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effects on intellectual capacity and academic achievement
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A Spanish intervention programme for students with special education needs: effects on intellectual capacity and academic achievement

Luz F. Pérez and Jesús A. Beltrán

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The purpose of the study was to determine whether the application of a school intervention programme based on the theory of multiple intelligences improves the academic achievement of students with low intellectual capacity, and whether the intervention programme also improves their level of general intelligence. The assessment design is quasi-experimental, with a non-equivalent control group, and with pre- and post-treatment measurements. The independent variable is the administration of the programme and the dependent variables are participants’ intellectual capacity and academic achievement in subject matters considered essential in the curriculum—mathematics, language and social sciences. The study was carried out with 113 students aged between 11 and 16 years. The results show that the project has fully achieved the proposed goals, contributed to scientific knowledge about the development of intelligence and shown that the teaching of processes is one of the most effective methods to increase academic learning. Significant improvements were observed in learning and in intellectual capacity.

Keywords: academic achievement; special needs; moderate intellectual disabilities; intelligence

Introduction

With his theory of multiple intelligences, Gardner (1983, 1993, 2003) contributed to changing the traditional viewpoint of human intelligence, which focused excessively on the IQ, as did other psychologists (Guilford 1967; Thurstone 1939) and, especially, Sternberg (1985), who defended the triarchic nature of intelligence. He went beyond the monolithic conception of intelligence and adopted a pluralistic viewpoint that describes cognitive competence in terms of a set of perfectly defined intelligences. Moreover, in contrast to other psychologists who defended a stable and unchangeable intelligence from birth (Herrstein and Murray 1994), Gardner conceived of intelligence as something that changes and develops as a function of individuals’ experiences during their lifetimes. But Gardner’s theory has particularly contributed to improving teachers’ beliefs to seeking new ways to an educational reformation and to renew academic practices (Eisner 2004; Pérez and Beltrán 2006).

Gardner’s theory also has many implications in the field of special education. First, it contributes to contextualising special education within a much broader setting than the one that was launched by classic intelligence, such as the multiple intelligences, which describe the strengths and weaknesses of every human being. According to this theory, everyone has some deficiencies and some strengths in their intellectual repertory. Therefore, children with some deficiency are no longer ignored and labelled, but, like everyone else, they have their strengths and weaknesses spread over the entire intelligence spectrum. Secondly, if everyone has strengths and weaknesses,
Gardner’s theory allows us to exchange the traditional educational paradigm, focused on deficits, for a different one, focused on growth or development (Pérez and Domínguez 2005).

But, in addition to the theoretical advantages of the model and the teachers’ favourable acceptance, it is necessary to know whether teachers apply it and whether the results confirm initial expectations (Komhaver 2004). In this study, we present the results of the application of an intervention programme based on the theory of multiple intelligences that a group of teachers carried out with low-ability students.

**Objectives**

The principle goal of this investigation is to verify whether the application of an academic intervention programme based on the theory of multiple intelligences improves the academic achievement of low-intellectual-ability students. A second goal is to verify whether the intervention programme also improves their level of general intelligence.

**Method**

**Participants**

Participants were 113 students with low intellectual capacity (slight or moderate mental deficiency according to the World Health Organisation, 1992, and the *Diagnostic and statistical manual of mental disorders* (American Psychiatric Association, text revision 2000), and diagnosed by the *Stanford-Binet test*). None of them had any associated pathologies. All the participants were Spaniards, and Spanish was their mother tongue. Their ages ranged between 11 and 16 years. They attended a special education centre. This centre is public (state run) and the socioeconomic level of the students’ families was similar, that is middle class. The students were randomly assigned to one of two groups, experimental and control (Table 1).

**Design**

The assessment design is quasi-experimental, with a non-equivalent control group, and with pre- and post-treatment measurements. The independent variable is the administration of the programme and the dependent variables are academic achievement and intellectual capacity.

The pre- and post-test measures were obtained with specific academic exams of students’ academic knowledge of the subjects considered essential in the curriculum: mathematics, language and social sciences. These exams were carried out by teams of teachers in the centre that the students attended, with advice from the team of specialists. These exam results were integrated into the general yearly achievement. They contained activities related to the comprehension of concepts, information analysis, creativity and practical problem-solving. The portfolios performed by each student during the programme were also included in the assessment of each final test.

<table>
<thead>
<tr>
<th>Ages 11–13</th>
<th>Ages 14–16</th>
<th>Ages 11–13</th>
<th>Ages 14–16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>Girls</td>
<td>Boys</td>
<td>Girls</td>
</tr>
<tr>
<td>16</td>
<td>15</td>
<td>15</td>
<td>17</td>
</tr>
<tr>
<td>15</td>
<td>16</td>
<td>15</td>
<td>16</td>
</tr>
</tbody>
</table>

Total boys, 31; total girls, 32. Total boys, 21; total girls, 29.
Intellectual capacity was assessed, as mentioned above, with the Stanford-Binet test (4 ed. 1986). This intelligence scale is a review of the Stanford-Binet L-M form of 1960 (Terman and Merrill 1960) and is considered a very efficient instrument to measure the cognitive abilities of subjects from the age of 2 years until adulthood. Partial and/or general IQs can be obtained; in our case, we used the general IQ.

**Pedagogic model**

Guidelines for the pedagogic model for exceptional students should take into account the important differences that set them apart from the rest of the students, on the one hand, and the need to prepare a realistic curriculum that is similar to that of the rest of the students and that prepares them for future social and work integration, on the other hand.

The model is directly designed for students with special needs and it combines Gardner’s (1983) multiple intelligences and Bloom’s revised taxonomy (Anderson and Krathwohl 2001; Bloom and Krathwohl 1956). On the one hand, the multiple intelligences act like a catalyst, allowing us to breach the gap created by labels and to consider all students as different and endowed with strengths and weaknesses, thus exchanging an educational paradigm focused on deficit for an educational paradigm focusing on development. On the other hand, Bloom’s taxonomy allows us to differentiate the learning processes (remembering, understanding, applying, analysing, evaluating, creating) and to design the school activities according to each student’s strengths and weaknesses. Other investigators have also done this, with students’ and teachers’ remarkable success (Noble 2004).

Both concerted models, multiple intelligences and Bloom’s taxonomy, provided us with a valuable didactic schema to plan the activities and tasks for students with learning difficulties. Our goal was to use the adequate strategies at their intersection points, for example, to design strategic activities to develop analytical skills either in the interpersonal domain or in the spatial domain, and so on (in the 48 possible intersection points of multiple intelligences × taxonomy goals). Understandably, given the characteristics of the sample, out of the six goals of Bloom’s taxonomy, we focused particularly on the first four: remembering, understanding, applying and analysing; although we sometimes also used the other two goals: evaluating and creating (Figure 1).

The model has four essential characteristics: it is individualised: it takes into account each students’ strengths and weaknesses; motivating: it favours the self-concept of the student with special needs by considering all students as being different; flexible: it allows teachers to adjust their teaching to the real possibilities and achievement of each student; and strategic: it contains

<table>
<thead>
<tr>
<th>Goals</th>
<th>Curricular contents</th>
<th>Processes</th>
<th>Intelligences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nucleus of knowledge, Regular curriculum</td>
<td>Remember</td>
<td>Spatial</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Understand</td>
<td>Mathematical</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Apply</td>
<td>Linguistic</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Analyse</td>
<td>Musical</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Evaluate</td>
<td>Naturalistic</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Create</td>
<td>Corporal</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Interpersonal</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intrapersonal</td>
<td></td>
</tr>
</tbody>
</table>

Figure 1. Structure of the instructional model.
all the resources and strategies needed by each student, and teachers can implement them at any moment, from the viewpoint of intelligence and learning.

All the teachers and specialists who participated in the experience were previously trained in the knowledge and mastery of the theory of multiple intelligences and in the pedagogic model we designed. The teachers took a course in which they learned to cope with the basic ideas of the theory of multiple intelligences and learning processes based on Bloom’s taxonomy. The course was taught at the local Teachers’ Training Centre, where they went after their classes. The training lasted a month. Hence, the teachers could take all the intelligences into account when carrying out their periodic instruction planning (Haley 2004).

Three areas of knowledge, which are considered essential in the academic curriculum, were selected for this experience: mathematics, language and social sciences. We selected two basic units from each one of the materials and the four learning levels into which the students were divided, making a total of 24 basic units. The activities were designed following Bloom’s taxonomy (Anderson and Krathwohl 2001; Bloom and Krathwohl 1956) for the topics and the corresponding intelligences.

It should be taken into account that, as these were students with special educational needs and slight or moderate intellectual disabilities, their instruction does not follow the pattern of ordinary schooling. In this case, the knowledge level of the group of 11- to 13-year-olds is comparable to that of 1st- and 2nd-graders with no deficiency and the knowledge of the 14- to 16-year-olds is comparable to that of regular 3rd- and 4th-graders.

Each unit was designed to be worked on during eight sessions, corresponding to each kind of intelligence (mathematical, linguistic, musical, spatial, corporal, natural, interpersonal and intrapersonal). In each session, new tasks were learned by means of the various goals or thought processes. The sessions constituted the students’ regular classes. The students worked with the material designed about 4 hours per week, and the classes were taught by the regular tutors in the centres, with the support of the specialists, who were also present. The programme was carried out throughout an entire academic course.

The structure of the unit that was the study object of the experience followed the sequence represented in Figure 2. First, the teachers created a favourable setting to motivate the students about the work theme. Then, they indicated the curricular goal corresponding to the students’ course. Afterwards, they enumerated the basic contents that the students would have to learn. Subsequently, they evaluated the students’ level in the necessary prerequisites to carry out the programmed activities. If any of the students had difficulties mastering these prerequisites, the teachers proposed some activities to reinforce them. They also determined the students’ degree of comprehension of the necessary basic vocabulary involved in the previously selected contents. From then on, the programmed activities corresponding to Bloom’s six revised basic processes were initiated, applied to the different intelligences. Lastly, the teachers initiated the evaluation process to verify the level of achievement of the main goals proposed.

The programme was designed to be carried out in an inclusive educational context. However, it was investigated in groups of students with special educational needs who, due to their level of disability, were not yet integrated in inclusion programmes. This was also due to methodological reasons, because, in integration conditions, it was very difficult to achieve an acceptable sample of subjects, and this was also a way of enhancing their future inclusion. The strength of the pedagogical model we present is precisely that it helps students with intellectual difficulties to realise that all their companions are different, that they all have strengths and weaknesses, and that one day, they will live and work together in a world made up of diverse people.

Complementarily, it should be noted that the academic contents of the curriculum of the groups of control and experimental students were the same in mathematics, language and social sciences. The two basic units selected from each subject were taught in parallel time intervals and
<table>
<thead>
<tr>
<th>Area: Mathematics</th>
<th>3rd level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit of content: Organisation of information</td>
<td></td>
</tr>
<tr>
<td>Academic goal: Represent and interpret the information of data from diverse sources, clearly, precisely, and in an orderly fashion</td>
<td></td>
</tr>
<tr>
<td>Concepts: Graphic representation, characteristics and functions</td>
<td></td>
</tr>
<tr>
<td>Procedures: Activities and processes to gather and register data in the area of each intelligence</td>
<td></td>
</tr>
<tr>
<td>Attitudes: Appraisal of graphic language in each of the intelligences</td>
<td></td>
</tr>
<tr>
<td>Assessment: Portfolio of the students. Rubric-scale of concepts and procedures. (The teacher could perform this for each intelligence or at the end of each unit)</td>
<td></td>
</tr>
</tbody>
</table>

Activities at intersection points between intelligences and processes:

Session 1:
- **Interspersonal intelligence**
  - Remember and arrange feelings according to the stages experienced (years or months)
  - Organise charts with guidelines to understand others’ feelings
  - Carry out and apply diagrams with different kinds of emotions
  - Create graphics that reflect the different strengths needed to control different emotions

Session 2:
- **Spatial intelligence**
  - Analyse and understand the representation of the cardinal points on the map of the country
  - Organise on a table the Autonomous Communities as a function of their situation, N-S-E-W
  - Make (apply) a map of our classroom, indicating the situation of the cardinal points

Session 3:
- **Linguistic intelligence**
  - Remember the concept of “register table” and when it should be used
  - Make (apply) a register table with the name of common sports
  - Create a model of a diagram to register the names and some characteristics of the classmates (colour of their hair, eyes, gender, etc.)

The sessions corresponding to the remaining intelligences (natural, musical, corporal, interpersonal and mathematical) were carried out in a similar manner.

Figure 2. Example of the content of the basic units, Experimental Group.

in a similar number of work sessions. The classes of the control group were taught by their regular teachers, who followed the methodology normally used in these centres. This methodology consisted of an oral exposition by the teacher of the concepts to be learnt, a practical demonstration of the procedures and some activities for the various sessions in which the students would work on these topics. At the beginning of each session, the teacher would remind the students of the concepts and reinforce good attitudes towards learning. At the end of the session, the students would present their work to the teacher, either orally or in written form. In Figure 3 can be observed the didactic sequence of the control group, which evidently contrasts with that of the experimental group.

**Results**

The results show that the project fully achieved the proposed goals, contributed to scientific knowledge of the development of intelligence, and that the teaching of processes is one of the most effective methods to enhance academic learning.

**Data analysis**

The goals of the investigation were addressed by univariate and multivariate analysis of variance and covariance. The covariates (gender, age group and pre-test levels of the dependent variables)
were included in order to determine whether they significantly accounted for the variability of the dependent variables in the model. The initial (pre-test) level of each dependent variable was included to control its effect on the final levels and so provide real information about the post-test differences between the experimental and the control groups.

In pre-test academic achievement (in the three curricular areas), the results show that there were statistically significant differences between the two groups of students (Wilks' $\lambda = 0.908$, $F_{3,107} = 3.616, p = 0.016, \eta^2 = 0.092$) in favour of the control group. At the particular level, these differences were observed in the areas of mathematics and language, whereas in knowledge of social sciences, the differences were non-significant (although they also favoured the control group). Therefore, the control group had initially higher achievement levels than the students of the experimental group.

In general, the results of the comparison of the groups at post-test revealed large differences (Wilks' $\lambda = 0.595$, $F_{3,107} = 24.253, p = 0.000, \eta^2 = 0.405$), favouring the experimental group. It is noteworthy that the variables of gender and age also significantly accounted for the final levels of academic achievement.

Considering the curricular areas, in particular, the data provided by this investigation revealed the existence of statistically significant differences in all three areas. In all the areas, the differences were in favour of the experimental group and the intervention explained almost 50% of the variance of achievement.

Regarding mathematics, after controlling the effect of the initial levels in this variable, statistically significant post-test differences were obtained between the control and experimental groups, in favour of the experimental group ($M_E = 65.75, M_C = 47.20, F_{1,112} = 97.206, p = 0.000, \eta^2 = 0.474$). It is notable that the intervention accounted for 47.4% of the total variance of achievement in mathematics. Moreover, the initial levels of this variable significantly predicted the final levels at post-test (Table 2). In addition, the variable age produced significant group differences, although the same cannot be said for gender.

Concerning language, after controlling the effect of the initial levels of this variable, significantly statistical group differences were obtained at post-test ($M_E = 69.03, M_C = 50.62, F_{1,112} = 102.508, p = 0.000, \eta^2 = 0.487$), favouring the experimental group. The intervention accounted for 48.7% of the total variance of academic achievement in language. The initial pre-test levels
Table 2. Academic achievement.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Experimental Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-test</td>
<td>Post-test</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Mathematics</td>
<td>14.49</td>
<td>5.27</td>
</tr>
<tr>
<td>Language</td>
<td>15.81</td>
<td>4.85</td>
</tr>
<tr>
<td>Social Sciences</td>
<td>16.67</td>
<td>4.961</td>
</tr>
</tbody>
</table>

of language also significantly predicted the final post-test levels (see Table 2). In contrast, neither age nor gender produced significant differences between the groups.

With regard to social sciences, after controlling for the effect of the initial levels of this variable, statistically significant differences were observed between the control and experimental groups at post-test, in favour of the experimental group ($M_E = 70.78$, $M_C = 48.96$, $F_{1.112} = 103.520$, $p = 0.000$, $\eta^2 = 0.489$). As in the previous cases, the intervention accounted for 48.9% of the total variance in social sciences. The initial levels of social sciences also significantly predicted the post-test levels (see Table 2). On the other hand, the variable age contributed significant group differences, but not the variable gender.

General intelligence

Controlling the effect of the initial levels of the variable Stanford-Binet total IQ, statistically significant differences were found between the control and experimental groups at post-test ($M_E = 56.31$, $M_C = 52.40$, $F_{1.109} = 5.345$, $p = 0.023$, $\eta^2 = 0.048$). As can be seen from the means, the differences were in favour of the experimental group. The initial levels of this variable also significantly predicted the post-test levels (Table 3). Moreover, the variable age also showed significant group differences, but not the variable gender.

Discussion

According to the results obtained, the intervention programme can be considered successful in achieving the proposed goals. The improvement of the experimental group’s achievement was noted in general terms and also in each one of the previously selected areas: mathematics, language and social sciences. The effect size was also high, as the value of partial $\eta^2$ was almost 0.50, which means that the observed effect is not only significant at the statistical level, but also at the practical level.

The results presented herein, and the atmosphere of students’ and teachers’ satisfaction that surrounded the experience confirmed our initial good expectations. This is even more remarkable when considering that, although there were some positive global assessments, such as that of

Table 3. General intelligence.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Experimental Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-test</td>
<td>Post-test</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>IQ</td>
<td>52.71</td>
<td>9.86</td>
</tr>
</tbody>
</table>
Campbell and Campbell (1999), the first evaluators did not manage to improve students’ achievement, as expressly stated in the Spectrum reports (Chen, Krechevsky and Viens 1998).

What can explain this improvement? First, this pedagogical model has placed emphasis on the development of learning processes, rather than on mere repetition of content. For this purpose, we followed Bloom’s taxonomy, in intersection with Gardner’s diverse intelligences, always seeking the successful conjunction of both approaches within the framework of each student’s strengths and weaknesses. It is well known that processes are what allow one to build knowledge, that is to transform information into knowledge, instead of limiting oneself to just reproducing it.

Another cause of the students’ improved achievement is that they had many achievement opportunities within this design, because they had many means of intellectual expression, some of which coincided with their predominant type of intelligence. Moreover, the students, encouraged by these opportunities, gained more self-confidence in their previously dormant – or even unknown – personal capacities, which were not taken into account by the traditional school systems. Such self-confidence – perhaps experienced for the first time after a history full of difficulties and failures – could have stimulated their general motivation to learn, and particularly, to learn to focus on their strengths, which, until then, had been undervalued (Noble 2004). To this can be added the effect on their self-concept of their growing awareness of their peers’ capacities, their self-comparison with their classmates and their teacher’s feedback, according to the theory of social comparison (Marsh and Craven 1997).

The new personalised learning design created by the merged methodology of multiple intelligences – the defence and the catalyst of diversity within the school context – and Bloom’s taxonomy of goals, which allows the gradual establishment of tasks and academic practice as a function of the students’ diverse intellectual strengths (Noble 2004), may have had singular influence. With this design, the students could work on the content of various subject materials at different mastery levels.

The evaluation system has also changed. We should not forget the impact of changing the assessment, which took into account and valued adequately the strengths that were previously forgotten at school, and which offered the students useful informative feedback for their subsequent work and, especially, which helped them to build their identity as students more objectively. Actually, two assessment modalities were introduced: the portfolio (typical of the model of multiple intelligences) and the rubric-scale. The portfolio allows students to adequately express the level of progress differentially as a function of their personal strengths and weaknesses. The rubric-scale allows the establishment of more precise levels of progress in the course of learning. Both of them favour the development of this difficult learning process that is so necessary to discern progress and maintain motivation and personal self-esteem.

Another key explanation is the tremendous effort made by the teachers. They received considerable prior training, carried out a new assessment and planning format in which the most important aspect was not the tasks, but to know and to prepare their students. Therefore, before beginning the intervention, the teachers, with the help of the specialists, established the profile of the intelligences and the initial academic achievement for each student. The purpose was to determine the set of strengths and weaknesses of the students in order to capitalise on the former and compensate for the latter.

Their teaching task was facilitated by the use of didactic instruments that were very different from those used until now, and reinforced by the almost unexpected results of their students. This confirms the findings of Guskey (1986), who indicated that crucial change in teachers’ attitudes and beliefs is facilitated when they change their practices and can observe their students’ good academic results. Thus, the intense relationship between the teachers and their students is revealed, and, above all, the close relation between the teachers’ beliefs and the class results (Good 1995).
The new school climate awakened by the introduction of multiple intelligences is another possible explanation of the students’ academic improvement. The creation of an atmosphere in which ideas flourished – for example, all the students have abilities, everyone can learn and they can all learn better when they use the learning style that that favours them – may have promoted the students’ interest and favoured their attitudes towards learning. This is more remarkable when these students have low capacities. The learning context is not competitive, but cooperative. The students perform some tasks together and join their findings, discoveries and applications in collaboration with each other. Thus, the success of some people does not depend on the failure of others, but instead it is linked to the success of the rest of the classmates.

The results of the improvement of general intelligence confirm Gardner’s (Gardner, Feldman and Krevchensky 1998) findings when noting that, in the assessment performed in the Spectrum Project, there was a significant correlation between preschoolers’ performance in the Spectrum activities and their performance on the Stanford-Binet test. Likewise, Campbell and Campbell (1999) have used the multiple intelligences approach for five years or more, and the gains in achievement are very impressive, because the teachers believe that all the students have and know their strengths, and this allows the students to believe in them too. Although there is no reliable evidence, it would not be surprising if we could add to this series of possible explanations, the collaboration of the parents, who were especially concerned with their children’s achievement (Shearer 2004).

A limitation of this work is that the students’ self-concept was not measured either at the beginning or at the end of the experience. It is likely that, in most of the students, it would be higher at the end than at the beginning. It would also have been interesting to have detected the students’ and teachers’ expectations at the beginning and at the end, in order to determine whether the pedagogical modal had improved such expectations and to verify their influence on the results of learning.

In future investigations, it would be interesting to perform a qualitative assessment of teachers’ and students’ level of satisfaction at the end of the experience, and of the difficulties that they encountered during the intervention. We believe that this pedagogical model could produce its best fruits within integrated educational programmes.

References


