Learning in a science centre with a language deficit?

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Abstract

Science centres are visited by schools with children that have a good comprehension of Dutch and by schools with children that have a poor comprehension of Dutch. This study investigates the learning gain of both groups in the new engaging interactive exhibition ‘Treasure Island’ at the Boerhaave Museum in Leiden, The Netherlands. Children with a poor comprehension of Dutch score worst on a knowledge test before and after the visit to the exhibition compared to the children with a good comprehension of Dutch. The later learning even more about the exhibition than the first, although not significantly. The results suggest that a good comprehension of Dutch is important in learning in a science centre but can also be interpreted as a case for interactive exhibitions.

Key words: Science, education, science centre, language deficit, museum Boerhaave

Introduction

Over the last fifty years many people migrated to The Netherlands to settle permanently. They tended to settle in cheap housing, creating areas with many migrants in the larger cities. Consequently the schools in these areas were confronted with many children who did not speak Dutch. Over the decades this process created schools were students have a poor comprehension of Dutch but also a lack in general knowledge like the subjects History (Wagenaar, van der Schot & Hemker, 2011) and Science and Technology (Thijssen, van der Schoot & Hemker, 2011). In The Netherlands these schools are referred to as stratum-3 schools and get extra funding from the government to facilitate smaller classes and extra teaching, focussing on language and mathematics and spending less attention to other disciplines. Schools that have mainly children from Dutch origin and score within the norm are referred to as stratum-1 schools. This pattern led to the hypothesis that students with an education gap would learn less from a visit to a science centre compared to students with no gap. For the latter have more background knowledge to make sense of the visit and their language skills are better developed enabling them to ask more explicit questions and understand the answers given by text or word. To test this hypothesis six groups of students from six primary schools were followed during their visit to Museum Boerhaave. The new exhibition Treasure Island was chosen because little text is used and visitors are challenged to engaged to interact with the exhibited materials aiming to give meaning to the items due to experience (Kolb, 1984). A language deficit might thus be circumvented.
A visit to such a museum can be a valuable learning experience (Henrikson & Jorde, 2001, Morentin & Guisasola, 2011, Ottenheim & Hoogenboom, 2014). In order to make it a learning experience instead of just fun (Guisasola and Morintin, 2010) the teacher should focus on the integration of the visit in the school curriculum and the activation of the student’s curiosity (Ottenheim & Hoogenboom, 2014) instead of focusing on the organisation (McLoughlin, 2004). Therefore also the role of the teacher during the visit to Museum Boerhaave was observed.

**Treasure Island / ‘Schateiland’**

The city Leiden has an old centre were many museums are located. In general a class of student visits about once a year a museum (Geukema, et al., 2011). The Boerhaave museum is a Science Centre that specializes in the history of science and medical science. In 2012 a new room around the Dutch explorations of the 17th century was opened for visitors and primary schools.

**Methods**

Six classes (7th grade, 9-11 years) of 6 different primary schools were selected to participate in the experiment: Three classes of stratum-1 schools and three classes of stratum-3 schools. The group size varied between 10 and 27 student with stratum-3 school having considerable smaller class sizes. In total 101 students participated. The visits took place over a period of one and a half month; between the first of April until the fifteenth of May 2013.

The students were given a pre-test directly before the visit to the exhibition Treasure Island. It consisted of twelve questions about the exhibition some of which were possible to know and some questions were very specific and would not be taught in class. During the visit to the exhibition students were observed how they interact with the exhibition. Directly after the visit, students were confronted with the post-test which consisted of the same 12 questions as the pre-test but in a different order. Teachers were observed during the visit and asked to fill in a short questionnaire about the textbooks they used and the number of museum visits the class had.

**Results**

Students preformed on average significantly (paired T-test $t_{100}=-13.4; P<0.001$) better on the post-test (correct answers=5.89, sd=2.23, n=101) compared to the pre-test (correct answers=3.81, sd=2.03, n=101) with stratum-1 schools significantly outperforming stratum-3 students in the pre-test ($F_{1,99}=9.97; P=0.002$) and post-test ($F_{1,99}=20.5; P<0.001$). Stratum-1: pre-test= 4.26, sd=2.10, post-test=6.56, sd=2.05, n=65; stratum-3: pre-test= 2.97, sd=1.62, post-test=4.63, sd=2.03, n=35. A two-way anova was preformed on the difference between the pre- and post-test with stratum and sex as factors. No difference between boys and girls was found (Boys: pre-test= 3.73, sd=2.36, post-test=5.88, sd=2.41, n=51. Girls: pre-test= 3.90, sd=1.66, post-test=5.90, sd=2.06, n=50. $F_{1,97}=0.53; P=0.46$). Although there were differences between the schools (table 1) it did not break with the pattern. The difference between the pre-test and post-test was greater for stratum-1 students but also not significantly ($F_{1,97}=3.73; P=0.056$). No interaction was found ($F_{1,97}=1.50; P=0.22$).
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**Tabel 1**: Summery of number of correct answers of the pre- and post-test made by the three stratum-1 schools (Str 1.1-1.3) and the three stratum-3 schools (Str 3.1-3.3). B/G= Boy/Girl. #=number of students. Ave=average, sd=standard deviation. Difference is the post-test minus the pre-test.

<table>
<thead>
<tr>
<th>School</th>
<th>B/G</th>
<th>#</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Difference</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>ave  sd</td>
<td>ave  sd</td>
<td>ave   sd</td>
</tr>
<tr>
<td>Str 1.1</td>
<td>B</td>
<td>7</td>
<td>4.0  2.6</td>
<td>6.6  3.0</td>
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</tr>
<tr>
<td></td>
<td>G</td>
<td>5</td>
<td>2.8  2.2</td>
<td>5.8  1.6</td>
<td>3.0   1.0</td>
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<tr>
<td>Str 1.2</td>
<td>B</td>
<td>13</td>
<td>3.3  2.6</td>
<td>5.4  2.4</td>
<td>2.1   1.1</td>
</tr>
<tr>
<td></td>
<td>G</td>
<td>14</td>
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<td>6.3  1.5</td>
<td>1.5   1.5</td>
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<tr>
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<td>2.2   1.0</td>
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<tr>
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<td>G</td>
<td>12</td>
<td>4.2  2.1</td>
<td>7.3  2.0</td>
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<tr>
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<td>4</td>
<td>2.5  1.7</td>
<td>4.5  2.1</td>
<td>2.6   2.1</td>
</tr>
<tr>
<td></td>
<td>G</td>
<td>8</td>
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<td>9</td>
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<td>5.1  2.2</td>
<td>2.0   1.2</td>
</tr>
<tr>
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<td>3.0  0.82</td>
<td>4.5  2.4</td>
<td>1.5   2.4</td>
</tr>
<tr>
<td>Str 3.3</td>
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<td>3</td>
<td>1.0  1.7</td>
<td>2.7  1.1</td>
<td>1.7   2.5</td>
</tr>
<tr>
<td></td>
<td>G</td>
<td>7</td>
<td>2.7  1.3</td>
<td>3.9  1.8</td>
<td>1.1   2.0</td>
</tr>
</tbody>
</table>

**Teachers**

During the visit five out of six teachers (of which four asked the guide what was expected of them) explored the exhibit together with the children. They asked questions and encouraging students to engage with the exhibit. Only the teacher of Str. 1.2 was not engaged with the students. All teachers indicated that they make about two visits a year to a museum in the city of Leiden. All stratum-1 schools used the same history text books, the stratum-3 school used three different textbooks, different again from books the stratum-1 schools used.

**Discussion**

It is clear that students from stratum-3 schools have a less knowledge of history of the golden age of Holland compared to the students from the stratum-1 schools. Although the difference is only on average only one less correctly answered question it is in the direction of the expectation (Wagenaar, van der Schoot & Hemker, 2010; Thijssen, van der Schoot & Hemker, 2011). Furthermore the stratum-3 students tended to more often to answer the questions with ‘I don’t know’. All groups score better on the post-test suggesting that they learned something during their visit to the Treasure Island exhibition. Other studies also showed an increased knowledge of the subject on hand after a museum visit (Morentin & Guisasola, 2011; Ottenheim & Hoogenboom, 2013) but in those studies a different methodological approach was used. In the current study
the same questions were used but presented in a different order. Consequently student could recognize the questions from the post-test and priming may have taken place. The aim of the study was to compare stratum-1 students with stratum-3 student and there is no reason to assume that the priming had a different effect on the two groups.

The difference between the pre- and post-test can been seen as a measure for how much the students have learned about the subjects tested during the visit to the Treasure Island exhibition. In this light the stratum-1 students learned more than the stratum-3 students, although not significantly. The probability is very low, bordering on significant, suggesting that stratum-1 student not only start at a higher knowledge level but also benefit more from the museum visit compared to the stratum-3 student. A possible explanation of this effect can be found in a general lower comprehension of the Dutch language. In many exhibits there are large information contributions via texts. In the Treasure Island exhibition the text contributions are kept to a minimum. Therefore the language barrier is kept to a minimum. Alternatively, because stratum-3 student lack knowledge on the subjects, new information cannot be adopted in the knowledge web (context) resulting in a lower information uptake.

Of the stratum-1 schools the students supervised by the teacher that did not interact with the students during the visit, performed worst suggesting that an active engagement of the teacher with the students is beneficial for the total museum experience as suggested by Ottenheim & Hoogenboom (2013). Teachers should be engaged with the students: asking them questions about the exhibition, challenging them to explore more and be inquisitive themselves.

The number of students and groups in this study is very low, furthermore using the same questions in the pre- and post-test was not the best method for exploring the learning of migrant and non-migrant children in a science centre. However, the results do point in the expected direction. Non-migrant children start off on a higher level and gain more by a museum visit. This effect only confirms that teachers from migrant (stratum-3) schools are confronted with a formidable task of not only teaching language but also providing the children with much context and back ground knowledge to facilitate stranger learning in Real Life Learning situations. On the other hand the nature of the exhibition in Boerhaave Museum (interactive learning) may have influenced the learning of both groups of children since little texts are used and learning mainly occurs with experimental learning. Language skills should not have influenced what the students learned. Stratum-3 students could have done worst on both tests because of poor language skills, not understanding the questions and/or the answers correctly and therefore guessing at the answer. In this study we had no way of controlling this problem. Additional research could provide valuable insight on the influence of the language deficit on test scores in science tests.

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References

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