Examining Canadian Teacher's Perceptions of the Importance of Cognitive Abilities in the Classroom

by

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Abstract

The current study examined the perceptions of pre-service and in-service teachers of the importance of different Cattell-Horn-Carroll (CHC) cognitive abilities in the classroom. The sample included 227 pre-service teachers from the University of Alberta and 44 in-service teachers from the St. Albert Catholic School district. Reliability (Coefficient alpha), and the mean level of importance was calculated for the responses of the two groups. An independent samples *t*-test evaluated whether there were significant differences in the ratings of the two groups. Finally, Within- Subject ANOVA evaluated whether the ratings for the level of importance differed significantly within each group. The results indicated that both the pre-service and the in-service teachers perceived Fluid Reasoning (Gf) as one of the most important predictors of student success in the classroom, followed by Crystallized Ability (Gc), Quantitative Ability (Gq), and Visual Processing (Gv). The results from the independent samples t-test displayed no significant differences in mean ratings between the two groups on all of the cognitive abilities. Implications for teaching practice as well as teacher-psychologist consultation are discussed.

Keywords: Cattell-Horn-Carroll (CHC) abilities, pre-service teachers, in-service teachers

Preface

This thesis is an original work by Deepak Singh. The research project, of which this thesis is a part, received research ethics approval from the University of Alberta Research Ethics Board, Project Name "Examining Canadian Teacher's Perceptions of Cognitive Abilities in the Classroom", No. Pro00058977, 16/09/2016.

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Examining Canadian Teacher's Perceptions of the Importance of Cognitive Abilities in the Classroom

School psychologists and teachers work together to help students succeed. Historically, teachers have considered the psychologists' role within schools to be important, but they believe that a closer relationship between the two professions would be beneficial (O'Hagan & Swanson, 1983). This was especially true in terms of being able to work collaboratively towards student development and in order to see the educational psychologist's job as worthwhile. (O'Hagan & Swanson, 1983). Similarly, teachers from eight different countries (Cyprus, Denmark, England, Estonia, Greece, South Africa, Turkey, and The United States of America) disclosed that they valued the services provided by the school psychologists and that they would like more services from the school psychologists (Farrell, Jimerson, Kalambouka, & Benoit, 2005). Specifically, teachers reported that school psychologists regularly spend time on tasks such as assessing individual students for special education placement, assessing for appropriate therapeutic services, and advising teachers and staff on children with particular behavior problems. However, teachers consistently reported a need for school psychologists to provide additional services such as working with teachers on entire school development as well as development of the curriculum, teacher training, vocational guidance, and working with parents. The teachers are consistently in contact with the school psychologists whether it's making referrals, learning interventions, or consulting. Buchanan (2011), discussed how the teachers are the primary readers of psychoeducational reports written by the school psychologists and there's an expectation that the teachers will follow the recommendations made in the report. Additionally, the teachers also use the information provided in the reports to further support the child in a better way. It is important

that both the school psychologists and the teachers have similar understanding of the issues that may be affecting the students so that they are able to help the students in a more proficient way.

Cattell-Horn-Carroll (CHC) Theory of Cognitive Abilities

According to Miller (2007), Cattell-Horn-Carroll theory represents a framework of human cognitive abilities consisting of three strata. **"**Cattell-Horn-Carroll (CHC) theory is a recent synthesis of the Cattell-Horn Gf-Gc theory and the Carroll three-stratum theory of cognitive abilities" (Miller, 2007, p. 461). General intelligence (g) represents stratum III, broad cognitive abilities represent stratum II, and narrow cognitive abilities represent the stratum I. General intelligence (g) is involved in complex higher-order cognitive processes. The broad abilities represent "basic constitutional and long-standing characteristics of individuals that can govern or influence a great variety of behaviors in a given domain" (Miller, 2007, p. 461). The narrow abilities "represent greater specialization of abilities, often in quite specific ways that reflect the effects of experience and learning, or the adoption of particular strategies of performance" (Miller. 2007, p. 461). Fiorello et al. (2009) discussed several broad abilities associated to academic achievement. These broad abilities include Fluid Reasoning (Gf), Crystallized Intelligence or Comprehension Knowledge (Gc), Visual Processing (Gv), Processing Speed (Gs), Auditory Processing (Ga), Short-Term Memory (Gsm), Long-Term Storage and Retrieval (Glr), and Quantitative Knowledge (Gq). Other broad abilities include Reaction and Decision Speed (Gt), Psychomotor Speed (Gps), Domain-Specific Knowledge (Gkn), Reading and Writing (Grw), Olfactory Abilities (Ga), Tactile Abilities (Gh), Kinesthetic Abilities (Gk), and Psychomotor Abilities (Gp; Schneider and McGrew, 2012). For the purpose of this study, only the eight broad abilities included in the Fiorello et al. (2009) study will be briefly defined here.

Broad CHC abilities. According to Schneider and McGrew (2012), Fluid Reasoning (Gf) is defined as the "deliberate but flexible control of attention to solve novel, on-the-spot problems that cannot be performed by relying exclusively on previously learned habits, schemas, and scripts" (p. 111); Crystallized Intelligence or Comprehension Knowledge (Gc) is the "depth and breadth of knowledge and skills that are valued by one's culture" (p. 122); Visual Processing (Gv) is the "ability to make use of simulated mental imagery (often in conjunction with currently perceived images) to solve problems" (p. 129); Processing Speed (Gs) is the "ability to perform simple, repetitive cognitive tasks quickly and fluently" (p. 119); Auditory Processing (Ga) is the "ability to detect and process meaningful nonverbal information in sound" (p. 131); Short-Term Memory (Gsm) is the "ability to encode, maintain, and manipulate information in one's immediate awareness" (p. 114); Long-Term Retrieval (Glr) is the "ability to store, consolidate, and retrieve information over periods of time measured in minutes, hours, days, and years" (p. 116), and Quantitative Knowledge (Gq) includes the "depth and breadth of knowledge related to mathematics" (p. 127).

Previous Study

Fiorello, Thurman, Zavertnik, Sher, and Coleman (2009) discussed the role of broad cognitive abilities based on the Cattell-Horn-Carroll (CHC) theory in predicting school achievement and compared teachers' and school psychologists' perceptions of the importance of CHC abilities in the classroom. The authors used Cognitive Abilities Questionnaire (CAQ) to measure the level of importance that the teachers and the school psychologists assign to various CHC abilities associated with academic learning. The Broad Ability Descriptors Questionnaires (BADQ) was also administered to the respondents as evidence of construct validity. The BADQ presents the CHC abilities as ability descriptors rather than behavioral indicators as used by the

CAQ. The authors found that the evidence of construct validity differed between the teachers and the school psychologists. The ratings by the teachers on the BADQ did not always show a strong correlation with the items on the subscales of the CAQ. On the other hand, the ratings by the school psychologists on the BADQ showed a strong correlation with the items on the subscales of the CAQ. The authors suggested that this is likely due to the school psychologists being familiar with the CHC model through their professional training, in comparison to the teachers.

Overall, both the school psychologists and the teachers rated quantitative knowledge (Gq), crystallized intelligence (Gc), and fluid reasoning (Gf) as the most important CHC abilities in terms of academic success. The authors also found that the school psychologists rated short-term memory (Gsm) and quantitative knowledge (Gq) as being more important to student's success in the classrooms in comparison to the teachers. Finally, the school psychologists and the teachers rated visual processing (Gv), processing speed (Gs), auditory processing (Ga), and long-term retrieval (Glr) similarly in terms of its importance. The Fiorello et al. (2009) study used a sample of teachers and school psychologists from the United States of America and it has been a number of years since the findings of the study. The importance of CHC abilities in the Canadian classrooms may differ from the United States. Due to a lack of empirical evidence, the use of CHC abilities in Canadian classrooms is currently unknown. Therefore, the current study will attempt to find the importance and the usage of different CHC abilities in the Canadian classrooms by comparing the perceptions of in-training and in-service teachers from the province of Alberta.

CHC Theory and Academic Achievement

CHC and reading achievement. In order to explore the relationship between CHC abilities and reading achievement, McGrew and Wendling (2010) conducted a review of 19

studies. The results indicated that the CHC abilities of Comprehension-Knowledge (Gc), Long-term Retrieval (Glr), Processing Speed (Gs), and Short-term Memory (Gsm) consistently predicted basic reading skills. The broad abilities of Fluid Reasoning (Gf), Visual Processing (Gv), and Auditory Processing (Ga) did not show a significant relationship to basic reading skills. In terms of reading comprehension (RC), the results indicated a significant relationship with Auditory Processing (Ga), Comprehension-Knowledge (Gc), Long-term Retrieval (Glr), and Short-term Memory (Gsm). Broad abilities of Processing Speed (Gs), Fluid Reasoning (Gf), and Visual Processing (Gv) did not show a significant relationship with RC. Further, Evans, Floyd, McGrew, and Leforgee (2002) examined the relationship between CHC cognitive abilities and reading achievement using the Woodcock-Johnson III clusters. The results displayed that Comprehension-Knowledge (Gc) demonstrated the strongest relationship to both basic reading skills and reading comprehension. Short-Term Memory (Gsm) consistently displayed moderate relationship with basic reading skills, but the relationship to reading comprehension was much smaller in magnitude. Auditory Processing (Ga) displayed moderate relationship with basic reading skills and reading comprehension from ages 6 to 9. Long-Term Retrieval (Glr) displayed moderate relationship to basic reading skills for ages 6 to 9 and ages 6 to 11 for reading comprehension. Processing Speed (Gs) also displayed moderate relationship to both basic reading skills and reading comprehension from ages 6 to 10. The CHC abilities of Fluid Reasoning (Gf) and Visual-Spatial Thinking (Gv) displayed no consistent relationship across all age groups. Finally, Floyd, Keith, Taub, and McGrew (2007) also examined the effect of CHC abilities on reading decoding skills and found General intelligence (g) to have indirect effect on reading decoding skills. Five CHC abilities (Auditory Processing, Short-term Memory, Long-term Storage and Retrieval, Crystallized Intelligence, and Processing Speed) displayed

significant effect on reading decoding skills. Visual Processing (Gv) and Fluid reasoning (Gf) did not influence reading decoding skills. It is important to note that latest study by Cormier, McGrew, Bulut, and Funamoto (2016b) indicates that the cognitive abilities of Fluid Reasoning (Gf), Auditory Processing (Ga), and Processing Speed (Gs) are shown to be stronger predictors of reading achievement than previously found in the literature.

CHC abilities and math achievement. McGrew and Wendling (2010) reviewed the relationship between CHC cognitive abilities and basic math skills (BMS) and Math Reasoning (MR). BMS includes arithmetic and computational skills and MR includes problem-solving skills related to mathematics. BMS displayed a medium relationship with Comprehension-knowledge (Gc) at ages 9 to 19, and medium relationship with Fluid Reasoning (Gf) and Processing Speed (Gs) across all age groups. Ga, Gv, Glr, and Gsm did not show a consistent relationship with basic math skills (BMS), but this was not consistent with the findings by Floyd, Evans, and McGrew (2003). In terms of Math Reasoning (MR), the relationship varied by age group. There was a low relationship between MR and Gc at ages 6 to 8, medium at ages 9 to 13 and high at ages 14 to 19. Gf demonstrated high relationship at ages 6 to 13 and medium at ages 14 to 19. Gs demonstrated medium relationship at ages 6 to 13. Gsm demonstrated low relationship at ages 14 to 19. The author also discussed how the importance of Gc increased with age. The broad abilities of Ga, Glr, and Gv did not show a significant relationship with MR at any age. Floyd, Evans, and McGrew (2003) examined the relationship between CHC cognitive abilities and mathematics achievement among school-aged population using the Woodcock-Johnson III Tests of achievement. The participants ranged from ages 6 to 19 years. The authors examined the participants' performance on two mathematics clusters of Math Calculation Skills and Math Reasoning. The results indicated that Comprehension-Knowledge (Gc) displayed the

strongest relationship to both the math clusters out of all the CHC abilities. For Math Calculation Skill, Gc displayed moderate relationship after the age of 9. For Math reasoning, Gc demonstrated a moderate relationship until the age of 10 and this relationship was strong for the other age groups. Fluid Reasoning (Gf) displayed a moderate relationship to Math Calculation Skills and moderate to strong relationship to Math Reasoning. Short-term Memory (Gsm) displayed a moderate relationship to Math Calculation Skills after the age of 7 and displayed a moderate relationship to Math Reasoning until the age of 17. Processing Speed (Gs) displayed a moderate to strong relationship with Math Calculation Skills and displayed a moderate relationship with Math Reasoning until the age 14. Long-term Retrieval (Glr) displayed a moderate relationship with both the mathematics clusters but the relationship only existed for ages 6 through 8. Auditory Processing (Ga) displayed moderate relationship with Math Calculation Skills, but this was only true during the early elementary years. Visual-Spatial Thinking (Gv) did not show a significant relationship with Math Calculations Skills or Math Reasoning. Finally, a study by Merkel (2001) found Comprehension-knowledge (Gc), Visual-Spatial Thinking (Gv), and Long-term Retrieval to be significant predictors of math reasoning among preschool children. Overall, as discussed, different CHC abilities have been shown to be related to various areas of math achievement, though the relationship may differ by age.

CHC abilities and writing achievement. Floyd, McGrew, and Evans (2008) examined the contribution of CHC cognitive abilities in explaining writing achievement among individuals aged 7 to 18 years. The authors used four tests from the WJ III Tests of Achievement to form two writing clusters. Basic Writing Skills cluster included spelling, punctuation, and capitalization rules. The Written Expression cluster included compositional fluency and accuracy. The results indicated that Comprehension-Knowledge (Gc) was the strongest and most consistent

predictor of writing achievement and the effect was strongest at the start of age 10. Processing Speed (Gs) demonstrated moderate effects on both of the writing clusters throughout the age groups studied. Short-Term Memory (Gsm) displayed moderate effects on both writing clusters after age 7. Long-Term Retrieval (Glr) displayed strong to moderate effects on basic writing skills cluster and moderate effects on written expression cluster. This effect only existed for individuals in the early elementary grades. Auditory Processing (Ga) displayed minor effects on basic writing skills and moderate effects on written expression cluster. The moderate effect was only observed at age 7 and the late adolescent years. Fluid Reasoning (Gf) exhibited minor effects on both writing clusters until the late adolescence, however these effects were moderate after late adolescence. Finally, Visual-Spatial Thinking (Gv) exhibited negligible effects for both the writing clusters throughout the age groups analyzed in the study. Merkel (2001) conducted a regression analysis and the results indicated that Processing Speed (Gs) and Auditory Memory Span (Gsm) are important contributors to basic writing skills when age is entered into the regression equation. When age is not entered into the regression equation, Processing Speed (Gs) and Fluid Reasoning (Gf) are important contributors to basic writing skills.

Though the theory itself is important for school psychologists, teachers are more likely to be interested in the practical implications of different CHC constructs in the classroom learning (Fiorello et al., 2009). One of the main goals of CHC theory is to make the individualized psychoeducational assessment more valuable in providing recommendations for teachers and providing recommendations for appropriate school based interventions. In order to effectively use the recommendations based on the various CHC abilities, both the teachers and the school psychologists should have a similar understanding of these abilities.

Importance of Teacher-Psychologist Consultation

The *Blueprint for Training and Practice III* published by the National Associations of School Psychologists (Ysseldyke et al., 2006) confers different domains of competence necessary to be an effective school psychologist. One of these domains stresses the importance of interpersonal and collaborative skills of the school psychologist. The collaborative consultation process between the school psychologists and the teachers can help promote change at the student, classroom, school and even district levels.

As discussed by Olvera and Gomez-Cerillo (2011), Flanagan et al. (2010), and Miller (2007), CHC-based assessments tools are important in identifying the strengths and weaknesses of children. This in turn can help teachers and school psychologists support their students in a more appropriate way. Gonzalez, Nelson, Gutkin, and Shwery (2004) conferred that the collaborative consultation process between the teachers and the school psychologists can help improve the knowledge and problem solving skills of the teachers. Additionally, this can increase teacher's effectiveness in dealing with a variety of children. The consultation process between the teachers and the school psychologists may have certain costs associated with it, such as the time demands of the consultation and the fear or discomfort that the teachers might experience over loss of control (Gonzalez et al., 2004). However, the consultation process has many potential benefits for the teachers, such as receiving support when their students present with behavioral or instructional problems and the opportunity to learn new strategies to be successful in resolving the presenting problem. Further, if the consultation process leads to successful student outcomes, it will reduce the teacher's workload (Gonzalez et al., 2004).

CHC Theory and Teachers

As discussed in Fiorello et al. (2009), perceived importance of various CHC abilities can differ between the teachers and the school psychologists. The teachers in the study rated short-term memory (Gsm) and quantitative knowledge (Gq) as being less important to student's success in the classroom when compared to school psychologists' ratings. Petruccelli, Fiorello, and Thurman (2010) compared teachers' and school psychologists' accuracy of assigning academic tasks to CHC cognitive abilities. The school psychologists were more accurate at assigning basic academic tasks to the appropriate CHC cognitive ability. School psychologists accurately placed 25 of the 34 academic tasks in the appropriate CHC cognitive ability category, whereas the teachers only assigned 16 of the 34 tasks accurately. The results indicated that teachers and school psychologist differed in their perception of the CHC cognitive abilities associations with certain academic tasks. Overall, for both the school psychologists and the teachers, the items assigned incorrectly belong to areas of fluid reasoning and crystallized intelligence. Since teacher's understanding of their student's cognitive abilities can affect the teachers' referral process and the interventions that they may use, it is important that the teachers can accurately determine the underlying cognitive ability that may be affecting the student's performance (Petruccelli et al., 2010). In general, the teachers are more satisfied with the assessment results when the school psychologists use CHC-based cognitive abilities in their reports to explain the findings (Buchanan, 2011). Therefore, it is important for school psychologists and teachers to have a similar understanding of the CHC based cognitive abilities. This way, the teachers can accurately refer the student for the appropriate support and implement interventions that will be successful in helping the student.

Current Study

The current study aims to extend previous findings of Fiorello et al. (2009) by focusing on a different population of interest (i.e. Canadian teachers). Historically, the U.S curriculum has differed from other countries including Canada (McKnight, 1987). Levin (2011) also discussed the difference in funding levels among school districts and the differences in consistency of curriculum, teaching methods as well as teacher training methods across U.S and Canada. This difference in teaching practice across the two countries makes it important to assess the results of the Fiorello et al. (2009) study among the Canadian population, as it is possible that what is seen as important to classroom success by the teachers in U.S may be different from teachers in Canada. Fiorello and colleagues examined teachers' and school psychologists' perception of the importance of different CHC cognitive abilities in the classroom. Given the prominence of CHC theory in current psychological practices, this study will focus on teacher's perceptions and use of CHC abilities in the classroom. Further, this study will extend previous findings by examining potential differences between pre-service teachers and practicing teachers. Specifically, the current study will address the following research questions:

1) What behavioral indicators of cognitive abilities do *pre-service* teachers perceive as important to success in the classroom?
2) What behavioral indicators do *in-service* teachers perceive as important to success in the classroom?
3) To what extent do *pre-service* and *in-service* teachers differ in their perceived level of importance of the different cognitive abilities to classroom success?

Method

Participants

Two hundred and twenty-seven undergraduate students (pre-service teachers) from the Faculty of Education at the University of Alberta and forty-four teachers (in-service teachers) from the St Albert Catholic school district participated in the study. Sample demographics are presented in Table 1. A non-probability sampling method was used to recruit participants for the study. This involved a combination of convenience and snowball sampling technique. For the pre-service teachers, information on the study was available to them on the University of Alberta research participation system (i.e. SONA system) and students were able to sign-up for the study for one course credit as part of EDPY 304. For the in-service teachers, an invitation email including the link to the google form was sent through their internal email from the associate superintendent responsible for student services. The in-service teachers were given the opportunity to be entered in a draw to win one of five $25 Starbucks gift cards. Both groups participated in the study online. There were no restrictions on participating in this study based on demographics characteristics. Therefore, the participants were not excluded or included in the study based on specific demographics parameters.

Materials

Cognitive Abilities Questionnaire (CAQ). The Cognitive Abilities Questionnaire includes 37 items rated on a scale of 1 to 5 (1 = not at all important and 5 = Very Important). According to Fiorello et al. (2009), the CAQ assesses the level of importance assigned to different CHC abilities that are shown to be associated with different aspects of learning in the classroom. These CHC abilities include Fluid Reasoning (Gf), Crystallized Ability (Gc), Visual Processing (Gv), Auditory Processing-Phonetic Coding (Ga-Pc), Short-Term Memory (Gsm),

Long-Term Storage (Glr), Processing Speed (Gs), and Quantitative Ability (Gq). To measure each cognitive ability, the CAQ uses several items to describe everyday skills.

Psychometric properties of the CAQ. As described by Fiorello et al. (2009) a panel of experts in the area of cognitive assessment provided their opinion on how well each item on the CAQ measured the associated CHC ability (Fiorello et al., 2009). The experts rated the items on a scale of 1 to 5 (1 = "Not at all" and 5 = "Excellent example of the construct"). The items with an average rating of less than four were discarded. Two rounds of ratings were conducted before finalizing the items for the scale. After finalizing the items for the scale, CAQ was provided to a sample of in-service and pre-service teachers as a measure of its reliability. The results from these initial tryouts indicated that the CAQ had an overall reliability of .93 and the subscales had a median reliability of .74. All the questions included in the CAQ for the current study can be found in Table 2. Furthermore, the Fiorello et al. (2009) results indicated that the total CAQ scale demonstrated a reliability of .93 for both the school psychologists and the teachers. In the current study, Coefficient alpha was also computed for the scores for each subscale on the CAQ. The items and the overall scale was also analyzed based on the coefficient alpha values if certain items were to be deleted. For the pre-service, deletion of Item 1 and Item 36 only displayed a slight increase in the coefficient alpha of their respective subscales of Gf and Gv. Deleting item 1 and 36 increased the coefficient alpha from .72 to.74 and .71 to .75 for Gf and Gv respectively. Similarly, for the in-service teachers, deletion of several items (Item 36, 34, 19, and 8) only resulted in a slight increase in the coefficient alpha of their respective scales of Gv, Ga-PC, Gsm, and Gs. Deleting item 36, 34, 19, and 8 increased the coefficient alpha from .81 to .82, .90 to .91, .77 to .79, and .76 to .77 for Gv, Ga-PC, Gsm, and Gs respectively. Due to a small amount of increase in the alpha coefficient and in order to maintain a level of consistency across data

analysis, none of the items were deleted from the analysis. Overall, total CAQ scores had a reliability of .90 and .95 for the pre-service and the in-service teachers, respectively. For both the pre-service and the in-service teachers, Gq demonstrated the highest reliability (.90 and .95 respectively). Gsm demonstrated the lowest reliability (.55) for the pre-service teachers whereas Glr demonstrated the lowest reliability (.66) for the in-service teachers. The reliability data for the individual subscales can be found in Table 3.

Procedure

All of the participants completed the study online. The pre-service teachers signed up for the study through the University of Alberta SONA System (i.e. a research participation for credit system) and the in-service teachers joined the study through the help of Associate Superintendent of Student Services for the St. Albert Catholic school district. The University of Alberta SONA system collected the data from the pre-service teachers whereas google forms collected the data from the in-service teachers. The pre-service teachers received 1 credit towards their course requirement for participating in the study whereas the in-service teachers received a chance to win 1 of 5 Starbucks cards valued at 25$ each. The study was approximately half an hour to an hour in length. The first part of the study obtained participant's informed consent. Participants then completed the CAQ and the items on the CAQ were presented in a random order. Finally, the participants completed the six demographics questions. As discussed before, the CAQ asked the participants to rate the items on a scale of 1 to 5, with 1 being "not at all important" and 5 being "very important." At the end of the study the participants were thanked for their participation.

Data analysis. The mean of ratings on CAQ was calculated for the pre-service and the in-service teachers and Within-Subjects ANOVA assessed for significant differences in the level

of importance placed on each CHC ability. Pairwise comparison assessed which mean ratings of the level of importance of the CHC cognitive abilities significantly differed from one another. Finally, an independent samples *t*-test evaluated whether the difference between the ratings of the two groups were significant for each of the broad CHC abilities included in the questionnaire (i.e. Gf, Gc, Gv, Ga-PC, Gsm, Glr, Gs, and Gq).

Results

Importance Ratings on the CAQ

A p-value of 0.05 was established based on the consideration that this is usually the recommended value in the social sciences fields (e.g. psychology and sociology). A more stringent p-value (0.01) is more often used in the medical field. With regards to the mean level of importance assigned to the eight CHC abilities within each group, the results from ANOVA indicated the following: For the pre-service teachers, Mauchly's test indicated that the assumption of sphericity had been violated, χ^2 (27) = 431.80, p = .00, therefore degrees of freedom were corrected using Greenhouse-Geisser estimate of sphericity (ε = .59). The results indicated that there was a significant difference in the mean ratings of the eight cognitive abilities by the pre-service teachers, F(4.11, 929.72) = 59.49, p = .00. Pairwise comparison using the Bonferroni post hoc criterion for significance indicated that the pre-service teachers perceived Gf as significantly more important than any of the other cognitive abilities, followed by Gc, Gq, and Gv as second most important, followed by Ga-PC, Glr, and Gs as third most important and finally, Gsm as the least important cognitive ability. For the in-service teachers, Mauchly's test indicated that the assumption of sphericity had been violated, χ^2 (27) = 89.92, p = .00, therefore degrees of freedom were corrected using Greenhouse-Geisser estimate of sphericity (ε = .61). The results indicated that there was a significant difference in the mean

ratings of the eight cognitive abilities by the in-service teachers, $F(4.25, 182.92) = 18.26$, $p = .00$. Pairwise comparison using the Bonferroni post hoc criterion for significance indicated that the in-service teachers perceived Gf and Gq equally as important. Though the in-service teachers perceived Gf as significantly more important than any of the other cognitive abilities, they perceived Gq just as important as Gc, Gv and GaPC. From these cognitive abilities, the in-service teachers perceived Gq, Gc, and Gv as significantly more important than Gsm, Glr, and Gs, but they perceived Ga-Pc just as important as Gsm and Glr. Finally, the in-service teachers perceived Gsm and Glr just as important as Gs.

Overall, both the pre-service and the in-service teachers consistently rated Gf as one of the most important predictor of success in the classroom followed by Gc, Gq and Gv as the second most important. (See Figure 1 and Table 4). An independent samples t-test compared the mean importance of different cognitive abilities as rated by the pre-service and the in-service teachers. Levene's Test for equality of variance demonstrated that all of the cognitive abilities except Gs assumed equal variance. The results from the independent samples t-test suggested that there are no significant differences in means between the two groups on each of the eight broad CHC abilities included in the questionnaire (See Table 4).

Discussion

The results of the current study indicated that both the pre-service and the in-service teachers perceived Gf as the most important predictors of academic success with Gq, Gc and Gv being second most important. When comparing the ratings by the two groups, the results from the independent samples t-test displayed no significant difference between the mean ratings of the two groups on all of the cognitive abilities.

Comparison to Previous Research

The results of the Fiorello et al. (2009) study demonstrated some similarity to the current study as both the school psychologists and the teachers perceived Gf, Gc and Gq as the most important predictors of academic success. The overall reliability of the ratings on the CAQ were also comparable between the studies, with Fiorello et al. (2009) demonstrating a reliability of .93 for both the school psychologists and the teachers (in comparison to the current study reliabilities of .90 and .95 for the pre-service and the in-service groups respectively). Similarly, for both the studies, Gq demonstrated the highest reliability across the comparison groups.

Importance of Results to Teaching Practice

The results suggest that both the pre-service teachers and the in-service teachers perceive certain classroom tasks as more important than other classroom tasks. There is consistency among the two groups in terms of what cognitive abilities they perceived as important, as both groups considered Gf as one of the most important predictors of student success in the classroom, followed by Gc, Gq, and Gv. If teachers perceive certain classroom tasks as more important than others, they may be more likely to implement interventions for those specific classroom tasks. Teacher acceptability along with several other factors such as complexity of the intervention, teacher's perceptions of intervention effectiveness, the match between teacher's teaching style and intervention, and teacher's motivation to intervene are important factors of establishing treatment integrity and the success of the interventions (Mautone et al., 2009). This is particularly important in teacher-psychologist consultations, as school psychologists are in consistent contact with teachers and they are part of a professional team that is responsible for the success of the students. By understanding teacher's perceptions of classroom tasks that are considered important, school psychologists could help explain how student's strengths and

weaknesses may affect their performance on these particular tasks. This collaborative consultation process between the teacher and school psychologist could help improve teacher's knowledge and problem solving skills (Gonzalez, Nelson, Gutkin, & Shwery, 2004). This in turn could help the teachers by increasing their effectiveness in dealing with different children by capitalizing on student's strengths through the tasks that are considered important in the classroom. It is important for practitioners working with students to be aware of the changes in the importance of different cognitive abilities and their associated tasks, in order to support their students based on current empirical evidence (Cormier, Bulut, McGrew, & Frison, 2016a). Finally, by understanding the level of importance placed on different cognitive abilities and by measuring these cognitive abilities, professionals may help explain why some children with deficits in particular academic areas do not respond to interventions (Floyd et al., 2008). This in turn could help them make the necessary changes to the interventions in order to ensure success for the students.

The results from the Fiorello et al. (2009) study also displayed that both the school psychologists and the teachers tend to perceive Gf, Gc, and Gq as the most important abilities for classroom success. Though school psychologists rated Gsm and Gq as significantly more important to classroom success than the teachers, overall the results of the current and Fiorello et al. (2009) study displayed some similarities in terms of the most important cognitive abilities. In the current study, the pre-service and the in-service teachers rated Gf as the most important cognitive ability to classroom success, which varies from the past literature on its relationship to various areas of academic achievement. Previous studies demonstrated that the broad ability of Gf did not show a significant relationship to basic reading skills, Reading comprehension, and reading decoding skills (Evans, Floyd, McGrew & Leforgee, 2002; Floyd, Keith, Taub, &

McGrew, 2007; McGrew & Wendling, 2010). Similarly, Gf only displayed weak effects on basic writing skills and written expression and it displayed some inconsistency in its relationship to mathematics achievement (Floyd, Evans, & McGrew, 2003; Floyd, McGrew & Evans, 2008; McGrew & Wendling, 2010). However, the findings from the recent studies (Cormier et al., 2016a; Cormier, McGrew, Bulut, & Funamoto, 2016b) along with the results of the present study suggest that the importance of Fluid Reasoning (Gf) to various areas of achievement such as math, reading, and writing may have changed over time.

Similarly, the pre-service and the in-service teachers from the current study also rated Visual Processing (Gv) as being important to classroom success, but the results from related research suggests that there is a weak to insignificant relationship between Gv and reading, mathematics, and writing achievement (Evans et al., 2002; Floyd et al., 2003; Floyd et al., 2007; McGrew & Wendling, 2010). It is possible that the teachers in the current study may perceive these cognitive abilities as being more important than some of the other cognitive abilities as these other abilities can be easily accommodated for. For example, children with processing speed deficits may be given more time to complete timed tasks and assignments in order to get a better representation of their ability; Children with working memory deficits, may be provided with step by step instructions in written format in order to prevent the child from being overwhelmed by the amount of directions being provided. Both the pre-service and the in-service teachers rated Gsm as less important than some of the other cognitive abilities (such as Gf, Gc, Gq, and Gv). Though item four and item twenty-three on the Gsm subscale may still measure the concept of short-term memory, the teachers were asked to rate how important each item would be to student's success in the classroom. Therefore, it is likely that the teachers did not perceive these specific items as being relevant to student's success in the classroom, which lead to their

lower ratings on the Gsm subscale. In terms of the level of importance assigned to Gv, future research could potentially explore why the pre-service and the in-service teachers considered Gv as highly important especially when the literature has not fully established the relationship between Gv and various areas of achievement. The pre-service and the in-service teachers also rated the broad ability of Gc as being fairly important to classroom success and this has been established in the literature as Gc displays a consistent relationship to various areas of achievement such as basic reading skills, reading comprehension, basic math skills, math reasoning, and overall writing (Cormier et al, 2016a; Cormier et al, 2016b; Evans et al, 2002; Floyd et al, 2003; Floyd et al, 2008; McGrew & Wendling, 2010; Merkel, 2001).

Though the current study compared the perceptions of the pre-service teachers to the in-service teachers and the Fiorello et al. (2009) study compared the perceptions of teachers to school psychologists, it is still encouraging to see that the results of the study in terms of importance of certain cognitive tasks across the two studies were similar to each other. This suggests that teachers and school psychologists across the two studies agree on the level of importance associated to specific cognitive abilities.

Limitations and Future Research

Though the number of pre-service teachers included in the study is relatively large, the number of in-service teachers is still relatively small, therefore the results of the study should be interpreted with some caution as it may be difficult to generalize the results of this study to the perceptions of all Canadian teachers. The use of non-probability sampling methods further impacts the generalization of the results. The use of non-probability sampling method also raises the question of selection bias and whether the motivation of pre-service and in-service teachers to participate in the study impacted the results. Another limitation of the study is that potential

covariates such as gender, age, and level of experience could also influence the results. Though this study compared the perception of pre-service and in-service teachers, more studies need to be conducted among Canadian population including school psychologists, in order to evaluate the ecological validity of different cognitive abilities and in order to evaluate a level of consistency among the school psychologists and the teachers. This would be especially important in promoting positive consultation sessions between the two professions. Finally, future research could potentially explore why the cognitive ability of Visual Processing (Gv) was rated as being important especially when the literature has not fully established the relationship between Gv and various areas of achievement. It is possible that the relationship between these abilities and various areas of achievement may have changed over time.

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Table 1

Demographics Information on Respondents

		Occupation			
		Pre-Service Teachers (n = 227)		In-Service Teachers (n = 44)	
		n	%	*n*	%
Gender	Male	63	27.8	6	13.6
	Female	160	70.5	38	86.4
	Declined to Answer	4	01.8		
Age	25 or under	177	78.0	1	2.3
	26-40	44	19.4	17	38.6
	41-55	4	01.8	22	50.0
	56 or older			4	9.1
	Declined to Answer	2	0.9		
Years of Experience	<1	104	45.8	22	50.0
	1	61	26.9		
	2-5				
	6-10				
	11-15				
	16-20	3	1.3	11	25.0
	21+	1	0.4	11	25.0
	Declined to Answer	58	25.6		
Highest Level of Education Completed	High School or equivalent	33	14.5		
	Some college	82	36.1		
	Bachelor's degree	93	41.0	26	59.1
	Master's degree	5	2.2	16	36.4
	Doctoral degree	2	0.9	1	2.3
	Registered Psychologists			1	2.3
	Other	6	2.6		
	Declined to Answer	6	2.6		
Ethnicity	White	167	73.6	42	95.5
	Hispanic or	3	1.3		

	Latino				
	Black or African American	7	3.1	1	2.3
	Native American or American Indian	5	2.2		
	Asian/Pacific Islander	24	10.6	1	2.3
	Other	12	5.3		
	Declined to Answer	9	4..0		
Level of Students currently taught or expected to teach	Elementary	78	34.4	19	43.2
	Middle	22	9.7	13	29.5
	Secondary	123	54.2	6	13.6
	Other				
	Declined to Answer	4	1.8		
	Administrator			1	2.3
	Consult to elementary			1	2.3
	Counsellor			1	2.3
	Junior and Senior High			1	2.3
	Various Grades			1	2.3
	All Grades			1	2.3

Table 2

CHC Cognitive Abilities Questionnaire (CAQ)

Gf (Fluid Reasoning) Items	
1. figure out what comes next in a series	1 2 3 4 5
3. derive rules explaining why objects or pictures are in different categories	1 2 3 4 5
10. select the correct missing piece to complete a logical puzzle	1 2 3 4 5
16. figure out which objects go together logically	1 2 3 4 5
Gc (Crystallized Ability) Items	
5. show good language development	1 2 3 4 5
7. know a great deal of general information	1 2 3 4 5
12. have a well-developed vocabulary	1 2 3 4 5
15. understand sentences when words are omitted	1 2 3 4 5
21. complete crossword puzzles	1 2 3 4 5
Gv (Visual Processing) Items	
6. pick out visual item among other distracting items	1 2 3 4 5
9. build a model with blocks or Legos from a picture of the completed model	1 2 3 4 5
11. visualize how an object would look from another perspective	1 2 3 4 5
13. identify a picture that is distorted or has parts missing	1 2 3 4 5
29. know what jigsaw puzzle piece will fit	1 2 3 4 5
36. "see" things in the mind's eye	1 2 3 4 5
Ga-PC (Auditory Processing–Phonetic Coding) Items	
14. tell when two sounds are subtly different	1 2 3 4 5
18. tell when two words sound subtly different	1 2 3 4 5
22. recognize a word when only parts of it are pronounced	1 2 3 4 5
27. say how a word would sound with one sound deleted ("blend" without the /l/)	1 2 3 4 5
32. figure out missing sounds in incomplete words	1 2 3 4 5
34. blend sounds together into meaningful words	1 2 3 4 5
Gsm (Short-Term Memory) Items	
4. remember a phone number briefly before calling it	1 2 3 4 5
19. remember a series of related words	1 2 3 4 5
23. remember the details of a phone message long enough to write them down after hanging up	1 2 3 4 5
25. remember a series of unrelated words	1 2 3 4 5
Glr (Long-Term Storage and Retrieval) Items	
2. remember historical events and dates on a later exam	1 2 3 4 5
26. recall the name of a new acquaintance when you meet again	1 2 3 4 5
28. remember a series of related words when one word is given after a long delay	1 2 3 4 5
30. recall information related to a particular topic quickly	1 2 3 4 5
Gs (Processing Speed) Items	

8. work quickly and accurately on tasks that are already mastered and automatic	1	2	3	4	5
20. quickly and accurately check work against an answer key	1	2	3	4	5
31. quickly copy routine information from the chalkboard	1	2	3	4	5
33. quickly find all the e's on a page	1	2	3	4	5
Gq (Quantitative Ability) Items					
17. figure out oral or written math word problems (not just rote memory of "math facts")	1	2	3	4	5
24. know mathematical concepts and terms	1	2	3	4	5
35. learn and carry out math procedures, such as solving algebraic equations	1	2	3	4	5
37. easily and efficiently work through mathematical problems	1	2	3	4	5

Note. For each of the items, the pre-service and the in-service teachers rated how important it would be for a student to possess that skill or ability to succeed in the classroom. Ratings are from 1 = not at all important to 5 = very important.

Table 3

Reliability of Subscales and Total Scale on the CHC CAQ

CHC ability	Number of items	Coefficient alpha: Pre-Service Teachers	Coefficient alpha: In-Service Teachers
Gf	4	.72	.80
Gc	5	.67	.78
Gv	6	.71	.81
Ga-PC	6	.84	.90
Gsm	4	.55	.77
Glr	4	.60	.66
Gs	4	.64	.76
Gq	4	.91	.95
Total	37	.90	.95

Table 4

Mean ratings by the pre-service and the in-service teachers of the importance of cognitive abilities to classroom success and the t-test results

Mean Ratings			
Cognitive Ability	Status	Mean	Standard Deviation
Fluid Reasoning (Gf)	Pre-Service Teachers	3.660	.644
	In-Service Teachers	3.818	.756
Crystallized Ability (Gc)	Pre-Service Teachers	3.402	.617
	In-Service Teachers	3.496	.733
Visual Processing (Gv)	Pre-Service Teachers	3.277	.634
	In-Service Teachers	3.409	.762
Auditory Processing-Phonetic Coding (Ga-PC)	Pre-Service Teachers	3.044	.858
	In-Service Teachers	3.292	1.022
Short-Term Memory (Gsm)	Pre-Service Teachers	2.687	.669
	In-Service Teachers	2.892	.936
Long-Term Storage and Retrieval (Glr)	Pre-Service Teachers	2.996	.685
	In-Service Teachers	2.921	.749
Processing Speed (Gs)	Pre-Service Teachers	2.851	.771
	In-Service Teachers	2.705	.880
Quantitative Ability (Gq)	Pre-Service Teachers	3.362	1.121
	In-Service Teachers	3.693	1.199

Independent samples t-test		
Cognitive Ability	t	Sig (2-tailed)
Fluid Reasoning (Gf)	-1.451	.148
Crystallized Ability (Gc)	-0.893	.373
Visual Processing (Gv)	-1.223	.222
Auditory Processing-Phonetic Coding (Ga-PC)	-1.696	.091
Short-Term Memory (Gsm)	-1.384	.172
Long-Term Storage and Retrieval (Glr)	0.656	.513
Processing Speed (Gs)	1.129	.260
Quantitative Ability (Gq)	-1.772	.078

Note. Ratings are on a 1-5 scale, with 1 being "not at all important" and 5 being "very important." The independent samples t-test P value was set at .05

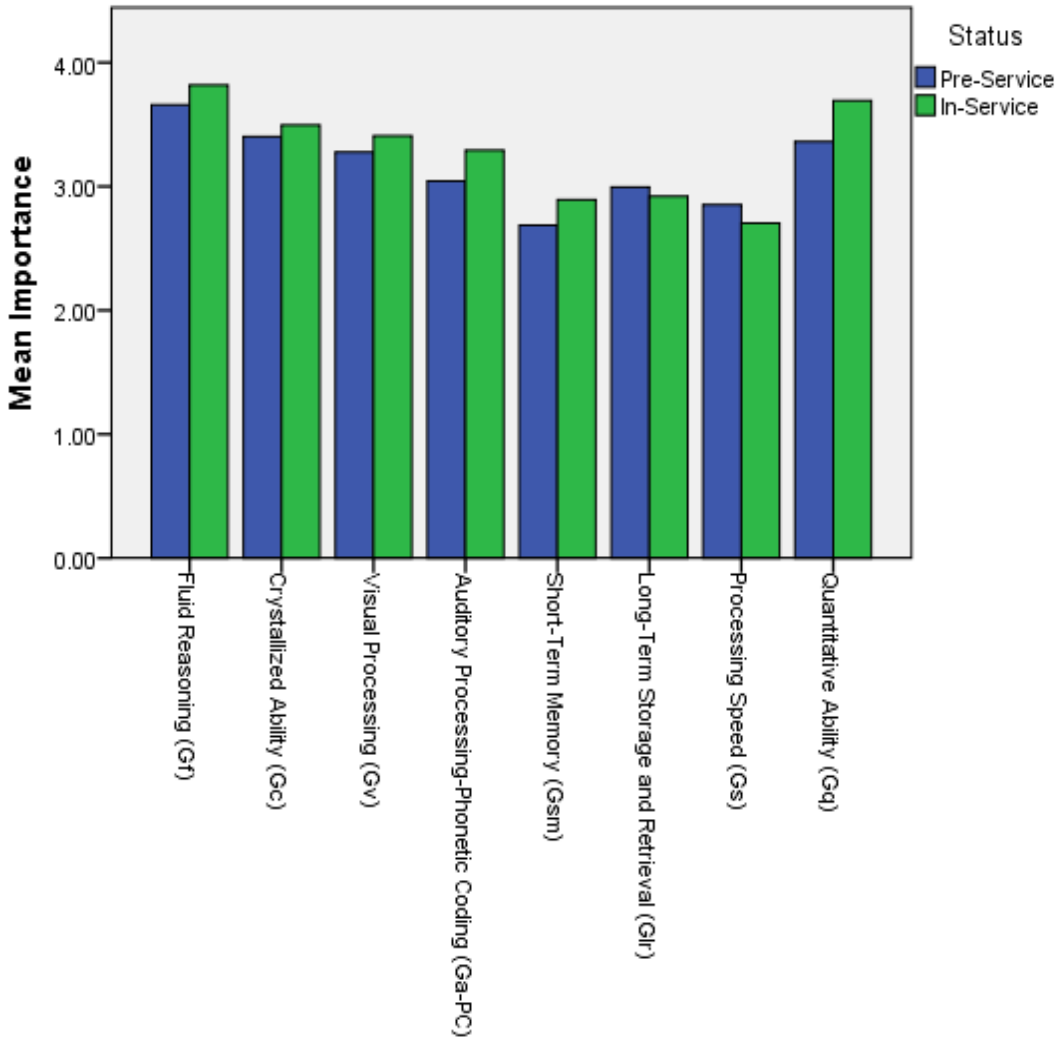

Figure 1. Mean ratings by the pre-service and the in-service teachers of the importance of cognitive abilities to classroom success. Ratings are on a 1-5 scale, with 1 being "not at all important" and 5 being "very important."