Teaching to address diverse learning needs: development and validation of a Differentiated Instruction Scale

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Abstract

In the province of Quebec, Canada, a trend towards full inclusion has impelled teachers to adapt their instruction to meet the needs of both advanced and weaker learners in regular school settings. The main purpose of the present investigation was to develop and validate the Differentiated Instruction Scale (DIS), which assesses the use of instructional adaptations and academic progress monitoring strategies in general education classrooms. A total of 125 elementary school teachers participated in a cross-sectional study, allowing us to develop and validate the DIS. Overall our results show that the DIS is composed of two factors that are consistent with the predicted constructs (instructional adaptations and academic progress monitoring). Evidence of convergent validity is provided through correlations among DIS' subscales and two criteria: (1) teachers' autonomy support and (2) perceptions of school climate. Results also reveal that teachers tend to use instructional adaptations that do not require much preparation or tailored instruction. The DIS could thus be used in future research to investigate outcomes of differentiated instruction. Moreover, it could provide useful information on optimal strategies for promoting learning in children with different abilities in general education classrooms.

Introduction

In many countries, there is an increasing educational trend towards full inclusion, meaning that every child, disabled or not, should be taught in a regular classroom (Ferguson 2008; Fuchs and Fuchs 1994; Kavale 2002). For example, in Quebec (a province of Canada), the Education Act and the Special Education Policy (MELS, 1999) state that students at risk for school failure or with learning disabilities should receive instruction in the most natural environment. In 2010, 65% of students with disabilities were taught in a regular classroom rather than in a resource room or self-contained school environment (MELS, 2010). Accordingly, general education teachers face growing challenges in addressing students' various learning needs (Ferguson 2008; McLeskey and Waldron 2011).

The need to provide learning environments that respond to individual differences has been a longstanding concern (Ainscow, Booth, and Dyson 2006; Glaser 1977; Thomas and Loxley 2001; Wang 1992). Now that regular classrooms have become even more diverse in terms of children's abilities, effective schooling requires the use of instructional practices that enable all students to learn and develop their competencies (Corno 2008). Differentiated instruction

has been recognised as a promising approach. It can be defined as a strategy by which teachers provide different avenues to students' learning in response to variation in readiness, interests, and learning profiles (Tomlinson 2001; Tomlinson et al. 2003). According to Tomlinson et al. (2003), there are three aspects of learning that teachers can differentiate: (1) content, (2) process, and (3) product. Content refers to what students develop such as competencies in core academic areas, goals, and expectations, whereas process denotes activities that allow students to understand important ideas and principles. Finally, product refers to students' demonstration of what they have learned (e.g. tests, evaluation of knowledge and skills). Hence, differentiated instruction involves varying content, process, and product according to students' abilities, interests, and learning styles. Although this definition has been widely accepted by practitioners, no theoretically based conceptualisation of differentiated instruction has been reported in the scientific literature.

We define differentiated instruction as an approach by which teaching is varied and adapted to match students' abilities using systematic procedures for academic progress monitoring and data-based decision-making. More specifically, we suggest that differentiated instruction includes two components: (1) instructional adaptations and (2) academic progress monitoring. This definition differs from the one proposed by Tomlinson in three ways. First, although individual differences may manifest themselves in more than one dimension, such as interests and learning profiles (Tomlinson et al. 2003), we only focus on differences in ability (in French and Math classes), which constitute the most important challenge in regular classrooms. Second, although it can be useful to distinguish between content, process, and product, we propose that all strategies aimed at varying instruction could be grouped under the concept of instructional adaptations. Third, we put emphasis on academic progress monitoring as it represents a distinct component of differentiated instruction. Based on the above definition, we have developed and validated a measure of differentiated instruction called the Differentiated Instruction Scale (DIS). Whereas many instruments have been developed to evaluate teachers' use of adaptation strategies, they have mostly focused on strategies intended to students with learning disabilities. In this regard, it appears important to make a distinction between the terms differentiated instruction and individualised instruction, which are sometimes used interchangeably in the literature. Individualised instruction is more associated with special education as it typically focuses on interventions intended to remediate students' learning difficulties (Landrum and McDuffie 2010). In contrast, differentiated instruction has been developed in response to the tendency in many countries to integrate children of various abilities in the same classroom environment. It aims at varying teaching to match a wide range of learning needs. Therefore, the major contribution of this study is to develop an instrument that assesses the use of differentiation strategies that are intended to students of all abilities, including weaker and stronger learners. In the following sections, we discuss the theoretical background underlying instructional adaptations and academic progress monitoring. We also provide a rationale as to why differentiated instruction should be related to teachers' autonomy support and perceptions of school climate, two criteria variables used to establish the convergent validity of the scale.

Instructional adaptations

Instructional adaptations have been recognised as key to academic success for all students in regular classrooms (Fuchs and Fuchs 1998; Fuchs, Fuchs, and Bishop 1992; McLeskey and Waldron 2002). In instructional adaptations, teachers provide a variety of learning options to students (Randi and Corno 2005). They make judgments about children's abilities and adjust their instruction accordingly to facilitate academic progress and provide optimal learning opportunities. Possible adaptation strategies include (1) altering the curriculum (e.g. goals, course content); (2) diversifying materials and assignments; (3) varying teaching strategies and pace of instruction; and (4) providing extra support (Scott, Vitale, and Masten 1998). These strategies can also be viewed as either being content, process, or product adaptations. Hence, students with different abilities may not pursue the same individual goals or take the same route to achieve common goals. Instructional adaptations can be part of planned instruction (i.e. routine adjustments intended for students of all abilities, including those with learning difficulties and exceptional aptitudes), or may be implemented after a lesson has proved unsuccessful for a particular child (i.e. specialised adaptations for specific needs or difficulties; Fuchs, Fuchs, and Bishop 1992).

Instructional adaptations have been largely studied in the past two decades. Thus, educational researchers have developed a number of instruments to investigate teachers' adaptation strategies. For instance, the Bender Classroom Structure Questionnaire (BCSQ; Bender 1992) was developed to evaluate inclusive learning environments. It assesses individualised instruction (e.g. use of peer tutoring, varying materials) and learning strategies (e.g. focus on how students learn, demonstrate educational tasks). It also assesses the use of teaching approaches such as reinforcement and classroom routines. Another questionnaire is the Adaptation Evaluation Instrument (AEI; Schumm and Vaughn 1991), which assesses general education teachers' willingness to make adaptations for students with special needs. Like the BCSQ, the AEI covers a wide range of themes, including reinforcement and encouragement for children with learning disabilities, communication with other teachers and parents, feed-back on tasks, and teaching adjustments (e.g. use alternative materials, adapt the pace of instruction, and allow extra time). In the same vein, the Teacher Intervention Questionnaire (Johnson and Pugach 1990) was developed to assess strategies for learning and behaviour problem management in regular classrooms. It covers areas such as teacher interventions (e.g. use supplementary materials), consultation (e.g. talk with the principal and other teachers about children's academic or behavioural difficulties), students' alternatives (e.g. clarify expectations, use audio recorded textbooks), special education involvement (e.g. collaborate with psychologists), and data collection about students' problems. In more recent studies, researchers have also developed instruments to assess instructional adaptations for learners who are struggling with specific academic areas such as spelling and writing (Graham et al. 2003, 2008).

Most studies conducted with these self-report instruments have revealed that teachers make few substantial adaptations (e.g. diversifying the curriculum, modifying materials, and altering the grading criteria) in order to match students' abilities in regular classrooms (Graham et al. 2008; McLeskey and Waldron 2011; Scott, Vitale, and Masten 1998). Instead, teachers reported using more interventions related to students' motivational adjustment (e.g. provide reinforcement and encouragement) or strategies requiring less preparation. Although

these studies provide useful information on some aspects of differentiated instruction, they emphasised strategies intended for students with learning or behavioural difficulties (Scott, Vitale, and Masten 1998) and neglected the needs of other children, such as those with stronger abilities. Therefore, as mentioned earlier and consistent with the literature on differentiated instruction (Tomlinson 2005), the present study sought to develop a self-report scale that focuses on adaptations addressing the needs of all students, including advanced and weaker learners. Moreover, existing instruments have not provided extensive evidence of construct validity (Bender, Vail, and Scott 1995), which we attempt to achieve. Finally, few of these instruments have addressed the issue of academic progress monitoring, a central component of differentiated instruction (Berkeley et al. 2009; Gresham 2007; Tomlinson 2005; Waldron and McLeskey 2010; Ysseldyke and McLeod 2007).

Academic progress monitoring

It has been recognised that academic progress monitoring procedures can be particularly helpful in making decisions about how to differentiate instruction to match a sufficient range of learning needs (Salend 2009). In the same vein, the literature on instructional adaptations acknowledges that such procedures must be implemented to enable effective teaching adjustments (Fuchs and Fuchs 1993; Scott, Vitale, and Masten 1998; Ysseldyke et al. 2003). Thus, in order to choose and apply appropriate strategies, teachers should assess students' prior knowledge and background in each school subject and monitor their subsequent achievement and improvement. The match between instructional practices and students' capabilities must be based on their actual competencies and the tasks to be performed (Randi and Corno 2005). Consequently, it is critical to use progress monitoring procedures that provide such information. This issue has been emphasised in the response-to-intervention (RTI) literature.

RTI is an approach to identifying and addressing learning difficulties in children (Johnson et al. 2006). Although this initiative dates back to the 1960s (Bender and Shores 2007), it has received greater attention in the last 10 years. Until recently, the most widely used method to identify learning disabled (LD) students was the IQ-achievement discrepancy (Fuchs and Fuchs 2006). However, research did not support the validity of this approach and suggested that some students' difficulties may reflect poor teaching. Therefore, RTI emerged as a means to identify LD students using progress monitoring classroom assessments, and evidence-based instruction. It consists of increasingly intensive interventions, referred to as tiers. Tier 1 typically involves class-wide instruction, using universal programmes and research-based teaching strategies (e.g. direct instruction, cooperative learning, and peer tutoring). Students' progress is then monitored, and those who do not respond adequately receive more specialised interventions. Traditionally, the next tiers involve individualised teaching, and ultimately, referral to self-contained classes. However, advocates of inclusive education have called for a different view of RTI (Fuchs, Fuchs, and Stecker 2010), whereby the primary purpose would be to enhance the achievement of all students by providing high-quality instruction and interventions that respond to diverse learning needs in the general education classroom (Burns and Gibbons 2008). Instructional practices are varied in order to match most students' abilities, and academic progress is assessed frequently (Berkeley et al. 2009). Teaching adaptations are then implemented according to students response, using appropriate support when more intensive instruction is required. In that perspective, the merging of RTI

and differentiated instruction implies that teachers use academic progress monitoring to identify students' learning needs and to adjust teaching accordingly (O'Meara 2011). Moreover, although RTI models have been typically designed to address the needs of students with learning difficulties, academic progress monitoring should also allow teachers to make appropriate adaptations for students with stronger abilities (e.g. provide materials beyond their grade level).

Academic progress monitoring is a key concept in the RTI literature. More specifically, it involves continuous data gathering about students' performance and rate of improvement. Teaching adjustments are implemented based on reliable and accurate information obtained through direct observations and frequent recordings of students' performance in basic skills such as reading and mathematics (e.g. curriculum-based assessment procedures; Hintze, Christ, and Methe 2006). By analysing this information, teachers can make data-based decisions about instructional adaptations. Interventions must also be assessed for effectiveness to ensure high-quality instruction that is differentiated according to children's current capabilities (Gresham 2007).

Autonomy support and school climate

In this study, we evaluate the convergent validity of the DIS using two variables: teachers' autonomy support and perceptions of school climate. Autonomy support refers to what one person says and does to enhance another's internal perceived locus of causality, volition, and sense of choice during action (Deci and Ryan 2002; Reeve, Nix, and Hamm 2003). In a school setting, this involves offering students various options and meaningful rationales (e.g. opportunities for decision-making during coursework), providing structure in the form of clear rules and expectations, and avoiding controlling language (Su and Reeve 2010). Because differentiated instruction and autonomy support both focus on children's needs, they should be positively related. Specifically, when teachers are autonomy supportive, they take the students' perspective so they are able to ascertain what type of instructional adaptations are appropriate for them (Deci 2009). Moreover, when teachers are autonomy supportive, they provide clear rules, guidelines, and expectations for behaviour (Grolnick, Friendly, and Bellas 2009), and they avoid control (e.g. pressuring students towards specific outcomes). Like differentiated instruction, these autonomy-supportive pedagogical practices encourage students to focus on their individual progress and achievement rather than on competition and on social comparison.

Moreover, past research has suggested that teachers are more likely to use differentiated instruction strategies when the school climate fosters inclusive education (e.g. positive leadership, collaboration, opportunities for in-service training, and availability of resources; Ainscow and Sandill 2010; Avramidis and Norwich 2002; De Jager 2011; Kinsella and Senior 2008; Schumm and Vaughn 1995; Soodak, Podell, and Lehman 1998). Therefore, a positive school climate seems to be critical for enabling effective use of adaptation strategies. For that reason, we believe that differentiated instruction should be positively associated with teachers' perceptions of school climate.

The present study

This study has three goals. The first is to develop a self-report scale, the DIS, containing items to address (1) instructional adaptations and (2) academic progress monitoring. Based on the reliability and exploratory factor analyses, we narrowed the range of potential items (Bentler and Wu 1995). The second goal is to verify the factor structure of the DIS, using confirmatory factor analyses (CFAs) and to assess the convergent validity through correlations with two variables: (1) teachers' autonomy support and (2) teachers' perceptions of school climate. More precisely, we hypothesised that differentiated instruction would be positively correlated with the following components of autonomy support: (a) promoting choice-making, (b) providing meaningful rationales, and (c) providing structure, but negatively correlated with teachers' use of control. We also predicted that differentiated instruction would be positively associated with the following characteristics of the school climate: (a) teacher collaboration, (b) principal's leadership, and (c) support services. The third goal of this study was to report teachers' differentiated instruction strategies, using the DIS. Although teaching adaptations have been widely studied, little research has been conducted on how general education teachers adapt their instruction to meet the needs of both advanced and weaker learners in regular classrooms (Graham et al. 2008). In Quebec, the school reform and the full inclusion movement have impelled teachers to implement differentiated instruction strategies that facilitate optimal learning and achievement in regular classrooms. To our knowledge, no empirical studies have investigated the use of differentiated instruction in French Canadian teachers.

Method

Scale development

We began by designing a preliminary version of the DIS. After reviewing the existing instruments for instructional adaptations, a committee of four experts (graduate students, professors) identified possible strategies for matching students' abilities in regular classrooms. For instance, these strategies could relate to curriculum (e.g. goals, course content), materials and assignments, teaching methods or pace of instruction. Although we do not distinguish between content, process, and product adaptations, we elaborated items that were in line with these three elements. Examples of items were: 'adjust course content at varied levels of readiness', 'modify goals and expectations for students with difficulties', 'use within-class ability grouping to facilitate tailored instruction' (content), 'use alternative materials to match students' abilities', 'vary the complexity of assignments to match students' abilities', 'accelerate the pace of instruction with more advanced learners' (process), 'adjust the amount of work required in accordance with students' capabilities', 'develop benchmarks for success based on individual student achievement', and 'adapt evaluations to match students' abilities' (product). Based on a review of the recent RTI literature, the expert committee then developed a number of items in line with academic progress monitoring (e.g. 'keep records about students' achievement and rate of improvement', 'use technology tools to monitor students' academic progress', and 'use students' data to make decisions about teaching adjustments'). A total of 20 items were initially included in the preliminary version of the DIS.

Next, we conducted focus group interviews with 43 elementary school teachers (6 males, 37 females) from different areas of Quebec City. Participants judged the relevance and accuracy of the 20 items, which allowed us to refine the formulations and determine the strategies that teachers actually used in their classroom. We consequently added five items to the questionnaire. The DIS assesses to what extent teachers use each teaching practice in French and Math classes. Items are rated on a five-point Likert scale (1 1⁄4 never, 5 1⁄4 very frequently). The preliminary version of the DIS is presented in Table 1. Items that were not retained for the final scale are presented as strikeout text.

Participants and procedure

A letter was emailed to approximately 500 teachers belonging to the Quebec Association of Elementary School Teachers inviting them to complete the questionnaire online. A total of 125 participants (113 females, 12 males) completed and returned it. Mean age was 41 years (SD 1⁄4 9.11). Participants taught in different areas of the province of Quebec (first grade 1⁄4 28, second grade 1⁄4 23, third grade 1⁄4 20, fourth grade 1⁄4 20, fifth grade 1⁄4 18, and sixth grade 1⁄4 16). Teaching experience ranged from 1 to 35 years (M 1⁄4 14.29; SD 1⁄4 8.12).

Measures

The questionnaire included (1) the preliminary version of the DIS (25 items), (2) a scale assessing the level of autonomy support that teachers offered to students, and (3) a scale evaluating teachers' perceptions of the school climate. The autonomy support scale was adapted from existing instruments assessing autonomy support provided by teachers (Su and Reeve 2010; Williams and Deci 1996). Participants responded to 19 items on a five-point Likert scale (1 1⁄4 never, 5 1⁄4 very frequently). Sample items are 'I provide my students with choices and options during coursework' (promote choice-making, a 1⁄4 0.66), 'I explain why we have to learn certain things in school' (provide meaningful rationales, a 1⁄4 0.73), 'I encourage competition in my classroom' (use control, a 1⁄4 0.73), and 'I provide my students with clear rules and expectations' (provide structure, a 1⁄4 0.76). The scale to assess the school climate was also adapted from existing instruments (Hallinger 2003; Leithwood and Jantzi 2005; Silins, Mulford, and Zarins 2002). Examples of items are 'Teachers work together to exchange ideas on good practices in teaching' (teacher collaboration, a 1⁄4 0.83), 'The principal is receptive to change and innovation at school' (principal's leadership, a 1⁄4 0.88), and 'The available teaching materials are sufficient to address diverse learning needs in the class-room' (support services, a 1⁄4 0.74). Participants rated 15 items on a six-point Likert scale (1 1⁄4 totally disagree, 6 1⁄4 totally agree).

Statistical analyses

Missing data

In the present study, data were missing for six participants. Several researchers have demonstrated the inadequacy of the list-wise procedure and other ad hoc methods, such as substituting missing values for the variable mean (Davey, Shanahan, and Schafer 2001; Peugh and Enders 2004). We used a full information maximum likelihood approach to compute the product of individual likelihood functions to estimate parameters. Many studies

have suggested that this method generally produces the least biased and most efficient parameter estimates (Peugh and Enders 2004). Thus, all analyses presented in the results section were based on a sample of 125 participants.

Exploratory factor analysis

Although we predicted identifying two factors from the data, we conducted an initial EFA to determine the dimensions a priori and to select appropriate scale items. A maximum likelihood (ML) EFA with the oblimin rotation was then performed using SPSS 13.0. In order to retain meaningful factors for differentiated instruction, we applied three criteria: (a) an eigenvalue greater than 1.00 as a cutoff value, (b) select items with factor loadings of 0.32 and above, and (c) select factors on which at least three items were loaded (Costello and Osborne 2005).

Confirmatory factor analyses

In order to further assess the DIS factor structure and convergent validity, we conducted CFAs using structural equation modelling. These analyses were performed on covariance matrices with Mplus version 6.1 (Muthe´n and Muthe´n 2006), using the weighted least squares means and variance adjusted (WLSMV) estimator for categorical variables. When categorical variables are used, the WLSMV estimator produces more accurate loadings and smaller standard errors than the ML estimator (Beauducel and Herzberg 2006). To assess the model fit, we used the Comparative Fit Index (CFI), the Tucker – Lewis Index (TLI), the root mean square error of approximation (RMSEA), the weighted root mean square residual (WRMR), and the chi-square/ degrees of freedom (x2/df) ratio. The TLI and CFI vary along a 0–1 continuum where values greater than 0.90 indicate an acceptable fit (Schumacker and Lomax 1996). It was also suggested that RMSEAs less than 0.05 reflect a close fit, and that values up to 0.08 indicate reasonable errors of approximation (Browne and Cudeck 1993; Jo¨reskog and So¨rbom 1993). However, Hu and Bentler (1999) called for more stringent cutoffs for goodness-of-fit indices, such as 0.95 for the CFI and TLI and 0.06 for the RMSEA. The WRMR is a relatively new fit index that is said to be more suitable for categorical data. WRMRs less than 1 indicate a good model fit (Hancock and Mueller 2006). Note that previous research has shown that traditional fit indices (TLI, CFI, and RMSEA) perform quite well when the WLSMV estimator is used (Beauducel and Herzberg 2006). Finally, the x2/df ratio is a function of model misfit (x2) compared to model parsimony, as indicated by the model's degrees of freedom (df). Smaller x2/df ratios occur when model misfit is lower than model parsimony. In general, a x2/df ratio around 2 indicates a relatively good model fit (Kline, 2005).

Results

Reliability factor analysis and EFA

Normality assumptions for each variable of the preliminary version of the DIS (25 items) were verified by skewness and kurtosis. Prior to the EFA, we inspected the inter-item correlation matrix in order to detect correlations lower than 0.30. According to Tabachnick and Fidell (2007), a factorable correlation matrix should include several sizable correlations. Of the 25 items assessing differentiated instruction, five were nearly uncorrelated or weakly

associated with others (r, 0.30). They were therefore removed from subsequent analyses. Using SPSS 13.0, we then computed the correlations between item and total scores. Four items with an item–total correlation lower than 0.30 were excluded.

An EFA was performed on the remaining items, revealing a final two-factor structure. Based on the results, we retained 12 items corresponding to two interpretable dimensions that accounted for 52% of the total variance. No cross-loadings were observed. Factor loadings, eigenvalues, and explained variance are presented in Table 2. The two yielded factors represented (1) instructional adaptations (e.g. varying the complexity of assignments to match students' abilities) and (2) academic progress monitoring (e.g. use students' data to make decisions about teaching adjustments). Cronbach's alpha for the two subscales was 0.86 (instructional adaptations) and 0.74 (academic progress monitoring), which, at greater than 0.70, was satisfactory (Nunnally and Bernstein 1994).

CFA and convergent validity

As recommended by Marsh et al. (2009), we performed first-order CFAs using Mplus 6.1 (Muthe´n and Muthe´n 2006) to further assess the adequacy of the factor structure and to confirm the bi-dimensionality of the DIS. We conducted two separate CFAs: (1) using uni-dimensional modelling (i.e. all DIS items loading on a single factor) and (2) testing the hypothesised model (a correlated two-factor structure as provided by EFA).

The first model comprised 12 observed variables loading on a single factor. CFA results indicated weak fit indices: x2(54) 1⁄4 166.82, x2/df 1⁄4 3.09, RMSEA 1⁄4 0.13 (confidence interval 1⁄4 0.11, 0.15), CFI 1⁄4 0.89, TLI 1⁄4 0.86, and WRMR 1⁄4 1.00. Alternatively, the hypothesised correlated two-factor structure yielded better fit indices: x2(53) 1⁄4 107.50, x2/df 1⁄4 2.03, RMSEA 1⁄4 0.09 (confidence interval 1⁄4 0.07, 0.12), CFI 1⁄4 0.95, TLI 1⁄4 0.93, and WRMR 1⁄4 0.78. Based on these results, we concluded that the correlated two-factor structure provided a better fit to the data. Factor loadings for this model are presented in Table 3.

A final CFA was performed, incorporating correlations between subscales of the DIS, teachers' autonomy support, and perceptions of school climate. Results indicated acceptable fit indices: x2(953) 1⁄4 1136.43, x2/df 1⁄4 1.19, RMSEA 1⁄4 0.04 (confidence interval 1⁄4 0.03, 0.05), CFI 1⁄4 0.93, TLI 1⁄4 0.92, and WRMR 1⁄4 0.97. Correlations (using categorical variable estimators) are presented in Table 4. We noted that the two factors underlying the DIS were positively correlated (r 1⁄4 0.69), indicating that instructional adaptations and academic progress monitoring were distinct but complementary dimensions of differentiated instruction. Moreover, the two subscales were positively associated with promoting choice-making (r 1⁄4 0.34, p, 0.01; r 1⁄4 0.28, p, 0.01), providing students with meaningful rationales in the classroom (r 1⁄4 0.32, p, 0.01; r 1⁄4 0.51, p, 0.01), and providing structure (r 1⁄4 0.25, p, 0.01; r 1⁄4 0.41, p, 0.01). In contrast, the differentiated instruction components were not associated with the use of controlling language. Moreover, instructional adaptations and academic progress monitoring were positively associated with teacher collaboration (r 1⁄4 0.27, p, 0.01; r 1⁄4 0.38, p, 0.01), principal's leadership (r 1⁄4 0.23, p, 0.01; r 1⁄4 0.26, p, 0.01), and sufficient support services in the school (r 1⁄4 0.20, p, 0.05; r 1⁄4 0.24, p, 0.01).

Teachers' use of differentiated instruction strategies

In order to investigate teachers' use of differentiated instruction strategies contained in the DIS, we computed the mean ratings for all respondents, as presented in Table 5. Schumm and Vaughn's (1991) procedure was applied to determine the use frequency of differentiated instruction strategies. Items that were 1 standard deviation (0.36) above the total mean for all items (3.35) were considered the most used, and items 1 standard deviation below the total mean for all items were considered the least used. The most frequently reported were: (1) adjust the amount of work required in accordance with students' capabilities and (2) provide weaker students with additional aids or tools (e.g. study guide). The least frequently reported were: (1) vary the complexity of assignments to match students' abilities and (2) adapt the lesson plan format (e.g. present information in a different sequence, give more explanations). Table 5 also shows that only 45% of participants reported frequently using alternative materials to match students' abilities, and only 38% adapted assessments (e.g. alter grading criteria). Taken together, these results are in line with previous studies showing that teachers tend to use instructional adaptations that do not require much preparation or tailored instruction (Graham et al. 2003, 2008; McLeskey and Waldron 2011; Scott, Vitale, and Masten 1998). However, about 60% of participants reported using students' data to make decisions about teaching adjustments and to assess the effectiveness after implementation.

Discussion

The main purpose of the present study was to develop and validate the DIS, which assesses the use of instructional adaptations and academic progress monitoring in French and Math classes. The DIS was initially factor analysed. Using EFA, we then refined the instrument and reduced the total number of items. The CFA results supported the hypothesised two-factor structure of differentiated instruction, which yielded better fit indices than the uni-dimensional model. These results suggest that instructional adaptations and academic progress monitoring are two distinct, but complementary dimensions of differentiated instruction.

The CFA results also provided preliminary evidence of the convergent validity of the DIS. All correlations between the subscales for differentiated instruction, autonomy support, and school climate were significant and positive, as we expected. Results revealed that the use of differentiated instruction was associated with promoting choice-making, providing students with meaningful rationales, and providing structure in the classroom. In fact, differentiated instruction and autonomy support both aimed at providing optimal challenges and learning conditions for all students to help them succeed and feel competent. These results are, therefore, theoretically sound, and they suggest that teachers who differentiate instruction also tend to be autonomy supportive.

Although we expected a negative correlation between the use of controlling language and differentiated instruction, we found no such association. In fact, autonomy support (i.e. providing choices, meaningful rationales, and structure) fosters the satisfaction of students' individual learning needs (Ryan and Deci 2000), whereas the use of controlling language involves reward contingencies and social comparison, which are believed to hamper feelings of competence and achievement. Therefore, we hypothesised that controlling teachers would

use less differentiated instruction. In this study, instructional adaptations and academic progress monitoring were not associated with this type of control. However, it is possible that some teachers use both controlling strategies and differentiated instruction. In that case, the use of instructional adaptations could be less effective. Alternatively, a great deal of differentiated instruction combined with a little control could produce better academic outcomes. This interpretation of the present findings is speculative, and further work is needed to explore this issue.

Additionally, use of instructional adaptations and academic progress monitoring were positively related to teacher collaboration, principal's leadership, and support services in the school. These results suggest that teachers are more likely to use differentiated instruction when school climate and resources are adequate, which is consistent with past studies (Avramidis and Norwich 2002; Soodak, Podell, and Lehman 1998). For example, Soodak, Podell and Lehman (1998) showed that teamwork and collaboration are associated with teachers' sense of efficacy about handling various learning needs in regular classrooms, which facilitates the use of differentiation strategies. Other studies have discussed the benefits of teacher collaboration in inclusive school settings (Kinsella and Senior 2008; Villa et al. 1996). It is also acknowledged that principals play an important role in providing teachers with sufficient support and encouragement (Riehl 2000). Finally, opportunities for in-service training and the availability of material resources have been recognised as facilitators for creating inclusive environments and using effective instructional practices (Avramidis and Norwich 2002). In sum, the adequacy of the school climate is an important aspect enabling differentiated instruction in regular classrooms.

This study also investigated teachers' use of specific differentiated instruction strategies included in the DIS. Teachers reported more frequent use of strategies that required less preparation or tailored instruction, which is consistent with previous studies (Graham et al. 2003, 2008; Johnson and Pugach 1990; Schumm and Vaughn 1991). For example, teachers would rather adjust the amount of work and provide additional aids or tools than vary materials and assignments to match students' abilities. Based on the present findings, one possible explanation is that elementary school teachers lack the time, training, and resources to plan for differentiated instruction or to use effective strategies. Therefore, better preparation and adequate support should be provided to teachers to facilitate differentiation in regular classrooms. We also noted that many teachers reported using students' data to make decisions about teaching adjustments and to assess their effectiveness after implementation. In this regard, recent studies have suggested that technology is needed to collect, manage, and analyse students' data effectively (Macintyre and Ireson 2002; Wayman 2005; Ysseldyke and McLeod 2007). Over the past 10 years, an increasing number of progress monitoring systems have been developed. For example, Accelerated Math enables teachers to create assignments that match students' current abilities, compute scores automatically, produce daily reports that can be used as feedback, and differentiate instruction according to individual learning needs. The use of Accelerated Math has been associated with improved academic gains for students of all abilities (Pivik, Mccomas, and Laflamme 2002; Spicuzza et al. 2001, 2003; Ysseldyke et al. 2003; Ysseldyke and Tardrew 2002). Further studies should investigate the actual use of such tools in regular classrooms.

From a theoretical perspective, although additional research would be required to further extend and validate the DIS, the present study provides an empirically based conceptualisation of differentiated instruction as well as initial support for its multidimensionality. Moreover, the DIS was designed to assess strategies that are intended to students of all abilities in the regular classroom, which represents an important contribution. Another implication is that the DIS could be used in future research to investigate students' outcomes associated with differentiated instruction strategies in general education settings. To our knowledge, very few studies have investigated these issues. Given that academic progress monitoring appears to be a requirement for effective and appropriate adaptations, further research could also explore the interaction between these two dimensions of differentiated instruction in order to assess students' outcomes. For instance, it is possible that the effect of instructional adaptations on children's achievement depends on a systematic use of progress monitoring. In practical terms, the DIS could provide useful information to guide teachers in addressing their students' learning needs and in selecting the most promising approaches for particular children or groups of children.

The present study had some limitations. First, teachers might have self-reported their practices in a favourable way. Second, the results from the initial DIS scores have not yet been replicated in different samples. Third, convergent validity was only partially established using the autonomy support and school climate subscales. Therefore, students' outcomes should also be investigated (e.g. academic achievement using standardised measures, self-concept, and motivation). Additional research is needed to support the factor structure and the construct validity of the DIS. Moreover, future investigations should use larger samples and longitudinal designs.

Conclusion

In conclusion, the present study allowed us to develop and validate the DIS to assess instructional adaptations and academic progress monitoring in regular classrooms. The DIS could be used to investigate various research questions concerning inclusive education. For instance, although differentiated instruction is assumed to foster students' academic achievement, this has yet to be confirmed. Moreover, studies have suggested that some children, especially those with learning difficulties, could experience social comparison and lower self-concept in inclusive classrooms (Marsh 2005; Zeleke 2004). It would, therefore, be useful to verify whether the use of differentiated instruction can attenuate or eliminate the potentially negative effects of social comparison. Finally, although differentiated instruction may be associated with positive outcomes in students of all abilities, it is possible that instructional adaptations and academic progress monitoring would have different effects, depending on students' characteristics (e.g. gender, age, ability, and difficulties). The DIS could allow a better understanding of the varied effects of differentiated instruction on students' outcomes.

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Table 1. Preliminary version of the DIS.

Differentiated instruction strategy
Instructional adaptations
1. ~~Set common goals for all students to achieve.~~
2. ~~Afford advanced learners additional course content.~~
3. Modify goals and expectations for students with difficulties.
4. ~~Adjust course content at varied levels of readiness.~~
5. ~~Provide all students with optimal challenges suited to their capabilities.~~
6. ~~Develop benchmarks for success based on individual student achievement.~~
7. Use alternative materials to match students' abilities (e.g. books below and beyond grade level).
8. Plan different assignments to match students' abilities.
9. Vary the complexity of assignments to match students' abilities (e.g. make judgments about a text or summarise, recognise the main themes).
10. Adjust the amount of work required in accordance with students' capabilities.
11. Adapt evaluations to match students' abilities (e.g. adjust grading).
12. ~~Use diverse teaching strategies to match varied ability levels (e.g. concrete demonstrations).~~
13. ~~Use within-class ability-grouping to facilitate tailored instruction.~~
14. ~~Provide after-class individualised instruction for weaker students.~~
15. ~~Use peer tutoring to assist slow learners.~~
16. Provide weaker students with additional aids or tools (e.g. study guide).
17. Adapt the lesson plan format (e.g. present information in a different sequence, give more explanations).
18. ~~Accelerate the pace of instruction with more advanced learners.~~
19. ~~Provide extra time on evaluations for students with difficulties.~~
Academic progress monitoring
20. ~~Keep records about students' achievement and rate of improvement.~~
21. Analyse data about students' academic progress.
22. ~~Use technology tools to monitor students' academic progress (e.g. software tool).~~
23. Assess low achievers' rate of improvement frequently.
24. Use students' data to make decisions about teaching adjustments.
25. Evaluate the effectiveness of teaching adjustments (e.g. monitor subsequent achievement and progress).

Table 2. Factor loadings, eigenvalues, and explained variance for items of the DIS.

Item	Factor	
	IA	APM
Instructional adaptations (IA)		
1. Use alternative materials to match students' abilities (e.g. books below and beyond grade level)	0.79	−0.10
2. Plan different assignments to match students' abilities	0.73	−0.08
3. Vary the complexity of assignments to match students' abilities (e.g. make judgments about a text or summarise, recognise the main themes)	0.70	−0.05
4. Adapt the lesson plan format (e.g. present information in a different sequence, give more explanations)	0.64	0.02
5. Adapt evaluations to match students' abilities (e.g. adjust grading)	0.62	0.17
6. Adjust the amount of work required in accordance with students' capabilities	0.48	0.08
7. Modify goals and expectations for students with difficulties	0.47	0.33
8. Provide weaker students with additional aids or tools (e.g. study guide)	0.39	0.19
Academic progress monitoring (APM)		
9. Evaluate the effectiveness of teaching adjustments (e.g. monitor subsequent achievement and progress)	0.06	0.69
10. Use students' data to make decisions about teaching adjustments	−0.10	0.68
11. Assess low achievers' rate of improvement frequently	0.04	0.59
12. Analyse data about students' academic progress	0.19	0.50
Eigenvalues	4.86	1.42
Explained variance	40.51	11.80

Table 3. CFA loadings for the correlated two-factor model.

Item	IA		APM	
	Estimate	SE	Estimate	SE
Instructional adaptations (IA)				
1. Adapt evaluations to match students' abilities (e.g. adjust grading)	0.77	0.04		
2. Use alternative materials to match students' abilities (e.g. books below and beyond grade level)	0.74	0.05		
3. Modify goals and expectations for students with difficulties	0.74	0.05		
4. Plan different assignments to match students' abilities	0.73	0.05		
5. Vary the complexity of assignments to match students' abilities (e.g. make judgments about a text or summarise, recognise the main themes)	0.71	0.05		
6. Adapt the lesson plan format (e.g. present information in a different sequence, give more explanations)	0.69	0.06		
7. Adjust the amount of work required in accordance with students' capabilities	0.64	0.06		
8. Provide weaker students with additional aids or tools (e.g. study guide)	0.57	0.06		
Academic progress monitoring (APM)				
9. Evaluate the effectiveness of teaching adjustments (e.g. monitor subsequent achievement and progress)			0.79	0.05
10. Analyse data about students' academic progress			0.74	0.06
11. Assess low achievers' rate of improvement frequently			0.64	0.06
12. Use students' data to make decisions about teaching adjustments			0.57	0.08

Table 4. Correlations among DIS, autonomy support and school climate subscales.

	IA	APM
Differentiated instruction		
Instructional adaptations (IA)	–	
Academic progress monitoring (APM)	0.69**	–
Autonomy support		
Promoting choice-making	0.34**	0.28**
Providing meaningful rationales	0.32**	0.51**
Using controlling language	0.00	−0.01
Providing structure	0.25**	0.41**
School climate		
Teacher collaboration	0.27**	0.38**
Principal's leadership	0.23**	0.26**
Support services	0.20*	0.24**
Mean (M)	3.29	3.45
Standard deviation (SD)	0.80	0.85
Skewness	−0.11	−0.43
Kurtosis	−0.24	−0.16
Cronbach's alpha	0.86	0.74

*$p < 0.05$.
**$p < 0.01$.

Table 5. Ranking and ratings of use of differentiated instruction strategies.

Strategies	Mean	Frequency (%)				
		1	2	3	4	5
1. Adjust the amount of work required in accordance with students' capabilities	3.82	2	6	26	39	26
2. Provide weaker students with additional aids or tools (e.g. study guide)	3.72	2	10	24	42	21
3. Evaluate the effectiveness of teaching adjustments (e.g. monitor subsequent achievement and progress)	3.64	4	13	22	38	23
4. Use students' data to make decisions about teaching adjustments	3.61	8	9	23	32	26
5. Analyse data about students' academic progress	3.58	1	16	32	26	25
6. Modify goals and expectations for students with difficulties	3.49	4	18	25	33	21
7. Use alternative materials to match students' abilities (e.g. books below and beyond grade level)	3.30	10	16	29	23	22
8. Plan different assignments to match students' abilities	3.27	3	25	30	23	18
9. Adapt evaluations to match students' abilities (e.g. adjust grading)	3.12	11	22	28	19	18
10. Assess low achievers' rate of improvement frequently	3.02	10	23	31	25	10
11. Vary the complexity of assignments to match students' abilities (e.g. make judgments about a text or summarise, recognise the main themes)	2.97	12	23	30	26	9
12. Adapt the lesson plan format (e.g. present information in a different sequence, give more explanations)	2.63	18	28	33	14	7

Note: 1 ¼ never, 5 ¼ very frequently.