Development and Usability Testing of a Web-Based Teacher Intervention for Students with Learning Disabilities

by

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ABSTRACT

Access to evidence-based interventions for LDs is limited by a number of factors (e.g., teacher knowledge of LDs, access to interventions). The Internet is becoming a popular medium to host interventions and has the potential to increase access to interventions. The current project aimed to develop and test the usability of an online teacher intervention for LDs, which consisted of evidence-based intervention strategies to help teachers learn to effectively assist children with LDs. The usability study asked LD specialists (n=18) to evaluate the usability of the *Teacher Help for LD* intervention and provide their feedback. Results from both the quantitative and qualitative data suggest that participants were very satisfied and found the program highly usable. Positive feedback and content-related feedback were most prominent. These results will help to modify the intervention in the process toward dissemination to classroom teachers.

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CHAPTER 1

The Theoretical Framework for the *Teacher Help for LD* Intervention Program

The goal of the current study was to develop a web-based teacher intervention for students with learning disabilities (LDs). To help understand the theoretical framework for the *Teacher Help for LD* intervention program and how it was developed, it is important to first describe some of the historical controversies surrounding the LD definition and diagnostic models. In the current chapter, the three main models for the identification of LD will be reviewed, including the ability-achievement discrepancy model, the response to intervention model, and the third method processing approach model. The strengths and weaknesses of each model will be highlighted and the decisions made regarding LD definition and diagnosis as well as its implications in the development for the *Teacher Help for LD* program will be described.

History of the LD Definition

Historically, there has been a great deal of controversy surrounding the nature of LDs, both in terms of reaching consensus on a LD definition and implementing best practices in LD assessment and diagnosis. The LD definition has changed frequently over time, with alternative definitions being proposed every few years since the early 1960s. Parts of the definition have been eliminated or changed, while other information has been added (Kavale & Forness, 2000). In 1962, Kirk first used the term LD in his textbook (*Educating Exceptional Children):*

> A learning disability refers to a retardation, disorder, or delayed development in one or more of the processes of speech, language, reading, writing, arithmetic, or other school subjects resulting from a psychological handicap caused by a possible cerebral dysfunction and/or emotional or behavioral disturbances. It is not the result of mental

retardation, sensory deprivation, or cultural and instructional factors (as cited in Kirk & Kirk, 1983, p. 20).

IQ-Achievement Discrepancy Model

The IQ-achievement discrepancy model (developed from the original definition provided by Kirk) says that a LD is diagnosed when an individual's IQ is found to be statistically significantly higher than his or her achievement in one or more academic areas and as such there is a discrepancy between potential ability and actual achievement (Flanagan, Ortiz, Alfonso, & Dynda, 2006). Often, this discrepancy is the only criterion required by practitioners and school boards in order to diagnose LDs (Jiménez, Siegel, Shanahan, & Ford, 2009).

There are several problems with this model of LD diagnosis. First, research has found that IQ-achievement discrepancy does not reliably differentiate between poor and good readers or those who are good or poor in mathematics (D'Angiulli & Siegel, 2003; Vellutino, Scanlon, & Lyon, 2000; Jiménez et al., 2009). Vellutino et al. (2000) investigated the efficacy of using an intensive early intervention to diagnose LDs affecting reading. An IQ test was administered to investigate whether an IQ-achievement discrepancy reliably determined which children had LDs and which would experience easy reading remediation. Vellutino et al. (2000) concluded that IQ-achievement discrepancy did not reliably predict which readers responded well to early intervention and which were identified as having LDs. Similarly, Jiménez and colleagues (2009) found that IQ scores were not related to any differences found between normally achieving Spanish readers and Spanish children with reading disabilities, as defined by performance on standardized reading tests. Further, the discrepancy criterion does not predict how children would respond to remediation.

Second, beyond IQ scores, there are no significant differences (e.g., on measures of phonological awareness skills, word reading, pseudoword decoding, rapid naming) between poor readers who meet discrepancy criteria and those who do not (Fletcher et al., 1994; Siegel, 1992; Stuebing et al., 2002). However, Stuebing et al. (2002) found that the two groups differed significantly on cognitive processing variables that were strongly linked to IQ but not reading skill. Further, low and high IQ poor readers do not differ in terms of their response to reading intervention. That is, they do not appear to require different treatments to remediate their reading impairments (Jimenez et al., 2003; Torgesen, 2004). Fourth, Siegel (1992) argued that IQ scores themselves are impacted by LDs and that IQ score is therefore confounded by achievement. As poor achievers advance in school they are less likely than their typically achieving peers to read for pleasure, seek out information in print, and to understand concepts in writing and as a result, their verbal IQ scores begin to diminish due to a lack of exposure to verbal information, which decreases their chances of meeting criteria for a LD based on a discrepancy model (Siegel, 1992).

In addition to the above noted concerns, some researchers argue that the discrepancy model encourages a wait to fail attitude, where children who do not yet meet criteria based on the discrepancy model are forced to wait for a diagnosis and/or special services until their achievement drops low enough to ensure a discrepancy (Fletcher, Coulter, Reschly, & Vaughn, 2004). Moreover, there is also variability in whether a discrepancy is evident, depending on the measure and indexes used to represent IQ (Kavale, 2007), indicating that LD diagnosis may vary unreliably. Finally, while there are a number of neuroanatomical studies that have found that atypical brain symmetries and other cortical anomalies are associated with the presence of a reading disability (as defined by a Full Scale IQ score equal to or greater than 80 and a decoding

composite score less than 90), there is no known evidence to suggest that the neuroanatomical structures are related to IQ-achievement discrepancy (Shaywitz et al., 2003).

In conclusion, the long-entertained theory that LDs can be diagnosed via an aptitude-achievement discrepancy has been soundly disputed (Büttner & Hasselhorn, 2011) and empirically discredited as an acceptable model by many well-known researchers in the field of LDs (D'Angiulli & Siegel, 2003; Fletcher et al., 2002; Flanagan et al., 2006; Fletcher et al., 1994; Jiménez et al., 2009; Johnson, Humphrey, Mellard, Woods, & Swanson, 2010; Siegel, 1992; Siegel & Himel, 1998; Stanovich, 1999, 2005; Tanaka et al., 2011; Vellutino et al., 2000; Warner, Dede, Garvan, & Conway, 2002).

Response to Intervention Model

Although most researchers agree that the discrepancy model is not sufficient for LD diagnosis the question becomes how do we identify LDs? What is the alternative? Response to intervention quickly became the front-running alternative (Fuchs et al., 2003). Response to intervention (RTI) is a preventative and early intervention-based approach to the identification of students with learning problems (National Joint Committee on Learning Disabilities (NJCLD), 2005). It is a multi-level (tiered) system whereby schools identify students at risk for poor learning outcomes, intervene, and monitor student progress.

The primary assumption upon which RTI is based is that typically achieving students will make good progress with high quality research-based instruction and remediation, while students with LDs will fail to respond to the tiers of intervention (NJCLD, 2005). RTI provides evidence-based interventions and adjusts the intensity and nature of those interventions depending on a student's responsiveness (NJCLD, 2005). RTI is primarily a prevention and remediation model, but at later stages uses assessment to identify students with LDs or other disabilities. As

originally described by Fuchs, Mock, Morgan, & Young (2003):

> In broad terms RTI may be described as follows: 1) Students are provided with generally effective instruction by their classroom teacher; 2) Their progress is monitored; 3) Those who do not respond get something else, or something more, from their teacher or someone else; 4) Again, their progress is monitored; and 5) Those who still do not respond either qualify for special education or for special education evaluation (Fuchs et al., 2003, p. 159).

According to its proponents, RTI solves many of the issues associated with IQ-achievement discrepancy. There are several benefits to the RTI approach to LD identification (Flanagan et al., 2006; Fletcher et al., 2004; Vellutino, Scanlon, Small, & Fanuele, 2006). First, it provides help more quickly to a greater number of struggling students. The focus shifts from diagnosis to intervention and evidence-based instruction (Fletcher et al., 2004). Therefore, If RTI procedures have been in place prior to a psycho-educational assessment, inadequate instruction should not be an issue (Flanagan et al., 2006). Second, this distinguishes children with LDs and children who appear to have LDs but do not (i.e., false positives), leads to a reduction in special education enrollment and cost. Additionally, evidence shows that RTI implemented in the earliest grades prevents reading difficulties for most at-risk children (Vellutino et al., 2006). And, finally, because some RTI approaches are non-categorical, they avoid placing labels (i.e., LD) on children.

There are also several limitations to the RTI approach to LD identification. First, to be able to use RTI to identify LDs, evidence-based instruction would need to be present in all academic areas for children at school and educators will need to be prepared to adequately administer research-based instruction, screening, and remediation (Fletcher et al., 2004; Kavale

& Flanagan, 2007). Second, opponents of RTI claim that RTI research has focused mainly on reading disabilities thereby narrowing the scope of the LD identification method and making it useless for other types of LDs (Kavale & Flanagan, 2007). Some researchers claim that RTI incorrectly associates reading disabilities and LD; RTI only confirms the presence of reading problems, not LD, and that without additional assessment information (e.g., scores on standardized measures of cognitive ability and academic achievement) a diagnosis based on non-response to RTI is not sufficient for LD identification (Fletcher et al., 2004; Kavale & Flanagan, 2007).

Concerns with this model are also apparent in research that demonstrates the poor long-term stability of children diagnosed with LD based on an RTI approach, such as challenges with differential diagnosis of ADHD and anxiety disorders (Kavale & Flanagan, 2007). Lastly, RTI does not identify the reason for the reading underachievement. As such, while RTI may be insufficient as a diagnostic tool on its own, it is a useful model of intervention and can be used as a component of a comprehensive LD assessment (NJCLD, 2005). Hale and colleagues (2010) concluded that an empirically validated RTI model is best considered as a means for preventing learning problems, but comprehensive evaluations should be required when diagnosing LD, as children with LD require individualized interventions based on comprehensive assessment results, not merely more intensive interventions.

Third Method Processing Approach Model

As noted above, many researchers believe that neither ability-achievement discrepancy analyses nor failure to respond-to-intervention approach are sufficient to diagnose a LD. While it is apparent that many researchers strongly refute the discrepancy model, some researchers claim that the problematic outcomes associated with the discrepancy model are in part due to using a

discrepancy-only approach as opposed to using a discrepancy model as a necessary but insufficient method in LD identification (Dombrowski, Kamphaus, & Reynolds, 2004; Hale et al., 2010; Reschly & Hosp, 2004; Scruggs & Mastropieri, 2002). Hale et al. (2010) argue that a third method approach that identifies a pattern of cognitive processing strengths and weaknesses, that is linked to achievement deficits, is the best option for diagnosing LD. There is no consistent label for this approach although it is often referred to as third method or information processing model; regardless of the label it refers to making research-based connections between known cognitive processes (e.g., phonological processing, language processing, visual processing) and areas of academic achievement for the purpose of identifying LDs (Kavale & Forness, 2000; Flanagan, Alfonso, & Mascolo, 2011). The definition of a LD adopted by LDAC in 2002 is an example of a definition that uses the presence of processing deficits to help identify a LD. Part of the official definition adopted is as follows (see Appendix A for the full definition):

> Learning Disabilities refer to a number of disorders which may affect the acquisition, organization, retention, understanding or use of verbal or nonverbal information. These disorders affect learning in individuals who otherwise demonstrate at least average abilities essential for thinking and/or reasoning. As such, learning disabilities are distinct from global intellectual deficiency.
>
> Learning disabilities result from impairments in one or more processes related to perceiving, thinking, remembering or learning. These include, but are not limited to: language processing; phonological processing; visual spatial processing; processing speed; memory and attention; and executive functions (e.g. planning and decision-making).
>
> Learning disabilities range in severity and may interfere with the acquisition and use of

> one or more of the following: oral language (e.g. listening, speaking, understanding); reading (e.g. decoding, phonetic knowledge, word recognition, comprehension); written language (e.g. spelling and written expression); and mathematics (e.g. computation, problem solving). Learning disabilities may also involve difficulties with organizational skills, social perception, social interaction and perspective taking (LDAC, 2002).

Over the past few decades, a great deal of evidence has emerged supporting strong associations between specific cognitive processes and academic strengths and weaknesses. Johnson and colleagues (2010) conducted a meta-analysis of 32 studies to investigate cognitive processing deficits between students with LD and their typically achieving peers. Results found moderately large to large effect sizes in cognitive processing deficits between groups, suggesting that assessing cognitive processes to diagnose LD is warranted (Johnson et al., 2010).

Despite the evidence, there are some of criticisms of this model. The first is that there is no evidence for unique underlying processing deficits affecting specific academic areas. For example, in the research on mathematics LDs there is disagreement on whether a cognitive processing deficit (primarily in working memory) causes poor achievement in math or whether these processing deficits are simply present in students with LDs affecting math (Landerl, Bevan, & Butterworth, 2004). Second, psychological processes are difficult to measure in pure form as abilities like attention and motivation arguably play a role. This, however, is true for many tests of psychological constructs and as such is a problem with all assessment approaches for LD. Processing deficits also occur in other disorders, such as ADHD, which makes it challenging to use processing problems as a tool for differential diagnosis. The last criticism is that it is impossible to assess all processing areas as that would be highly expensive, time consuming, and potentially unethical.

Current Situation in Canada, the United States, and Internationally

There is limited consensus in the field regarding the definition and diagnostic criteria for a LD (Hale et al., 2010; Harrison, 2012). The ambiguity and inconsistency of the LD definition results in unreliable LD identification (Flanagan, Keiser, Bernier, & Ortiz, 2003). Further, LDs are identified, subtyped, and labeled differently across various systems, including medicine (e.g., dyslexia, dysgraphia, and dyscalculia), education (e.g., reading disability), and law (e.g., specific learning disability). The various sets of diagnostic criteria include differences in terminology. For example, the Learning Disabilities Association of Canada (LDAC) uses the term l*earning disability*, while the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5) uses the term *specific learning disorder*, and the International Statistical Classification of Diseases and Related Health Problems, 10th Edition (ICD-10), uses *specific developmental disorders of scholastic skills*. The diagnostic criteria also differ drastically in how they define LDs, or in other words, what is required to warrant an LD diagnosis.

In Canada, LD assessment is conducted differently from province to province and is inconsistent even within provinces (Kozey & Siegel, 2008; Wiener & Siegel, 1992). In Canada (unlike the United States), there is no federal legislation that provides guidelines for LD diagnosis. Ontario and Quebec are the only provinces that mention LDs in their provincial Education Acts, and these acts do not provide guidance on how to define or diagnose LDs (Ontario Education Act, 1990; Quebec Education Act, 1997). Instead, LDs are defined in provincial non-legislative policies (e.g., British Columbia Education has a document called *Special Education Services: A Manual for Policies, Procedures, and Guidelines*). However, the interpretation of these policies varies widely across school boards, indicating that the existence of these non-legislative policies alone is insufficient. Most provincial policies either list

discrepancy as required for LD diagnosis (Ontario) or highlight the discrepancy model as an integral part of the LD definition (Kozey & Siegel, 2008; Harrison, 2005), which does not follow best practices for LD diagnosis (Stanovich, 2005) and will be discussed later in more detail. A wait to fail approach is also common, with some provinces requiring children to have fallen a specified number of grade levels behind before they are eligible for severe learning disabilities (SLD) support programs (Kozey & Siegel, 2008).

Nova Scotia Context

Prior to 2010, in Nova Scotia, Canada (the location of the current study) definitions, labels, and terminology of LDs varied across the province. Even within the same systems (e.g., school boards or hospitals) psychologists were not using the same definition, criteria, or diagnostic language to diagnose a LD. Research has shown that the reduction of LD symptoms in childhood may improve academic performance at school and lead to better educational outcomes and work performance, higher income in adulthood, and increased self-esteem (Hazell, 2007). Moreover, children who are not appropriately identified as having a LD and as such are not given appropriate and timely treatment are at a higher risk for many serious life problems, including adolescent suicide, running away, and homelessness (Siegel, 2003). As such, variations in how psychologists conceptualize and diagnose LDs has important implications for children and their families and to both the health care and educational systems. Accurate LD assessment is the first step in ensuring that the child receives appropriate educational interventions. As a result of the situation in NS, all of the school psychologists and student services coordinators in the province gathered to try and reach a consensus on the definition, assessment, and diagnosis of a LD. This meeting was facilitated by Dr. Penny Corkum (Dalhousie University), Mr. Dan Stephenson (Chignecto-Central Regional School Board), Dr. Crystal Lowe-Pearce (IWK Health

Centre) and Ms. Annie Baert (LD Consultant, NS Department of Education and Early Childhood Development).

At this 2010 meeting attendees decided that the LD definition provided by LDAC, although not perfect, was most closely aligned with current research and practice. However, in order to provide accurate and reliable LD diagnoses in schools across NS, the psychologists decided that further operationalization of the LDAC definition was necessary. To be diagnosed with a LD (as discussed at the meeting) a student would be required to meet the following criteria:

1) Based on a standardized individually administered IQ test, the individual has to have at least average cognitive ability essential for thinking and reasoning (which was further defined as 1SD from the mean based on an individually administered IQ test). It was also decided that psychologists could use their clinical judgment when deciding which measure (of intelligence) and index on that measure to use.
2) Using an individually administered norm-referenced achievement test, the individual would need to evidence low academic skills in one or more academic areas (defined as more than 1 standard deviation from the mean).
3) Deficits in one or more cognitive processes (based on history, observations, interviews or testing) that are logically linked to the academic difficulties needed to be identified.
4) Exclusionary factors need to be assessed based on a broad clinical assessment and cannot be thought to account for the academic problems.

Wording to use in a psychological report for diagnosing a LD was also discussed at the meeting and the following example was agreed upon:

Kaleb has a learning disability. He has average skills for thinking and reasoning, but specific processing deficits in the areas of working memory and phonological awareness. Currently, these processing problems are negatively impacting his reading, spelling and listening skills, which are below average for his age.

Implications for the *Teacher Help for LD* Program

The decisions listed above for LD diagnosis in NS had important implications for the development of the *Teacher Help for LD* intervention program. When developing the *Teacher Help for LD* program we decided to be consistent with the Nova Scotia definition of a LD and assessment/diagnostic practices that were decided upon at the provincial meeting in 2010. This is beneficial as it will provide teachers with accurate and evidence-based information that is consistent with how their school psychologists define, assess, diagnose, and develop programming for LDs.

Chapter 2

Introduction

Prevalence rates estimate that 3.2% of school-aged children in Canada have a LD (Statistics Canada, 2007). LDs are often life-long and have a number of associated negative impacts, including increased rate of mental health problems, poorer overall health, and lower levels of income than individuals without LDs (Hazell, 2007; Wilson, Armstrong, Furrie, & Walcot, 2009).

According to LDAC, LDs are disorders that affect the organization, retention, understanding, and/or use of information (LDAC, 2003). LDs affect learning in individuals who demonstrate at least average cognitive ability necessary for thinking and/or reasoning (LDAC, 2003). LDs result from deficits in one or more underlying processes (e.g., phonological processing, processing speed, memory) that affect the acquisition of one or more academic skills, such as reading, written language, and mathematics. Importantly, LDs may also affect other areas such as organizational skills and social perception. Often, LDs are suggested by academic under-achievement or achievement that is maintained only by especially high levels of effort and support (LDAC, 2003).

According to the LDAC definition, LDs are lifelong conditions, and are associated with long-term negative impacts on mental health, social-emotional development, and occupational functioning (LDAC, 2003). The long-term implications for individuals with LDs include lower levels of education and income (Wilson et al., 2009). Additionally, Wilson et al. (2009) found that individuals with LDs are more than twice as likely to report high levels of distress, suicidal thoughts, visits to mental health professionals, and poorer overall health compared to individuals without LDs. These significantly higher rates of mental health problems remained when income,

education, social support, and physical health were controlled for (Wilson et al., 2009). Children with LDs are also more likely to receive a diagnosis of a mental health disorder (e.g., ADHD, depression, and anxiety disorders) than their typically developing peers (Bryan, Burstein, & Ergul, 2004; Voeller, 2004; Wilson et al., 2009). Given that LDs are associated with life-long difficulties, it is critical for LDs to be identified early and that appropriate interventions are implemented. Research has shown that the reduction of childhood LD symptoms may improve academic performance at school and lead to better educational outcomes and work performance, higher income in adulthood, and increased self-esteem (Hazell, 2007).

Given the long-term implications of LDs, their chronicity, and high prevalence rates, many researchers have pursued the development of effective interventions, especially strategies that can be implemented in the classroom (Boyle & Scanlon, 2010). Unfortunately, the translation of this research into common practice in the classroom has not yet taken place (Chafouleas & Riley-Tillman, 2005). Research suggests that teachers have a limited understanding of how LDs affect a student's ability to acquire knowledge and demonstrate their understanding (DeSimone & Parmar, 2006). This lack of knowledge is likely one of the key reasons why evidence-based interventions are not being implemented in the classroom (Chafouleas & Riley-Tillman, 2005). To overcome this barrier, an intervention where teachers can learn skills and strategies to help students with LDs succeed in the classroom may prove effective.

Interventions for LDs. Two types of interventions are commonly used for individuals with LDs: remediation and adaptations. Remediation, by definition, involves providing explicit instruction to improve functioning in the area(s) and process(es) affected by LDs. For example, a child with an LD affecting reading may receive additional instruction in order to learn

phonological awareness skills to better sound out words. Remediation is often provided by a resource teacher rather than the classroom teacher. In contrast, adaptations, mostly implemented by the classroom teacher, involve circumventing deficits while taking advantage of a student's strengths (Bryant, Bryant & Raskind, 1998; McGregor & Pachuski, 1996). Adaptations typically include changes in the medium through which information is presented, the response formats, the classroom environment, or the demands placed on the student. Adaptations are designed to compensate for the effects of a student's LD that prevent understanding or expression of what the student knows (Haladyna & Downing, 2004). To accomplish this, barriers to performance (caused by the disability) are removed (Fuchs & Fuchs, 2001). For example, a child with an LD affecting reading may be provided the opportunity to have questions read-aloud during tests. Although this does not provide the student with any remedial instruction (i.e., will not improve reading), it will permit the student to demonstrate knowledge of academic content that would otherwise be contingent on reading ability.

Remediation is essential to address the underlying impairments of students with LDs and to improve academic achievement in school; however, remediation is not always feasible, as it can be highly time consuming and labour intensive (e.g., Torgesen et al., 2001). Although providing classroom adaptations can by no means replace remediation, adaptations can reduce barriers, thereby enabling students to demonstrate their knowledge of curricular content (Fuchs & Fuchs, 2001). Removal of barriers will likely result in more success, which in turn is likely to enhance self-esteem and hopefully reduce the possibility of some of the negative consequences often experienced by individuals with LDs.

While there are a range of disorders for which children require school adaptations, the majority of children receiving adaptations in school are children with LDs (Bielinski, 2001). It is

commonly accepted that students with LDs benefit from both evaluation and instructional adaptations (Byrnes, 2008). Evaluation or test adaptations permit students with LDs to display their understanding of curricular content through alternative means (e.g., providing read-aloud versions of tests, providing an alternative environment to write tests); whereas instructional adaptations help students with LDs accomplish the requirements of the academic curriculum in regular classroom settings, such as repetition and chunking of directions (Lovett, 2010; Vallecorsa, deBettencourt, & Zigmond, 2000).

When assigned and administered consistently and accurately, classroom adaptations can help remove barriers that prevent individuals with LDs from demonstrating their true abilities. When choosing effective adaptations for an individual with an LD, it is recommended that three questions are considered: 1) does the student have a functional impairment in an area that is required for the area being tested, 2) are any adaptations available to address the impairment, and 3) if selected, will the adaptation change the construct being measured (Kettler, 2012). For example, an oral evaluation provided to an individual who experiences difficulty with reading on a science or math test is appropriate as reading ability is clearly not the construct being measured.

No adaptation is valid for every individual or for every test or situation (Kettler, 2012). For example, not all students with LDs require extra time to complete tests or assignments, as not all individuals with LDs experience difficulty with output of information. Research has shown that to be effective, it is important that instructional and evaluation adaptations are consistent with one another (Byrnes, 2008). If the purpose of assessing academic abilities is to provide information on the extent to which students are progressing in school, instructional and evaluation adaptations need to be matched closely (Ysseldyke et al., 2001). This means that a

child should receive the same adaptations during tests as he or she receives during instruction.

Many researchers have developed and evaluated a range of classroom strategies (Boyle & Scanlon, 2010). Generally, studies conducted across academic areas have indicated that students with LDs achieve relatively better with instructional adaptations than without (Ketterlin-Geller & Jamgochian, 2011). Several studies have demonstrated the effectiveness of using assistive technology (e.g., laptops, electronic spell checkers, iPads, speech recognition systems) with students who have LDs to compensate for deficits in reading, mathematics, spelling, and other academic areas (Bryant, Bryant, & Ok, 2014; Eden, Shamir, & Fershtman, 2011; Retter, Anderson, & Kieran, 2013). Other than adaptations involving the use of assistive technologies, most adaptation policies and evidence-based practices address the effectiveness of evaluation adaptations rather than instructional adaptations. While currently a comprehensive best practice adaptation model does not exist, most evaluation adaptations involve changes in the setting and the way in which the test is administered rather than changes to the test itself (Bielinski, 2001). Common changes to test administration include extended time and read-aloud administrations (Bielinski, 2001). Extended time is the most frequently used test adaptation for students with LDs. Some researchers (e.g., Cormier, Altman, Shyyan, & Thurlow, 2010; Fuchs, Fuchs, & Capizzi, 2005) have shown that extra time increases test scores for both students with LDs and students without, while other studies (e.g., Sireci, Scarpati, & Li, 2005) have demonstrated a differential boost for students with LDs (i.e., a greater increase in scores between non-adapted and adapted conditions for individuals with LDs than for individuals without LDs). Read aloud adaptations involve having all or part of a test read aloud to students who experience difficulty with reading. Sireci et al. (2005) conducted a review investigating the results of implementing read aloud adaptations. They found that read aloud instruction were effective (i.e., there was

presence of a differential boost) in five of seven studies. Importantly, in each of these five studies, mathematics was the construct being measured (Sireci et al., 2005). While the results of studies evaluating adaptations for LD are not always consistent, it is important to remember that individuals with LDs are a heterogeneous group and therefore there is enormous variability when considering which adaptations will work for any individual. For an extensive review on testing adaptations see Kettler (2012).

The research to practice gap. Given that there are evidence-based strategies for improving the functioning of children with LDs in the classroom, it is important that they are implemented in the classroom setting. Unfortunately, research suggests that generally classroom teachers do not implement evidence-based adaptations and remediation strategies on a consistent basis (Chafouleas & Riley-Tillman, 2005). Perhaps this research to practice gap is a result of insufficient professional training and teacher knowledge about LDs. Research suggests that teachers have a limited understanding of the learning needs of students with LDs and teachers do not feel that they receive adequate training to teach students with LDs in inclusive classrooms (DeSimone & Parmar, 2006). In Nova Scotia (NS), Canada (the setting of the current study), teachers do not receive specialized training in LDs during their Bachelor of Education degree, but instead are required to complete one to two courses on teaching students with exceptionalities. While teachers may have the opportunity to engage in professional development opportunities that may cover topics such as LDs, the vast majority of their experience with LDs consist of interactions with these students in the classroom. Perhaps as a result of their lack of training, teachers report being unsure of how to provide classroom adaptations and are often willing to provide only those that do not interfere with the classroom routine (Fletcher, Bos, & Johnson, 1999; Polloway, Epstein, & Bursuck, 2003). However, Brown (2007) found that

teachers do understand the importance of adaptations and providing alternative assessments to students with disabilities in the classroom.

Online interventions. To overcome the research to practice gap, an intervention where teachers can learn skills and strategies to help children with LDs succeed in the classroom may prove effective (Corkum, Coulombe, & Blotnicky-Gallant, 2013). Online intervention programs are interactive in that they provide highly specialized treatment and feedback tailored to user characteristics (Proudfoot et al., 2011). Online interventions have been shown to be effective for a variety of health-related topics, such as insomnia, encopresis, obesity, and depression (Manzoni, Pagnini, Corti, Molinari, & Castelnuova, 2011; Ritterband et al., 2013; Thorndike et al., 2013; Wagner, Horn, & Maercker, 2014). A recent study found that an online teacher intervention for ADHD (*Teacher Help for ADHD)* was effective in decreasing students' ADHD symptoms at the end of treatment and after a six-week follow-up (Barnett, Corkum & Elik, 2011; Russell, Blotnicky-Gallant, & Corkum, 2013). Online interventions are more accessible as well as cost and time effective than face-to-face interventions (Wantland, Portillo, Holzemer, Slaughter, & McGhee, 2004). The Internet is an attractive medium to host interventions in that treatment and education can be delivered to large quantities of people simultaneously (Christensen, Griffiths, & Jorm, 2004). Consequently, these advantages have resulted in the creation of more and more Internet-based interventions for psychological and behavioural health problems (Proudfoot et al., 2011). Given the many benefits of online interventions listed above, an online teacher intervention for students with LDs may be helpful in increasing teacher knowledge and practice, and improving student success at school.

Usability testing. Usability testing is often conducted to ensure online interventions are user-friendly, accessible, and result in user satisfaction. In fact, studies have shown that usability

testing can guide program revisions that result in up to a ten-fold decrease in usability problems (Kushniruk, Patel, & Cimino, 1997). Usability testing is the process by which users interact with a program and provide feedback on their experience to inform changes in the program. Morville & Sullenger (2010) described a user experience honeycomb that consists of seven usability dimensions that are important to consider when designing websites (i.e., useful, usable, desirable, valuable, accurate, credible, and accessible). The honeycomb layout indicates that the variables interact with one another to create the overall user experience (Morville & Sullenger, 2010). Ritterband et al. (2009) proposed a behaviour change model for Internet interventions suggesting that the characteristics of a website (e.g., appearance, content) are associated with increased adherence and improved effectiveness of web-based intervention programs. More specifically, Ritterband et al.'s (2009) model suggests that characteristics of the user, who is influenced by factors in the environment, affects website use and adherence, which is influenced by external support and characteristics of the website (e.g., content, message, appearance). Website use leads to behaviour change and symptom improvement. Using the behaviour change model for Internet interventions in conjunction with evidence-based practice increases the likelihood of achieving desired outcomes (Hilgart et al., 2012). As such, usability testing has shown to be an effective way for detecting the majority of issues with a program, and has often been used specifically with web-based interventions (Kushniruk, 2002).

Teacher knowledge, attitudes, and behaviour. Given that there are effective strategies for improving functioning of students with LDs in the classroom, we are interested in determining how to change teacher behaviour to implement these strategies. To understand what motivates teachers to carry out effective classroom practices, we look to theories of behaviour change. One theory, the Theory of Reasoned Action (TRA), can help to explain the link between

teacher knowledge, attitudes, and behaviour (Kos, 2008). According to the TRA, a combination of factors result in the performance of specific behaviours (Ajzen & Fishbein, 1980). An individual's attitude toward a behaviour, the individual's beliefs toward the outcomes of a specific behaviour, and the extent to which the person finds the outcomes desirable, all influence whether or not an individual will engage in a behaviour. Perceived influence of subjective norm also contributes to the likelihood of behaviour performance (Ajzen, 2006). Subjective norm refers to the individual's perception of the social pressure to perform a specific behaviour (Armitage & Connor, 2001). Taken together, the above factors influence the individual's intention to perform a given behaviour, which then determines whether or not they go on to perform the behaviour (Ajzen, 2006).

Teachers' knowledge and attitudes can play a role in how they manage LDs in the classroom setting. In fact, in most cases a teacher is first to notice the signs of LDs, which are most often detected in mid-elementary school when a child's learning problems are interfering with schoolwork or daily functioning (Hendriksen et al., 2007). Al Khatib (2007) found that teachers have a moderate level of knowledge of LDs and that teacher knowledge was not related to age, experience, or academic qualifications, but was related to sex (female teachers having more knowledge than male teachers). One study by Brook, Watemberg, and Geva (2000) aimed to investigate teachers' knowledge and attitudes of ADHD and LDs. They found that knowledge of LDs and ADHD was relatively low among both special education teachers and regular classroom teachers. Additionally, 13% of all of the teachers erroneously considered LDs to be the result of poor parenting (namely parental spoiling) and most (59%) teachers thought that LDs disappear with age (Brook et al., 2000). Overall teachers had positive attitudes towards students with LDs, however, special education teachers had significantly more positive attitudes than

regular education teachers. Brook et al. (2000) found no correlation between teachers' knowledge of ADHD and LDs and their attitudes.

The current study. The current study fills an important gap in the literature. To our knowledge there are no studies examining online interventions for teachers to address the needs of students with LDs. The research team, consisting of Ms. Ashton Parker (Mount Saint Vincent University), Dr. Penny Corkum (Dalhousie University), Dr. Melissa McGonnell (Mount Saint Vincent University), and Ms. Annie Baert (NS Department of Education and Early Childhood Development), designed a web-based intervention for teachers who have students with LDs in their classroom and conducted a usability study on the intervention program. The intervention structure was based largely on the *Teacher Help for ADHD* program, developed by Dr. Penny Corkum and Dr. Nez Elik, which is an online intervention focused on helping teachers to effectively work with students with ADHD. The current project consisted of two phases, (1) development of the intervention, and (2) usability study. The development of the intervention (*Teacher Help for LD*) was based on an extensive review of the literature and consultation with experts in the LD field. The intervention consisted of six online sessions that each contained evidence-based information that was designed to help teachers learn strategies to effectively assist children with LDs in the classroom environment (see Appendix B for an overview of the sessions). Each session included slide show presentations, worksheets, and supplemental materials (e.g., web links, videos). Before the web-based intervention is formally evaluated (i.e., pilot study, Randomized Controlled Trial), the usability of the intervention program needed to be assessed. The usability study followed guidelines for usability testing set out in Peter Morville's *user experience honeycomb*, which describes a structured way to understand the components of a user's experience. Generally, the feedback received from the usability study was used to ensure

that the intervention program is user-friendly, promotes sustained participation, results in user satisfaction, and that the content of the intervention is appropriate. Data was collected from a group of LD specialists with expertise in the field of LDs. Both quantitative and qualitative data was collected to inform revisions of the *Teacher Help for LD* intervention program. Usability testing of the intervention program helps to ensure that users receive an effective and satisfying experience, and as such is a necessary step prior to formally assessing the effectiveness of the intervention program.

The objectives of the current research were to 1) develop an evidence-based intervention for online use by classroom teachers of students with LD, and 2) evaluate the usability of the intervention, named *Teacher Help for LD,* within the context of Ritterband et al.'s (2009) model of behaviour change and Peter Morville's dimensions of usability (Morville & Sullenger, 2010). LD specialists evaluated the usability of the intervention for each of the six sessions and for the intervention program as a whole. By doing this, the research aimed to inform both the changes that are required to promote user satisfaction and adherence to the *Teacher Help for LD* intervention program and identify what factors are most important to the success or failure of e-health interventions more broadly.

Method

Participants

The first phase of this study (*Intervention Development*) did not involve any participants. The second phase of the study (*Usability Study*) consisted of recruiting a sample of LD specialists to provide quantitative and qualitative feedback on the intervention program. As LD assessment and diagnosis varies greatly across Canada, LD specialists were recruited locally in Nova Scotia. Members of the research committee developed a list of potential participants and

LD specialists were recruited from educational and health-related systems (e.g., resource teachers, principals, psychologists). Individuals placed on this list were known to be knowledgeable and experienced in the field of LDs. Identified LD specialists were contacted via e-mail to ask if they would be willing to participate in a review of the *Teacher Help for LD* intervention program. This e-mail included an advertisement with more information about the study and a link to an online consent form and demographics questionnaire that they were asked to complete if they were interested in participating. Participants were required to have Internet access in order to review the intervention materials and complete the online questionnaires. Participants were e-mailed an iTunes gift card ($10) as a thank-you gift for their participation in the study. The purpose of the iTunes gift card was to allow participants to sample some of the apps that were recommended as part of the *Teacher Help for LD* program. Participants were given a list of various apps that may be effective for students with LDs.

Measures

Demographic questionnaire. The data collected from this questionnaire were used to describe the sample. The Demographic Questionnaire is an 8-item, investigator-created questionnaire (see Appendix C). Questions asked about participants' age, sex, highest level of education, current occupation/profession, percentage of time spent working spent working with children with LDs, number of years spent working in the field of LDs, and knowledge of LDs. Participants were also asked to describe their experience working with children with LDs; however, this question was open-ended and not answered by all participants. Therefore, these data were not analyzed.

End of session usability questionnaire. The End of Session Usability Questionnaire is a 22-item, investigator-adapted, questionnaire (see Appendix D). The questionnaire was adapted

from a questionnaire used in usability study for a web-based intervention for pediatric insomnia (Speth, Coulombe, Markovich, & Corkum, 2014). Participants completed this questionnaire after reviewing each session of the intervention program to provide feedback on each session individually.

Items on this questionnaire were based on Peter Morville's user experience honeycomb (Morville & Sullenger, 2010). Questions focused on the following six usability dimensions: 1) useful – the degree to which the *Teacher Help for LD* program is perceived as a helpful resource that will help increase teacher knowledge of LDs, 2) usable/findable – the degree to which the user is able to navigate the website, find information, and perceives the website as user-friendly, 3) desirable – the extent to which the website is visually appealing and organized, 4) valuable – the degree to which the user values the information provided by the website, 5) accessible – the degree to which the use of the website is influenced by user characteristics, 6) accuracy – the extent to which the information provided in the website is accurate and consistent with current knowledge regarding LDs, and 7) credible – the degree to which the information provided by the website is perceived as coming from a reputable source in the field of LDs. These usability variables provided participants with a framework in which to conceptualize their feedback. Participants were also asked to provide general comments and satisfaction ratings that were not necessarily directly related to any usability dimensions. The dimensions of usability also allow us to relate participant feedback to the website characteristics presented in Ritterband et al.'s (2009) model.

For each of the usability variables listed above, participants were asked to rate their level of agreement (e.g., Session X of the *Teacher Help for LD* program is a useful resource for elementary teachers of students with LDs) using a quantitative rating scale, ranging from 1-

strongly disagree to 5-*strongly agree.* They were then asked to indicate whether changes were required to make each session useful, usable/findable, desirable, valuable, accessible, accurate, and credible. A quantitative rating scale ranging from 1 to 3 was used (1-*no changes requires*, 2-*minor changes required*, 3-*major changes required*). Participants were asked to elaborate if they indicated that changes should be made.

For each session, participants were also asked to indicate how long it took them to review all of the materials and how long they thought it would take a teacher to work through the session and apply the information they learned with an individual student. Finally, participants were asked to rate their overall satisfaction with each session on a five-point scale ranging from 1-*not at all satisfied* to 5-*extremely satisfied,* and to provide any other general comments about each session (e.g., any information that they would like to see included or removed from the session).

End of program usability questionnaire. All participants completed this 13-item questionnaire after reviewing the entire *Teacher Help for LD* program. Similar to the End of Session Usability Questionnaire, items on this questionnaire were based on Peter Morville's usability dimensions (Morville & Sullenger, 2010) and asked participants to rate how useful, usable/findable, desirable, valuable, accessible, accurate, and credible the *Teacher Help for LD* intervention program is in general. Space was provided for participants to give feedback about things they would like to see added or removed from the program, indicate the things they liked and did not like, and to provide general comments about the intervention program as a whole. Participants were also asked to rate their overall satisfaction with each session on a five-point scale ranging from 1-*not at all satisfied* to 5-*extremely satisfied*. Again, the items used in this questionnaire were adapted from those used in a usability study for a web-based intervention for

pediatric insomnia (Speth et al., 2014). The End of Program Usability Questionnaire can be found in Appendix E.

Blackboard learn (Bblearn) participant tracking website. Participants' use of the *Teacher Help for LD* intervention website was measured using the Bblearn generated user statistics. The Bblearn site kept record of the cumulative time each user was logged into the course. The timer began when the user entered the course web site and stopped when they logged out or their session expired due to inactivity (i.e., after 60 minutes).

Procedure

Intervention development. The *Teacher Help for LD* program was based on a third method processing approach to LD identification and diagnosis that is consistent with clinical practice in Nova Scotia. This approach to LDs allows teachers to develop a comprehensive intervention plan for their student based on that student's individual strengths and weaknesses. The *Teacher Help for LD* intervention program was developed by the research team, which consisted of two psychologists/academics and a LD consultant from the Nova Scotia Department of Education and Early Childhood Development. The literature was reviewed to ensure that only evidence-based information was provided in the intervention program. Documentation from the NS Department of Education and Early Childhood Development, NS school boards, and other relevant policy documents were also reviewed.

The six sessions of the *Teacher Help for LD* intervention program were designed for online use (Appendix B). Typically, once a session was designed it was then reviewed and edited by the thesis supervisor. Once feedback from the supervisor had been incorporated into the session it was sent to the research committee for feedback. Finally, the edited session was sent to the research supervisor for a final review. A research assistant also helped to review the sessions for

spelling, grammatical, and formatting errors. After the session was approved by the research supervisor, it was uploaded onto the *Teacher Help for LD* Bblearn website for participant review.

Usability study. LD specialists were asked to review each session of the intervention and provide feedback about the usability of the program. LD specialists were contacted via e-mail and invited to take part in the study. Once the LD specialists indicated that they were interested in participating in the study, they were sent (via e-mail) a web-link to complete informed consent and the Demographics Questionnaire. All data from questionnaires were collected via Opinio, a secure web-based survey system.

Participants were then e-mailed a unique username and password along with instructions on how to navigate the Bblearn website. Participants were instructed to review the sessions of the intervention program (including slide show presentations, worksheets, and web-links). Participants were required to review the entire intervention program and complete online questionnaires (after each session) over a 3-week period. Participants were e-mailed weekly reminders to complete the End of Session Usability Questionnaires, and at the end of the three weeks, participants were asked to complete the End of Program Usability Questionnaire.

Data Analysis

All of the data used for this study was first downloaded from Opinio and organized in Microsoft Excel. Detailed information on how qualitative and quantitative data were analyzed are included in the sections below.

Quantitative data. Quantitative data for the current study was analyzed using SPSS (Version 20). All categorical data (e.g., gender) was coded. Descriptive statistics were calculated to describe sample characteristics. Participants' usability ratings were examined by 1) determining the frequency with which participants advocate the need for change across the

sessions of the intervention program and 2) determining the average rating across the sessions of the *Teacher Help for LD* intervention program for each of the seven usability variables (i.e., useful, usable/findable, desirable, accurate, accessible, credible, and valuable). Participants' overall satisfaction ratings with the program were also investigated by calculating the average satisfaction ratings across the intervention program. To determine whether any differences in usability or overall satisfaction ratings existed between sessions, a series of repeated measures ANOVAs were conducted with session (1, 2, 3, 4, 5, and 6) as the within-subjects variable. The dependent variables analyzed included the seven usability variables (useful, usable/findable, desirable, accessible, credible, accurate, and valuable), and overall satisfaction. Descriptive statistics were also used to describe website use (e.g., amount of time spent on the website) Finally, a Pearson product-moment correlation was completed to determine whether participant satisfaction with the program was related to the amount of time spent on the *Teacher Help for LD* website. As both overall satisfaction and ratings of each of the usability variables were rated on a 5-point Likert scale, we treated this data as continuous and parametric statistical tests were used (i.e., repeated measures ANOVAs and Pearson product-moment correlations).

Qualitative data. Qualitative data was analyzed using directed content analysis, which involves the use of a pre-existing theoretical framework to guide qualitative analysis (Hseish & Shannon, 2005). The coding scheme used in the current study was adapted from the coding scheme used by Speth et al. (2014) to evaluate the usability of an Internet intervention for pediatric insomnia. The coding scheme used by Speth et al. (2014) was adapted from a model of behavioural change for Internet interventions designed by Ritterband et al. (2009). The codes adapted from Ritterband et al.'s model include: the user (set of user characteristics, such as socioeconomic status, attitudes, and beliefs), environment (includes environmental influences

such as family/friends, employer/organization/school), support (includes support external to the intervention program, such as e-mails or face-to-face contact from a clinician), website characteristics (includes several separate codes related to the website itself), symptom improvement (refers to the effectiveness of the intervention), and behavioural change (refers to behaviours that are identified for change that are specific to the intervention). Six factors from Ritterband et al.'s (2009) model were not included in the coding scheme for the study, as they were not represented in participants' feedback. These factors were: mechanisms of change, treatment maintenance, behavioural prescriptions, website use (adherence), symptom improvement, and assessment. In addition to the codes adapted from Ritterband et al.'s model, three codes were also added (that were also included in Speth et al.'s [2014] version of the model) for the purpose of classifying feedback that did not clearly belong to any of the designated codes. These codes include technical issues (refers to technical issues experienced by the users), positive feedback (refers to any positive feedback about the intervention program), and other (refers to any feedback that does not relate to any of the codes listed above). More detailed information about the coding scheme can be found in Appendix F.

Qualitative data were collapsed across all open-ended usability questions for each session (i.e., from the End of Session Questionnaire). This consisted of questions where participants were asked to indicate what (if any) changes were required for each of the seven usability variables (i.e., to make the session more useful, usable, desirable, etc.) and to provide any general comments about the session. Qualitative data were also collapsed across all open-ended questions for the overall program (i.e., from the End of Program Questionnaire). This consisted of questions where participants were asked to describe what they liked and disliked and to provide any other general comments about the *Teacher Help for LD* program as a whole. The

End of Program Questionnaire did not include questions about how to increase program usability, as that was already covered in previous sessions. All of the qualitative data for each session and end of program was organized in Microsoft Excel. Prior to coding, open-ended feedback was broken down into individual units of analysis. Feedback was considered fully broken down when each unit of analysis represented a single idea. For example, one participant who wrote "there was a lot of good information but I think it would be too much to do in one session", was broken down into two units of analysis: "there was a lot of good information" and "but I think it would be too much to do in one session". Feedback was first broken down by one of the coders (A.P.) and was then reviewed by the second coder (A.M.). Both coders reviewed any changes that were made to the data (i.e., how the feedback was broken down). Data were then coded according to the coding scheme by each of the coders independently.

Percent agreement between coders was calculated per session by dividing the number of instances the coders agreed by the total number of units of analysis. Although there is no standard or base percentage of agreement, 85-90% has been suggested by qualitative researchers as a minimal benchmark (Saldana, 2012). Percent agreement between coders for sessions 1 and 2 was insufficient following the first round of coding (63.6% and 76.3%, respectively). Codes were then refined through discussions between coders and Sessions 1 and 2 were recoded. After a second round of coding percent agreement between coders improved (97.7% and 98.2%, respectively). Recoding over various cycles is considered a common practice in qualitative analysis (Saldana, 2012). The remaining sessions (including sessions 3 to 6 and the end of program qualitative data) were coded once as percent agreement was adequate the first time. Final percent agreement between the two coders across all End of Session and End of Program qualitative data, ranged from 89.4% to 98.2%.

Results

Sample Characteristics

Initially, 26 LD specialists were e-mailed and invited to take part in the study. Of those invited, 19 LD specialists consented to participate in the study. One participant withdrew from the study due to time constraints. The final sample therefore consisted of 18 LD specialists. All participants reviewed the six sessions of the intervention program and completed all of the questionnaires with the exception of one participant who did not complete one questionnaire (i.e., the End of Program Usability Questionnaire) and one participant who did not complete two questionnaires (i.e., the End of Session Six Usability Questionnaire and the End of Program Usability Questionnaire). However, given that these participants provided feedback on the vast majority of the sessions, their data was included in the analyses.

Of the 18 LD specialists that participated in the study, 16 were female. The average age of LD specialists was 46.22 years (*SD* = 7.44), ranging from 30 to 60 years. LD specialists reported spending an average of 16.33 years (*SD* = 8.77, range = 3 to 34 years) working professionally in the field of LDs, and reported spending an average of 56.67% (*SD* = 33.52, range = 10 to 100%) of their time (across all settings in which they work) working with children with LDs. In terms of education, 94.5% of participants indicated that they had at least a master's level degree. Personal knowledge ratings indicated that 88.90% of the sample reported that they were very knowledgeable about LDs and the remaining individuals rated their knowledge level as moderate. When asked about profession, 27.8% indicated they were resource teachers, 22.6% were itinerant LD teachers, 16.7% indicated they were clinical psychologists, 16.7% reported they were school psychologists, 11.1 % said they were learning center teachers, and 5.6% indicated they were principals. Categorical demographic data is presented in Table 1.

Quantitative Data

Usability dimensions.

Usability ratings. Average ratings for the usability variables for each individual session as well as overall are presented in Table 2. Across all sessions, all usability variables were given a rating between 4 and 5 (on a 1-5 scale), which corresponds to a score in the *agree* to *strongly agree* range. This is consistent with overall program ratings, where all usability variables were also given a rating between 4 and 5 on the same scale. Discrepancies between usability ratings on successive intervention sessions were not found to be statistically significant, based on the repeated measures ANOVAs[1] (useful: F (1, 15) = .76, p = .61, usable/findable: F (1, 15) = .84, p = .56, desirable: F (1, 15) = .50, p = .80, valuable: F (1, 14) = 1.54, p = .27, accessible: F (1, 15) = 2.10, p = .14, accurate: F (1, 14) = 1.83, p = .20, and credible: F (1, 14) = 1.54, p = .27), indicating that usability variables were rated consistently across the six sessions of the *Teacher Help for LD* program.

Changes required. The results describing the extent to which participants advocated the need for changes to the intervention program are presented in Table 3 (across each session and usability variable). Across all six sessions of the *Teacher Help for LD* intervention program there were only five instances (which corresponds less that 1% of responses) where participants indicated that major changes were necessary to improve the usability of the session (i.e., one instance was indicated in Session 2 for the accurate usability variable and four instances were indicated in Session 3 for the useful, accessible, accurate, and valuable usability variables). It is also important to note that all five of these instances were made by only two of the 18

[1] Differences in degrees of freedom for the RM ANOVAs are a result of participants selecting "prefer not to answer" on questionnaires. This happened infrequently (i.e., only 3 participants selected "prefer not to answer" fewer than nine instances over the course of data collection for the study).

participants and both were educators. Three of these five instances were indicated by one participant and were regarding the usability of Session 3 (useful, accessible, and valuable). This participant's feedback was related to the content of the session (e.g., the participant suggested the removal of information related to the role of the psychologist, noted that the concepts and terms used in this session do not correspond with Department of Education terminology or what teachers use in everyday practice, and commented that psychologists do not diagnose LD in their board), in addition to pointing out a few typos and making suggestions for session re-organization. For the other two instances, one participant indicated that major changes were necessary to improve the accuracy of Session 2 (i.e., more how-to's/practical examples) and Session 3 (i.e., make it more clear that processing deficits are related to specific areas of academics). In comparison, 'no changes required' were indicated in 79.83% of participants' responses and 'minor changes required' were indicated in 19.74% of participants' responses across the entire program. It is important to note that some participants chose to provide feedback even when they selected that no changes were required, despite the fact that they were told to comment only if they indicated that changes were required. Often, these comments were positive in nature.

Satisfaction. Participants rated their satisfaction with the *Teacher Help for LD* intervention program for each of the six sessions as well as overall. Across all sessions, all satisfaction ratings were given a rating between 4 and 5 (on a 1-5 scale), which corresponds to a score in the *very satisfied* to *extremely satisfied* range. This is consistent with overall program satisfaction ratings, where satisfaction was given an average rating of 4.37. Average satisfaction ratings for each individual session as well as overall are presented in Table 2. A repeated measures ANOVA was calculated to test whether there were differences in satisfaction ratings

across the six sessions of the intervention. The repeated measures ANOVA revealed no difference in participants' satisfaction ratings, F (1, 14) = 2.04, p = .19.

Website use. The time participants spent reviewing the materials of each session of the intervention program is presented in Figure 1. We estimated that it would take no more than two hours for LD specialists to review each session of the intervention program. For all six sessions of the *Teacher Help for LD* intervention, all (i.e., 100%) participants reported spending less than two hours reviewing session materials. According to data collected from the Bblearn website, participants spent an average of 3.89 hours (SD = 3.06), ranging from 0.19 to 11.86 hours, on the *Teacher Help for LD* intervention website across all sessions. A Pearson product-moment correlation was run to determine the relationship between amount of time spent on the intervention website and overall satisfaction with the program. The correlation was not found to be statistically significant, r (14) = -.06, p = .84.

Participants were also asked to estimate how long it would take for the average teacher to review the *Teacher Help for LD* materials and apply the information they learned. The LD specialists reported the following times for each session: Session 1 (44.4% reported it would take 2 hours or less), Session 2 (77.8% reported it would take 2 hours or less), Session 3 (88.9% reported it would take 2 hours or less) Session 4 (88.9% reported it would take 2 hours or less), Session 5 (88.0% reported it would take 2 hours or less), and Session 6 (81.3% reported it would take 2 hours or less).

Qualitative Data

Across all six sessions (including the End of Program Usability Questionnaire that was completed after reviewing the entire program) of the intervention, LD specialists provided an average of 5.88 units of analysis per questionnaire. The number of units of analysis provided by

each participant ranged from 1 to 31 per session. Overall, participants provided 723 units of analysis across all six sessions and overall. Codes (as defined by Ritterband et al.'s model) were defined as occurring frequently if they were strongly supported by the data (i.e., the code occurred in at least 10% of the total units of analysis for a given session, which represents on average ten or fewer units of analysis per session). Described below are the most common codes by session as well as some examples. See Table 4 and Table 5 for more examples of participants' comments in each of the six sessions, and Table 6 for more examples of participants' comments for the intervention program as a whole.

Session 1. The frequency of each of the codes for Session 1 is presented in Figure 2. The most common codes for Session 1 were: positive feedback (33.7% of total units of analysis) and website characteristics-content (28.0% of total units of analysis). Examples of the most commonly occurring codes are as follows: positive feedback (e.g., *the questions at the onset are helpful; I also believe this information is absolutely essential for every educator*), website characteristics – content (e.g., *more explicit instruction of executive functioning would be helpful; perhaps a simple case presentation).*

Session 2. The frequency of each of the codes for Session 2 is presented in Figure 3. The most common codes for Session 2 were: website characteristics-content, positive feedback, and website characteristics-appearance, at 38.6%, 32.5%, and 10.5% of total units of analysis, respectively. Examples of the most commonly occurring codes are as follows: website characteristics – content (e.g., *on p. 13 the case study ends on a negative note. You could make it more helpful by adding something like: 'The use of speech to text technology was successfully implemented'; the checklist is from the USA...is there a Canadian version?*), positive feedback (e.g., *use of additional resources from Sick kids video to other reputable sources lend credibility*

to the information; *I found the video informative and thought provoking*), and website characteristics – appearance (e.g., *just organization; the lifespan slides would be better suited on the last session*).

Session 3. The most common codes for Session 3 were: website characteristics – content (31.9% of total units of analysis), positive feedback (27.6% of total units of analysis), technical issues (12.1% of total units of analysis), and website characteristics-message (11.2% of total units of analysis). See Figure 4 for the frequency and distribution of codes for Session 3. Examples of the most commonly occurring codes are as follows: website characteristics – content (e.g., *I suggest adding how classroom observations can provide insight into the student's strengths, challenges, and motivators; not sure what the third part about psychologist training is about*), positive feedback (e.g., *I like how it was NS focused; not sure about the LD funding, not sure it belongs, some boards have LD teachers*), technical issues (e.g., *slide 10 spells support wrong; the last sentence is missing a word after 'sorts'*) and website characteristics-message (e.g., '*student may receive supports...' should change to 'students should receive supports...'; modified test format is now 'adapted' test format*).

Session 4. The frequency of each of the codes for Session 4 is presented in Figure 5. The most common codes for Session 4 were: positive feedback (38.8% of total units of analysis), website characteristics-content (29.9% of total units of analysis), and the user (11.9% of total units of analysis). Examples of participant feedback for the most common codes are as follows: positive feedback (e.g., *very useful, I think you did a great job with adaptations; very easy to understand*), website characteristics – content (e.g., *I suggest links throughout as before; your recommendations for assistive technology are not as thorough as I would like them to be for teachers*), the user (e.g., *I think that development and implementation of adaptations is becoming*

the role of resource teachers. Classroom teachers need more instruction and accountability for their delivery; new teachers need this, experienced teachers need the reminder, and reluctant teachers may start to buy in with the repetition).

Session 5. The frequency of each of the codes for Session 5 is presented in Figure 6. The most common codes for Session 5 were: website characteristics – content (31.3% of total units of analysis), positive feedback (30.1% of total units of analysis), and technical issues (16.9% of total units of analysis). Examples of participant comments for each of the codes above are as follows: website characteristics – content (e.g., *perhaps YouTube videos that present 'how to' examples; refer to research*), positive feedback (e.g., *good as is; love the apps*), and technical issues (e.g., *remove the word 'that'; wording error slide 24*).

Session 6. The frequency of each of the codes for Session 6 is presented in Figure 7. The most common codes for Session 6 were: positive feedback (47.2% of total units of analysis), website characteristics-content (22.6% of total units of analysis), and technical issues (17.0% of total units of analysis). Examples of participant comments for each of the codes above are as follows: positive feedback (*e.g., the session itself was an excellent review; I was pleased to see the need for explicit teaching documented*), website characteristics – content (e.g., *you should note that many students will reject assistive technology particularly for use in the classroom in grades five and six; there is not much information about predictive text on the computer or on tablets. I have found this to be a very useful tool in getting students who are reluctant writers to take risks*), and technical issues (e.g., *slide 28 has continue spelled wrong; I couldn't find the PDF on 10 tips on talking to elementary students about LD*).

Overall. The frequency of each of the codes for the overall *Teacher Help for LD* intervention program is presented in Figure 8. The most commonly reported codes by

participants (when looking at the *Teacher Help for LD* program overall) were: positive feedback (e.g., *"Clear, concise, accurate, recent, and relevant", "Solid recommendations that can be implemented in the classroom without unreasonable preparation", "I like the emphasis on processing deficits which impacts academic performance", "I liked that the information and resources were applicable in Nova Scotia, and provided some local resources and policies, often lacking in other resources")* and website characteristics – content (e.g., *"It might be helpful to have references or links to some research articles", "I would like to see some examples of types of remedial exercises for the various areas of concern", "Not enough links posted to Department of Education or Board information", "It may be worthwhile to remind users that they are not expected to independently solve the student's learning challenges").*

Discussion

The purpose of the current study was to develop an online intervention for elementary school teachers working with students with LDs in their classrooms and to examine the usability of the intervention using Peter Morville's usability dimensions (Morville & Sullenger, 2010) and Ritterband et al.'s (2009) model of behaviour change. Quantitative results of the study indicated that the intervention was well-received, highly usable, and that users were very satisfied with the program overall. Qualitative results consistently indicated that a large proportion of LD specialist feedback (across all sessions and overall) was positive. A large proportion of the feedback was also dedicated to changes in intervention content. Overall, it appears that characteristics of the website itself (e.g., content, technical issues) were viewed by LD specialists as most important to the success of the *Teacher Help for LD* intervention program.

Internet interventions are typically derived from existing evidence-based face-to-face interventions that have been transformed for use online (Ritterband et al., 2009). The *Teacher*

Help for LD intervention program was developed to be consistent with the LD definition and assessment practices used by school psychologists in Nova Scotia (including the NS Special Education Policy and the NS Department of Education and Early Childhood Development Program Planning Process). The information provided in the program is based on the LDAC definition for a LD and the approach to LD diagnosis that was decided upon at the provincial meeting in Nova Scotia in 2010. This is beneficial as it provides teachers with accurate and evidence-based information that is consistent with how psychologists in their schools define, assess, diagnose, and treat LDs.

Based on quantitative data, participants reported that the *Teacher Help for LD* intervention program is highly usable. All usability variables were rated in the *agree* to *strongly agree* range, and were consistent across the entire intervention program. Participants reported being *very satisfied* to *extremely satisfied* with the intervention program, and almost 80% of the time, participants indicated that no changes were required to increase intervention usability. In fact, there were only five instances where two participants advocated the need for major revisions to the sessions. It is important to note that these two participants were educators, and as such may not have been aware of the decisions regarding LD conceptualization from the 2010 meeting. This speaks to the need to educate educators as well as psychologists. Overall, these results are comparable to other online usability studies, which have found moderate to high user ratings for the content, usability, appearance, and theme of online intervention programs (e.g., Long & Palermo, 2009). However, it is rare not to observe any issues in usability within an intervention program during usability testing (Stinson et al., 2010; Stoddard, Augustson, & Mabry, 2006). As such, our usability data is consistent with previous usability studies that include both positive and constructive feedback.

One critical usability factor is the time it takes to complete the program. Ritterband et al. (2009) note that it is possible that if an intervention program is too long, users may not be able to continue using the program, which could result in premature withdrawal. This is important as the World Health Organization indicates that intervention adherence is the most important predictor of program effectiveness (WH0, 2002). We estimated that it would take no more than two hours for LD specialists to review each session of the intervention program. Consistent with this, all participants reported spending less than two hours reviewing the materials for each session. According to data collected from the Bblearn website, participants spent less than 4 hours on the entire *Teacher Help for LD* intervention, suggesting that participants reported spending more time reviewing the sessions, which may be due to reviewing materials outside of the Bblearn system. However, these user statistics continued to measure time spent on the website until the participants logged out or until 60 minutes of website inactivity, suggesting that there may have been some issues with the accuracy of these statistics. When asked to estimate how long it would take a teacher to review the materials and apply them to a student in their class with a LD, the majority of participants indicated that it would take less than 2 hours to review all of the sessions, with the exception of Session 1. For Session 1, only 44.4% of participants reported that it would take teachers less than 2 hours to review and apply the information. While it may not be possible to substantially shorten Session 1, it is advisable to at least address the user's expectation that the session will be brief. Although this is an Internet intervention program, it is important that teachers are aware that the program will require effort and time on their end. It will be necessary to tell teachers in advance that Session 1 is the most time consuming, as it orients them to the *Teacher Help for LD* program and covers a lot of general information about LDs.

It is also important to note that according to the intervention website participants spent less than 4 hours (on average) reviewing all six sessions, and this ranged from approximately 11 minutes to almost 12 hours. This large range may be in part due to the way participants chose to review the intervention materials. Participants were able to download the sessions from the intervention website onto their computers. If participants did choose to download the intervention materials, the website would not have been able to accurately measure the time participants took to complete their review, thereby underestimating the amount of time participants spent reviewing the sessions. Further, the website stopped measuring time only after the participant logged out or after 60 minutes of inactivity. As a result, the website may have overestimated the amount of time participants spent reviewing intervention materials.

Participants provided qualitative feedback that was largely consistent with the quantitative data discussed above. Two of the 13 codes were endorsed consistently across the entire intervention program (positive feedback and website characteristics – content). LD specialists provided a large number of comments that were coded as positive feedback. The high level of positive feedback suggests that the intervention was well-received by participants. LD specialists were selected for participation in the study based on their knowledge and expertise in the field of LDs. LD specialists reported spending an average of more than 16 years working professionally in the LD field and 89% rated themselves as very knowledge about LDs. As such, to be able to meet LD specialists' expectations for this intervention is considered a great success. It is important to note that participants were asked only to provide qualitative feedback if they indicated that changes were required to increase program usability. As such, the amount of positive feedback may actually be an under-representation.

LD specialists also provided a large number of comments that were coded as website characteristics – content. The large proportion of feedback regarding intervention content is not surprising given that participants were LD specialists who were identified as being knowledgeable in the field of LDs, and as such are likely to have input on appropriate content for this type of intervention. Moreover, given that LD definition, assessment, and diagnosis is a controversial topic and the *Teacher Help for LD* intervention program followed a specific framework (i.e., following a third method processing approach to LD identification and diagnosis that is used to inform individualized interventions) it is not surprising that there may be differing opinions across LD specialists. When looking at the feedback from LD specialists on content, there was generally a lack of consensus on the types of changes to content that were suggested, with the exception of a few suggestions that were made consistently across participants (e.g., include/site references, modify content so that it is consistent with the Department of Education and Early Childhood Development/Nova Scotia School Boards). The finding that specialists in the field provided the most feedback in terms of usability variables on intervention content is consistent by the usability study conducted by Speth et al. (2014) on a web intervention for pediatric insomnia. Ritterband et al (2009) mentions that content is the most important component of an intervention program, since without good content it is unlikely that behaviour would change or symptoms would improve. Good content can also lead to improved website use and adherence, which, according to the Word Health Report of 2002, is the primary determinant to the effectiveness of treatment (WHO, 2002).

Technical issues, although not one of the most highly reported variables across all sessions of the intervention, was endorsed as a common factor for several sessions (Session 3, Session 5, and Session 6). The number of technical issues is not surprising given that the study

was an evaluation of a preliminary version of the intervention, and as such technical issues are expected. Most commonly, technical issues included comments related to typos and spelling and grammatical errors rather than technical issues with the website itself. These technical issues were found after the entire research team and a research assistant had completely reviewed the intervention program. This could have important implications on teacher adherence to the intervention program; technical issues may affect program credibility and users may become less likely to trust the information provided in the intervention. As a result, these technical issues will need to be addressed.

There were three other codes that emerged frequently in the data (i.e., occurred in more than 10% of the total units of analysis for a session). They were website characteristics – appearance (Session 2), website characteristics – message (Session 3) and the user (Session 4). Although perhaps not critical when considering revisions to the *Teacher Help for LD* program as a whole, these re-occurring codes will be important when considering revisions for individual sessions. Website characteristics – appearance is important for encouraging initial and continued use of the intervention program and may actually increase the amount of engagement with a program (Ritterband et al., 2009). Participants' comments about appearance were regarding organization of content and amount of content per slide. Website characteristics – message focuses on the source and style of the content, and how the content is presented to the user (Ritterband et al., 2009). Participants' comments regarding website characteristic – message are largely regarding the way that the information about the LD definition and LD assessment is presented (i.e., the terminology and wording) which was the focus of Session 3. The source of a website dictates its believability and can impact behaviour change (Beck, 1990; US Department of Commerce, 2002). This suggests the importance of making references more visible in the

intervention program. It is important to keep in mind, however, that the LD definition and approach to assessment remains highly controversial in the literature, and as such it will not be possible to eliminate issues with the message of the website. Instead, it might be beneficial to tell teachers early on in the intervention about the third method processing approach that the program is based on and explain the reasons why to help them understand where the information is coming from. Participants' comments regarding the user (in Session 4) were largely regarding what teachers do and do not know about adaptations and how to implement them. This is important as teacher knowledge and the role of teachers may be able to predict whether a teacher implements effective adaptation strategies and adheres to the intervention program (Ritterband et al., 2009).

When interpreting the results of the current study, a number of strengths and limitations should be considered. The current study had a large sample size (18 participants), which is well above the minimum recommended sample size for usability testing (Kushniruk et al., 1997). Further, while online interventions have shown to be effective for a variety of health-related topics (e.g., insomnia, depression, chronic pain), there is only one other online intervention study for classroom teachers (*Teacher Help for ADHD*; Barnett et al., 2011) and no known studies that have examined an online intervention for teachers of students with LDs, and as such this study is the first of its kind. Finally, the *Teacher Help for LD* program itself is evidence-based and was developed by a research team that has extensive expertise in the field of LDs.

Despite these strengths, the current research was limited in three main ways. First, not all participants provided their feedback for the entire intervention program (i.e., two participants did not complete all questionnaires). As a result, the feedback collected for these specific sessions (Session 6 and End of Program) may not accurately reflect participants' experience with the

program. It is possible that those who did not complete the study found the program more difficult to work through than the LD specialists who continued to participate. It is also possible that these participants (who were school board employees) ran out of time to review the program given that the school year had ended while data collection was still being carried out. Second, it is important to note that the study sample consisted entirely of LD specialists. That is, none of the participants were currently teaching in the classroom. This is a limitation of the study because the *Teacher Help for LD* program is designed for use with teachers, and as such, understanding how teachers perceive the usability of the program would give important information about user satisfaction and adherence. This will be an important next step in developing the *Teacher Help for LD* program for effective teacher use. Finally, the current study is limited by the framework that was used to inform the design for the intervention program. The *Teacher Help for LD* intervention program is based on a particular definition of LD and model for assessment and diagnosis (i.e., a third method processing approach), which may not be consistent with other provinces and countries. This potentially limits the generalizability of the study results.

Implications and Future Research

The next step is to revise the program based on LD specialists' feedback. First, the length of Session 1 needs to be addressed. If it is not possible to substantially cut down Session 1 due to the nature of the program, it will be important to forewarn teachers that Session 1 is more lengthy and time consuming than the other sessions of the program. Second, all technical issues (typo, spelling errors) will need to be addressed. Finally, there were many comments regarding the content of the intervention program that will need to be addressed (e.g., make references more visible). However, it is important to note that changes should only be made if these were

consistently noted across participants. It would not be appropriate to make changes based on one participant's feedback, especially if it was inconsistent with the other participants' feedback or the intervention design team. Also, due to the chosen framework of the intervention program it may not be possible to make all suggested changes, as we want to remain consistent with the model used to identify LD in NS.

Once the revisions have been made, it may be important to conduct another round of usability testing with the LD specialists to get their feedback on the program revisions. Next, it will be necessary to conduct a usability study and/or pilot study with classroom teachers to determine how users (i.e., classroom teachers) perceive the program. Lastly, it will be necessary to conduct a larger-scale evaluation of the *Teacher Help for LD* intervention, such as a Randomized Controlled Trial, to determine program effectiveness (in increasing teacher knowledge of LD, changing teacher attitudes and practices, improving academic skills and student functioning). If further evaluation the *Teacher Help for LD* intervention finds this program to be effective, we will have an accessible web-based program for elementary classroom teachers who teach children with LD. The intervention program may have important implications for the teacher, in terms of increased knowledge of LD and improved sense of competency in programming for students with LD, as well as for the student, in terms of academic success and social and emotional functioning.

In the future, it might also be important to develop online interventions for other childhood psychological disorder that present themselves in the school setting. For example, the *Teacher Help for ADHD* program is an online teacher intervention program for students with ADHD that has been shown to be effective in decreasing students' ADHD symptoms and improving teacher knowledge of ADHD (Barnett et al., 2011; Russell et al., 2013). It would also

be important to extend these types of programs to junior high and high school teachers.

Conclusion

Overall, the results of the current research suggest that the *Teacher Help for LD* program is a highly usable program that is also feasible, in that it can be delivered to many individuals simultaneously via the Internet, and is more cost and time-effective than face-to-face interventions. Considered in the context of Ritterband et al.'s (2009) model, the results of the current usability study provides evidence as to the factors that are perceived as critical to the success of the *Teacher Help for LD* intervention program, and that will need to be addressed prior to future teacher use.

Table 1

Demographic Data for LD Specialists

	LD Specialists (n = 18)	
Demographics	*n*	%
Sex		
Female	16	88.9
Male	2	11.1
Profession		
Clinical Psychologist	3	16.7
LD Itinerant Teacher	4	22.2
Learning Centre Teacher	2	11.1
Resource Teacher	5	27.8
School Psychologist	3	16.7
Principal	1	5.6
Highest Level of Education		
B.Ed.	1	5.6
M.Ed.	10	55.6
M.A.	4	22.2
Ph.D.	3	16.7
Knowledge of LD		
Very Knowledgeable	16	88.9
Moderately Knowledgeable	2	11.1

Table 2

Participants' average ratings for each of the seven usability variables and overall satisfaction.

	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Overall
Usability Variables							
Useful	4.78	4.56	4.61	4.78	4.61	4.59	4.81
Usable/Findable	4.56	4.72	4.56	4.83	4.67	4.70	4.75
Desirable	4.44	4.50	4.50	4.61	4.44	4.53	4.69
Accessible	4.28	4.50	4.39	4.72	4.44	4.70	4.69
Credible	4.28	4.39	4.44	4.67	4.59	4.47	4.56
Accurate	4.39	4.39	4.33	4.56	4.71	4.59	4.56
Valuable	4.72	4.78	4.72	4.78	4.76	4.59	4.75
Overall Satisfaction	4.06	4.33	4.50	4.50	4.29	4.29	4.37

Note. Usability variables were rated on a five-point scale ranging from *1–strongly disagree* to 5*–strongly agree.* Overall satisfaction was rated on a five-point scale ranging from *1–not at all satisfied* to *5–extremely satisfied.*

Table 3

Frequency of participants' ratings for need for change across all sessions and usability variables.

	Usability Variable										
	Useful	Usable/Findable		Desirable		Accessible	Credible		Accurate		Valuable
		user-friendly	navigation	visuals	organ-ization		reputable source	trust info	accurate	evidence-based	
Session 1											
No Changes	4	12	14	13	16	13	9	8	12	14	14
Minor Changes	14	6	4	5	2	5	9	10	6	4	4
Session 2											
No Changes	8	15	15	16	16	12	12	13	12	16	13
Minor Changes	10	3	3	2	2	6	6	5	5	2	5
Major Changes	0	0	0	0	0	0	0	0	1	0	0
Session 3											
No Changes	8	15	17	13	16	14	14	14	10	15	14
Minor Changes	9	3	1	5	2	3	3	4	6	3	3
Major Changes	1	0	0	0	0	1	0	0	1	0	1
Session 4											
No Changes	14	17	16	14	17	15	15	16	16	17	14
Minor Changes	4	1	2	4	1	3	3	2	2	1	4
Session 5											
No Changes	11	18	17	17	17	13	14	16	15	15	12
Minor Changes	6	0	1	1	1	5	2	1	2	2	6
Session 6											
No Changes	14	16	14	15	16	16	15	17	15	17	16
Minor Changes	3	1	3	2	1	1	2	1	2	0	1

Note. In sessions where major changes were omitted from the table, none of the participants indicated that major changes to the session were required.

Table 4

Examples of qualitative comments for the most frequently reported codes in sessions one to three.

Session 1	Session 2	Session 3
1. Positive Feedback ○ Breadth and depth is good ○ The slideshow was informative, clear, and not too lengthy ○ I believe Session 1 is very well suited to both new and experienced teachers **2. Website Characteristics – Content** ○ You might want to cite your references ○ I think highlighting the variability in diagnosis is important ○ Make sure you're using the most up to date resource material	**1. Website Characteristics – Content** ○ You need to cite your sources. In this session I questioned a number of your stats ○ Change 'accommodations' to 'adaptations' as that is the current language we are expected to use in the public school system ○ Possible inclusion of a teaching strategy/practice slide that would benefit all learners in a diverse classroom, but particularly those with ADHD **2. Positive Feedback** ○ Liked the Canadian content ○ It is great to see that anxiety was included ○ Presents the information in an easy to understand format **3. Website Characteristics – Appearance** ○ Maybe less information per slide ○ I found it choppy, maybe too many bullets where bullets are not required ○ Less technically advanced teachers may be frustrated by moving between screens	**1. Website Characteristics – Content** ○ P. 37 is a repeat of a previous session and should be deleted ○ I am not sure if this is province wide or unique to our board, but it would be helpful to include if it is province wide ○ Maybe include information about how long it can take from referral to assessment **2. Positive Feedback** ○ The slides on the roles and assessment were good ○ It is very clear that classroom adaptations will be required and expected for students with LD, and this is great ○ The example and explanation of the identification, process, and diagnosis of the student's LD was excellent! **3. Technical Issues** ○ Check spelling on slides, I noticed a mistake ○ Typos ○ Tabs did not come up automatically as they did on the first session **4. Website Characteristics – Message** ○ The 'average intelligence' thing is really being over-stressed. It's controversial ○ The current language is 'assessment'. Psychologists do not give tests - they complete assessments. They do not report on tests - they report on assessment results

Table 5

Examples of qualitative comments for the most frequently reported codes in sessions four to six.

Session 4	Session 5	Session 6
1. Positive Feedback o Very easy to navigate! o You did a very good job of referring to the DOE o The list of adaptations will be extremely useful for teachers **2. Website Characteristics – Content** o Some citations supporting the different adaptations might be useful o More examples of each type of adaptation o The information sheet is not needed **3. The User** o Many teachers struggle with 'when' an adaptation is needed o I think that development and implementation of adaptations is becoming the role of resource teachers. Classroom teachers need more instruction and accountability for their delivery o Most teachers are well informed regarding adaptations and the types	**1. Website Characteristics - Content** o Resources from Reading Rockets are heavy. It would be great to have more variety o Add links o There were good suggestions however I think there are a lot of effective and valuable professional resources that could have been included **2. Positive Feedback** o Amazing session. Loads of helpful links/lists o Remedial approaches are evidence-based and provide an excellent set of resources **3. Technical Issues** o Last bullet is old (from Session 4) o Slide 10: First bullet: 'There is' should read 'There are' o Spelling errors	**1. Positive Feedback** o Great links in the supplementary materials section o Very practical o Love the famous people with LD **2. Website Characteristics - Content** o I would stress that AT is essential for our students with LD especially as they move towards middle school and high school o Would be interested in how to get more information on UDL o More focus on what AT can do for the students to level the playing field **3. Technical Issues** o I didn't find the recommended resource about talking to a child about his/her LD in the supplemental material, as noted in the slide show. o There were spelling errors on some slides o Review text features some things are in bold that should just be in brackets

Table 6

Examples of qualitative comments for the most frequently reported codes from the End of Program Questionnaire.

Overall Program Comments
1. Positive Feedback
o Your work on assistive technology and universal design alleviated most of my concerns
o The sessions were mostly well laid out. They were presented in a logical order
o The information was excellent
o The handouts were outstanding
o Easy to read through, not overly time consuming, very well organized, visually appealing, evidence-based
o I think it is very comprehensive and stresses the importance of adaptations AND remediation
o I will be referring to it and referring others to it as well
2. Website Characteristics – Content
o I would have liked to seen more activities and discussion around preparing and planning a classroom intervention plan
o More information on evaluating and improving upon selected interventions
o As adaptations do not pop up until Session 4 and remediation until Session 5, I think it is possible that post-intervention scores upon RCT testing may underestimate the value of the program. Additional follow-up testing will be important
o I am not sure about the information about the school psychologist
o Given that there was a fair bit of info on ADHD (including the very good video from SickKids) I wonder about providing some evidence based info on medication as many teachers do look for that info
o I would have liked to have seen more information on executive functioning and some strategies/ready to use resources.

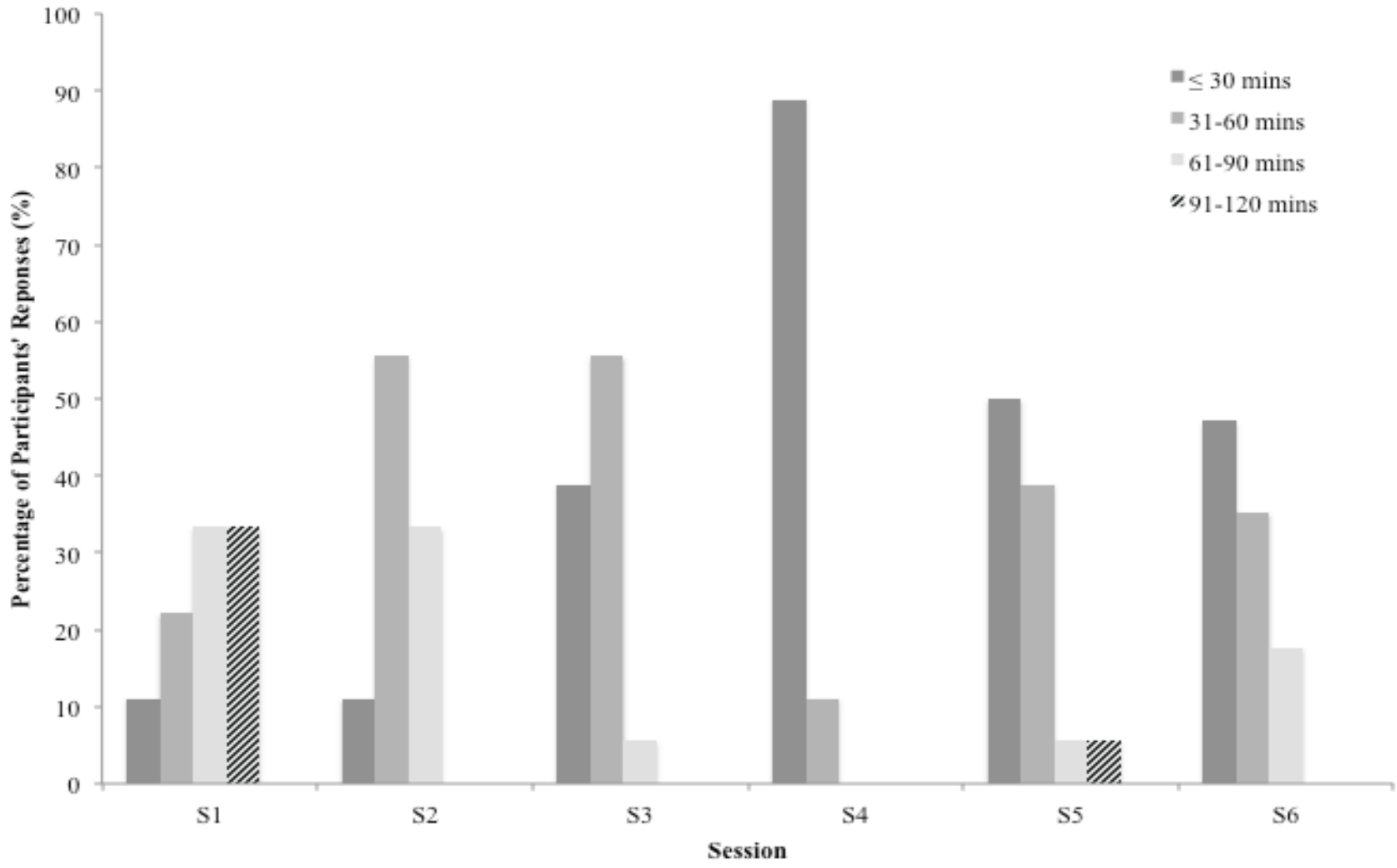

Figure 1. Participant reported time spent reviewing the materials for each session of the *Teacher Help for LD* intervention program.

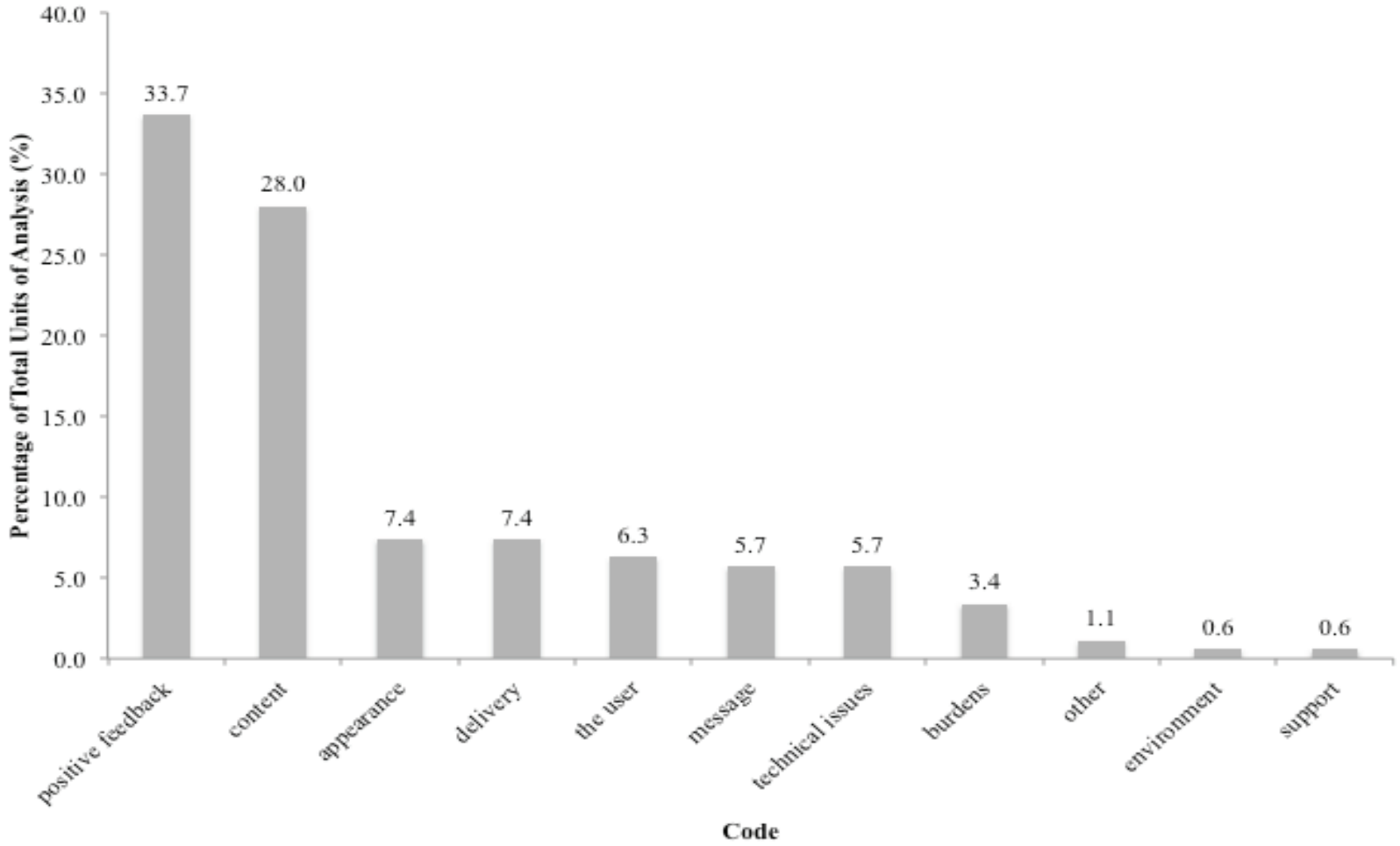

Figure 2. Distribution of codes for qualitative feedback provided by LD specialists for Session 1 of the *Teacher Help for LD* intervention program.

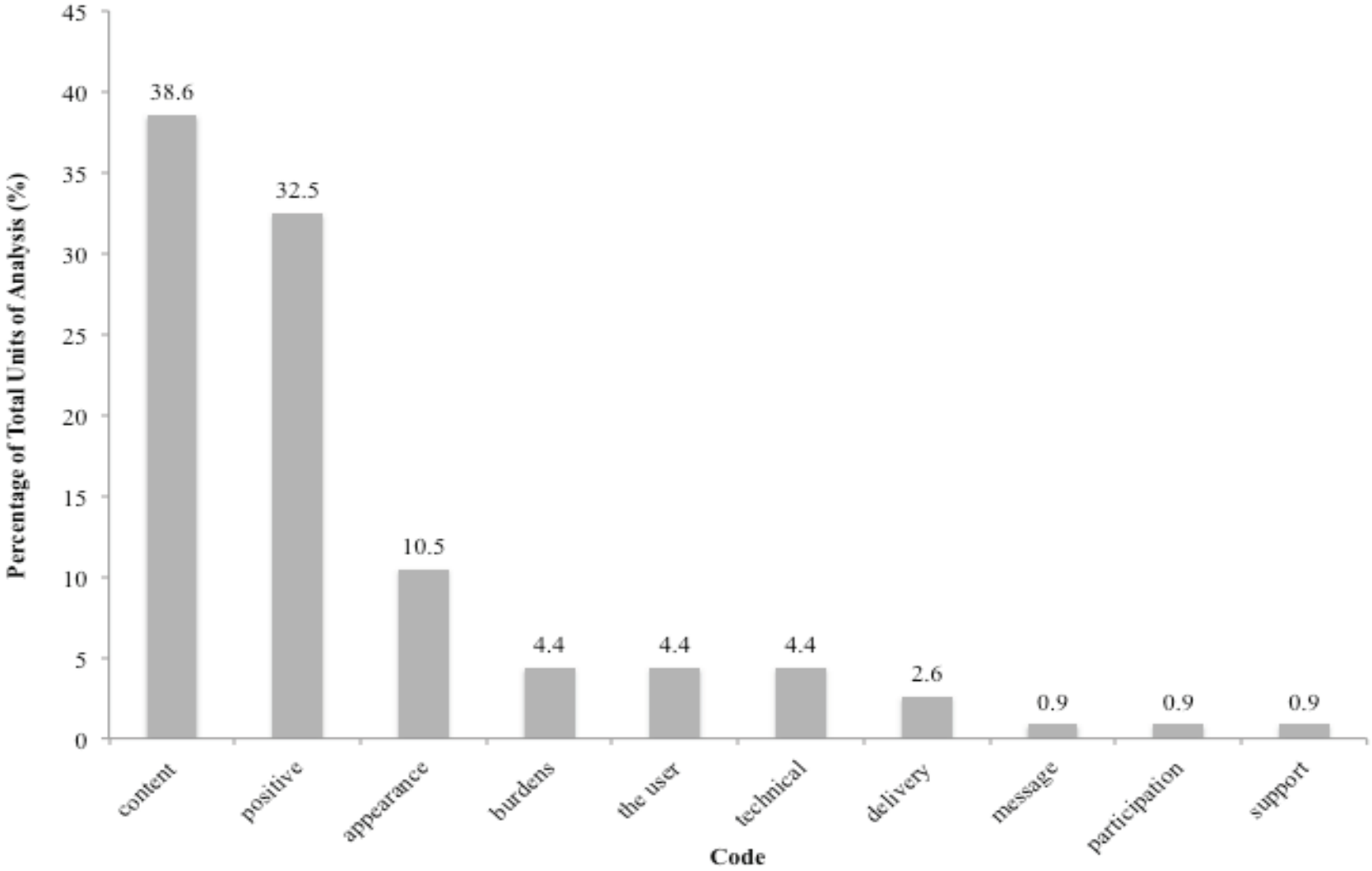

Figure 3. Distribution of codes for qualitative feedback provided by LD specialists for Session 2 of the *Teacher Help for LD* intervention program.

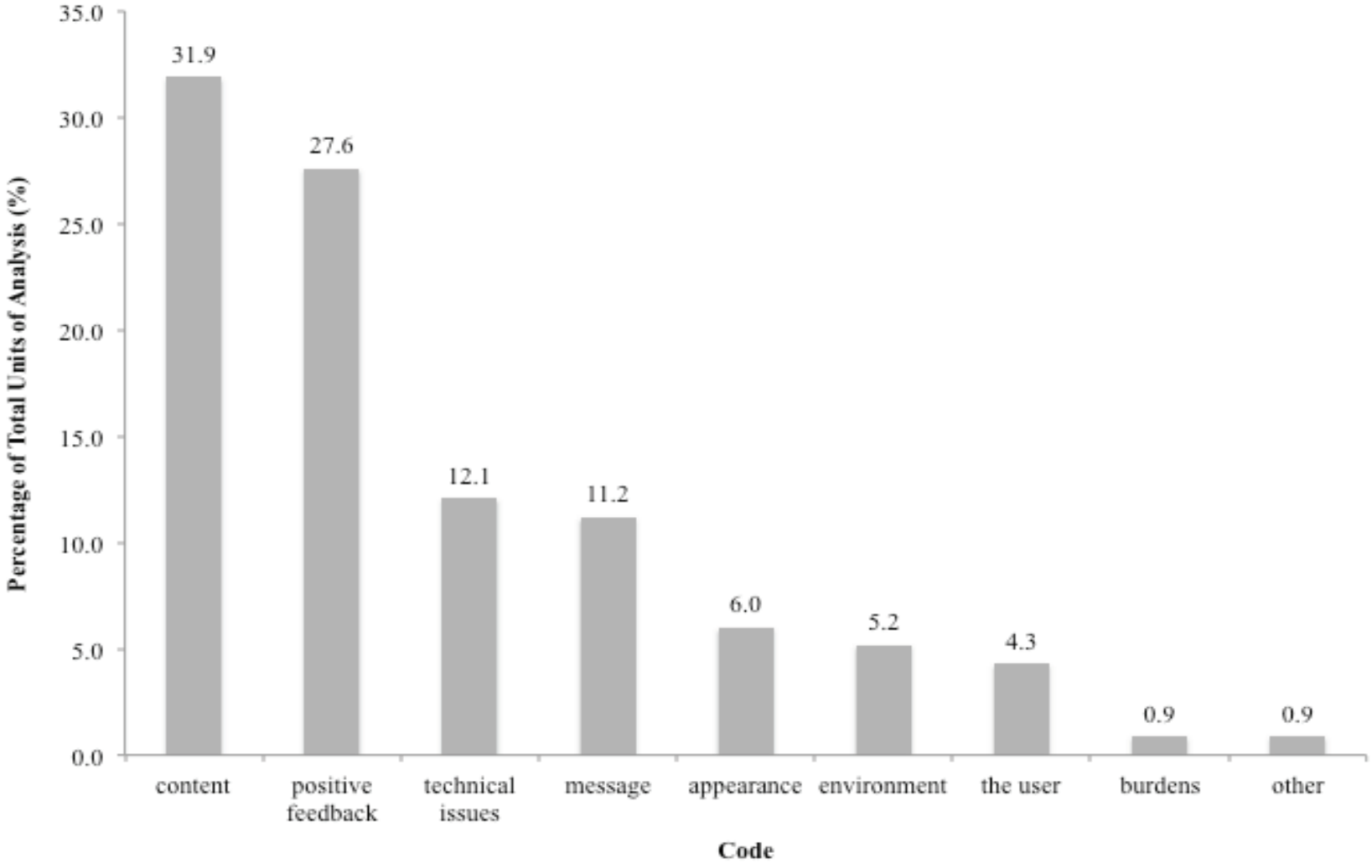

Figure 4. Distribution of codes for qualitative feedback provided by LD specialists for Session 3 of the *Teacher Help for LD* intervention program.

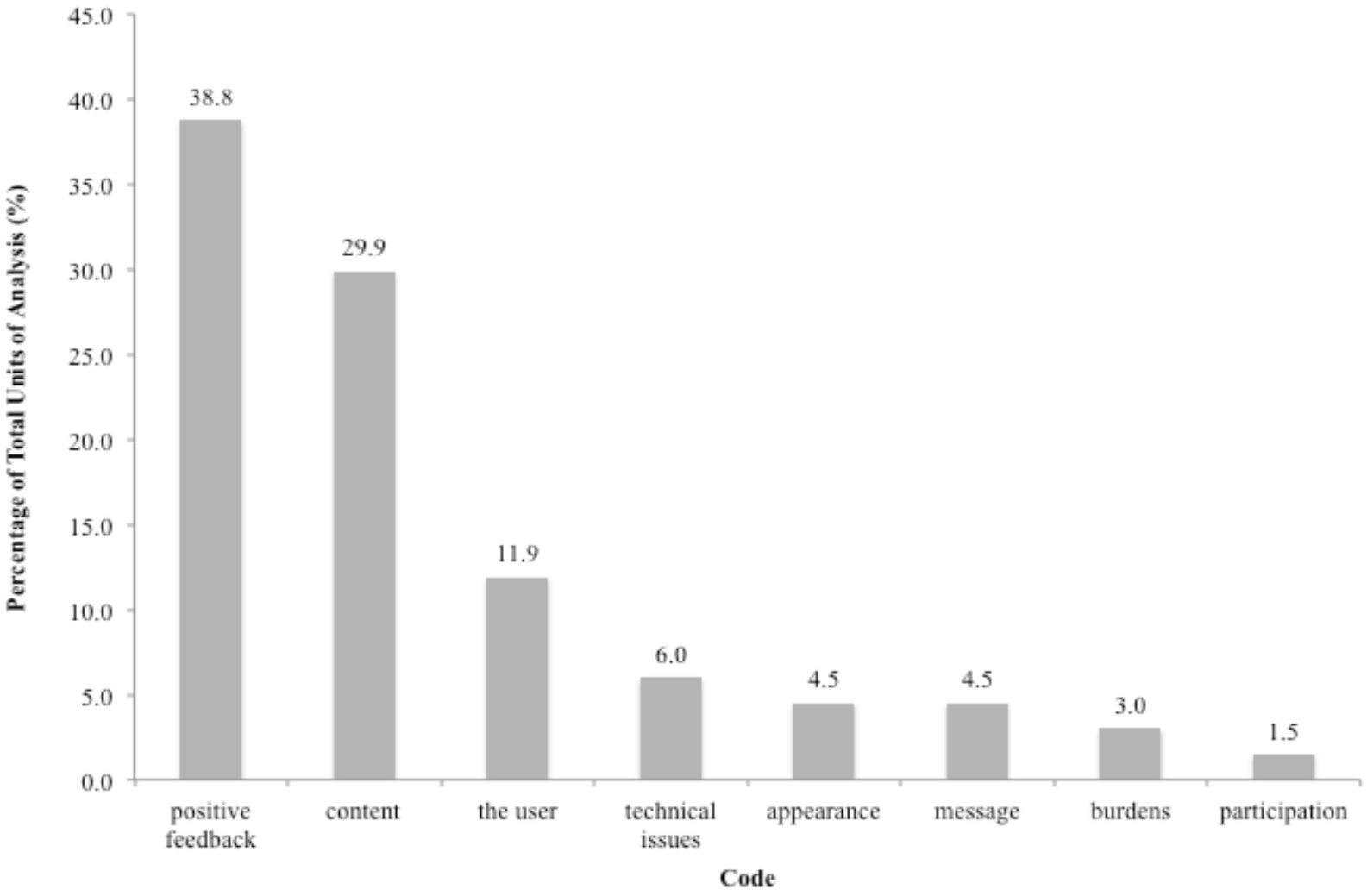

Figure 5. Distribution of codes for qualitative feedback provided by LD specialists for Session 4 of the *Teacher Help for LD* intervention program.

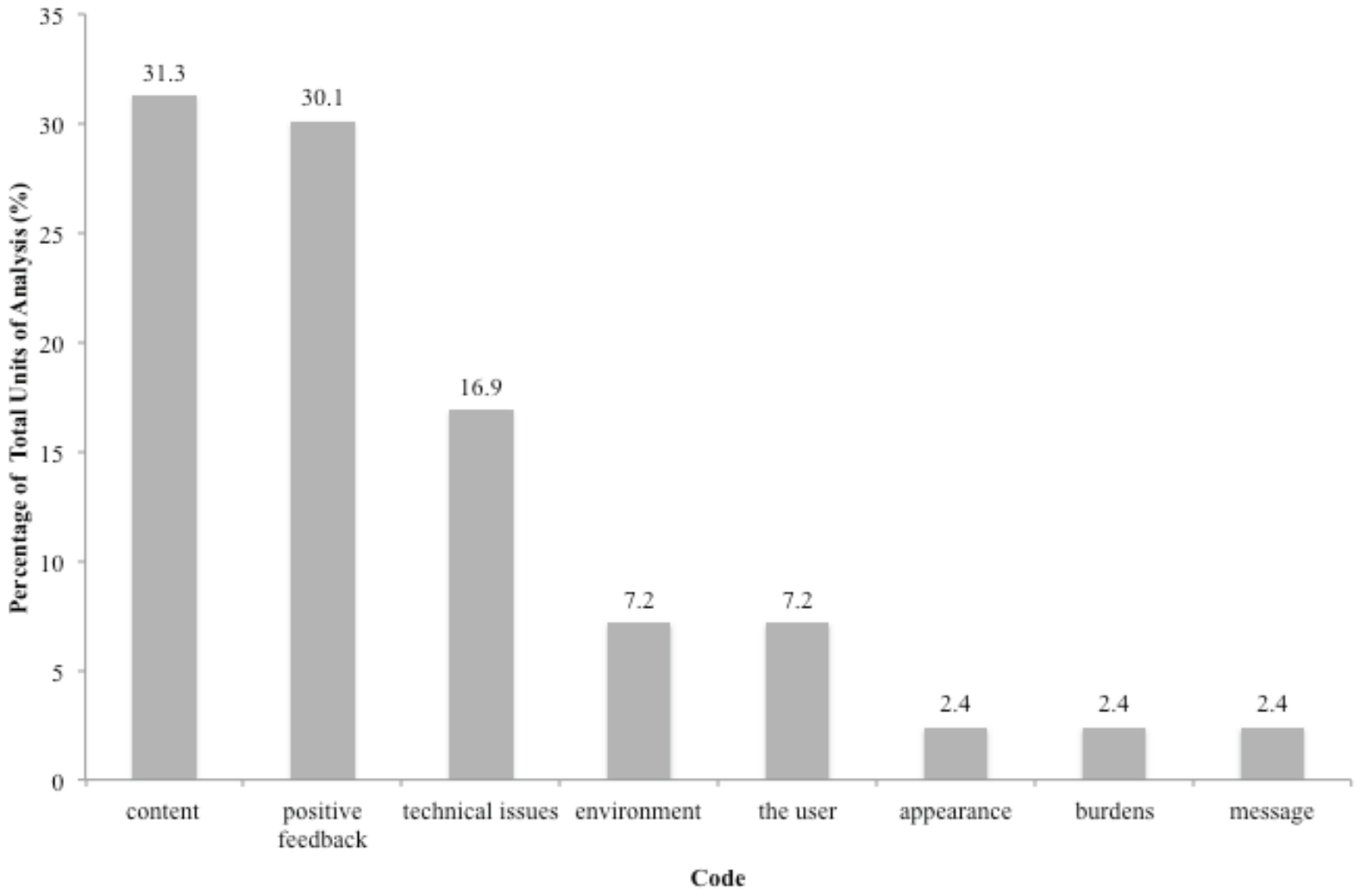

Figure 6. Distribution of codes for qualitative feedback provided by LD specialists for Session 5 of the *Teacher Help of LD* intervention program.

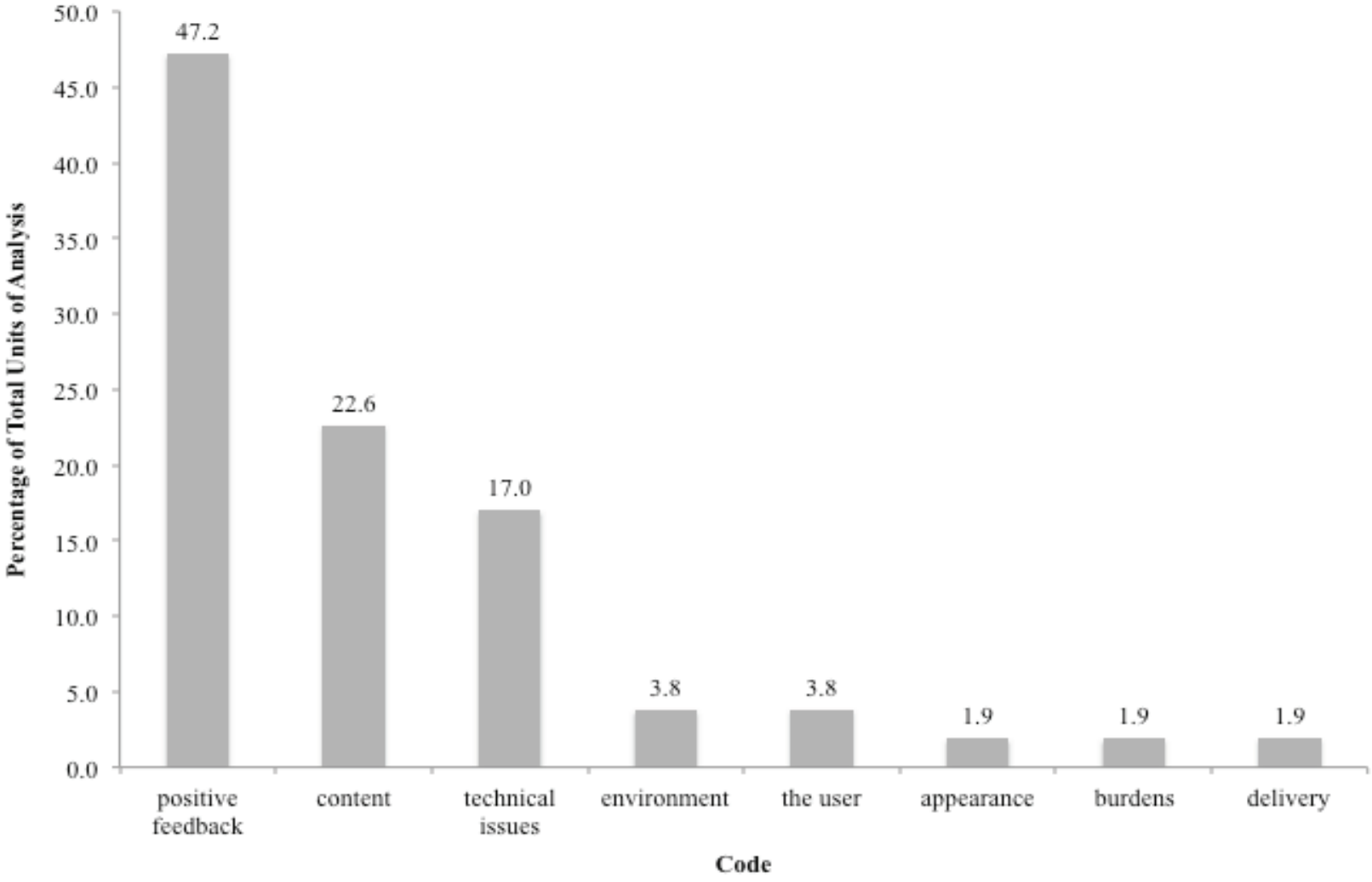

Figure 7. Distribution of codes for qualitative feedback provided by LD specialists for Session 6 of the *Teacher Help for LD* intervention program.

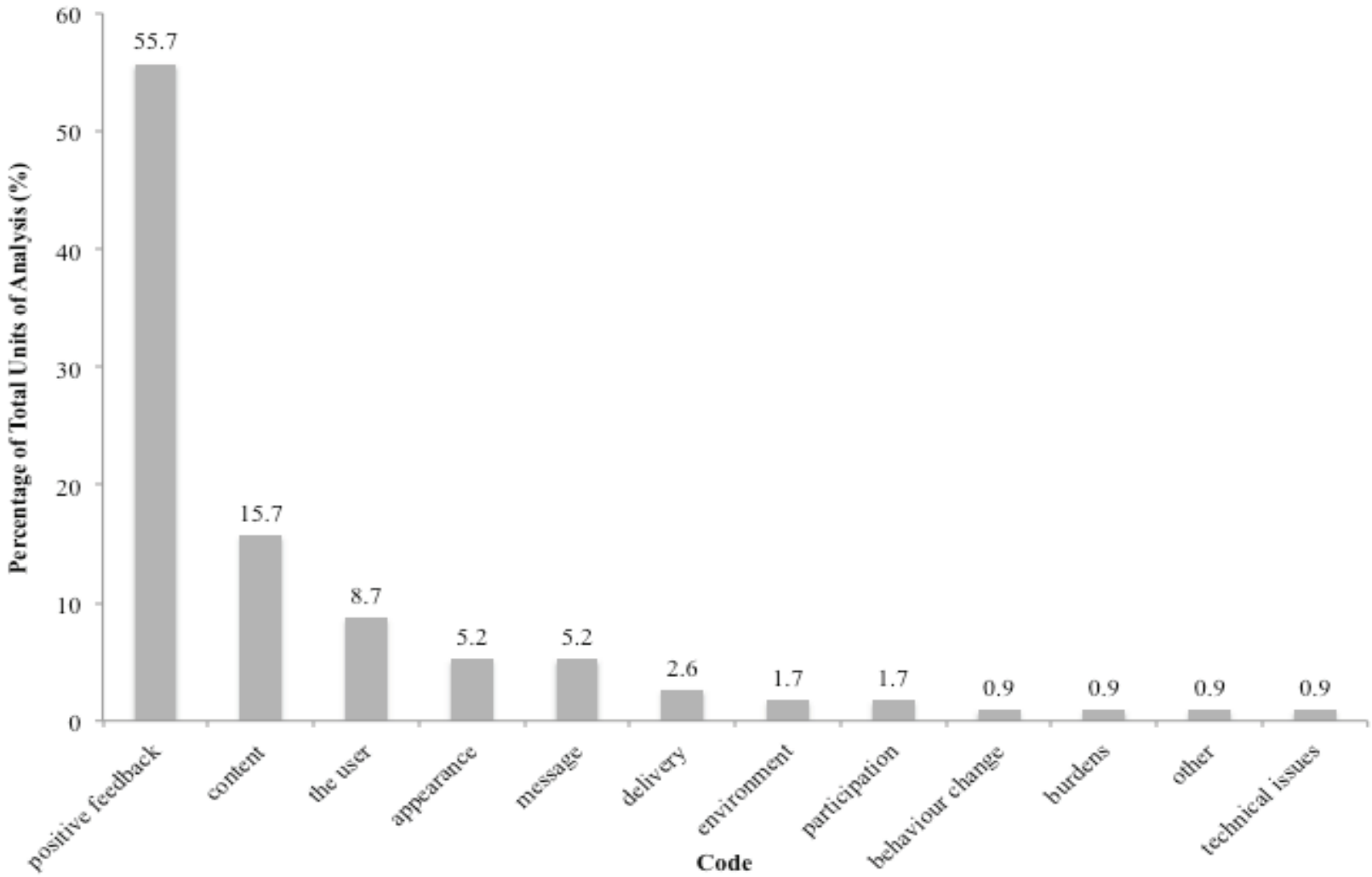

Figure 8. Distribution of codes for qualitative feedback provided by LD specialists for the *Teacher Help for LD* intervention program.

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Appendix A
The Official Definition of a Learning Disability as adopted by the Learning Disabilities Association of Canada in 2002

Learning Disabilities refer to a number of disorders which may affect the acquisition, organization, retention, understanding or use of verbal or nonverbal information. These disorders affect learning in individuals who otherwise demonstrate at least average abilities essential for thinking and/or reasoning. As such, learning disabilities are distinct from global intellectual deficiency.

Learning disabilities result from impairments in one or more processes related to perceiving, thinking, remembering or learning. These include, but are not limited to: language processing; phonological processing; visual spatial processing; processing speed; memory and attention; and executive functions (e.g. planning and decision-making).

Learning disabilities range in severity and may interfere with the acquisition and use of one or more of the following:

- oral language (e.g. listening, speaking, understanding);
- reading (e.g. decoding, phonetic knowledge, word recognition, comprehension);
- written language (e.g. spelling and written expression); and
- mathematics (e.g. computation, problem solving).

Learning disabilities may also involve difficulties with organizational skills, social perception, social interaction and perspective taking.

Learning disabilities are lifelong. The way in which they are expressed may vary over an individual's lifetime, depending on the interaction between the demands of the environment and the individual's strengths and needs. Learning disabilities are suggested by unexpected academic under-achievement or achievement which is maintained only by unusually high levels of effort and support.

Learning disabilities are due to genetic and/or neurobiological factors or injury that alters brain functioning in a manner which affects one or more processes related to learning. These disorders are not due primarily to hearing and/or vision problems, socio-economic factors, cultural or linguistic differences, lack of motivation or ineffective teaching, although these factors may further complicate the challenges faced by individuals with learning disabilities. Learning disabilities may co-exist with various conditions including attentional, behavioural and emotional disorders, sensory impairments or other medical conditions.

For success, individuals with learning disabilities require early identification and timely specialized assessments and interventions involving home, school, community and workplace settings. The interventions need to be appropriate for each individual's learning disability subtype and, at a minimum, include the provision of:

- specific skill instruction;
- accommodations;
- compensatory strategies; and
- self-advocacy skills.

Appendix B
Descriptions of the Sessions of the *Teacher Help for LD* intervention program

Session	Title	Description
1	What is a LD?	Teachers learn about the definition of a LD (according to the definition provided by the Learning Disability Association of Canada) along with general information about LDs [i.e., prevalence of LD, correct terminology in NS, an introduction to cognitive processes (e.g., phonological processing), and myths and facts associated with LD].
2	Associated characteristics, risk factors, and comorbid conditions	Teachers learn more in-depth information about LD, including what LD typically looks like in the classroom, how LD can affect social and emotional development, and how the symptoms of a LD can change throughout the lifespan. In-depth information is provided on comorbid conditions, with particular emphasis on the relationship between LD and ADHD and LD and internalizing disorders. We ask teachers to start thinking about their own student who has a LD and his or her symptoms and strengths and weaknesses (which will be used as the first step in building the intervention program for their student).
3	How are LD identified and diagnosed?	This session provides teachers with an overview on the assessment and diagnostic process of individuals suspected of having a LD. Teachers are introduced to The LD Support Team and the roles of the individuals involved. Teachers are encouraged to seek out support from the LD Support Team on a regular basis. During Session 3 teachers are asked to take the intervention for their student one step further by identifying his or her cognitive and academic strengths and weaknesses. To help guide teachers in the process they are provided with case studies, information sheets, and worksheets.
4	Adaptations for LD	In this session teachers are provided with detailed information on what adaptations are, how they can help students with LDs, and how to select appropriate adaptations for their student based on the areas of processing and learning affected by his or her LD. Teachers learn that selecting and monitoring the effectiveness of adaptations should be an ongoing process in conjunction with the LD Support Team.
5	Remediation for LD	Teachers learn about effective remediation for LDs affecting math, reading, and writing, how to choose appropriate remediation strategies, and how to monitor student progress and make changes in a student's program, as appropriate.
6	Assistive technology, demystification of LD, & wrapping up the *Teacher Help for LD* program	In this last session, teachers learn about assistive technology (AT) and how AT can be used to both compensate for and remediate LD. Teachers are also given some information about how to talk to their student about his or her LD, and finally previous sessions of the Teac*her Help for LD* program are summarized. A number of additional resources are provided in the supplemental materials section for Session six.

Appendix C
Demographic Questionnaire

1) Age (Give number or type "Do not wish to disclose"): _____

2) What is your sex:
   - Male
   - Female
   - Prefer not to answer

3) Please select your current profession:
   - Resource Teacher
   - Learning Center Teacher
   - Learning Disability Itinerant Teacher
   - School Psychologist
   - Clinical Psychologist
   - Speech-Language Pathologist
   - Occupational Therapist
   - Other (please specify): _____
   - Prefer not to answer

4) Please enter your highest level of education (e.g., BSc, BA, BEd, MA, MSc, PhD) or type "prefer not to answer": _____

5) Across all settings in which you work professionally (including academic positions), what **percent** of your time is spent working with children with learning disabilities (or type "prefer not to answer"): _____%

6) How many years have you been working professionally in the field of learning disabilities? (or type "prefer not to answer"): _____years

7) Please describe your experience working with children (i.e., ages 6-12) who have learning disabilities. (or type "prefer not to answer") _____

8) How would you rate your current knowledge of learning disabilities?
   - Very knowledgeable
   - Moderately knowledgeable
   - A little bit knowledgeable
   - Not very knowledgeable
   - Unknowledgeable
   - Prefer not to answer

Appendix D
End of Session Usability Questionnaire (same for all sessions)

The following statements pertain to the usability of Session X of the *Teacher Help for LD* intervention. When thinking about the usability of Session X, we would like you to consider that *Teacher Help for LD* is an intervention program aimed towards elementary classroom teachers with average skills and knowledge related to learning disabilities. Please choose the response that best describes the extent to which you agree with each statement.

1. How long (approximately) did it take you to review all of the materials for session x?

- o 30 minutes or less
- o 31-60 minutes
- o 61-90 minutes
- o 91-120 minutes
- o More than 120 minutes (Please record time in the space provided: _____)

2. If a classroom teacher was going to work through this session with a student and apply the information learned, how long do you anticipate it would take?

- o Less than 20 minutes
- o 20 minutes
- o 30 minutes
- o 40 minutes
- o 1 hour
- o 1.5 hours
- o 2 hours
- o 2.5 hours
- o 3 hours
- o 3.5 hours
- o 4 hours
- o More than 4 hours

Useful:
3a.Session x of the *Teacher Help for LD* program is a useful (i.e., helpful) resource for elementary teachers of students with learning disabilities.

- o 1 – Strongly Disagree
- o 2 – Disagree
- o 3 – Neutral
- o 4 – Agree
- o 5 – Strongly Agree

3b. Please indicate below the changes you think would be required so that this session would provide teachers with information that will help them to become more knowledgeable about learning disabilities.

1 – No changes required

2 - Minor changes required (please describe)

3 – Major changes required (please describe)

Usable/Findable:
4a. Session (one) of the *Teacher Help for LD* program is user-friendly and would be easy for teachers to navigate.

- 1 – Strongly Disagree
- 2 – Disagree
- 3 – Neutral
- 4 – Agree
- 5 – Strongly Agree

4b. Please indicate below the changes you think would be required so that a teacher would find this session user-friendly.

1 – No changes required

2- Minor changes required (please describe)

3- Major changes required (please describe)

4c. Please indicate below the changes you think would be required so that a teacher would find this session easy to navigate.

1 - No changes required

2 – Minor changes required (please describe)

3 – Major changes required (please describe)

Desirable:
5a. Session x of the *Teacher Help for LD* program would be visually appealing to teachers and the content is organized logically for teacher use.

- 1 – Strongly Disagree
- 2 – Disagree
- 3 – Neutral
- 4 – Agree
- 5 – Strongly Agree

5b. Please indicate below the changes you think would be required so that a teacher would find this session visually appealing.

1- No changes required

2 - Minor changes required (please describe)

3 - Major changes required (please describe)

5c. Please indicate below the changes you think would be required so that a teacher would find this session well-organized.

1 – No changes required

2- Minor changes required (please describe)

3-Major changes required (please describe)

Accessible
6a.The average teacher would understand session (one) of the *Teacher Help for LD program*.

- 1 – Strongly Disagree
- 2 – Disagree
- 3 – Neutral
- 4 – Agree
- 5 – Strongly Agree

6b. Please indicate below the changes you think would be required so that a teacher would easily understand the information provided by the *Teacher Help for LD* intervention program.

1 – No changes required

2 – Minor changes required (please describe)

3 – Major changes required (please describe)

Credible

7a. A teacher would believe that the information provided in this session comes from a reputable source and would trust the information in this session enough to feel comfortable using it to help students with learning disabilities in the classroom.

- 1 – Strongly Disagree
- 2 – Disagree
- 3 – Neutral
- 4 – Agree
- 5 – Strongly Agree

7b. Please indicate below the changes you think would be required so that a teacher would believe that the information provided in this session comes from a reputable source.

1- No changes required

2 - Minor changes required (please describe)

3 - Major changes required (please describe)

7c. Please indicate below the changes you think would be required so that a teacher would trust the information in this session enough to feel comfortable using it to provide interventions to students with learning disabilities in their classrooms.

1 – No changes required

2- Minor changes required (please describe)

3 – Major changes required (please describe)

Accuracy

8a. Session (one) of the *Teacher Help for LD* intervention program provides teachers with accurate, evidence-based information on how to help students with learning disabilities in the classroom.

- 1 – Strongly Disagree
- 2 – Disagree
- 3 – Neutral
- 4 – Agree
- 5 – Strongly Agree

8b. Please indicate below the changes you think would be required so that this session would provide teachers with accurate information.

1 – No changes required

2 – Minor changes required (please describe)

3 – Major changes required (please describe)

8c. Please indicate below the changes you think would be required so that the content of this session would be consistent with evidence-based information.

1- No changes required

2 - Minor changes required (please describe)

3 - Major changes required (please describe)

Valuable

9a. Session (one) of the *Teacher Help for LD* intervention program is a valuable resource for teachers of students with learning disabilities.

- 1 – Strongly Disagree
- 2 – Disagree
- 3 – Neutral
- 4 – Agree
- 5 – Strongly Agree

9b. Please indicate below the changes you think would be required so that the information provided in this session would be valuable to a teacher of a student with a learning disability.

1 – No changes required

2 – Minor changes required (please describe)

3 – Major changes required (please describe)

10. Overall, how satisfied do you think an elementary classroom teacher would be with session (one) of the *Teacher Help for LD* intervention?

- 1 – Not at all satisfied
- 2 – Slightly satisfied
- 3 – Moderately satisfied
- 4 – Very satisfied
- 5 – Extremely satisfied

11. Please provide any other general comments about Session (One) of the *Teacher Help for LD* program. For example, we would be interested in knowing if you believe there is any missing information or information that is not relevant.

Appendix E
End of Program Usability Questionnaire

The following statements pertain to the usability of the *Teacher Help for LD* intervention **as a whole**. When thinking about the usability of the intervention program, we would like you to consider that *Teacher Help for LD* is an intervention program aimed towards elementary classroom teachers with average skills and knowledge related to learning disabilities. Please choose the response that best describes the extent to which you agree with each statement.

Useful:
1. Overall, the *Teacher Help for LD* program provides information that would be useful for elementary school teachers of students with learning disabilities.

- 1 – Strongly Disagree
- 2 – Disagree
- 3 – Neutral
- 4 – Agree
- 5 – Strongly Agree

Usable/Findable:
2. Overall, the *Teacher Help for LD* program is user-friendly and easy for teachers to navigate.

- 1 – Strongly Disagree
- 2 – Disagree
- 3 – Neutral
- 4 – Agree
- 5 – Strongly Agree

Desirable:
3. Overall, the *Teacher Help for LD* program is visually appealing and the content was organized logically for teacher use.

- 1 – Strongly Disagree
- 2 – Disagree
- 3 – Neutral
- 4 – Agree
- 5 – Strongly Agree

Accessible
4. Overall, teachers would easily understand the information provided in the *Teacher Help for LD* program.

- 1 – Strongly Disagree
- 2 – Disagree
- 3 – Neutral
- 4 – Agree
- 5 – Strongly Agree

Credible

5. Overall, teachers would believe the information provided in the *Teacher Help for LD* program comes from a reputable source and would trust the information enough to feel comfortable using it to help students with learning disabilities in their classroom.

- 1 – Strongly Disagree
- 2 – Disagree
- 3 – Neutral
- 4 – Agree
- 5 – Strongly Agree

Accuracy

6. Overall, the information provided in the *Teacher Help for LD* program provides teachers with accurate, evidence-based information on how to help students with learning disabilities in the classroom.

- 1 – Strongly Disagree
- 2 – Disagree
- 3 – Neutral
- 4 – Agree
- 5 – Strongly Agree

Valuable

7. Overall, the information provided in the *Teacher Help for LD* program is a valuable resource for teachers of students with learning disabilities.

- 1 – Strongly Disagree
- 2 – Disagree
- 3 – Neutral
- 4 – Agree
- 5 – Strongly Agree

General Feedback

8. Was there anything that you would have liked to have seen in the *Teacher Help for LD* intervention that was not included in the version you reviewed?

- Yes (please describe)

  _____

  _____

- No

9. Was there anything that you think should be removed from the *Teacher Help for LD* intervention?

- o Yes (please describe)

  _____
  _____

- o No

10. Overall, how satisfied do you think a teacher would be with the *Teacher Help for LD* intervention?

- o 1 – Not at all satisfied
- o 2 – Slightly satisfied
- o 3 – Moderately satisfied
- o 4 – Very satisfied
- o 5 – Extremely satisfied

11. What I liked about the *Teacher Help for LD* program:

12. What I didn't like about the *Teacher Help for LD* program:

13. Please provide any other general comments about the *Teacher Help for LD* program:

Appendix F

Coding Scheme – Adapted from Ritterband et al. (2009) and Speth et al. (2014)

1. **The User** (User Characteristics)

Set of characteristics possessed by the user. These characteristics can be both fixed (e.g., age, gender) while others are not fixed and may be modified (e.g., cognitive factors, beliefs and attitudes, skills). These user characteristics may serve as predictor variables or be targeted for change along with the identified problem. The main areas of user characteristics are:

- Disease (pathology, severity of the disease, problem being targeted)
- Demographics (age, gender, socioeconomic status)
- Traits (personality, temperament, intelligence)
- Cognitive factors (cognitive style (verbal vs. visual) information processing, developmental stage, goal setting and pursuit, decision making, judgment, self-efficacy, knowledge, self-regulatory strategies (e.g., planning))
- Beliefs and attitudes (treatment expectations, intentions, interest, motivation, readiness for change (stage of change), self-efficacy, perceived benefits and barriers to treatment)
- Physiological factors (motor functioning)
- Skills related to both psychological mindedness
- Skills related to computer abilities
- Language: user's capacity to understand the language (i.e., on the user's end)

2. **Environment** (Environmental Factors)

This factor includes environmental influences such as family/significant others/friends, employer/organization/school, the health care system, community, and societal level influences, such as the media, policy and cultural factors. The environment can provide support or serve as a barrier to individuals implementing a self-help intervention.

- Things that are already present in the environment
- Setting, e.g., school system, classroom
- Accessibility of intervention (e.g., ease of accessing the program online) Restraints placed on clinician and/or teacher or challenges that arise based on system in which they work
    - E.g., limited time with clients, high caseloads, differences in terminology
- Includes reassurance/emotional support that doesn't necessarily constitute extra support (i.e., not coded as 3 if external support isn't directly discussed/implied)
    - Includes others encouraging or discouraging use

3. **Support**

This factor refers to support that is external to the intervention itself. Support directly impacts website use and the development of the website. Support can be delivered in a variety of ways including personalized emails, instant messaging, phone communication, and in-person meetings.

- Provide more personalized support for teachers throughout the intervention
- Things that aren't already in the environment or part of the intervention
- External to intervention, but related to it

4. **Website** (Website Characteristics)
Factors related to the web program or website itself. The main areas of the website are:

a) Appearance
This factor relates to the look and feel of the website. Elements include use of color, page/screen layout, organization of content, and screen size.

- Includes suggestions for breaking intervention down into 2 or 3 sessions,
- Includes reducing the amount of text
- Chunking, breaking apart, or re-arranging information

b) Burdens
This factor relates to burdens that are specific to the content of the intervention, and that are not related to technological or environmental obstacles (such as accessing the internet). Burdens include difficulty of use related to the length and navigation of the intervention.

- Long/tedious in length
- Ease of use
- Too much information

c) Content
This factor relates to the actual information provided by the intervention and further, whether the content is accurate, clear and simple.

- Content – JUST information (concerns about editing of videos/images etc. coded as 4e)
- Empirical evidence - Includes suggestions to add references and/or web links
- Concern re: content (whether valid or not)
- Includes suggestions for content
- Includes suggestions to make resource materials more recent/less outdated
- Language: related to clarity etc. of website language (i.e., on the intervention's end, as opposed to the user's end)
- Concerns re: representativeness/applicability of data (e.g., whether the intervention includes questions/suggestions that relate to children of different ages)

d) Delivery
This factor relates to the ways in which the content is delivered to the user. Methods of delivery include animations, audio, illustrations/graphics, text, video, and vignettes/testimonials/stories.

- Includes criticisms re: content of existing graphics, videos, etc.
- Ask: Would the criticism be the same if it were in a different modality? (If specific to modality, code as 4e, BUT if not specific to modality and more in terms of content, code as 4d)
- Includes criticisms re: video is dated without specific reference to content or terminology included within the video

e) Message

This factor relates to the source and the style of the content, in other words, who created the content and the way in which it is presented. Characteristics of the source include credibility (trustworthiness and expertise) and likability (the extent to which the user enjoys using the website).

- Diversity, relatability, representativeness of website in how it's presented (note: concerns re: representativeness of intervention itself coded as 4d)
- Includes criticisms of specific terminology that would change the way the information is presented or represented without changing the content

f) Participation

This factor relates to the extent to which the website engages the user in the intervention. Elements of participation include interaction (the user interfacing with the system resulting in a cause-and-effect action), reinforcement (rewards, used to motivate the user to progress, can include feedback that's made available to the user), and testing (questions/quizzes).

- Cause & effect interaction with website

5. **Technical Issues**

Factor not taken from Ritterband et al. (2009). This factor relates to technical problems that may be, or have been, experienced by users (e.g., videos not playing, typos).

- Any technical issues that are under responsibility intervention designer (e.g., wrong text, missing materials)
- Includes items that would receive complaints because they have been done incorrectly (i.e., typos, broken links, etc.)
- Grammar, spelling, etc.

6. **Positive Feedback**

Factor not taken from Ritterband et al. (2009). This factor relates to any positive feedback, regardless of whether it relates to the factors from the Ritterband et al. (2009) model.

7. **Other**

This code is reserved for any feedback that does not clearly relate to any of the codes above.

8. **Behaviour Change**

Behaviours that are identified for change - specific to the problem or intervention (e.g., more knowledge of LD)