THE FEASIBILITY OF ONLINE ASSESSMENT OF STUDENTS’ INDUCTIVE REASONING SKILLS ABILITIES IN NAMIBIA

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Abstract

The aim of the paper was to explore the feasibility of assessing inductive reasoning using an online platform in Namibia. Inductive reasoning (IR) is a general thinking skill related to almost all higher order cognitive skills and processes. It is regarded as one of the major skills that students ought to have in the 21st century. In recent years, a broad range of instruments, including observation protocol, tests and item banks, are available which can be used to assess different aspects of general cognitive development including reasoning skills which learners are expected to master at school. The goal of this study was (1) to examine the feasibility and reliability of computer-based assessment in Namibia, (2) to examine the students’ abilities and development of inductive reasoning, which developmental level strongly influences the success of knowledge acquisition and application, the effectiveness in learning. The data collection was conducted in Namibia (N=621; 268 boys; 348 girls; from grade 5 and 7) via the Electronic Diagnostics Assessment (eDia) platform. The internal consistency reliability was high (Cronbach’s α: 0.87). The means and standard deviations for students’ performance in the assessments are M=25.94% SD=12.33%, which is seemingly below the 50% pass mark in Namibia. The results showed that Namibian students’ inductive reasoning skills are not well developed and may not be explicitly enhanced at school, which must be a very important task for the future in the Namibian primary education.

Keywords: computer-based assessments, inductive reasoning, primary education, thinking skills.

1 INTRODUCTION

Inductive reasoning (IR) is a general thinking skill related to almost all higher order cognitive skills and processes ([1] Csapó, 1997). There is no universally accepted definition of IR, though several definitions have been proposed ([2] Molnar, Greiff, & Csápo, 2013). A classical understanding of IR is that IR is the process of moving from the specific to the general ([3] Sandberg & McCullough, 2010). That is to say, IR is described as the generalization of single observations and experiences in order to reach general conclusions. Our IR test is based on [4] Klauer’s (1990) definition of IR as discovering regularities by detecting similarities, dissimilarities, or a combination of both, with respect to attributes or relations to or between objects ([5] Csapó, Molnar, & Nagy, 2014).

In order to develop reasoning and thinking skills effectively, we need to explore students’ inductive reasoning abilities by means of assessment. Many studies have been conducted on students’ inductive reasoning skills, mostly in developed countries: for example, the large-scale international assessments, Programs for International Student Assessment (PISA) and Trends in International Mathematics and Science Studies (TIMSS) ([6] Bao, et al., 2009; [7] Han, 2013; [8] Mayer, Sodian, Koerber, & Schwipert, 2014). Unlike in most of the developed world, this kind of study is unknown in Namibia, where the research focus is mostly qualitative, and hardly any research on general assessment and the assessing of thinking and reasoning skills has been carried out.

In recent years, a large number of studies have highlighted the importance and benefits of technology based assessment (TBA). A broad range of instruments is available, including observation protocols, tests and item banks, which can be used to assess different aspects of general cognitive development as well as specific skills—such as scientific reasoning skills and inductive reasoning skills—that learners are expected to master at school ([5] Csapó, et al., 2014). Namibia currently has few mechanisms below the grade 12 end-of-school year examination for measuring the performance of the system against international benchmarks ([9] Ministry of Education, 2007). In primary education, the only scientific and reliable assessment that attempts to measure students’ reasoning and thinking skills are the Standardized Achievement Tests (SATs) that were introduced in 2009 ([10] lipinge & Likando, 2012). However, these tests too fall short of assessing inductive reasoning skills in the broader sense of the concept ([1] Csapó, 1997), as they only assess students’ achievement in the
discipline of science, mathematics and English upon completion of the Grade 7 curriculum, and not on inquiry and thinking skills as needed for success in everyday life ([11] Nemeth & Korom, 2012). It is against those backgrounds that easy to use assessment instruments are necessary in everyday school practice and technology based assessment may provide feasible solutions due its innovative characteristics such as innovative item design and data processing ([5] Csapó et al, 2014).

Therefore, the goals of this study were (1) to examine the feasibility and reliability of computer-based assessment in Namibia, (2) to examine the students’ abilities and development of inductive reasoning, which developmental level strongly influences the success of knowledge acquisition and application, the effectiveness in learning.

2 METHODOLOGY

Our research took place in Oshana region (Namibia), where students were assessed in inductive reasoning skills tasks. Because of lack of computer labs (ICT infrastructures) at the schools where we conducted the assessment, students were ferried to nearby University of Namibia computer labs to take the test. All the schools that took part in the research are in the towns of Oshakati and Ongwediva, but no fully functional computer labs were found at these schools. If they do have computers, either the machines are out of order or there is no reliable internet connectivity. The Electronic Diagnostic Assessment (eDia) platform was used to collect the data. The sample of the study was drawn from the fifth and seventh graders (N=621; 268 boys; 348 girls; age M=12.40, SD=1.19) from five different schools in and around Oshakati. For grade 5, the sample was N=275 (121 boys; 152 girls, 2 missing data, age M=11.19, SD=.68), while the grade 7s numbered 346 (147 boys; 196 girls, 3 missing data, age M=13.23, SD=.61). The assessment instrument of inductive reasoning consisted of 56 items ([12] Pásztor, Molnár, Korom, Németh, & Csapó, in press). The test has four sub constructs, which are figural series reasoning, figural analogy reasoning, number analogy reasoning and number series reasoning. See figure 1, sample items from each subscale.

![Sample items from each subscale](image)

Figure 1, inductive reasoning sample items ([12] Pasztor et al., in press)
3 RESULTS

The reliability of the IR was good for both grades, 5 and 7, (.811) and (.863) Cronbach alpha's respectively and as a whole sample at (Cronbach's $\alpha$: =.87). The test contained four sub constructs figural series with (.700 alpha) consisted of 13 items, figure analogy with (.736 alpha) consisted of 15 items, number analogy with (.528 alpha) consisted of 9 items and number series with (.775 alpha) with 20 items. With regard to gender differences: F= (12.52), p<0.01, Welch-probe: n.s. –therefore, no significant difference was found at both of the levels.

Participants' score distribution confirmed the applicability of the pilot test, which proved that online assessment is feasible and reliable to be conducted in Namibia. The overall ability level of students was low (Mean = 362 and SD: = 84). The grade five ability level mean was 334 and standard deviation (SD) was at 75, while the grade 7 ability stood at 385 and SD: = 84. In terms of gender ability, the males mean was at 367 and the SD was at 95 while the female ability level mean stood at 359 and the SD at 72. Rasch model analysis was carried out to determine the items difficulty and the ability level of students. The results showed that the test was hard for the students; see the figure 3, for the Wright item/person map. The probability of students scoring 50% or more is low. More items seemed to be more difficult for the students and no items were easy for the students. This result may indicates that from the pre-primary and lower primary phase to the fourth grade of primary education onward, such general reasoning activities may not necessarily be part of the lessons ([13] De Koning, Hamers, Sijtsma, & Vermeer, 2002). It also worth to note that males performed better than the female samples, however there was no significant gender difference found as well, t = (-1.292), p >.05.

Figure 2. Item person maps for Inductive reasoning tasks; each 'x' represents 1.0 cases, and the numbers represent the item numbers on the test used.

3.1 The inductive reasoning development from grade 5-7

Figure 3, shows the ability level growth from grade 5 to 7 students in both inductive reasoning skills.
The comparison shows that grade 7 students' ability level was 0.124 higher in inductive reasoning than the fifth graders. Significant difference can be found between grades ($t=7.957$, $p<.001$). The results indicates that Namibian students may have little exposure to inductive reasoning training during the teaching and learning of science in this age group at school. Furthermore, the results also indicate that, students may not have adequate inductive reasoning training at school, although it is subject independent, research have indicated that training in inductive reasoning improve performance in both science and mathematics subjects ([4] Klauer, 1990; [1] Csapó, 1997). Additionally, research have shown that, this age-range has been considered as the stage where students are supposed to have the fastest growth regarding thinking and reasoning skills ([14] Inhelder & Piaget, 1958; [2] Molnár et al., 2013), however for this sample, the results indicate a marginally significant difference between the two grades.

4 CONCLUSIONS

One of our research aims was to examine the feasibility and reliability of technology-based assessment in and the students abilities in inductive reasoning. As indicated above, the test showed high internal consistencies in Namibia (Cronbach alpha for inductive reasoning: 0.846), which is a very good indicator for a starter. This proved that computer-based assessment is feasible and reliable in Namibia, even though some of the Namibian schools do not have sufficient ICT facilities. Although the results may not be generalized, as this case was restricted to the Oshana region, our online assessment tool for inductive reasoning skills proved reliable as well as feasible in Namibia. Research has indicated that online test administration and automatic scoring reduces the time and cost of the testing process, and makes the assessment tool suitable for everyday school practice and large-scale assessments ([15] Csapó, Ainliney, Bennett, Latour, & Law, 2012). However, Namibian education authorities need to ‘walk the talk’. There is a policy on ICT for education detailing the ICT infrastructures that state schools are supposed to have, which does not correspond to the situation on the ground. Our experiences suggest that in order to apply online assessments nationwide in everyday school practice, the Namibian education system needs urgently to pay more attention to the development of basic ICT infrastructures within schools.

The low performance and the low ability level of the students as compared suggests that the Namibian primary education system needs to improve in enhancing students' inductive reasoning ability. Research has indicated that inductive reasoning is highly correlated with academic achievement ([1] Csapo, 1997). In addition, [1] Csapo (1997) also found that, there were high correlations between inductive reasoning and applied science knowledge at both ages and there were significant correlations between inductive reasoning and school grades (p. 621). In K-12 education in the USA, the development of thinking and reasoning skills has been shown to have a long-term impact on student academic achievement ([16] Adey & Shayer, 1994). These findings support the consensus of the science education community on the need for K-12 students to develop an adequate level of thinking and reasoning skills, along with a solid foundation of content knowledge ([6] Bao, et al., 2009). In the light of these findings, Namibia could make an effort to improve the inductive reasoning skills and content learning of the students. It is not what we teach but rather how we teach that makes a difference to student learning of higher order abilities such as inductive reasoning skills.
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