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Connecting beliefs, noticing and differentiated teaching practices: A study among pre-service teachers and teachers.

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## **Connecting beliefs, noticing and differentiated teaching practices: A study among pre-service teachers and teachers**

The ability of identifying decisive classroom situations such as inclusive instructions, named ‘noticing’, has been identified as a crucial skill in the context of creating inclusive classrooms. To our knowledge, the associations between differentiated teacher beliefs (i.e., growth mindset and ethical compass), noticing abilities, and implementation of differentiated teaching practices have not been empirically explored. This study aims to explore and contrast these associations by conducting two structural models within both pre-service teacher and in-service teacher contexts. The instruments consisted of self-reported questionnaires and a standardised video-based comparative judgement instrument. Results indicated that differentiated teachers’ beliefs predict teachers’ noticing of inclusive classroom situations. Regarding pre-service teachers, growth mindset beliefs also worked as filters on noticing inclusive instructions but not for ethical compass beliefs, as they are still inactive. Another important finding is that pre-service and in-service teachers’ ability to notice inclusive instructions did not function as mediator between differentiated beliefs and practices. It can be concluded that more empirical grounding on the connection between pre-service teachers’ and teachers’ noticing of inclusive classroom situations with actual classroom practices is needed.

*Keywords:* Inclusive Education, Teacher and pre-service teacher beliefs, Teacher and pre-service teacher noticing, Differentiated Instruction, Inclusive teaching practices

## **Connecting beliefs, noticing and differentiated teaching practices: A study among pre-service teachers and teachers.**

One of the leading movements in the international educational field is inclusive education. This form of education is defined as a “process of strengthening the capacity of the education system to reach out to all learners” (UNESCO, 2017, p. 7) in which “every learner matters and matters equally” (UNESCO, 2017, p. 13). Differentiated Instruction (DI) is currently seen as a means to achieve this aim (European Commission, 2017; UNESCO, 2004). DI is both a philosophy and practice of teaching aimed at maximizing learning by taking into account students’ academic differences in interests, readiness and learning profiles (Tomlinson, 2014). Lately, the ability of identifying decisive classroom situations, called ‘noticing’ (Seidel & Stürmer, 2014) has been identified as a crucial skill in the context of creating inclusive competences (Sherin & van Es, 2009). With respect to inclusive education, competences include a connected set of personal resources (i.e. knowledge, beliefs, and skills) allowing teachers to successfully respond to all students’ learning needs (Blömeke, Gustafsson & Shavelson, 2015). However, to our knowledge, the complex associations between (pre-service) teachers’ beliefs, noticing abilities and differentiated teaching practices have not been empirically explored. This study aims to present two structural models that explore and contrast these associations within both pre-service teacher and in-service teacher contexts.

### **Theoretical framework**

#### ***Differentiated instruction***

Differentiated Instruction (DI) is grounded in the belief that student diversity is inherent in every classroom. Therefore, teachers should anticipate students to have diverse learning needs and adapt their instruction accordingly. The principal model of DI was developed by Tomlinson (1999) in order to meet the learning needs of gifted students. However, it has evolved into both a philosophy (or beliefs) and a practice of teaching which aims to maximise the learning needs of all students (Tomlinson, 2005; 2014). The practice of teaching refers to the proactive adjustments of the curricula, teaching methods, resources, learning activities and students’ products based on the students’ readiness (the ‘what’ of learning), personal interests (the ‘why’ of learning) or learning profile (the ‘how’ of learning).

#### ***The DI-QUEST model***

Recently, Coubergs and colleagues (2017) performed a validity study to measure teachers' beliefs and practices regarding DI based on Tomlinson's theory (2014), which resulted in the 'DI-Quest model'. The DI-Quest model comprises five constructs: two represent the DI teaching beliefs or philosophy (i.e., growth mindset and ethical compass) and three constructs represent the DI teaching practices (i.e., output=input, flexible grouping and adaptive teaching). The constructs are discussed in more detail below.

#### *Fixed and growth mindset about learning*

Based on Dweck's theory (2006), teachers' growth mindset about learning is defined as the implicit beliefs about the stability of ability. This construct can be measured between two ends of a spectrum ranging from a fixed to a growth mindset. Teachers with a more fixed mindset, tend to believe that pupils' qualities (e.g., intelligence or talent) are fixed traits and no amount of effort can change these qualities. These teachers tend to use more controlling teaching methods (Leroy, Bressoux, Sarrazin, & Trouilloud, 2007), create a more competitive class climate (Trouilloud, Sarrazin, Bressoux, & Bois, 2006) and value certain efforts and skills of their students less (e.g., social behaviours, practical skills) (Lynott & Woolfolk, 1994). On the other hand, teachers with a more growth mindset believe that pupils' intellectual abilities can be developed through dedication and practice. These teachers are more inclined to accept differences among students (Hattie, 2005), differentiate their lessons according to students' readiness, interests and learning profile (Couberts et al., 2017) and value cooperative and social behaviours in class (Leroy et al., 2007; Lynott & Woolfolk, 1994).

#### *Ethical compass*

The 'Ethical compass' construct refers to the teachers' beliefs of the use of curriculum as a compass for their teaching versus the observation of student learning (Tomlinson & Imbeau, 2010). Teachers that strictly focus on the curriculum and other external influences as a guide for teaching (e.g., school leaders, parents, time pressures, governmental inspection) differentiate their instruction less and consider structure, discipline, accountability to be the most important part of learning (Chandler, 1999). On the other hand, teachers holding student-centred beliefs differentiate more their instruction according to students' readiness, interests and learning profile (Couberts et al., 2017), spend more time on exploration and creativity (Chandler, 1999), ask more questions and work in small groups (Wilson, Abbott, Joireman, & Stroh, 2002).

### *Output=input*

Continuous assessment and DI are indivisible (Tomlinson, 2014; Tomlinson & Moon, 2013; Valiande & Koutselini, 2009). Output=input represents the importance for teachers to use the students' output (e.g., conversations, tasks, classroom behaviour) to adapt their teaching accordingly and ensure that all pupils reach the learning goals (Hattie, 2012). Ongoing learner-centred assessment activities boost high expectations, foster feedback, collaboration between students, and promote learning coherence by gathering output to conduct curriculum development and revision processes (Huba & Freed, 2000; Webber, 2012). Continuous assessment that informs teaching and learning is crucial to enhance the learning needs of all pupils and promote inclusive classrooms (Tomlinson, 2000; Moon, 2005).

### *Flexible grouping strategies*

In order to effectively differentiate the instruction, teachers need to plan with flexible grouping in mind (Tomlinson, 2001). Within-class flexible grouping strategies allow teachers "to match students and tasks when necessary, and to observe and assess students in a variety of groupings and task conditions" (Tomlinson, 2001, p.26). In order to ensure differentiated teaching and gains in achievement (Deunk et al., 2018), flexible grouping practices (e.g., work in pairs, individual work) need to be combined with adaptations of curriculum, teaching methods and instructional materials and practices (Lou et al., 1996; Tieso, 2005).

### *Adaptive teaching*

Adaptive teaching is what DI is essentially about. By means of adaptive teaching practices, teachers address three types of students' differences in order to meet all students learning needs: differences in interests, readiness and learning profile (Tomlinson, 2001). Responding to students' interests consists of providing students with choice (e.g., in assignments, subject matter or teaching methods) and providing learning content which is interesting to students. Teachers that tackle students' interests will reach higher level of intrinsic motivation and student autonomy, higher levels of student engagement and productivity (Eisenberger & Shanock, 2003). Differences in readiness focus on the student's learning position relative to the learning goals that are to be attained within a given subject at a certain time, which stands for a state of preparedness, which can be tackled by addressing the content of what is to be learned and by providing scaffolding. Scaffolding has shown significant effects on the improvement of teachers' instructional quality and student achievement (Kleickmann et al., 2016). Differences in learning profile refer to a student's preferred modes of learning which

can be affected by different factors (i.e., preference, gender, culture, and context). For example, boys tend to be more achievement oriented, whereas girls are more socially and performance oriented (Chang, 2004). Research has found positive effects on students' learning when teachers tackle differences in learning profiles (Hilliard, 2003; Sternberg & Grigorenko, 1997). Overall, by tackling students' differences in interests, readiness and learning profile teachers may foster positive learning behaviour such as joy, persistence and perseverance among students and meet their leaning needs (Tomlinson, 2001).

### ***Noticing of inclusive classrooms characteristics***

The cognitive process of identifying or perceiving classroom events that are important for effective teaching and learning, is defined as 'noticing' (Stürmer, Seidel, & Schäfer, 2013; Van Es & Sherin, 2002, 2008). Noticing also consists of ignoring aspects that are irrelevant for learning in complex classroom situations. Noticing abilities have been found to be a crucial aspect for achieving inclusive classrooms, as it implies noticing students' learning needs (van Es & Sherin, 2002). Effective inclusive classrooms are those of which the teachers implement an extensive range of strategies such as flexible grouping, peer-assisted learning, using a variety of assessments, designing individualised learning tasks, managing disruptive behaviours, etc. (Sharma, Loreman, & Forlin, 2012; Tschannen-Moran & Hoy, 2007). Research has shown how teachers' noticing of classrooms is influenced by their experiences, backgrounds and beliefs (Jacobs, Lamb, & Philipp, 2010; Miller & Zhou, 2007). Recently, research with teachers has found professional beliefs about students' diversity act as filters for teachers' noticing inclusive classroom characteristics in video clips (Roose et al., 2019). Research among mathematic teachers shows important shifts in teachers noticing after video club meetings or methods courses. This indicates that noticing is a skill that can be learned (van Es & Sherin, 2002; Star & Strickland, 2007). However, research among pre-service teachers in that regard has not been explored yet. Overall, it is important to test the association on how teacher noticing impacts on their teaching performance, as noticing has not been validated yet in terms of consequences of use (Chan, 2014).

### ***The current study***

This study builds on Blömeke, Gustafsson and Shavelson's (2015) conceptual framework for teacher competences, in which competences are viewed along a continuum, an integrated set of dispositions (i.e., knowledge, beliefs) which affect situation-specific skills (i.e., perception, interpretation, and decision), and then reflect in the professional performance. In

the context of inclusive education, the complex associations between teachers' DI beliefs (i.e., growth mindset and ethical compass), noticing abilities of inclusive classrooms characteristics, and differentiated teaching practices (i.e., output=input, flexible grouping and adaptive teaching) have not been empirically explored. Therefore, this study aims to explore and contrast these associations using prediction models (see Figure 1). Because previous research has shown that teachers' willingness to implement pedagogical practices such as DI is strongly predicted by their educational beliefs (Hattie, 2012), most of which develop during the teacher education program and the first years of teaching (Bransford et al., 2005; Wertheim & Leyser, 2002), this study will focus on both pre-service teacher and teacher level in order to explore to what extent the same relationships continue to exist once teachers enter the actual field of education.

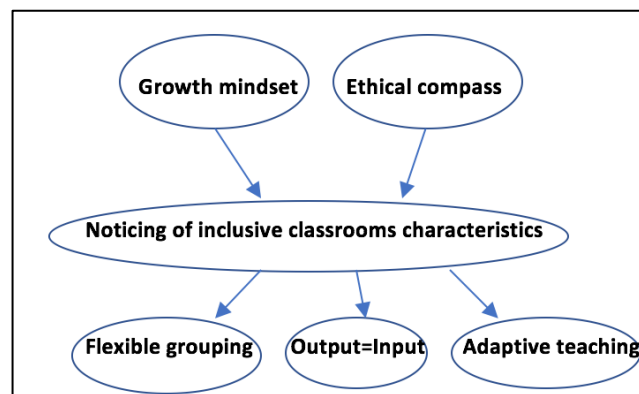


Figure 1: Hypothesized model of DI beliefs, the ability of noticing and DI teaching practices

## Methods

### Participants and Procedures

This study uses data from the “Potential – Power to teach all” project, which was collected in October 2017 from two samples; a sample of secondary schools and a sample of teacher education colleges of secondary education.

Eight colleges were contacted from a list of all Flemish colleges who provide teacher education (i.e., 14 in total) provided by the Flemish Department of Education and they all agreed to take part in the study. The eight participating colleges were selected so they are from every province in Flanders, located in both rural and urban areas, and pertain to different education authorities. The pre-service teachers were contacted by email based on the details supplied by the teacher education institutions. In total, 4775 pre-service teachers preparing to teach in secondary education were contacted. From those, 2349 began the survey, representing an initial response rate of 49.2% with an attrition rate of 1.4% (i.e., 34 participants stopped



filling out the survey). As the dependent variables include teaching practice, only those participants who indicated that they had more than two weeks of teaching experience were included for these analyses. Hence, 598 pre-service teachers from seven institutions with more than two weeks teaching experience provided data for each of the study variables. Of the 598 participants, 50.3% were female with a mean age of 21.5 years ( $SD = 2.8$  years). Additional sample descriptives are presented in Table 1.

Schools were selected so they are from every province in Flanders and located in both rural and urban areas. For each school that refused, a school with similar characteristics was contacted. In total, 23 schools participated in the study. All teachers within each school were invited by the research team to participate and fill out the online instruments. From the 908 teachers (47.6%) that started filling out the instruments, 462 teachers provided data for each of the study variables. This equals a response rate of 24.2%. Of the 462 participants, 66% were female with a mean age of 40.5 years ( $SD = 10.76$  years). Additional sample descriptives are presented in Table 2.

## **Measures**

### **Dependent variables**

#### *Adaptive teaching*

This construct was measured using the ‘adaptive teaching’ subscale of the validated DI-QUEST instrument (Coubergs et al., 2017) aimed at measuring teachers’ adaptation of their classroom practices related to students’ differences in learning related to readiness, interests and learning profile (number of items = 8). An example item is “I choose the learning content and teaching methods based on my students (e.g., interests, talents...)”. This subscale consists of eight items with a 7-point Likert scale (0 = never, 6 = always). The descriptive statistics can be found in Tables 1 and 2.

#### *Output=input*

This construct was measured using the ‘output = input’ subscale of the DI-QUEST instrument (Coubergs et al., 2017). This subscale measures teachers’ use of formative and summative assessment to get information on the learning processes of their students and adjust their lessons accordingly, as well as using feedback as an engine for learning. This subscale consists of four items with a 7-point Likert scale ranging from ‘never’ to ‘always’. An example item is “I use assessment to gain insight into the learning processes of my students”. The descriptive statistics can be found in Tables 1 and 2.

### *Flexible grouping*

This construct was measured using the “flexible grouping and peer learning” subscale of the DI-QUEST instrument (Coubergs et al., 2017). This subscale measures teachers’ perceptions about different forms of within-class grouping and cooperative learning to address students learning needs. This subscale consists of eight items with a 7-point Likert scale ranging from ‘I totally disagree’ to ‘I totally agree’. An example item is “During my lessons, students need to work together in order to progress in their learning process”. The descriptive statistics can be found in Tables 1 and 2.

### **Mediator variable**

#### *Noticing of inclusive classrooms characteristics*

Noticing was measured using the e-PIC instrument, which uses the method of comparative judgement (Gheysens et al., 2017). Respondents needed to compare pairs of video clips and indicate which of the clips they consider as ‘most inclusive’ with regards to teaching approach by making a global judgement (Sadler, 2009). The comparative judgement method enables (pre-service) teachers to assess video clips as a whole instead of guiding their comparisons using predetermined criteria. This holistic method is especially relevant to measure concepts that are very broad dimensions or complex to deconstruct in independent criteria (Lesterhuis et al., 2017) such as inclusive education. In total, respondents compared ten pairs of video clips randomly selected from 15 video clips recorded in secondary education contexts. As a result, a rank order was determined that was compared with a valid rank order with regard to inclusive education (i.e., from most inclusive to least inclusive) made by a group of educational experts (N=34) such as teacher educators, academics, in-service teachers and pedagogical guidance counsellors. The comparison between the respondents’ choices and the expert benchmark was indicated by means of a ‘misfit’ score. This score was 0 if the comparison was exactly similar and increased when more dissimilarity was found. Therefore, a low misfit score means high similarity with the experts’ ranking (see Roose et al., (2018) for the validation of the expert rank orders and Keppens et al., (2019) for the validity of the method to measure noticing). Therefore, for each teacher and pre-service teacher, a misfit score was calculated, representing the extent to which their noticing of inclusive classrooms characteristics matched those of the experts. The descriptive statistics can be found in in Tables 1 and 2.

### **Independent variables**

### *Growth mindset about learning*

The pre-service teachers' and in-service teachers' mindset about learning was measured using the 'growth mindset' subscale of the DI-QUEST instrument (Coubergs et al., 2017). The 'growth mindset' subscale is based on Dweck's theory (2006) and taps whether the teaching mindset is more fixed or growth-oriented. This subscale consists of four items with a 7-point Likert scale (0 = totally disagree, 6 = totally agree). An example item is "Classroom experiences of success can influence the intellectual capacities of students". The total score indicates how growth-oriented the preservice teachers' mindset about learning is. The descriptive statistics can be found in in Tables 1 and 2.

### *Ethical compass*

This construct was measured using the 'ethical compass' subscale of the validated DI-QUEST instrument (Coubergs et al., 2017). This subscale measures teachers' perceptions regarding strictly following a curriculum without taking the students into consideration. This subscale consists of six items with a 7-point Likert scale (0 = totally disagree, 6 = totally agree). An example item is "The curriculum does not provide any flexibility to cope with an individual student". The scale was reversed, consistent with the theoretical notion of an 'ethical compass' by Tomlinson: the more teachers feel autonomous when taking curriculum decisions in class, the more they are inclined to adapt their instruction to student interests, readiness and learning profiles (Coubergs et al., 2017). The descriptive statistics can be found in in Tables 1 and 2.

### **Sociodemographic and contextual information**

Based on previous studies on pre-service teachers' and teachers' development of beliefs and practices regarding inclusive education (Forlin et al., 2009; Kahn et al., 2014; Groenez et al., 2018; Zumwalt & Craig, 2005), we controlled for some sociodemographic and contextual variables. More specifically, for the teachers' sample, we took into account the effect of age, gender, teacher experience and school location. For the pre-service teachers' sample, the sociodemographic and contextual variables assessed in this study are age, gender, language at home (i.e., Dutch; the official language of Flanders) and bachelor year. Language at home served as proxy for ethnic origin (Farkas, 2017).

[Insert here Table 1 and Table 2]

### **Plan of analysis**

Structural equation modeling (SEM) was used to analyse the predicted paths among the variables on both the pre-service teacher and in-service teacher level. We proceeded with constructing two multivariate multivariable regression models. Both models included the constructs related to DI beliefs (i.e., growth mindset and ethical compass) as predictors of the variable ‘noticing of inclusive classrooms characteristics’. At the same time, the noticing variable was used as predictor of the three constructs related to DI teaching practices (i.e., output=input, flexible grouping and adaptive teaching), noticing was used as a mediator between DI beliefs and practices. Latent constructs (i.e., growth mindset, ethical compass, flexible grouping, output=input, and adaptive teaching) were created using confirmatory factor analysis (i.e., the measurement part of SEM), each time using the corresponding original items for each construct. As explained above, noticing was assessed directly as a misfit score, and was subsequently included directly in the SEM. Both models were adjusted for sociodemographic covariates. Model fit was evaluated with the following indices (Byrne, 2010): (1) the Chi-Square test of Model Fit, the main index for evaluating the global significance of a model; (2) the Tucker Lewis Index (TLI), with values above .95 indicating good model fit; the Comparative Fit Index (CFI), with values above .90 indicating good model fit; and (3) the Root Mean Square Error of Approximation (RMSEA), with values ranging from .08 to .05 or less, indicating good model fit. All analyses were conducted using MPlus version 7.4.

## Results

Both structural models indicated a reasonable fit to the data for both pre-service teachers ( $X^2(561) = 1412.08, p < .0001, CFI = .86, TLI = .85, RMSEA = .05$ ) and teachers ( $X^2(534) = 1408.45, p < .0001, CFI = .84, TLI = .83, RMSEA = .06$ ). Taking into account the suggestions by Hu and Bentler (1999), we allow a combination of TLI/CFI-values approaching .90 with RMSEA values smaller than .06 as good model fit. In the teachers’ model (see Table 3), the DI beliefs appeared as significant predictors of their ability to notice inclusive classrooms, especially ethical compass (standardized effect  $\beta = -0.174, p \leq .001$ ) followed by growth mindset (standardized effect  $\beta = -0.091, p \leq .05$ ). However, the teachers’ ability to notice inclusive classrooms did not predict any of the constructs related to DI teaching practices (flexible grouping:  $\beta = -0.081, p < .117$ ; output=input:  $\beta = -0.023, p < .668$ , adaptive teaching:  $\beta = -0.070, p < .161$ ). Regarding the pre-service teachers’ model (see Table 4), growth mindset was also a predictor of noticing (standardized effect  $\beta = -0.087, p \leq .05$ ), while ethical compass was not (standardized effect  $\beta = -0.040, p < .377$ ). Findings also showed that adaptive teaching

was significantly related to the pre-service teacher's noticing (standardized effect  $\beta = 0.100$ ,  $p \leq .05$ ) but in the opposite direction, meaning the more implementation of adaptive teaching the higher the misfit (i.e., distinct with the experts' ranking). Finally, the other DI teaching practices (flexible grouping:  $\beta = -0.011$ ,  $p < .806$ ; output=input:  $\beta = 0.056$ ,  $p < .233$ ) were not predicted by noticing among pre-service teachers.

[Insert here Table 3 and Table 4]

### Discussion

As diversity within educational settings and differences between students are realities (Belfi, Goos, De Fraine & Van Damme, 2012), pre-service and in-service teachers find that they need to understand how to effectively meet them. DI is described as both a philosophy and practice of teaching (Tomlinson, 2014), and is currently seen as a promising framework to achieve inclusive education with a focus on all learners (UNESCO, 2004, 2016). The effectiveness of the DI model (including DI beliefs and practices) in maximizing learning opportunities for every student in the classroom has been proven (Coubergs et al., 2017). Recently, the ability of identifying decisive classroom situations such as inclusive instructions, called 'noticing' (Seidel & Stürmer, 2014; Van Es & Sherin, 2008), has been identified as a crucial skill in the context of inclusive education competences. Based on the framework of competences of Blömeke and colleagues (2015), we hypothesized that teacher beliefs affect teachers' noticing which in turn affects teachers' behavior. However, to our knowledge, the complex associations between teacher beliefs, noticing, and implementation of teaching practices within the context of inclusive education, and more concretely within the DI framework, have not been empirically explored. Therefore, this empirical study of pre-service teachers and teachers was carried out to explore and compare these associations.

The results of this study show that growth mindset about learning was found to be a predictor of noticing in both contexts. In-service and pre-service teachers who believe that their students' intelligence is more malleable than fixed, have a higher ability to notice significant features of inclusive instructions in video clips. This is in line with research among teachers which found that noticing is influenced by professional beliefs about teaching diverse learners (Roose et al., 2019). This might not be surprising, considering the concept of growth mindset is often seen as part of the theories on inclusive education such as DI and Universal Design for Learning (UDL) (Tomlinson, 2014; Meyer, Rose & Gordon, 2014). More specifically, these

inclusive pedagogical frameworks consider growth mindset as a pre-condition for the implementation of their practices.

Further, ethical compass was found to be the most important predictor of in-service teachers' noticing abilities on inclusion. Teachers who hold beliefs about using the observation of the student learning as a compass for teaching rather than using the curricula as a compass for their teaching, tend to be more proficient at noticing inclusive classrooms characteristics. However, this was not the case for pre-service teachers. Although speculative, one explanation for these findings could be that the 'ethical compass' construct is still inactive among pre-service teachers, as it mainly focuses on sources of information and pressures from outside the classroom (e.g., textbooks, time pressure) and pre-service teachers usually do not have to cope with this pressure during the field experiences. Hence, it is plausible that these beliefs have no significant impact on their noticing abilities, although this could change once they become part of a school in the long-term, which is suggested by our data considering the difference between in-service and pre-service teachers in this regard. By using longitudinal data and really following how teachers' beliefs change as they transition into the actual education field, this process could be checked in future research.

Another important finding of this study is that in-service teachers' ability to notice inclusive classrooms characteristics did not function as mediator between DI beliefs and DI practices. None of the DI practices (i.e., flexible grouping, output=input, adaptive teaching) were predicted by teachers' noticing. Although speculative, one explanation for the disconnection identified between teachers' noticing and their actual practices can be found in previous research on models of behaviour, such as the ready-willing-and-able model (Miller & Rollnick, 2002) or the theory of reasoned action (Ajzen & Fishbein, 1980). These models discuss the disconnection between beliefs and skills and actual implementation of conditions, among others due to environmental pressures. In our study, these pressures could be referred to classroom climate, school autonomy, degree of collaboration and support from colleagues, isolation conditions, etc. Future research should examine other relevant constructs related to the connection between beliefs and practices on inclusive education, such as 'self-efficacy in using inclusive instructions' which takes more explicitly into account the extent to which teachers see themselves capable of actually implementing inclusive practices (Sharma et al., 2012). Another possible construct is 'reasoning' (i.e., the ability to take a reasoned approach to events noticed in the classroom) (Seidel & Stürmer, 2014). Regarding the pre-service teachers model, flexible grouping and output=input were also not predicted by noticing. Nevertheless, it was found that adaptive teaching was predicted by noticing. However, it was in the opposite

direction than expected, meaning that pre-service teachers who tend to notice less inclusive classroom characteristics are also the ones who tend to adapt their teaching more according to students' interests, readiness and learning profile. As mentioned before, environmental pressures (e.g., emotional climate in teacher education, degree of collaboration and support from colleagues and teacher educators, isolation conditions during internships) could explain the misfit scores about the connection between noticing with actual inclusive practices. Another possible explanation could be that pre-service teachers who are not as developed at noticing, tend to try a lot of different teaching approaches during their internships (hence, their higher scores on adaptive teaching). While pre-service teachers that are more developed at noticing are first more focused on creating a positive classroom climate and not yet as concerned with didactical aspects in their teaching.

Overall, teachers' DI beliefs (i.e., growth mindset and ethical compass) work as filters on teachers' noticing of inclusive classroom situations, in accordance with suggestions from previous research (i.e., Roose et al., 2019). Regarding pre-service teachers, growth mindset beliefs also work as filters on noticing inclusive instructions but not for ethical compass beliefs, as they are still inactive. Another important conclusion is that in-service and pre-service teachers' ability to notice inclusive instructions does not function as mediator between DI beliefs and DI practices. It can be concluded that more empirical grounding on the connection between pre-service teachers' and teachers' noticing of inclusive classroom situations with actual classroom practices is needed.

### **Limitations and Suggestions for Further Research**

There are some limitations to the present study. First, the participants who participated were restricted to college students preparing for teaching in secondary education and secondary education teachers. To assess the robustness of these findings, future research should examine if the same relationships appear in samples of student teachers and teachers at different academic levels and contexts (e.g., pre-service teacher primary education, in-service primary school teachers). Second, the instruments used to measure the DI beliefs and practices were self-reported surveys, which allow for potential socially desirable responses. Triangulation or use of other research methods (e.g. interviews, class observations, focus groups) on DI could overcome this weakness. Third, results of the current study are based on cross-sectional data, making it impossible to explore how DI teaching beliefs and practices and noticing abilities change as pre-service teachers gain experience. Future research that combines longitudinal data and qualitative research methods such as observations could explore possible shifts in both pre-

service teachers' beliefs and practices regarding DI as well as their noticing abilities on inclusive education. Subsequently, it would be interesting to provide a follow-up when they enter in the teacher profession. Fourth, we did not control for the nested structure of the data, as the central research question here was to explore the associations between beliefs, noticing abilities and differentiated teaching practices among the overall Flemish (pre-service) teacher population. Future research could use multilevel regression techniques to explore variations in effects among schools and teacher training institutions. Finally, previous research has indicated that beginning teachers' knowledge, beliefs, skills and teacher practices are bidirectional (Santagata & Yeh, 2016). Therefore, longitudinal research is needed to address the direction of effects and draw causal conclusions. For example, intervention studies could investigate how changes in DI practices affect the teachers noticing and DI beliefs and vice versa.

### **Implications**

First, this study has implications for teacher educators involved in developing pre-service teachers' competences on inclusive education. It is important that teacher educators consider whether they are stimulating a growth mindset in their students, as this was found to be a predictor of pre-service teachers' noticing of inclusive classrooms events. To explore pre-service teachers' beliefs about the stability of ability of their pupils, it would be useful to hold group discussions about learning and pedagogy and allow the pre-service teachers to express their views on this subject (Woolfolk Hoy, Davis, & Pape, 2006). Pre-service teachers might change their fixed views after their hands-on experience and realise there are different student learning styles when building positive relationships with their pupils. This might create a conflict between their fixed beliefs and their new experiences in classrooms, known as cognitive dissonance (i.e., discomfort) (Gorski, 2009). By experiencing a cognitive dissonance, pre-service teachers will be able to align their preconceived beliefs with the realities of the classroom (Eisenhardt, Besnoy, & Steele, 2012). Further, video analysis and the method of comparative judgement can be used as a tool during mentoring to reflect with pre-service teachers about their decisions for choosing one clip over another, and from there, induce awareness and reflection about their own inclusive teaching experiences (Tiainen et al., 2018).

Second, our results provide insights for professional development initiatives to support teachers in responding to implement inclusive education with a focus on all learners. It is important to pay special attention to teachers' beliefs for teacher professional development on inclusive education. Through video-based measurement instrument and the use of think-aloud procedures, teachers can reflect and discuss in group about their DI beliefs (growth mindset and



ethical compass) and their decisions for choosing one clip over another. The second step can be to reflect how the same beliefs apply to their own pupils and how this influences their own teaching practices and decisions.

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## Tables

Table 1: *Descriptive statistics of the pre-service teacher sample (n = 598).*

Variables	%	Mean	SD	Min.	Max.	Cronbach's alpha
Growth mindset		4.32	0.96	0.25	6	0.76
Ethical Compass		2.88	0.94	0	5.83	0.78
Noticing of inclusive classrooms		1.63	0.61	0	4	
Output=input		3.24	0.94	0	6	0.75
Flexible grouping		4.44	0.72	0	6	0.83
Adaptive teaching		3.09	0.89	0	6	0.83
Gender						
male	50.3					
female	49.7					
Age		21.16	2.81	18	58	
Language at home						
2 parents speak Dutch	91.5					
0 or 1 parent speak Dutch	8.5					
Bachelor year						
first year	8.0					
second year	51.0					
third year	4.0					
Higher Education Institution						
Higher Education Institution 1	26.6					
Higher Education Institution 2	1.5					
Higher Education Institution 3	8.0					
Higher Education Institution 4	1.8					
Higher Education Institution 5	0.5					
Higher Education Institution 6	25.9					
Higher Education Institution 7	35.6					

Table 2: *Descriptive statistics of the teacher sample (n = 462).*

<b>Variables</b>	<b>%</b>	<b>Mean</b>	<b>SD</b>	<b>Min.</b>	<b>Max.</b>	<b>Cronbach's alpha</b>
Growth mindset		4.11	1.17	0	6	0.86
Ethical Compass		3.07	1.24	0	6	0.83
Noticing of inclusive classrooms		1.4	0.54	0.37	3.3	
Output=input		3.61	0.97	1	6	0.71
Flexible grouping		4.56	0.67	2.25	6	0.78
Adaptive teaching		2.64	0.96	0	6	0.85
Gender						
male	66.0					
female	34.0					
Age		42.52	10.76	23	65	
Experience in education		15.84	10.32	0	40	
School						
School 1	6.5					
School 2	0.2					
School 3	2.8					
School 4	1.7					
School 5	1.5					
School 6	10.4					
School 7	10.6					
School 8	10.4					
School 9	16.9					
School 10	5.2					
School 11	0.4					
School 12	0.9					
School 13	1.3					
School 14	4.1					
School 15	1.3					
School 16	1.1					
School 17	3.5					
School 18	0.9					
School 19	2.2					
School 20	1.7					
School 21	1.3					
School 22	7.8					
School 23	7.4					



Table 3: *Prediction Model of teachers' DI beliefs, the ability of noticing and DI teaching practices.*

<b>Main effects</b>	<b>Est (S.E)</b>
Growth Mindset → Noticing	-0.091 (0.047)*
Ethical compass → Noticing	-0.174 (0.049) ***
Noticing → Flexible grouping	-0.067 (0.051)
Noticing → Output=input	-0.020 (0.054)
Noticing → Adaptive teaching	0.076 (0.050)
<b>Covariates → Noticing</b>	
Male (vs. Female)	0.084 (0.046)
Age	0.052 (0.089)
Teaching experience	-0.008 (0.089)
City School (vs. Rural school)	-0.060 (0.190)
<b>Covariates → Flexible grouping</b>	
Male (vs. Female)	-0.208 (0.051) ***
Age	-0.005 (0.099)
Teaching experience	0.077 (0.439)
City School (vs. Rural school)	-0.050 (0.051)
<b>Covariates → Output=input</b>	
Male (vs. Female)	-0.066 (0.055)
Age	-0.018 (0.106)
Teaching experience	0.000 (0.105)
City School (vs. Rural school)	-0.059 (0.054)
<b>Covariates → Adaptive teaching</b>	
Male (vs. Female)	-0.071 (0.051)
Age	-0.020 (0.098)
Teaching experience	-0.047 (0.098)
City School (vs. Rural school)	-0.047 (0.051)

\*:  $p \leq .05$ . \*\*:  $p \leq .01$  \*\*\*:  $p \leq .001$

Table 4: Prediction Model of pre-service teachers' DI beliefs, the ability of noticing and DI teaching practices.

<b>Main effects</b>	<b>EST (S.E)</b>
Growth Mindset → Noticing	-0.087 (0.044) *
Ethical compass → Noticing	-0.040 (0.045)
Noticing → Flexible grouping	-0.011 (0.044)
Noticing → Output=input	0.056 (0.047)
Noticing → Adaptive teaching	0.100 (0.045) *
<b>Covariates → Noticing</b>	
Male (vs. Female)	0.144 (0.040) ***
Age	0.029 (0.043)
0 or 1 parent speak Dutch at home (vs. 2 parents speak Dutch)	0.046 (0.040)
Bachelor year (ref= Third year)	
First year	-0.223 (0.077) **
Second year	-0.168 (0.076) *
<b>Covariates → Flexible grouping</b>	
Male (vs. Female)	-0.148 (0.044) ***
Age	-0.011 (0.047)
0 or 1 parent speak Dutch at home (vs. 2 parents speak Dutch)	0.106 (0.044) *
Bachelor year (ref= Third year)	
First year	-0.012 (0.085)
Second year	-0.025 (0.083)
<b>Covariates → Output=input</b>	
Male (vs. Female)	-0.035 (0.047)
Age	-0.038 (0.050)
0 or 1 parent speak Dutch at home (vs. 2 parents speak Dutch)	0.027 (0.047)
Bachelor year (ref= Third year)	
First year	-0.170 (0.090)
Second year	-0.090 (0.088)
<b>Covariates → Adaptive teaching</b>	
Male (vs. Female)	-0.071 (0.045)
Age	-0.025 (0.047)
0 or 1 parent speak Dutch at home (vs. 2 parents speak Dutch)	0.003 (0.045)
Bachelor year (ref= Third year)	
First year	-0.099 (0.086)
Second year	-0.051 (0.084)

\*:  $p \leq .05$ . \*\*:  $p \leq .01$  \*\*\*:  $p \leq .001$

