Designing and implementing a test for measuring critical thinking in primary school

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ABSTRACT

The importance of critical thinking in education is underpinned by decades of theoretical and practical work. Differences have been demonstrated between students who receive education in this area from an early age and those who do not. However, not enough work has been done to measure these skills in a classroom setting. Given that the best time to teach critical thinking is during the first years of primary education, we designed a test to determine the level of critical thinking among 3rd and 4th grade students in Language Arts using a graphic novel. We showed the legitimacy of the instrument through Construct Validity, Content Validity, Pearson product-moment correlation, Reliability and Item Analysis. Using the instrument, we studied how critical thinking skills differ among 3rd grade students, according to their socioeconomic status (SES), studying schools with low, middle and high SES. We found significant differences between the schools, which suggest that there may be a relationship between socioeconomic status and the development of critical thinking skills. The test presented in this study is an improvement on existing assessment tools as it replaces unidimensional models with models that provide a more detailed and multidimensional picture of student learning.

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1. Introduction

Teaching critical thinking in schools is one of the main topics in the discussion regarding so-called 21st Century skills (Greenhill, 2009). Critical thinking has been regarded as an essential requirement for responsible human activity (Marques, 2012). It is also considered fundamental if citizens are to perform their social, professional and ethical duties (Griffin, McGaw & Care, 2012; Greenhill, 2009). Critical thinking skills allow individuals to make autonomous decisions and to question beliefs when these are not based on solid evidence (Halpern, 2003; Mulnix, 2012).

There is a wide range of definitions of critical thinking. Some of these definitions are more philosophical, relating to classical thought and human development (Nussbaum, 2011); others are more focused on how critical thinking is received and developed in education (Facione, 1990; Halpern, 2003; Bailin, 2002). Despite these divergent approaches, one essential element of critical thinking is that it is a metacognitive process. Critical thinking allows us to think not just about the world

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around us (first-order skills), but also about the thought process itself (second-order skills) (Kuhn, 1999; Halpern, 2003). This element of metacognition has consequences in teaching, relating directly to how the context is perceived and understood (Halpern, 2003). For example, it has been established that metacognitive processes linked to critical thinking are fundamental to the transfer of acquired knowledge (Nickerson, 1988). This study will use a definition of critical thinking that explicitly states its link to metacognition. It is therefore defined as "a metacognitive process, consisting of a number of sub-skills (e.g. analysis, evaluation and inference) that, when used appropriately, increases the chances of producing a logical conclusion to an argument or solution to a problem" (Dwyer, Hogan & Stewart, 2014, p.43).

The importance of critical thinking in education is underpinned by decades of theoretical and practical work (Lai, 2011). The inclusion of critical thinking in school curriculums has been widely reported since at least the first half of the 20th Century, influenced by John Dewey (Bean, 2011). Facione (1990) suggests that developing critical thinking skills should be an objective for every grade level in the K-12 curriculum. In this sense, teaching critical thinking in schools should be integrated into regular classroom activities (Bailin, Case, Coombs, & Daniels, 1999). It is also important to teach critical thinking from early childhood. This is because significant differences have been demonstrated between students who receive education in this area from an early age and those who do not (Osakwe, 2009).

However, although the importance of critical thinking to global education has been defended repeatedly, not enough work has been done to measure these skills in a classroom setting. According to UNESCO (2000), measuring improvements in critical thinking skills is essential for improving the quality of education. If tests are understood to shape both the curriculum and teaching, then an efficient way to improve the quality of education in critical thinking is to develop better tests (Yeh, 2001).

The literature reports that specific knowledge of the subject in which critical thinking skills are being taught is needed if these skills are to be measured properly (Facione, 1990; Ennis 1989; McPeck, 1981; Bailin, 2002; Willingham, 2008). In order to assess children's critical thinking skills in the classroom, the assessment must therefore be situated and take into account the specific subject in which these skills are being taught (Merrell, 2003). This is because of the influence that different subjects can have on the findings or conclusions of a study, depending on the objectives of the task (Bailin et al., 1999). Therefore, although a certain level of generality can be assigned to critical thinking skills, their use depends on their connection to a specific subject (McPeck, 1981).

Ennis (1989) suggests that the best time to teach critical thinking is during the first years of primary education. This suggestion is coherent with other studies, which conclude that young children benefit from being taught and assessed on critical thinking (Kennedy, Fisher, & Ennis, 1991). However, the critical thinking tests that are available are not designed for young children and do not focus on a specific subject. Instead, they only measure critical thinking as a general skill (Ennis & Millman, 1985; Watson & Glaser, 1980; Facione, 1990; Ennis & Weir, 1985; Halpern, 2003). Faced with this problem, our first research question asks: "How can we design and validate a test that determines the level of critical thinking among primary school children in a specific subject?"

The relationship between socioeconomic status and the acquirement of skills is best expressed by Bourdieu (2011). In his study, the author shows that the accumulation of economic capital can be transferred to society as cultural capital, in the form of educational skills and abilities (Bourdieu, 2011). It has been revealed that a student's socioeconomic status substantially influences their achievements in education (Breen & Goldthorpe, 1997). It has also been shown that levels of poverty and reading skills among third grade students have an impact on their performance in higher levels of education (Hernandez, 2011). Some authors suggest that a student's socioeconomic status could also plausibly influence their level of critical thinking (Cheung, Rudowicz, Lang, Yue, & Kwan, 2001). Our second research question therefore asks: "How do critical thinking skills differ among 3rd grade students, according to their socioeconomic status?"

2. Methodology

2.1. Designing the test

A literature review was conducted during the first stage of this study in order to define a model of critical thinking. The aim of this model is to provide **a suitable sequence** of the skills required by critical thinking. The proposed model was based on the Delphi Report (Facione, 1990), in which a group of experts defined the **main** skills of a critical thinker. These skills include interpretation, analysis, evaluation, inference, explanation, and self-regulation. Furthermore, the proposed model also incorporates the concepts of transferability and metacognition (Halpern, 2003). **Therefore, through sequences of questions and images, it is possible to assess the student's level of ability for each of the skills included in the model**.

During this sequence, the students address how their thoughts are formulated (interpretation), evaluate solutions (evaluation), explore and clarify inconsistencies or missing information (analysis and inference), and, finally, explain the results of their mental process (explanation). The sequence successively infuses higher-order thinking skills (analysis, interpretation and inference) with the metacognitive process (evaluation, explanation and self-regulation). This is done by explicitly forming arguments in response to a given narrative. Special weighting is given to the explanation as the cognitive strategies used by students when constructing an explanation are heavily influenced by metacognition (McNamara & Magliano, 2009).

Questions requiring reasoning were included in the model so as to track the explanatory process. According to Berland & McNeill (2012), the explanatory and reasoning processes occur simultaneously. Using reasoning to put critical thinking into operation makes measuring this skill much simpler (Yeh, 2001). Reasoning is particularly important when it comes to