Mathematics instruction in US psychiatric schools for secondary students with emotional/behavioural disorders or learning disabilities

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Students served in alternative and segregated settings tend to receive educational services that are not on par with their public school peers. To develop a better understanding of the problem, the authors conducted a national study of secondary psychiatric schools in the United States. Specifically, the authors administered a survey to mathematics teachers in psychiatric schools to investigate (a) student and classroom level characteristics, and (b) special education mathematics teachers’ reported use of research-supported instructional practices with students classified with a learning disability (LD) or emotional/behavioural disorder (ED). The majority of the participating teachers stated that most of their students performed below grade level in mathematics. Teachers also reported frequently using a number of research-supported practices, including components of explicit instruction, strategy instruction, real-world problem solving, and instructional adaptations. However, the respondents also indicated that they seldom or never used a number of other research-supported practices. The authors provide implications for practice and future research based on the findings.

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Introduction

Psychiatric schools are therapeutic settings that serve students with serious mental disorders and behavioural difficulties and provide mental health and educational services. Youth may attend the school and return home at the end of the school day (i.e., day treatment) or reside at the school (Gagnon et al., 2010). In the US there are 878 facilities with some combination of day treatment and/or residential services for adolescents. Although information is limited, estimates indicate that about 62 per cent of psychiatric programmes for younger youth solely offer day treatment (Gagnon and Leone, 2005). Typically, students who attend psychiatric schools have been identified with a mental disorder and experience difficulties at home, with peers, and at school (CDC, 2013). Furthermore, many of these children have a school-identified learning disability (LD) or emotional disturbance (ED) that significantly affects their learning. These youth typically exhibit disaffection with school. In fact, 57 per cent of youth with ED and 29 per cent of youth with LD exit school without a regular diploma (US Department of Education, 2012).

In many ways, secondary students in psychiatric schools within the US are at a disadvantage in their efforts to access the general education curriculum (Gagnon, 2010; Wilkerson et al., 2012). The US is home to a number of public and private psychiatric schools, both subject to state regulation. However, practices employed by the schools vary widely (Ireys et al., 2006). These schools are essentially out of the public eye, and operate outside of the purview of local school districts, state education agencies, and accreditation bodies (see Gagnon and McLaughlin, 2004; Gagnon et al., 2010). For example, in a national study of principals of secondary psychiatric schools in the US, participants reported a number of concerns, including a lack of alignment of mathematics curriculum, instructional materials, and professional development with state assessments (Gagnon et al., 2010).

Given the intensive needs of youth in psychiatric schools and the lack of external oversight, concerns exist with the level of actual instruction. Studies have revealed a dearth of research-based reading instruction within this setting (Wilkerson et al., 2012), and researchers have yet to investigate mathematics teacher instructional practices in these environments. Additionally, the reported lack of support for teacher professional development may result in special education mathematics teachers’ reliance on instructional methods that are not research-based. Furthermore, in other exclusionary settings, there are problems with teachers who teach subjects outside of their certification area or have teaching loads that cover multiple content areas, grade levels, and instructional levels (Mulcahy and Leone, 2012). Researchers have yet to demonstrate whether these issues also exist in psychiatric schools. If so, these
factors may contribute to an instructional situation that is less than desirable and antithetical to the notion of equal access and the spirit of No Child Left Behind (2002) and the Individuals with Disabilities Education Act (IDEA, 2004).

NCLB (2002) emphasized access to the general education curriculum by requiring content and performance standards for all students across content areas, including mathematics (Karger, n.d.). NCLB’s focus on providing access to all students converged with the expectations set forth for students with disabilities in IDEA (2006) regulations. According to IDEA, teachers of youth with disabilities must rely on the same rigorous standards and curriculum set forth in NCLB. These policies rest on the fundamental assumption that providing all students with research-based instruction, and access to the general education curriculum, is necessary to prepare students for post-school integration into institutions of higher education, the workforce, and the community (National Center on Secondary Education and Transition, 2004).

When secondary students with disabilities have access to grade level curriculum, and subsequently pass state assessments and earn a high school diploma, their post-school outcomes are favourable. In fact, these students are less likely than are their peers who do not earn a diploma to become unemployed or underemployed or to live below the poverty level (Newman et al., 2011). Mathematics is one content area that is particularly critical for school and post-school success. All states in the US require students to pass mathematics assessments for graduation, and secondary course requirements for students in the area of mathematics continue to become more demanding, with increases in the number of required mathematics courses (Reys et al., 2007). In order to prepare students in psychiatric schools for post-school success, teachers in these settings must have access to research-based practices, and the ability to implement them effectively.

Mathematics instruction for youth with disabilities at the secondary level in all settings is woefully understudied in the United States. Over an 11-year period, researchers conducted only 23 inquiries into mathematics instruction for secondary youth with LD (i.e., 1995–2006; see Maccini, Mulcahy, and Wilson, 2007), and completed only three studies involving students with ED during the same period (Mulcahy and Krezmien, 2013). Over the last forty years, researchers conducted only four studies on mathematics instruction with students in psychiatric schools (Mulcahy and Krezmien, 2013). Considering the level of academic and emotional needs among youth in psychiatric settings, high quality education is essential. Despite the lack of research specific to mathematics instruction in secondary psychiatric schools, research-based instructional practices are available for mathematics
teachers of youth classified as LD or ED (Maccini et al., 2007). While researchers have not investigated these practices in psychiatric settings, they have examined students with LD across grade levels and settings, and have demonstrated a degree of efficacy. Few studies exclusively address mathematics instructional practices for students with ED, because interventions for this population traditionally have focused on improving behaviour as a means to improve academic performance (Mulcahy and Krezmien, 2013). However, some of the existing research for students with LD has included students with ED and other disabilities (e.g., ADHD) in the samples. Using practices found to be efficacious in research that included students with ED in the sample (even if data were not collected on participants with ED as a subgroup), may be a first step to identifying potentially effective practices for this population. For example, Bottge and colleagues conducted a series of studies on the effects of anchored instruction in mathematics primarily with secondary students with LD, but also included at-risk students and those with ED. While this approach is not ideal, it can serve as a launching point for conducting research with this population, as well as for improving practice in exclusionary settings, such as psychiatric schools, that serve similar populations of students.

To provide a backdrop for the current study, we briefly define and summarize the empirical research available that includes six categories of research-based practices for teaching mathematics to secondary students with LD or ED: (a) explicit instruction; (b) strategy instruction; (c) real-world activities, and technology; (d) graduated instructional sequence; (e) grouping for instruction; and (f) instructional adaptations. These categories of instructional practices were derived from comprehensive reviews of the literature on best practices for teaching mathematics to secondary students with LD or ED (Maccini and Gagnon, 2005; Maccini et al., 2007). It is also important to consider the frequency with which teachers utilize each instructional approach with students. Adequate exposure to research-based instructional approaches is necessary to ensure maximum benefit to students (Gersten et al., 2009; Maccini et al., 2008).

Explicit instruction represents a set of practices for teachers to present in a defined, systematic format (Hall, 2009). The practices include: (a) reviewing prerequisite skills; (b) teacher modelling of the skill; (c) guided practice; (d) independent practice; and (e) ongoing correction and feedback (Rosenshine and Stevens, 1986). Explicit instruction also involves cumulative reviews and scaffolded instruction, or the gradual release of responsibility from the teacher to the student. Finally, in explicit instruction students should reach a level of mastery before advancing to the next skill or topic (Rosenshine and Stevens, 1986). Researchers
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consistently report the efficacy of explicit instruction for instructing youth with high incidence disabilities (i.e., LD, ED) in secondary mathematics (Hudson and Miller, 2006; Maccini and Hughes, 1997; Ozaki et al., 1996; Scarlato and Burr, 2002). Further, as recommended by the What Works Clearinghouse IES Practice Guide, mathematics instruction should include explicit instruction for students who have difficulty in mathematics on a regular basis to support their ‘foundational skills and conceptual knowledge necessary for understanding their grade-level mathematics’ (Gersten et al., 2009: 21). A review of literature revealed that researchers have recommended daily or weekly use of explicit instruction for students with LD and ED across settings (Maccini et al., 2008).

Additional research-based instructional practices fall under the categories of strategy instruction and the graduated instructional sequence. Strategy instruction is ‘a plan that not only specifies the sequence of needed actions but also consists of critical guidelines and rules related to making effective decisions during a problem solving process’ (Ellis and Lenz, 1996: 24). Practices within strategy instruction include: (a) memory strategies; (b) strategy steps for problem solving; (c) explicit teaching of problem representation and solution; and (d) self-monitoring instruction. Strategy instruction is an effective approach to assisting middle and high school students with disabilities (Jitendra et al., 2002; Jitendra et al., 1999; Manalo et al., 2000; Test and Ellis, 2005; Xin et al., 2005) that teachers should use on a regular basis to help students with LD and ED improve their problem-solving performance and recall (Maccini et al., 2008).

The graduated instructional sequence first requires that students solve problems using concrete manipulatives, then helps them progress to the representational phase in which they rely on pictures and drawings. In the final abstract phase, students use numbers and symbols to represent and solve mathematical problems (Maccini et al., 2008). Several researchers have validated the graduated instructional sequence with secondary students with high incidence disabilities (Cass et al., 2003; Maccini and Ruhl, 2000; Strickland and Maccini, 2012). Experts have recommended that mathematics instruction include the extensive and consistent use of visual representations with direct connections to abstract representations (Gersten et al., 2009: 31). Additionally, researchers have recommended the use of the graduated instructional sequence on a daily or weekly basis to help students with LD and ED with their conceptual understanding of mathematics (Maccini et al., 2008). Additional categories of research-based approaches include real-world activities and technology. Real-world activities are an effective approach that embeds problem-solving information within real life contexts to which students can relate.
The use of technology in mathematics instruction continues to evolve as technology advances and becomes more user-friendly and affordable. Haydon et al. (2012) compared the use of iPads to paper/pencil mathematics in the independent practice of money skills, order of operations, and fractions, among secondary students with ED, and found that the iPads were more effective in engaging students for the entire independent practice period.

Although real-world activities and technology involve distinct instructional practices, researchers have often combined the two approaches. For example, Bottge and colleagues combined the real-world activities and technology approaches in a number of studies involving students with LD and students with ED, with promising results (Bottge, 1999; Bottge et al., 2001; Bottge et al., 2002; Bottge, Rueda, LaRoque, Serlin, and Kwon, 2007; Bottge, Rueda, Serlin, Hung, and Kwon, 2007). Given the complementary nature of real-world activities and technology, and the work of Bottge and colleagues, the current study presents a combination of these two categories. Researchers have recommended daily or weekly use of embedding real-world activities and technology into instruction for students with LD and ED across settings (Maccini et al., 2008).

Finally, researchers have identified the categories of grouping for instruction and instructional adaptations as effective approaches and have recommended that teachers use these on a daily or weekly basis with students with LD or ED (Maccini et al., 2008). Grouping for instruction primarily refers to peer-mediated instruction, including use of peer tutoring (for example, class-wide peer tutoring, see Allsopp, 1997; peer-assisted learning strategies, see Calhoon and Fuchs, 2003). Studies have shown that peer-mediated instruction has a positive effect on student mathematics performance for students with LD and mathematics difficulties (Bowman-Perott et al., 2007; Kunsch et al., 2007). Peer-mediated instruction has also resulted in positive effects on the behaviour of secondary youth with ED (Spencer et al., 2003; Sutherland and Snyder, 2007). To date, only two studies assessed the efficacy of peer-mediated instruction on these students’ mathematics performance (Franca et al., 1990; Salend and Washin, 1988). Franca et al. found positive effects for accuracy of mathematics computation and attitudes toward mathematics, while Salend and Washin found positive effects for behaviour, but mixed results for mathematics performance.

Instructional adaptations include approaches to support: (a) concept development; (b) retention and recall; and (c) monitoring progress. Some examples of concept development include separating confusing concepts/terms when
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introducing mathematics concepts for clarity, teaching students to discriminate between similar strategies or concepts, and introducing skills/concepts via examples and non-examples. Incorporating structured worksheets/prompt cards to help students remember multiple steps is one example of an adaptation for retention and recall. Finally, graphing student progress to make instructional decisions or to show progress is one way to monitor progress. These adaptations can be useful in efforts to support secondary students with difficulties in a variety of mathematics domains (Maccini and Gagnon, 2000; Maccini et al., 2008).

Purpose

Despite the critical need for high quality education in psychiatric schools (Gagnon et al., 2010), no information exists on teacher instructional approaches in mathematics for youth with LD or ED within this setting. This study serves to address this gap in the research literature. Based on a survey of a national random sample of special education mathematics teachers in psychiatric schools, the current study provides data on teacher accounts of student and classroom characteristics, as well as the instructional practices used by the teacher, the frequency with which the teacher used the practice, and the primary reason teachers did not use certain strategies. We sought to address the following research questions:

1. What are the student and classroom characteristics of secondary students with LD or ED in mathematics classrooms within psychiatric schools?
2. What instructional practices do special education mathematics teachers report using with secondary students with LD or ED, how frequently do they use the practice, and what is the primary reason they do not use certain practices?

Methods

Sample and participant selection

The researchers used the following procedures to determine a nationally representative sample of psychiatric schools for inclusion in the present study. First, the Market Data Retrieval database proved a useful tool for locating schools for possible inclusion in the study. To be eligible for inclusion, schools needed to: (a) be part of a psychiatric facility; (b) offer services beyond that of a hospital programme; and (c) provide educational services to youth in any grade between 7 and 12. Once the researchers had identified eligible schools, graduate assistants called each institution to verify the contact information and confirm that each school met criteria for inclusion. Although the research team identified 1,154 schools using
the initial criteria, responses from school representatives led to the deletion of 276 schools from the database, and only 878 schools met the operational definition and proved appropriate for the research sample. Based on resource constraints, the researchers randomly selected 400 schools from the initial search and included them in the sample.

The survey used in the present inquiry was one of three tools sent to mathematics special education teachers, reading special education teachers, and principals at each school. Mailings to each school’s principal consisted of a cover letter, the three separate surveys, and three return envelopes. Each principal received a cover letter indicating the purpose of the study and directions for completing the survey. The letter requested that the principals give the other two surveys to the appropriate teacher. If more than one teacher qualified, the letter instructed the principal to provide the survey to the first teacher in an alphabetized list. As an incentive, researchers enclosed a $2 bill in the first mailing for each participant. The team sent four subsequent survey mailings to non-responding schools. Data collection for the entire research project concluded in 2005.

Respondents and non-respondents

Although the research team mailed 400 surveys to schools around the nation, the final sample consisted of 348 schools. In the remaining 52 cases, principals identified on the survey that the school did not meet criteria for participation. Despite the monetary incentive and follow-up mailings to schools, a total of 33 per cent (n = 115) of teachers responded, representing 2,696 students with ED or LD. This response rate is lower than the 50 per cent response rate suggested in the literature (Weisberg et al., 1989). However, the information obtained allowed researchers to draw comparisons between respondents and non-respondents. Based on Chi-square analyses conducted on several categories (i.e. type of school, census region, locale, and enrolment), respondent versus non-respondent comparisons were statistically insignificant.

Instrumentation

The researchers developed the survey questions from a review of special education policy (e.g., NCLB, IDEA), a thorough examination of the existing literature through 2003 on research-based practices for teaching mathematics to secondary students with LD and ED, feedback from members of an advisory board of researchers, and a focus group of principals. The national mathematics survey included the following sections: (a) teacher, student, and school characteristics; (b) mathematics curriculum; (c) state assessments; and (d) instructional practices. The current report
focuses on special education mathematics teacher responses to questions about student and classroom characteristics and use of instructional practices. Questions related to student characteristics included disability categories, ethnicity, gender, and overall mathematics performance. Questions about classroom characteristics included inquiries about the number of students enrolled in mathematics classes and the amount of time (in minutes) spent on mathematics instruction for students with LD or ED. The researchers organized the instructional practices into the following six categories (Maccini and Gagnon, 2005; Maccini et al., 2007): (a) explicit instruction; (b) graduated instructional sequence; (c) strategy instruction; (d) grouping for instruction; (e) technology and real-world problem solving; and (f) instructional adaptations.

Research supports implementation of these practices on a regular basis, either daily or weekly, to support learning, retention, and/or generalization of mathematics skills (Maccini et al., 2008). Therefore, the present study included questions related to the frequency with which teachers used each of the instructional practices, as well as queries related to the reasons respondents did not use certain practices.

**Reliability of data entry**

To address reliability of data entry, consistency with coding, and replication, the researchers developed a codebook of all survey procedures and related decisions that two graduate assistants closely maintained (Fink, 1995; Yin, 1994). The research team analysed all survey data using SPSS statistical software package and conducted reliability checks on 30 per cent (n = 34) of the data entered to ensure accuracy (99 per cent accuracy).

**Teacher characteristics**

Close to two-thirds of the teacher respondents were female. Further, the majority of the study participants reported holding graduate degrees, had certifications to teach general or cross-categorical special education, and taught in self-contained classrooms. Most of the respondents also reported having four or more years of experience as a special education or mathematics teacher. The majority of the teachers also indicated that they had taught at their current position for at least four years, and had an average of approximately ten years of experience across teaching positions and locations. Further, most of the respondents reported teaching middle school mathematics, pre-algebra, and general mathematics/basic skills to students with LD or ED.
Data analysis
Data analysis included descriptive statistics to determine teacher accounts of the following: (a) student and classroom characteristics; and (b) the instructional practices they used, the frequency with which they used each practice (see Table 1), and the primary reason they did not use certain practices (see Table 2). Variation exists within the frequency of responses per survey item, as some teachers did not answer every question. Further, the results do not include a report of the cumulative percentages for the questions that asked respondents to *Check all that apply*.

Results
The following section presents the study results by research question. The section begins with the results from questions pertaining to student and classroom characteristics, and follows with data related to the teachers’ use of research-based instructional practices and the reported frequency with which they used those practices.

Student and classroom characteristics
To address the first research question related to student and classroom characteristics, this section presents frequencies and percentages for each question in this category. Specifically, teachers noted that over two-thirds of students on their caseload were male \((n = 1,850; 69\text{ per cent})\), and close to one-third were female \((n = 846; 31\text{ per cent})\). In terms of disability classification, teachers reported that the majority of the students on their caseload received services for ED \((n = 1,686; 63\text{ per cent})\) or LD \((n = 522; 19\text{ per cent})\). Further, teachers noted that the ethnic groups of students on their caseload were primarily Caucasian \((n = 1,346; 50\text{ per cent})\) and African American \((n = 625; 23\text{ per cent})\), followed by Hispanic \((n = 267; 10\text{ per cent})\). On average, teachers noted having approximately 11 students \((SD = 15.19; \text{range 1–125 students})\) in their mathematics classes, and stated that class duration was approximately 48 instructional minutes per day \((SD = 11.24; \text{range = 20–90 minutes})\). Respondents further reported that less than one-third of the students with ED or LD on their caseload functioned at or above grade level in mathematics \((M = 27.23; SD = 26.64)\).

Frequency and use of instructional practices
Teachers reported on the frequency with which they used recommended instructional practices that help students with disabilities in mathematics (see Table 1). For practices reported as *not used*, teachers also reported the reasons why they did not employ certain practices (see Table 2). As noted in Table 1, each
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instructional practice reflects one of the six main categories: explicit instruction; graduated instructional sequence; strategy instruction; grouping for instruction; technology and real-world problem solving; and other instructional adaptations. Across the six main categories, four of the five most frequently reported practices were associated with explicit instruction. Specifically, teachers reported using on a daily basis: (a) teacher modelling of a concept, skill, and/or strategy (75 per cent; n = 86); (b) guided practice (62 per cent; n = 70); (c) independent practice (74 per cent; n = 84); and (d) feedback and reinforcement to students (87 per cent, n = 99). Teachers also reported using the instructional adaptation of providing examples and non-examples when introducing a skill/concept (44 per cent; n = 49) on a daily basis.

The five recommended research-based practices teachers most often reported not employing included: (a) using web-based learning environments in mathematics instruction (50 per cent, n = 56); (b) graphing student progress to make instructional decisions or to show progress (49 per cent, n = 55); (c) encouraging the practice of basic mathematics skills/algorithms via computer-assisted instruction (37 per cent, n = 42); (d) giving an orientation or advance organizer for a new lesson (23 per cent, n = 26); and (e) providing opportunities for peer tutoring sessions (14 per cent, n = 16). The most commonly reported reasons for not using technology-based practices were a lack of resources and training. Specifically, 80 per cent (n = 45) of the subset of teachers reported never including web-based practices in mathematics instruction; and 88 per cent (n = 37) of respondents reported never using computer-assisted instruction when practising basic mathematics skills/algorithms, due to the lack of training and lack of resources. Of the subset of teachers who reported that they never provided opportunities for peer tutoring sessions, 56 per cent (n = 9) reported that the practice did not meet their students’ needs. Further, of the subset of teachers who reported never providing an orientation or advance for a new lesson, 26 per cent (n = 7) also noted the practice did not meet their students’ needs. The main reason teachers reported not using graphing techniques to monitor student progress was other (40 per cent, n = 22) and lack of training (20 per cent; n = 11).
Table 1. Frequency of teacher use of mathematics instructional practices

<table>
<thead>
<tr>
<th>Mathematics instructional practice</th>
<th>M (SD)</th>
<th>Always (daily)</th>
<th>Often (2–4 per week)</th>
<th>Sometimes (1–4 per month)</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Explicit instruction</strong></td>
<td></td>
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<tr>
<td>Give orientation or advance organizer for new lesson</td>
<td>2.71 (0.94)</td>
<td>10.6 (12)</td>
<td>31.0 (35)</td>
<td>35.4 (40)</td>
<td>23.0 (26)</td>
</tr>
<tr>
<td>Provide teacher modelling of a concept, skills, and/or strategy</td>
<td>1.30 (0.55)</td>
<td>74.8 (86)</td>
<td>20.9 (24)</td>
<td>4.3 (5)</td>
<td>0</td>
</tr>
<tr>
<td>Provide guided practice</td>
<td>1.42 (0.56)</td>
<td>61.9 (70)</td>
<td>34.5 (39)</td>
<td>3.5 (4)</td>
<td>0</td>
</tr>
<tr>
<td>Scaffold instruction (i.e., gradually fade teacher assistance)</td>
<td>2.14 (0.81)</td>
<td>21.2 (24)</td>
<td>48.7 (55)</td>
<td>24.8 (28)</td>
<td>5.3 (6)</td>
</tr>
<tr>
<td>Provide independent practice</td>
<td>1.31 (0.57)</td>
<td>74.3 (84)</td>
<td>20.4 (23)</td>
<td>5.3 (6)</td>
<td>0</td>
</tr>
<tr>
<td>Incorporate mastery learning/criterion before having students advance to the next topic/skill</td>
<td>1.80 (0.73)</td>
<td>38.3 (44)</td>
<td>43.5 (50)</td>
<td>18.3 (21)</td>
<td>0</td>
</tr>
<tr>
<td>Provide feedback and reinforcement to students</td>
<td>1.14 (0.37)</td>
<td>86.8 (99)</td>
<td>12.3 (14)</td>
<td>0.9 (1)</td>
<td>0</td>
</tr>
<tr>
<td>Provide cumulative reviews</td>
<td>2.51 (0.84)</td>
<td>16.1 (18)</td>
<td>23.2 (26)</td>
<td>54.5 (61)</td>
<td>6.3 (7)</td>
</tr>
<tr>
<td><strong>Graduated instructional sequence</strong></td>
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<tr>
<td>Use a graduated instructional sequence (i.e., concrete, semiconcrete, abstract) to teach concepts</td>
<td>2.22 (0.96)</td>
<td>27.7 (31)</td>
<td>31.3 (35)</td>
<td>32.1 (36)</td>
<td>8.9 (10)</td>
</tr>
</tbody>
</table>

Note. Responses coded 1 = always, 2 = often, 3 = sometimes, 4 = never. Smaller means indicate more frequent use of the activity.
<table>
<thead>
<tr>
<th>Mathematics Instructional Practice</th>
<th>% (n)</th>
<th>% (n)</th>
<th>% (n)</th>
<th>% (n)</th>
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<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>Always (daily)</td>
<td>Often (2–4 per week)</td>
<td>Sometimes (1–4 per month)</td>
</tr>
<tr>
<td><strong>Strategy instruction</strong></td>
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<tr>
<td>Incorporate memory strategies (e.g., first-letter mnemonics)</td>
<td>2.60 (0.79)</td>
<td>9.7 (11)</td>
<td>29.2 (33)</td>
<td>52.2 (59)</td>
</tr>
<tr>
<td>Incorporate strategy steps into problem solving instruction (e.g., read the problem, represent the problem)</td>
<td>1.71 (0.70)</td>
<td>42.5 (48)</td>
<td>45.1 (51)</td>
<td>11.5 (13)</td>
</tr>
<tr>
<td>Teach both problem representation and problem solution during</td>
<td>2.15 (0.83)</td>
<td>23.2 (26)</td>
<td>42.9 (48)</td>
<td>29.5 (33)</td>
</tr>
<tr>
<td>Teach self-monitoring strategies to help students with problem solving activities</td>
<td>2.14 (0.83)</td>
<td>24.8 (28)</td>
<td>39.8 (45)</td>
<td>31.9 (36)</td>
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<tr>
<td><strong>Grouping for instruction</strong></td>
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<tr>
<td>Provide cooperative learning activities</td>
<td>2.35 (0.91)</td>
<td>19.5 (22)</td>
<td>35.4 (40)</td>
<td>35.4 (40)</td>
</tr>
<tr>
<td>Provide opportunities for peer tutoring sessions</td>
<td>2.63 (0.88)</td>
<td>12.4 (14)</td>
<td>26.5 (30)</td>
<td>46.9 (53)</td>
</tr>
<tr>
<td><strong>Technology and real-world problem solving</strong></td>
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<tr>
<td>Encourage the practice of basic maths skills/ algorithms via computer-assisted instruction</td>
<td>2.88 (1.09)</td>
<td>15.9 (18)</td>
<td>17.7 (20)</td>
<td>29.2 (33)</td>
</tr>
<tr>
<td>Embed maths in real-world tasks</td>
<td>1.99 (0.79)</td>
<td>31.0 (35)</td>
<td>38.9 (44)</td>
<td>30.1 (34)</td>
</tr>
<tr>
<td>Include web-based learning environments into maths instruction</td>
<td>3.34 (0.79)</td>
<td>3.6 (4)</td>
<td>8.9 (10)</td>
<td>37.5 (42)</td>
</tr>
</tbody>
</table>

Note. Responses coded 1 = always, 2 = often, 3 = sometimes, 4 = never. Smaller means indicate more frequent use of the activity.
<table>
<thead>
<tr>
<th>Table 1. Frequency of teacher use of mathematics instructional practices (continued)</th>
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<td>Mathematics instructional practice</td>
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<td>-------------------------------------</td>
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<tr>
<td></td>
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<tr>
<td><strong>Instructional adaptations</strong></td>
</tr>
<tr>
<td>Incorporate prompt cards or structured worksheets to help students remember multiple steps</td>
</tr>
<tr>
<td>Separate confusing concepts/terms when introducing mathematics concepts</td>
</tr>
<tr>
<td>Teach students to discriminate between similar strategies or concepts</td>
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<td>Graph student progress to make instructional decisions or to show progress</td>
</tr>
<tr>
<td>Introduce a skill/concept via examples and non-examples</td>
</tr>
</tbody>
</table>

Note. Responses coded 1 = always, 2 = often, 3 = sometimes, 4 = never. Smaller means indicate more frequent use of the activity.
### Table 2. Reasons teachers provided for never using mathematics instructional practices

<table>
<thead>
<tr>
<th>Mathematics instructional strategy</th>
<th>Percentage never using the strategy (%)</th>
<th>Lack of training</th>
<th>Lack of resources</th>
<th>Does not meet students’ needs</th>
<th>Does not agree with views on teaching</th>
<th>*Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web-based learning</td>
<td>50.0</td>
<td>11</td>
<td>34</td>
<td>6</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Graph student progress</td>
<td>48.7</td>
<td>11</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>22</td>
</tr>
<tr>
<td>Computer-assisted instruction</td>
<td>37.2</td>
<td>6</td>
<td>31</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Advance organizer</td>
<td>23.0</td>
<td>5</td>
<td>2</td>
<td>7</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Peer tutoring</td>
<td>14.2</td>
<td>1</td>
<td>1</td>
<td>9</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

Note: * = Closed-ended response.
Discussion
The current study provides the first examination of US psychiatric schools in terms of student and classroom level characteristics, as well as teachers’ use of mathematics instructional practices for students with LD or ED. The researchers derived the data from a random selection of a national sample of US psychiatric schools and special education mathematics teachers who served students in this setting. Given recent administrator-reported problems with alignment of instructional materials, curriculum, and professional development with state mathematics assessments (Gagnon et al., 2010), this study provides an important initial picture of instructional practices in these settings. Moreover, in light of the statistics showing that students with ED and LD become disaffected and exit school without a regular diploma, it is critical that these youth receive research-based instruction to maximize their learning opportunities and increase the likelihood of their success with mathematics content and process requirements.

It is promising that, overall, about two-thirds or more of the teachers reported frequently using a number of research supported practices, including components of explicit instruction, strategy instruction, real-world problem solving, and instructional adaptations. However, teachers indicated that they seldom or never used a number of other practices (e.g., use of web-based learning environments, graphing student data to make instructional decisions or show progress). Furthermore, the results indicated that teachers used some of the practices in isolation of other essential components. For example, while teachers reported using some components of explicit instruction daily, without using all of the components regularly and systematically, the practice may be less effective (Hall, 2009; Rosenshine and Stevens, 1986). These findings are problematic, given the research that documents the need for effective practices for these troubled students (e.g., Maccini et al., 2006; Mulcahy and Krezmien, 2013; Templeton et al., 2008).

Student and classroom characteristics
Overall, the majority of teachers reported that most of the students on their caseload were male, Caucasian, and received services for ED or LD. Respondents also indicated that less than one-third of the students on their caseload functioned at or above grade level in mathematics. The teachers also reported having a relatively small class size of 11 students on average, with daily class sessions of almost an hour. Given the high percentage of youth with LD and ED, and their common difficulties with mathematics (Maccini et al., 2008), it is not surprising that the majority of teachers reported that students on their caseload performed
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below average. Teachers who serve students in psychiatric settings have to meet students’ various emotional and behavioural needs, while providing the necessary academic supports to help them access a rigorous mathematics curriculum.

**Explicit instruction**

Explicit instruction is an effective practice for teaching students with disabilities (Gersten *et al.*, 2009). Teachers in the current study reported frequent use of some instructional practices that related to explicit instruction. Ideally, however, teachers should implement the explicit instruction approach systematically and systemically, rather than as isolated components. The lack of fidelity in the implementation of explicit instruction is concerning.

Nevertheless, teachers did report using some components of explicit instruction. The most frequently reported instructional strategy was *providing feedback and reinforcement to students*, with the majority of teachers reporting their use as either *often* or *always*. Providing consistent and ongoing feedback is useful in guiding and improving student practices and increasing student performance (Steedly *et al.*, 2008). It is also promising that at least 80 per cent of teachers reported using other explicit instruction practices, including teacher modelling, independent practice, guided practice, and mastery learning, either *daily* or *always*. Teacher modelling is particularly useful when teachers demonstrate the cognitive strategies involved in solving a mathematics problem by ‘thinking aloud’ while solving the problem on the board (Jayanthi *et al.*, 2008). In addition, providing students with guided practice helps to reinforce their understanding of mathematical skills and concepts, while independent practice allows students to apply the strategies they have learned and analyse their own understanding of the content. Moreover, requiring students to meet specific learning criteria before advancing to the next topic or skill promotes student growth and mastery. In the present study, approximately 40 per cent of teachers reported that they *incorporate[d] mastery learning/criteria before having students advance to the next topic/skill* on a daily basis, and reported using this practice two to four times per week. While incorporating mastery learning may be difficult in a classroom where student performance levels and learning needs vary widely, Zimmerman and Dibenedetto (2008) found that the use of a teacher-developed mastery learning programme in an Algebra I course improved student achievement and retention of mathematical skills and concepts.

Almost half of teachers reported either *seldom* or *never* using an advance organizer and cumulative reviews. Use of an advance organizer provides the content focus and rationale for learning the content, and links previously learned...
information to the new content (Hudson and Miller, 2006) to support student motivation, comprehension, and preparedness for learning (Gurganus, 2007). The frequent use of cumulative reviews further supports learners’ maintenance of acquired skills and connections across mathematics topics (Gersten et al., 2009). Without these features, students with LD and/or ED, who typically struggle with retaining information, may not be able to make the critical connections that reinforce prior learning.

**Graduated instructional sequence**
Researchers have suggested that teachers provide a sequence and variety of examples and activities to students, such as concrete-representational-abstract sequence (Gersten et al., 2009; Jayanthi et al., 2008; Witzel et al., 2003). The majority of teachers in this study reported incorporating the graduated instructional sequence into instruction, and over half reported using the strategy either *daily* or *often*. Further, providing students with opportunities to explore mathematical ideas using manipulatives or other visuals aligns with one of the principles of the Universal Design for Learning (UDL), which encourages teachers to provide multiple representations as students learn new skills and concepts (Center for Applied Special Technology, 2011).

**Strategy instruction**
A strategy involves an overall plan for addressing a problem and includes a set of actions or guidelines one must follow to solve a problem (Ellis and Lenz, 1996; Hudson and Miller, 2006). Hudson and Miller described a procedural strategy as one that included an ‘analysis of the steps necessary to solve a problem’ (Hudson and Miller, 2006: 88). Therefore, it is promising that more than 60 per cent of teachers in the present study reported incorporating strategy steps and self-monitoring techniques into problem solving instruction *daily* or *often*. However, more than 60 per cent of teachers reported *seldom* or *never* using memory strategies. This finding is concerning, as use of mnemonics within strategy instruction may help students remember information and assume more responsibility for their learning (Hudson and Miller, 2006).

**Technology and real-world problem solving**
Technology-based supports refer to tools that support the learning of mathematics with evolving uses and applications, including computer software programs, web and video-based instruction, and media (Gurganus, 2007; Maccini et al., 2008). Real-world problem solving involves linking mathematics concepts to problem
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situations encountered in the real world to promote motivation and generalization (Hudson and Miller, 2006). In the current study, at least 70 per cent of teachers reported incorporating contextualized word problems in mathematics instruction. However, more than half of the teachers reported seldom or never using web-based learning experiences and computer-assisted instruction to practise basic mathematics skills/algorithms. Teachers indicated that a lack of resources was the primary reason for not using them. Clearly, teachers in psychiatric schools need additional technology resources for implementing computer-aided instruction in their instructional mathematics programmes (Bouck and Flanagan, 2009).

**Grouping for instruction**

Grouping for instruction refers to a variety of arrangements in which students work together to learn or practise a skill, investigate a problem situation, and/or examine and present data (Gurganus, 2007). Two common configurations include (a) peer-assisted instruction, which refers to student pairs in which one student assists the other with learning or practising mathematics skills, and (b) cooperative learning arrangements in which 2–6 learners work as a team towards meeting a common goal (Gurganus, 2007). In the present study, more than half of the teachers reported using cooperative learning activities; on the other hand, more than half of the teachers reported that they seldom or never use peer tutoring. The most frequent reason reported for not using these approaches was that they [did] not meet their students’ needs. However, given the unique learner characteristics of students with ED and LD, and the research support for the academic and social benefits of peer-mediated instruction, it is important to consider instructional arrangements that include collaborative and peer-based instruction.

**Instructional adaptations**

Instructional adaptations include changes made during instruction or to materials that do not alter the mathematics curriculum standards, but help students access the content (Gurganus, 2007). More than half of the teachers in this study reported using these adoptions daily or often during instruction in their mathematics classes. However, most of the teachers also reported seldom or never using graphs to monitor student progress, and the most frequent reason reported was lack of training. Graphing student performance helps to track student progress towards meeting their learning goals over time and can promote student engagement through self-graphing performance (Gurganus, 2007).
Limitations

There are three notable limitations to the current study: the low response rate, the use of self-reported data, and the delay between data collection and dissemination. In terms of the low response rate of 33 per cent, it remained below an acceptable level of 50 per cent (Weisberg et al., 1989), despite repeated follow-up mailings and reminders. However, the researchers identified no significant differences across responders and non-responders on the noted school-level characteristics. Further, the researchers drew the reported data from teachers’ self-reports of their use of the strategies and the frequency of their use. Triangulation of the data with principals, LEA directors, and SEA directors (as reported in other studies; see Gagnon, 2010; Gagnon et al., 2010) has helped to validate the credibility of the reports. Finally, although there has been a delay in disseminating the results of this study, there has been minimal progress in the way of new research in this area. In fact, to our knowledge, the only published data on education policies and practices in psychiatric settings has come from a single group of researchers. There is no published evidence to suggest that teachers in psychiatric schools are using strategies that are different from those reported here. Furthermore, changes in teacher and school practices often take many years, pressure from external sources like political or legal groups, and financial and human resources. There is not a great likelihood that, across the US, policies and practices in psychiatric schools have drastically changed in the last few years.

Implications for practice and future research

Based on the findings in the current national study of psychiatric schools and instructional approaches in mathematics for youth with LD or ED within this setting, the researchers developed two recommendations for professional development:

- Provide professional development opportunities for teachers on the use of systematic and explicit instruction, as recommended by the What Works Clearinghouse IES Practice Guide (Gersten et al., 2009). The panel recommended professional development opportunities for teachers that included observations of the instruction, practice opportunities like role-playing, and specific feedback to improve practice.

- Provide professional development opportunities for teachers and paraprofessionals to implement graphing student performance for documentation, instructional decision-making, and increased student engagement through self-charting performance (Gurganus, 2007).
Additionally, teachers should consider the following recommendations for instruction:

- Incorporate memory devices that address the characteristics of effective procedural strategies, including a remembering device and cognitive and/or metacognitive tools for monitoring the problem solving process when teaching procedural strategies to improve learner recall, retention, and independence (Hudson and Miller, 2006).
- Include technology-based resources for students, such as computer-aided instruction, to develop students’ skills and concepts. Consider organizations and programmes that offer free or reduced computer equipment to schools.

To validate teacher responses to this survey study, future research should include observational data of teachers’ use of the instructional practices. Although this study reports on the frequency of use, the researchers did not collect data on the fidelity of strategy implementation. It is encouraging that teachers used many research-based instructional practices regularly; the next step should be to investigate the level of fidelity teachers demonstrate when using the practices. Moreover, future research should utilize teacher and student interviews and document reviews to increase understanding of teacher plans for and use of instructional practices. To teach students in psychiatric schools more effectively, research is also necessary on youth academic needs and strengths, including mathematics performance, number and types of mathematics courses taken, behavioural needs and strengths, length of stay in day treatment and/or residential facilities, number of transitions in and out of psychiatric facilities, and presence of mathematics IEP goals. Future research should also examine the reasons teachers reported for not using certain research-based practices under the other choice. Although the survey included the other option, it did not provide an open-ended section for participants to elaborate on their response.

**Conclusion**

All students, including those with disabilities, must have access to an age-appropriate, rigorous mathematics curriculum to help prepare them for post-secondary opportunities, future occupations, and life in their community (Common Core State Standards Initiative, 2010; IDEA, 2006; NCLB, 2001). Further, teachers in all settings must have the knowledge and support to implement research-based practices that will help their learners with disabilities access the general education curriculum. These practices are especially critical for students with LD or ED educated in psychiatric schools, given the severity of academic and behavioural
needs among this population. Youth with these disability classifications commonly are disaffected with school, and enrolment in a psychiatric school puts them at further risk of academic failure. Although teachers reported using a number of research-supported practices in these settings, there is a need for rigorous research, professional development opportunities, and resources to support teachers in their work to provide the best possible education to these troubled youths.

References


