention of diseases rather than on curing and treatment only (Taskforce Juiste Zorg op de Juiste Plek, 2018; Ministry of Health, Welfare and Sport, 2018). But to many people, ageing also means that they have to deal with multiple diseases at the same time, which makes research and treatment more complex. In addition, healthcare becomes more expensive[i], and time pressure from regulation and registration increases (Raad voor de Volksgezondheid en Samenleving, 2019b). Furthermore, the difference in life expectancy between the rich and the poor is growing, also within Utrecht[ii] (Gemeente Utrecht, 2018).

It is the *mission* of the Educational Centre at University Medical Centre Utrecht to prepare healthcare professionals for these developments. In order to do so, Care, Research and Education are merged into CaREducation.

The amalgamation of the words Care, Research and Education stands for the 3 pillars of UMC Utrecht. Only a strong connection between these three allows us to train the professionals of the future. CaREducation also stands for the balance of values in qualification, socialization and personal development in education and training (Biesta, 2015a, 2015b). On the one hand, education and training are focused on what one needs as a professional to qualify for a profession, i.e. what one should know and be able to do. Besides, its focus is on socializing, i.e. participating in the culture of a profession and the organization. On the other hand, education and training focus on the development of the person behind the professional. That is because only with personal development, a professional can act meaningfully in a work environment. The reverse also applies: a work environment gives meaning to a professional's actions (Sandberg & Pinnington, 2009).

My goal is to explain how technological and social changes are guiding us towards other choices in the balance of values in the educating and training of our students. Our long

tradition based on acquiring and retaining individual expertise within one field (monodisciplinary) (Dreyfus & Dreyfus, 1986; Ericsson, 2004; Ericsson, Krampe, Tesch-Röme, 1993), is no longer sustainable, given the new challenges faced by professionals.

First, I will answer the question "What are we educating for?" In short, my answer will be thoughtfulness[iii]. Thoughtfulness means to act with attention, in considerate interaction with the other and the environment, for example with a patient, a colleague or with new technology (Brown, 1987, 1989; Newmann, 1990, 1991; Onosko, 1992; Van Manen, 1991, 2016). Thoughtfulness is, in my opinion, the main disposition[iv], i.e. a tendency to act, of a professional (Katz & Raths, 1985; Matteson, Anderson & Boyden, 2016). It is at the heart of our *vision* of education and training at UMC Utrecht.

I will also address the processes in our thinking and behaviour behind this, which promotes that people can proactively respond to a changing environment, i.e. adaptive expertise (Hatano & Inagaki, 1986; National Research Council, Bransford, Donovan, 2005). Adaptive expertise is "the ability to perform at a relatively high level in unfamiliar situations thanks to understanding why a specific procedural skill should be used in a specific situation" (Bohle Carbonell & Van Merriënboer, 2020, p. 263). Adaptive expertise allows professionals to meet new situations flexibly and to commit to lifelong learning. Adaptive experts are knowledgeable and sensitive in understanding the environment while being flexible and adaptable during changes in that environment[v] (Bohle Carbonell, Stalmeijer, Könings, Segers & van Merriënboer, 2014; Engeström, 2018; Ward, Gore, Hutton, Conway, & Hoffman, 2018).

Next, I will answer the question "How can we innovate our learning and working environments to support the development of thoughtfulness and adaptive expertise?" This concerns our educational *strategy* at UMC Utrecht, called Fit for the Future[vi]. Our strategy innovates education in themes such as: lifelong learning, teaching careers, diversity and inclusion and, from a research perspective, it adds up to what we know about adaptive expertise. I will outline four emphases that I believe we need to give to our strategy to train the healthcare professionals of the future.

Thoughtfulness

Qualification by means of training is important to becoming a professional, but getting trained in one specialty for one's whole career is not thinkable anymore. Besides that, expertise does not develop upwards in one dimension (like a stairway) and is always connected to practice. My predecessor, Olle ten Cate, shows this worldwide when it comes to entrusting professional activities to medical students or specialists in training (Ten Cate, 2005, 2019; Ten Cate et al., 2015).[vii] In the PhD study by Esther van Dijk, together with colleagues Kluijtmans and Van Tartwijk, we investigate how academic teachers, including teachers from the biomedical and medical domain, develop expertise through their careers. An international

analysis shows that academic teachers indeed can improve in terms of being better teachers. Furthermore, they can take on a wider range of tasks with other roles and responsibilities, for instance by performing a tutor role in addition to teaching. They can also expand their spheres of influence, for instance by becoming programme directors. To conclude: whatever trajectory professionals follow, they always have to progress in their development. This comes down to lifelong learning, not only with a focus on oneself, but also to improve the work environment; the organization in which a professional works.

As mentioned, to develop as a professional means to qualify, to socialize in the work environment and to develop as a person. Education is interaction; this means that one will socialize in the environment of an organization and profession by adaptation or by imitation of role models. Teachers have a strong responsibility towards students in this process, as their behaviour communicates an interpersonal message of influence and proximity. Teachers' influence concerns the degree of control over students' learning environments. Their proximity regards the genuine contact they have with their students. Wubbels, Brekelmans and Van Tartwijk, among others, from the Department of Education at our university, researched interpersonal teacher behaviour worldwide. Results show that students' motivations and performances increase when teachers combine their influence with emotional closeness (Brekelmans, Wubbels, Van Tartwijk, 2005). In other words, kindness and understanding in the supervision of students are key. Teachers matter! We should do more to value their work.

Teachers have a major influence on students' learning environments. Within healthcare, this leads to additional challenges. How interpersonal behaviour during training is perceived by residents is evident in recent research conducted by former PhD student Judith Voogt. Supervised by Schneider, Noordegraaf, Rensen and yours truly, she studied nearly 500 residents. She found that a large number of them tend to remain silent about their ideas for the improvement of care and the hospital, for fear of negative consequences and based on the belief of not having any influence: "Expressing your thoughts does not contribute anything, as nothing will change anyway." If residents do not feel safe to speak out, their professional capabilities and responsibilities are undermined and that can be a risk for patient safety (Voogt et al., 2019a; 2019b).

Developing as a professional requires getting an overview of the playing field[viii]with disciplines and stakeholders in one's learning and working environments, including one's own role in this field. Colleagues Akkerman and Bakker (2011) call this the learning mechanism of identification. It also demands that one can coordinate different practices within the playing field; the learning mechanism of coordination. Other required learning mechanisms are reflection on perspectives of different players, for instance from colleagues and patients and, finally, transformation. Transformation takes place during larger changes, such as identity development, development of new routines, gathering insights from different

practices, or interdisciplinary work on a larger problem. It is necessary that we stimulate our students in the development of these learning mechanisms.

Studies by Benner (e.g. Benner, 1982; Benner, Tanner & Chesla,1996; Benner, 2004) show how nurses often don't get to these learning mechanisms when they focus on just looking for symptoms that can explain a patient's physical condition:

> *"We found that nurses who had some difficulty with understanding the ends of practice and difficulty with their skills of interpersonal and problem engagement did not go on to become expert nurses (...). They literally thought of rational calculation as the scientific and objective way of practicing, and thus, they failed to see significant moral corporations and failed to recognize qualitative distinctions between situations because they attempted to apply the same metric of rationally calculating odds, prevalence, and evidence in each situation. This computational and calculative approach to practice, coupled with a disciplined stance of detachment, blocked experiential learning"* (Benner, 2004, p. 200).

A relatively narrow focus on developing (technical) skills or small competencies in a curriculum can hinder the development of professionals who have a broader understanding of the context they work in (Dall'alba & Sandberg, 2006).

As a healthcare professional, researcher or teacher, one should constantly deal with the latest insights from research and practice, and be able to 'commute' between different practices. This requires a process of 'translation' (Weggemans, Van der Schaaf, Kluijtmans, Hafler, Rosenblum, & Prakken, 2018), involving several disciplines. For the past 20 years, I have seen in many educational institutions I have worked with how this can lead to 'being lost in translation'. This refers to the phenomenon that scientific findings are misinterpreted, misconstrued or ignored, whereas, conversely, obvious signs of problems and challenges in practice are not sufficiently noticed by scientists. This can lead to urban myths that are incorrectly attributed to scientific research. Urban myths exist in healthcare as well as in education (Brown & Nestel, 2020; De Bruyckere, Kirschner, & Hulshof, 2015; Kirschner & Van Merriënboer, 2013; Martimianakis, Tilburt, Michalec & Hafferty, 2020). For an example, take a look at the so-called learning pyramid; it is not true that people will only remember 5 % of what they hear and that they are able to remember 75 % of the content when they experience it. People don't develop skills without knowledge, not even 21st century skills. And unfortunately, you can't multitask and don't have a certain personal learning style. Right-handed people, don't worry; you are not less creative than left-handed people (Groothuis, 2015).

The work context of professionals and scientists, with the central need for being able to commute between borders and practices, is best presented as an 'Agora' (Gude, 2017; cf. Boon et al., 1991). In ancient times, the Agora was a public central physical space for trade,

politics, arts and judiciary. It was connected to the training spheres of religion, sports, art and philosophy. The Agora links these different spheres. This means that science is multidisciplinary in nature and that claims in scientific knowledge consist of argumentation based on data and other underpinnings (Toulmin, 1958). For various institutions, such as media, university, practice, scientific journals, these knowledge claims differ in relevance and meaning. A dialogue between players at the Agora is essential to understand the meaning of scientific claims (Frederiksen, Hansson & Wenneberg, 2003). This representation of the role that science plays demands another view towards science, with a central focus on social needs, transparency and openness (cf. Benedict, Miedema, & Ferguson, 2016; Moher et al., 2018).

Back to the question "What are we educating for?" Professional development requires an open mind to others and to the situation. As a variant on our University's motto[ix]:"Open minds, better future". This vision can be found in the 'new Utrecht profile' in which we educate and train our students at UMC Utrecht: you are thoughtful, you have professional expertise and you can solve creative problems from those perspectives. You are enterprising, make innovative use of new technology, take responsibility for yourself, the patient and the organization, and participate in the social debate.

The core of this mindset can be summarized as thoughtfulness. A thoughtful person has sufficient broad and in-depth knowledge to interpret information from the environment. This is combined with attention and adaptation to the other, such as a patient or colleague. Thoughtfulness consists of continuous reflection on what the other or the environment needs, the use of feedback in the form of information and signals that the environment offers you, and reflection on how your own knowledge, skills, and values are related to it and how the information of feedback can be used (Brown, 1987; Cuenca, 2010; Nixon, Walker & Clough, 2003; Wiggins, 1989). It touches on the existential question: What kind of healthcare professional, researcher or teacher am I or do I want to be, given my expertise and the environment in which I work?

The concept of thoughtfulness is not new; it was used by Dewey (1910) more than a century ago. Pedagogue Van Manen (1991) described thoughtfulness in detail a quarter of a century ago[x], and his teacher, Langeveld (1979), thought in the same direction more than half a century ago. His name is on the building where the Department of Education of the Faculty of Social and Behavioural Sciences of Utrecht University is housed: the Langeveld building. Clinician, researcher and teacher Hijmans van den Bergh worked during the last century in evidence-based medicine with an eye for the human psyche (Pannekoek, 1993). The building of our Education Centre in UMC Utrecht bears his name. For more than 10 years, I have been walking back and forth between the Langeveld building and the Hijmans van den Bergh building at our Science Park for teaching and research. In every course, I feel respect for our

predecessors in whose footsteps I follow. With my position, I will remain committed to connecting health care and educational sciences.

Ever since the concept of thoughtfulness was first described, the circumstances have considerably changed. We work more digitally, faster, more internationally, and above all, working in healthcare increasingly requires creative problem solving. This means that healthcare professionals have to deal with multiple perspectives and levels of abstraction, and should anticipate that an issue can change unpredictably over time. For instance: how do you as a nurse relate to a robot that supports your patient, who is a demented elderly person? New technology makes it possible to diagnose, treat or prevent more diseases than before. But how far would you like to go, where is the border to what is beneficial for the quality of life? Dealing with new technology requires ethical reflection on the value of life, interpretation of data, collaboration and the translation of consequences into practice.

Adaptive expertise

The essential processes in our thinking and doing to act thoughtfully are described in literature on adaptive expertise. In this literature, a distinction is made between routine experts and adaptive experts. Routine experts have high-quality knowledge and skills to perform tasks efficiently and effectively, and they can manage, or self-regulate, themselves well (Baroody, 2003; Pandy, Petrosion, Austin & Barr, 2004). Adaptive experts share the characteristics of routine experts, but also have deep and broad theoretical knowledge that can be used flexibly (Barnett & Koslowski, 2002; Carbonell, Konings, Segers, Van Merriënboer, 2015; Ericsson, Hoffman, Kozbelt & Williams, 2018; Van Tartwijk, Van Dijk, Kluijtmans & Van der Schaaf, 2020). As they understand what they see, adaptive experts can perceive their environment more accurately. Adaptive experts not only know what to do and how to act, but also why and in what situation, and which alternatives are available. As a result, they are flexible in connecting[xi] their behaviour to different and changing situations. Their profound and broad theoretical knowledge and flexibility in thinking and doing probably also makes them creative[xii] (Simonton, 2003). This means that they can convert their expertise into new ideas, insights or products that are original and of practical use (Nijstad, De Dreu, Rietzschel & Baas, 2010).

It is a challenge for healthcare professions and education to stimulate the development of learners' adaptive expertise. For instance, Mylopoulos and Regehr (2007) describe how the development of expertise in medical education is often based on a traditional cognitive approach: training for routine diagnostics, developing automated behaviour by gaining experience, and viewing developed knowledge as a relatively static resource on which experience can be built. Building knowledge and routines is essential for beginners, but to develop as a professional requires much more than that. Two years later, Mylopoulos and Regehr describe how medical students' beliefs about what expertise is influence their actions in practice. Students shared the view that it was not their responsibility to exhibit innovative

behaviour, nor that they had a responsibility for innovation. Logically, they did not act innovatively (Mylopoulos & Regehr, 2009).

Similarly, Kneebone (2009) describes how a focus on developing narrow skills in training can impair the development of a professional who can deal with unexpected situations (Kneebone, 2009, p. 956):

> *"A medical student has learned how to insert an intravenous cannula into the skills centre, practicing on model arms on a laboratory bench. She has become skilled in the technique, done well in an OSCE and feels confident about the procedure. Then she qualifies as a doctor and is called to a patient who has pulled out his intravenous line. He's elderly, agitated and has been difficult to fake. The student realizes that resiting his line involves far more than going through the set procedure she has perfected. She has to introduce herself, establish a report, reassure her patient and gain his confidence, enlist the help of a nursing colleague, assemble the necessary equipment, put in the cannula, secure it so he doesn't pull it out again, and ensure that he understands what she's done. Not only has practice in the skills lab not equipped her for all these challenges, it has given a misleading impression of what the task entails. By making the procedure seem simpler than it actually is, task-focused simulation has left her unprepared for the complex realities of clinical care."*

Expanding expertise, or learning, is much more than just remembering information and developing routines. It means that we should give students sufficient opportunities to learn to deal with complex situations (Dacey & Nasca, 2019). What a person knows and can do is only useful if he or she can create flexible mental models that can be used in new situations. In other words: when a person transfers his or her knowledge and skills. Such a transfer starts with links or associations between what a person thinks and what he or she experiences. Potential links between a person and the environment are also called affordances. A person can learn by first developing a lot of knowledge about a subject or task in an environment (building a mental model) and then using (e.g., applying) this knowledge[xiii]. This also works vice versa, by first doing (psychomotor action in the environment) and deducing knowledge from there (Hutto, Sánchez–García, 2015). In fact, both go together (Shapiro, 2014) [xiv]. Recently, I studied how learning new concepts works through peoples' senses (Abrahamson, Shayan, Bakker & Van der Schaaf, 2015; Duijzer, Shayan, Bakker, Van der Schaaf & Abrahamson, 2017).

How does this work in practice? (Van der Schaaf, 2019; Van der Schaaf, Bakker, Ten Cate, 2019)

Figure 1. The actions of an interventional radiologist are led by ultrasound images.

Figure 1 shows interventional radiologist Irene at work. She inserts a drain into a patient's dilated kidney that has outflow obstruction of the kidney. She does so using the information she receives from the ultrasound images. Of course, she can't touch the kidney directly, but she constructs and visualizes the situation in her imagination and then plans how to position the drain into the kidney. Her planning of the puncture and positioning of the drain are based on the information she receives from the echo and the experience she has of how the kidney tissue feels when one pokes through it. In the meantime, she takes the patient's breathing rhythm into account, as the kidney moves with it. This imagined 'gestalt' of the kidney, as well as the knowledge of how the tissue feels and the patient's breathing pattern, support her in the motor activity of insertion of the drain.

The medical specialist is led by the findings of the ultrasound. As a chair invites us to sit and a doorknob invites us to open the door, the echo offers her an affordance or inviting opportunity to act. Perception and action flow into one another (Gibson, 2015; Greeno, 1994). As a specialist, she sees the environment based on the ability to act on it. It allows her to choose the best approach, given the possibilities she has.

Figure 2. The intervention radiologist inserts a drain into a patient's kidney.

Inserting a drain in a kidney is a routine task for Irene, because she is an expert. But what happens if her act is interrupted, for example in case of an arterial bleeding of the kidney as complication of the puncture? She will have to take responsibility for the patient, her colleagues and herself, to manage herself, and be both critical and decisive. She has to make a plan B, but how much time and which resources does she have? In the meantime, she monitors how the patient is doing, contacts her colleague, head of department of anaesthesiology professor Hoff, and coordinates the process to find a solution. Various studies of adaptive expertise show that the coordination of processes of planning, monitoring and communication are essential ingredients to solving complex problems in flexible ways. One conditional factor is to learn to manage oneself, which means that one has to develop self-regulation skills.

Educational Strategy

How can we innovate our learning and working environments so that we can support the development of thoughtfulness and adaptive expertise? Developing thoughtfulness and adaptive expertise requires specific accents in education and training. It requires a balance in qualification, socialization and personal development, and a balance in technology and human dialogue.

I will discuss four principles that can be accentuated in our curriculums in order to establish this balance. The principles are derived from literature on how the development of adaptive expertise can be stimulated (Bohle Carbonell et al., 2014; Croskerry 2018; Lazzara et al., 2010[xv]; Mylopoulos, Kulasegaram & Woods, 2018[xvi]; Wallin, Nokelainen & Mikkonen, 2019[xvii]), and meet the formulated training principles of Ward, Gore, Hutton, Conway, & Hoffman, 2018 and Ward, Schraagen, Gore, Roth, Hoffman & Klein, 2020. Based on empirical studies on

the development of adaptive expertise, Ward et al. (2018; 2020) describe training principles that stimulate the development of adaptive expertise[xviii]. In specific order, these are:

- Practicing with a diversity of cases and tasks that vary in difficulty. The tasks selected contain functional complexity. Mentoring and guidance by a supervisor is available. I summarize this as: consciously and frequently, under supervision, gaining experience with complex problems.
- Experiencing how the meaning of certain concepts can vary between situations.
- Active reflection on experiences and performance. This goes beyond monitoring one's own development or performance and is aimed at being able to explain what happened, why and how, and to extrapolate experiences to new situations. Ward et al.'s studies were not conducted in the context of healthcare, in which motor action plays a role. For that reason, I add 'sensory' to 'experiences'.
- Feedback aimed at stimulating cognitive flexibility. Cognitive flexibility concerns the ability to apply knowledge in flexible ways without falling into simplification or reduction of complex reality (Spiro, 1988; Spiro et al., 2020). Such feedback encourages a learner to see when certain used strategies work or not. It stimulates the development of new strategies and concepts to be used in new situations. This makes it possible for a learner to be able to assess a situation from a different perspective. In other words, this is feedback that allows learners to reflect.

In sum, the principles can be developed based on four characteristics.

First. Consciously and frequently gaining experience with complex issues, under supervision.

Experience does not necessarily turn people into experts. Routinization in professionals' work is useful, because it leaves more cognitive space and it makes actions more predictable. For beginners, it is useful that they learn to develop routines before they come to conscious changes and reflection on their actions. However, if you want to become an expert, I strongly advise you to not develop routines too quickly. Expertise development takes years of practice, just above the level of one's expertise (the zone of approximate development), with a lot of reflection while practicing and using feedback, for instance from a supervisor or coach. Ericsson et al. (1993) summarize this as[xix] 'deliberate practice'. This conscious practice takes a lot of time, effort and discipline. Ericsson, Hoffman, Kobetz & Williams (2018) have frequently investigated this practice and training among, for instance, top athletes, musicians and physicians. In certain professional domains, for instance the domain of teaching, in which there are barely protocols and acting takes place 'immediately' in interaction with others (Eraut, 2002), and the concept of 'deliberate performance' is often used instead. Deliberate performance refers to workplace learning (Billet, 2001) in the form of a targeted effort to increase expertise during the performance of tasks in everyday work (Fadde & Klein, 2010; Fadde & Jalaeian, 2020).

In the past years I have researched deliberate practice with colleagues in different ways. For instance, in a line of study concerning education in Radiology, we show that frequent practice with and feedback on interpreting images leads to the more accurate and faster interpretation of those images. Another example is our studies on video interaction training, in which nursing teachers were trained in developing reflection skills in their students. During video interaction training, teachers learn purposefully from looking back on their own actions in practice by using reflection and feedback from a coach. The training was aimed at purposeful, active practice, based on reflection and feedback from a coach with expertise in the field of nursing. The training consisted of: (1) instruction, exercise and feedback (Tillema & Veenman, 1987); (2) discussion about and exchange of experiences (social learning, Bandura, 1977); (3) attention to the current practices of teachers and their reflections on alternatives (development & reflection, Kuijpers, Houtveen & Wubbels, 2010); (4) provision of information and the use of relevant knowledge (knowledge-based learning, Timperley, Wilson, Barrar & Fung, 2007). As a result, the teachers developed a larger repertoire in asking meaningful questions to their students. This stimulated students to think more deeply (Dekker-Groen, Van der Schaaf and Stokking, 2013).

Leading models to solve complex challenging problems are often focused on design thinking (Frith, 2020) and research processes (Stokking, Van der Schaaf, Jaspers & Erkens, 2004). Both include the process of problem formulation, information collection and analysis, drawing conclusions and coming up with solutions and new designs or research ideas in a systematic, independent way, whether or not in cooperation. This vision is comparable to the conceptualization of expertise by Bereiter & Scardamalia (1993), who see expertise as a progressive form of problem solving. Adaptive experts develop new concepts and methods for solving unknown issues. In this work, reflection and teamwork are key. Variants of this type of education are 'co-challenges' in which students from different disciplines solve complex problems. Our university innovates education in this direction. PhD student Heleen van Ravenswaaij investigates this phenomenon under supervision of Van Rijen, Dilaver, Bouwmeester, De Kleijn and yours truly. Scientific educational research into this type of education is essential to understanding what works, how it works and under which circumstances it works.

Secondly. Experiencing how the meaning of certain concepts can vary between situations.

The development of adaptive expertise requires the development of in-depth knowledge about one's profession, the environment and who you are as a person; knowledge that is flexible. In-depth conceptual knowledge about a profession develops by analysing practical situations through theory, i.e. contextualization. In addition, this theory also gets meaning by systematical evaluation and analysis of practical situations and by identification of (theoretical) patterns and mechanisms, i.e. decontextualization. This second principle concerns the development of the understanding that concepts or ways of working can vary

from situation to situation. This insight can be stimulated within a discipline by practicing with a wide variety of issues. An alternative is to give students multidisciplinary tasks. Some studies show that students who receive integrated education from different disciplines with a variety of tasks, for example focused on the use of biomedical knowledge and clinical knowledge, can build a deeper understanding (Woods, Brooks & Norman, 2007). This integration and exercise with reflection will prevent knowledge and skills from grinding into fixed routines. At our university, we see this principle more often now, for example in broad Bachelor's programmes and in Master's programmes that integrate several disciplines. Digitalization within education fosters the possibility of flexible education (Dutch Ministry of Education, Culture and Science, 2019). Students can broaden their horizons and get more opportunities to follow their own learning paths. However, our understanding of this phenomenon is limited; we should study more explicitly what interdisciplinary education means to students' learning processes.

Thirdly. Active reflection on sensory experiences and performance.

Learning takes place through the senses, through what is perceived (Van der Schaaf, 2019; Kneebone, 2009, 2017). Our education, on the other hand, is mainly focused on thinking processes (cognition) and behaviour (what is done). As a result, our education is suboptimal. In the example of the intervention radiologist, we saw how she interacted with machines on a sensory level. Given the increase in robotics and artificial intelligence in the work of healthcare professionals, research is important to understanding how sensory experience and thinking (cognition) work together.

In addition, sensory experience is also about emotions, for example in dealing with setbacks, the stress that performance entails, the fear of rejection and the risk of failure. Picking up signals from others and taking things into perspective are important; research shows that compassion does well to patients (Lombarts, 2019). Thanks to a number of inspirational colleagues, education based on patient participation is becoming more common at UMC Utrecht. Education is made together with patients, and up and coming healthcare professionals learn from patients' feedback. This education is about raising awareness of how others experience you as a healthcare professional and whether you are relying on correct and sufficient information of the other, and to what extent you are free of bias and stereotyping. We must celebrate our differences, which is why diversity and inclusion are also essential characteristics of our educational strategy.

The development of adaptive expertise requires a constructive and active process of carrying out meaningful tasks, and self-regulation is conditional in this process (Shuell, 1993). This means that reflection, i.e. giving cognitive and affective meaning to experiences, as well as the development of in-depth knowledge from experience, are important (Oosterbaan, Van der Schaaf, Baartman & Stokking, 2010). During the process, the learner looks back on one's own work (monitoring), to learn from it for improvement or adjustment. Reflection is a

conscious and deliberate process of thinking about and interpreting experiences, behaviours, feelings and knowledge, with the aim of raising awareness of one's own actions and learning from them.

Developing thoughtfulness is very similar to what the American sociologist Mezirow (1990) described as 'premise reflection'. This is a profound form of reflection. In my research, I show that this deep form of reflection is barely present in education. We explicitly asked students to reflect in their writings and in dialogues with their mentors to reflect on their development in portfolios. Only 20 % of students' utterances included reflection and only 1 percent contained this most profound form of reflection (De Bruin, Van der Schaaf, Oosterbaan & Prins, 2012; Oosterbaan, Van der Schaaf, Baartman & Prins, 2010; Poldner, Simons, Wijngaardens, & Van der Schaaf, 2012). Examples of this profound form of reflection are (De Bruin et al., 2012, p. 425):

> 'When I look back, I can see that I learned a lot about cooperating. In the beginning I thought ''to cooperate is to divide the tasks and to have a bit of meeting before starting.'' I learned that this doesn't work. Cooperating should happen more intensively than just dividing the assignment into tasks. I have dealt with situations in which other people did not respect the appointments with the consequence that I was victim because our assignment was not ready to hand in. Cooperating is more than asking for the parts made by others and just putting them together. That doesn't work. It is also important to make a whole good thing when the parts are ready. Still, I should learn a lot at the point of cooperating, but I think That I have made a pretty good start by discovering this line of thoughts.'

> "I've changed a lot in the last periods and I'm very grateful to Mrs. Smith for that. Usually, I started to defend myself immediately when I received criticism from peers and especially teachers. But that isn't necessary, criticism is just directed at a point you can change. Mrs. Smith showed me that very well, and the first times I continued doing it and I didn't listen, but after a talk it became very obvious to me! Now, I'm very quiet in a conversation, I wait and listen, and at the end I don't need to say very much, I just accept it and I will see whether I will use the feedback in the future! This hasn't had consequences only for my relations in school, but also in my daily social intercourse. I am very proud of it and I hope to hold it on."

There is a world to win, for example by focusing on more academic education that reflection is a part of.

Fourth. Feedback aimed at stimulating cognitive flexibility.

Learning can be best supported by making environmental signals visible, by strengthening and clarifying these signals, and by providing suggestions to improve thinking and acting.

This is all part of feedback. Feedback is a process in which learners interpret signals about the quality of their performances and use this as input to develop their future performances or learning strategies (Carless, 2019). This definition highlights the importance of learner's engagement with feedback to move towards actions based on feedback in the short or longer term. Feedback is a very powerful tool for learning (Hattie, 2008; Shute, 2008; Wisniewski, Zierer & Hattie, 2020) and is therefore central to my research programme.

As feedback is only feedback if it is experienced in that way and used by a recipient, it also means that a feedback process is always a process of interaction between the environment (a task, person or a learning tool) and a recipient (cf. Winstone, Hepper, Nash, 2019). This implies that reflection is needed to interpret feedback and that self-regulation is needed to act on it and to use it to develop one's learning goals. This often goes wrong. Consequently, feedback is often not supportive and could even be damaging (Kluger & DeNisi, 1996). Think of a meaningless assessment you received or unsolicited advice you weren't waiting for, or the times students were extrinsically motivated to write reflection reports. We need a different feedback and assessment culture, aimed at stimulating learning, rather than on high impact consequences and control (Boud, 2000; Boud & Falchikov, 2007; Carless, 2019; Sadler, 2010; Sluijsmans & Segers, 2018; Van der Leeuw, Teunissen & Van der Vleuten, 2018; Wiliam, & Thompson, 2017). In the PhD research by Lonneke Schellekens and the accompanying Utrecht project Equality[xx], led by Bok, together with Kremer, Van der Vleuten and Prins, we promote a change from 'assessment of learning' to 'assessment for learning' and 'assessment as learning' (Wiliam, 2011). That means we see learning and feedback as interlinked to each other. We investigate when feedback and assessment are perceived as meaningful for learning.

I research feedback processes in interaction with another person, such as a colleague or patient, and in interaction with technology. My research shows that it is difficult for students to look for feedback that can stimulate their development (Agricola, Van der Schaaf, Prince, & Van Tartwijk, 2019; Leenknecht, Hompus & Van der Schaaf; 2019, see also: Winstone, Nash, Rowntree & Parker, 2017; Winstone, Nash, Perker & Rowntree, 2017). It also appears that feedback giving behaviour often does not match another person's needs.
In my research, I focus on three themes:
1. Interprofessional feedback from colleagues and from patients;
2. Feedback from new technology, focused on expertise development;
3. Feedback of students' own learning processes to take more control of their learning.

Interprofessional feedback from colleagues and from patients.

In the research of PhD student Claudia Tielemans, supervised by Westerveld, De Kleijn and yours truly, we focus on how students in medical education and nursing can set goals and develop in giving and receiving interprofessional feedback. In Larissa den Boer's PhD

trajectory, with co-supervisors Hoff and Eurelings, we investigate interprofessional feedback, in particular feedback behaviour from residents, at the workplace. In the project of PhD student Charlotte Eijkelboom, together with supervisors Frenkel and De Kleijn, we focus on how medical students can learn from patient feedback and develop their 'perspective taking'. Our aim is to understand how people learn from each other's feedback and which mechanisms could play a role in this, including new forms of interprofessional education and education in patient participation (cf. Winstone et al., 2017a, 2017b; Noble et al., 2019).

Feedback from new technology, focused on expertise development.

Imaging is used in many procedures in medicine. Errors frequently in image interpretation, with possible negative consequences to patients (Donald & Barnard, 2012). In the case of false diagnoses, it is not immediately clear to students and their supervisors why a mistake happened and how they can improve. As a result, the process of image interpretation remains a blackbox, and multimodal feedback, i.e. feedback from multiple sources, can provide insight into this (Waite et al., 2020). We study how feedback can stimulate expertise development and how we can help supervisors to monitor how students develop.

In a multi-disciplinary research and innovation team, consisting of experts from imaging sciences and from educational sciences, we investigate how expertise develops and how expertise development can be supported with new technology (Ravesloot et al., 2017; Rutgers et al., 2020; Stuijfzand et al., 2016; Van der Gijp et al., 2015). We for instance found that the behaviour of digitally scrolling through images is related to students' thought processes in radiology while interpreting digital images (Boer et al., 2018). Comparable research is done on the use of Virtual Reality and serious games in education, in a European Training Network project called Charming[xxi], led by Kester and with an international team of PhD students. We investigate how such new techniques can be applied in education to improve learning processes.

Feedback of students' own learning processes to take more control of their learning.

Students often suffer from stress. About 20 % of Dutch residents experience characteristics of a burnout (Esch & Soomers, 2018). Learning environments in which students, supported by dialogues with their tutors or study advisors, get insight in their study progress can improve their study behaviour and motivation. Insight by students in how they develop during their study and what their feelings toward their studies are, as well as an appropriate understanding and support from tutors and study advisors, can give students more control over their learning. This is especially the case when learning environments at the workplace are not often perceived as safe, as in healthcare. Relinking collected data into visualized form gives learners information about their learning processes. This is also referred to as learning analytics. In my research, I focus on learning analytics for and with students: learning from

your own data on how you learn and develop in order to direct your own learning, i.e. agency (Van der Schaaf et al., 2017, see also www.project-watchme.eu). In our Utrecht development and research project, entitled Thermos[xxii], we work with PhD students Lieselotte Postmes and Lars de Vreugd on a way in which students get action-oriented feedback on where they stand in their studies and how they feel about it, in terms of their resilience, study motivation and engagement.

In sum. In this lecture, I outlined the vision and components of the strategy of education and training of the healthcare professionals of the future at UMC Utrecht. The development of thoughtfulness, based on expertise with attention to the other person, and adaptive expertise that allows a person to develop in a flexible way, requires specific accents in education and training.

What would I like to contribute in the next few years? I want to understand how thoughtfulness and adaptive expertise develop. I want to help in implementing innovations that reinforce this, for example, by using feedback to students in their interactions with colleagues, patients and technology, and to have them learn about their own development through learning analytics. My research programme entitled CaREducation has three goals:
1. To develop and validate new knowledge about education, training and learning;
2. To promote application in practice in co-design with practice as much as possible;
3. To contribute to educational innovations.
That means I also see it as my task to support others in their educational research and innovation projects.

My final words are a repetition of the theorem at the start of this inaugural lecture: Education and training are essential for healthcare progress.

Ik heb gezegd.

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Endnotes

[i] Public expenditure in healthcare is increasing by an average of 2.9 percent per year. Under the same economic conditions and unchanged policies, spendings in healthcare are estimated to be around EUR 174 billion by 2040. Source: RIVM: Public Health Future Exploration 2018. A healthy prospect.

[ii] The difference in life expectancy between the district with the lowest and the district with the highest absolute life expectancy in Utrecht is around five years. The variation in life expectancy in good quality in Utrecht in number of years is about twelve years. Source: https://www.volksgezondheidsmonitor.nl/upload/publicaties_pdf/181_VMU_Utrechts_gezondheidsprofiel_2018.pdf

[iii] Van Manen, 1991, p. 48 describes thoughtfulness as: "We can speak of pedagogical thoughtfulness as a form of knowledge; and yet pedagogical thoughtfulness is less a body of knowledge than a mindfulness oriented toward children". Brown (1987) describes thoughtfulness as: "absorbed into thought, meditative, "characterized by careful reasoned thinking", considerate of others, selflessly concerned with the needs of others" (p. 49)

[iv] A definition: "A disposition is defined as an attributed characteristic of a teacher, one that summarizes the trend of a teacher's actions in particular contexts (...). The acts that constitute a disposition may be conscious and deliberate or so habitual and "automatic" that they seem intuitive or spontaneous" (Katz & Raths, 1985, p. 301). Katz, L. G., & Raths, J. D. (1985). Dispositions as goals for teacher education. *Teaching and Teacher Education*, *1*(4), 301-307.

[v] In line with this, Engeström (2018) shows in his book 'Expertise in Transition, Expansive Learning in Medical Work', that physician's expertise is more than an individual feature. Instead expertise is a common dynamic activity with other professionals. Based on activity theory and underpinned by research and case studies, he describes how changes in healthcare require a different vision of expertise and how expertise is based on interprofessional learning as a collective activity (cf. Bereiter & Scardamalia, 1993). In short, the flexibility and sensitivity of adaptive experts always take place in interaction with others.

[vi] https://www.umcutrecht.nl/nl/Opleidingen/Onderwijsstrategie.

[vii] Ten Cate (2019, p. 1) describes 'to be entrusted with an activity or responsibility' in accordance with the Oxford Dictionary's meaning of entrustment: to "*assign the responsibility for doing something to someone*' or '*to put something into someone's care or protection*'. It is an act of choice by the trustor: one can make an 'entrustment decision' or choose not to". Ten Cate, O. (2019). When I say... entrustability. *Medical Education*. Advance online publication. doi.org/10.1111/medu.14005

[viii] Gude (2017) speaks of different spheres: private, private, public and political "(...) always recognize the atmosphere in which you are active and what rules of the game go to it. Only when you know those rules you can act within such an sphere" (p. 57).

[ix] Utrecht University's motto is: "Bright minds, better future".

[x] Van Manen (1991) describes (pedagogical) thoughtfulness as a form of knowledge besides skills and techniques to be developed, such as management skills or instructional techniques. "The preparation of educators obviously includes much more than the teaching of knowledge and skills, more than a professional ethical code or moral craft. To become a teacher includes something that cannot be taught formally: the most personal embodiment of a pedagogical thoughtfulness" (Van Manen, 1991, p. 10).

[xi] Adaptive expertise consists of the components: domain-specific skills, metacognitive skills and innovative skills (Bohle Carbonell, Stallmeijer, Könings, Segers & Van Merriënboer, 2014).

[xii] Although the origin of creativity has not yet been established (Weisberg, 2018) Weisberg, R. W. (2018). Expertise and structured imagination in creative thinking: reconsideration of an old question. *The Cambridge Handbook of Expertise and Expert Performance*, 812-834. https://doi.org/10.1017/9781316480748.041

[xiii] Professional knowledge of experts does not consist of individual facts, but can be imagined as a network or pattern of what you know and can. That pattern is getting stronger, bigger, more meaningful and specific through what you experience and practice. A pattern as a whole can be more easily recognized than individual parts and has meaning for you. This ensures an efficient use of your memory. For example, remembering "the pattern of numbers in a given date," is easier than remembering loose numbers. This mechanism has been known as chunking (Miller, 1956) and is a useful strategy if you want to remember lots of information in a short period of time. Chunks, larger meaningful clusters of knowledge, take less space in people's working memory and provide

efficiency as they help to distinguish between relevant and irrelevant information in new domain-specific situations. Expert knowledge depends heavily on such mental constructs. In total, they form large, interrelated schematic representations that help you with what you do, for instance, in your work. Mind the mental schedules available to experienced taxi drivers. They use information to quickly propose detours and make decisions when they are on the go.

[xiv] As summarized by Abrahamson & Sánchez (2016): Learning is moving in new ways.

[xv] Lazzara et al. (2010) provide the following training guidelines to develop adaptive expertise in healthcare professionals: learning to recognize cues to build mental models from there, the importance of feedback, sense making training to learning to give meaning to cues in context and unexpected situations.

[xvi] Mylopoulos, Kulasegaram & Woods (2018), describe three characteristics in medical education that can stimulate adaptive expertise: education focused on understanding rather than performance, students' opportunities for exploratory learning with associated difficulties and risks that students have to overcome, learning to deal with a variety of clinical concepts.

[xvii] A systematic literature study by Wallin, Nokelainen & Mikkonen (2019) on how experienced higher-educated professionals develop their expertise confirms that expertise is being developed through the transfer and integration of theoretical, practical and self-regulation knowledge. To develop expertise, it is important to practice with complex problemsolving, 'boundary crossing', integration and transformation of knowledge, and learning from errors (p. 368).

[xviii] Ward et al. (2018) call these principles:
1. Practicing with a diversity of cases that vary in difficulty and complexity (tough-case time compression);
2. Practice tasks with functional complexity and preventing learning in terms of oversimplified relations (complexity preservation);
3. Mentoring and other scaffolding methods for skill development (case-proficiency scaling);
4. Experience how working with and the meaning of certain concepts can vary between situations (concept-case coupling);
5. Active reflection on experiences and performance (active reflection);
6. Feedback aimed at stimulating cognitive flexibility (flexible-focused feedback).

[xix] In addition to talent and depending on the task, about a third of the variance in the professional's performance can be explained by deliberate practice (Hambrick et al., 2014). Ericsson & Harwell (2019) even report an explained variance of around 60% after correction.
Hambrick, D. Z., Oswald, F. L., Altmann, E. M., Meinz, E. J., Gobet, F., & Campitelli, G. (2014). Deliberate practice: Is that all it takes to become an expert? *Intelligence*, *45*, 34-45.
Ericsson, K. A., & Harwell, K. (2019). Deliberate practice and proposed limits on the effects of practice on the acquisition of expert performance: Why the original definition matters and recommendations for future research. *Frontiers in psychology*, *10*, 2396.

[xx] https://cat-database.sites.uu.nl/kennis_item/equality/

[xxi] https://charming-etn.eu

[xxii] https://thermos.sites.uu.nl