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Learning and cognitive development

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ABSTRACT. For decades an explanation for failure in schooling in the first grades has been the concern of researchers. In Brazil it was only in the 80s that studies have been undertaken so that a link between learning difficulties and performance in Piaget's operational tests could be found. Results of these studies may be grouped in three categories: a) studies indicating a strict relationship among variables; b) studies that show certain difficulties in nonconservative children in reading and writing and in mathematics; c) studies that state that results of Piaget's tests do not have any relationship with success in reading and writing and in mathematics. Interest in the present analysis is due to these controversial results. Its aim is to verify whether there exist significant differences at operational level among children who have a good or bad class performance. Two hundred 6 to 10 year-old children from the first two lower grades of four public schools in Maringá, Paraná, Brazil, took part in the research. Children sat for Raven's Progressive Matrixes Test and Stein's Class Performance Test. Four groups of 15 children each were formed according to results, combining the grade (first or second) with class performance (good or bad). Groups were compared with regard to performance in five Piaget's tests (classification, class inclusion, mass conservation, length conservation and mental image). Results show that there were no considerable differences among grade groups at operational level. It may be concluded that schools have not benefited from the knowledge of stages in the construction of cognitive competence towards the practice of significant learning.

Key words: learning, development, evaluation.

RESUMO. Aprendizagem e desenvolvimento cognitivo. Há décadas a busca de explicação para o fracasso escolar nas séries iniciais tem sido objeto de preocupação de pesquisadores de diversas áreas. Entretanto, percebe-se que foi somente na década de 80 que começaram a ser realizados estudos brasileiros que visam encontrar alguma relação entre dificuldades de aprendizagem e desempenho nas provas operatórias propostas por Piaget. Os resultados de tais estudos podem ser agrupados em três categorias: a) trabalhos que encontram uma estreita relação entre as variáveis; b) trabalhos que apontam certas dificuldades apresentadas pelas crianças não-conservadoras, em tarefas relativas à alfabetização e à matemática; e c) trabalhos que afirmam não terem os resultados nas provas piagetianas qualquer relação com o sucesso na alfabetização e na aprendizagem matemática. Em função desses resultados controversos surgiu o interesse pela realização do presente estudo, o qual teve como objetivo verificar se existem diferenças significativas, quanto ao nível operatório, entre crianças que apresentam um bom ou um mau desempenho escolar. Participaram do estudo 200 crianças, com idade entre 6 e 10 anos, matriculadas na 1ª e na 2ª séries do 1º grau em quatro escolas públicas de Maringá, Paraná, Brasil. Essas crianças foram submetidas ao Teste das Matrizes Progressivas de Raven e ao Teste de Desempenho Escolar de Stein. A partir dos resultados encontrados nesses instrumentos foram constituídos quatro grupos, de 15 crianças cada, combinando-se a série (1ª e 2ª) com o desempenho escolar (bom e mau). Estes grupos foram comparados, quanto ao seu desempenho, em cinco provas piagetianas (de classificação, de inclusão de classes, de conservação de massa, de conservação de comprimento e de imagem mental). Os resultados indicaram que não houve diferenças significativas entre os grupos das duas séries, no que se refere ao nível operatório. Concluiu-se que a escola não tem aproveitado o conhecimento das etapas de construção das competências cognitivas para a realização de uma prática que propicie uma aprendizagem significativa.

Palavras-chave: aprendizagem, desenvolvimento, avaliação.

Failure in schooling among pupils in the first grades of Brazilian public schools is an old problem and has already called the attention of educators, psychologists, psychopedagogists, sociologists and departments involved in education. Through studies and the establishment of pedagogical suggestions these professionals verified the factors interfering in the school success of these children.

Teachers have pinpointed many causes to justify students' difficulties. Destitution, malnutrition, visual and hearing problems, neurological problems, emotional problems, intelligence setbacks, perception and motor immaturity and others have been listed (Yaegashi, 1995). Due to lack of theoretical and practical references to deal with this problem, it is a common practice to send children diagnosed as having "difficulties in learning" to health facilities and to professionals. It seems that they expect to find an organic cause, whether affective or cognitive that would explain their low schooling performance (Keiralla, 1994a; Kieralla 1994b; Yaegashi, 1997).

On the other hand, many teachers with deficient training do not know how to deal with school children. They confirm the grim "prophesies" of teachers and sign certificates that stigmatize children with learning difficulties (Tiosso, 1989; Pernambuco, 1992; Vizzoto and Mauro, 1994). However, in recent decades the number of studies has increased. They were aimed at discovering the causes of schooling failure detected during the process of learning to read and write and in the teaching of mathematics. Polemic results ensued.

Since teachers' discourses insist in putting the blame on the pupils for their schooling failure and the results in many researches on the same subject are very controversial, great interest has been shown in the theme (Assis, 1985; Camargo, 1986; Moro, 1986; Carraher, 1987; Camargo, 1990). The aim of this research is to verify whether there are significant differences at operational level among children with good or bad performance in school. In other words, we intend to verify the interrelationships between performance in schooling and cognitive development.

Methodology

Subjects

Two hundred 6-to-10-year-old children took part in the research work. Children came from the 1st and 2nd lower grades of four government-run elementary schools in Maringá PR Brazil. While the age of first grade pupils ranged from 6 to 8 years, that of the second grade ones was between 8 and 10 years. According to information given at school, the children came from families of low classes.

Materials

The following materials were used for collection of data:

a) Schooling Performance Test - Writing and Arithmetic.
b) Raven's Progressive Matrixes Test - Special Scale.
c) Piagetian Tests (classification, class inclusion, mass conservation, length conservation and mental image tests).

Application

Handbook instructions were applied for Schooling Performance Test and for Raven's Progressive Matrixes Test (Stein, 1994; Angelini *et al.* 1987). Piagetian tests were applied according to suggestions by Yaegashi (1997).

Procedures for Collection of Data

First stage. Four public elementary schools out of 36 were selected. Two groups from each school, one from the 1st grade and the other from the 2nd grade, were selected. Total amounted to 8 groups, or rather, 4 from the 1st grade and 4 from the 2nd grade. Out of the 8 groups 100 children of the 1st grade and 100 from the 2nd were selected. Raven's Progressive Matrixes Test - Special Scale and a written test were applied to the first sample of 200 pupils. An arithmetic test was also applied to pupils of the 2nd grade. Although samples were randomized, only nonrepeaters and those with at least one year at a kindergarten were analyzed.

Second stage. After Schooling Performance and Raven's Tests were applied, children who showed the best and the worst results in writing and in mathematics were selected. Children who were classified as having average or above average intelligence were also chosen. Thus the variable "intelligence" was neutralized since its lack has been pinpointed by many teachers as the cause of schooling failure. Finally only 60 children were selected. Four study groups were formed: one group (n = 15) of children from the 1st grade that showed bad performance in writing; one group (n = 15) of children from the 1st grade with good performance in writing; one group (n =15) of children from the 2nd grade with bad performance in writing and arithmetic; one group (n =15) of children from the

2nd grade with good performance in writing and arithmetic. Groups were called respectively 1st CD, 1st SD, 2nd CD and 2nd SD.

Piaget's tests were applied two weeks after the children had sat for Schooling Performance and Raven's Tests.

Results and discussion

1st Grade

Table 1. Distribution of 1st CD and 1st SD subjects according to results in Classification Test

Levels Grade	I	II a	II b	III	Total
1st CD	1	10	4		15
1st SD		10	5		15
Total	1	20	9		30

Table 1 shows that many subjects of 1st CD (10 subjects) were classified at level II a. Children in this classification have already substituted figure for non-figure collections. However, only one criterion (color, shape, thickness etc) was used by children for classification. One subject is at level I and four at level II b (use of two criteria for classification). Similar pattern may be found in 1st SD, since 10 subjects are at level II a and 5 at level II b. Mann-Whitney test resulted in p = .5287. This shows that there was no significant difference with regard to performance in 1st CD and 1st SD subjects in the Classification Test.

Table 2. Distribution of 1st CD and 1st SD subjects in Class Inclusion Test

Levels Grade	Absence of quantification	Intermediary behaviors	Presence of quantification	Total
1st CD	14		1	15
1st SD	10	1	4	15
Total	24	1	5	30

Table 2 shows 14 subjects of 1st CD with absence of inclusive quantification, or rather, they are incapable of comparing the number of elements in a subclass with that of a more general class in which it is included. Only 1 subject of 1st CD demonstrated a notion of class inclusion. On the other hand, in 1st SD 10 subjects showed absence of inclusive quantification, 1 subject showed intermediary behaviors and 4 demonstrated the notion of inclusive quantification. Mann-Whitney test resulted in p = .0786. Therefore, there was no significant difference with regard to performance in 1st CD and 1st SD subjects in the class inclusion test. Nevertheless, there is a slight trend in the 1st SD group to differentiate itself from the 1st CD group since p value is close to statistical significance.

Table 3. Distribution of 1st CD and 1st SD subjects according to results in the Mass Conservation Test

Levels Grades	Non-conservation	Intermediary behaviors	Conservation	Total
1st CD	7	5	3	15
1st SD	5	2	8	15
Total	12	7	11	30

According to Table 3, 7 subjects of 1st CD are nonconservative. For them mass quantity is changed after transformation of one of the modeling balls. Five subjects of 1st CD have intermediary behaviors. These are characterized by inconstancy in replies. Three subjects in 1st CD are conservative: they state that transformed balls have the same mass and justify their replies with logical arguments of reversibility, simple reversibility and reciprocal reversibility. With regard to 2nd SD five subjects are nonconservative, while 2 showed intermediary behavior and 8 are conservatives. Mann-Whitney test resulted in p = .1559, which suggests that there is no significant difference with regard to performance in 1st CD and 1st SD subjects in mass conservation.

Table 4. Distribution of 1st CD and 1st SD subjects according to results in the Length Conservation Test

Levels Grades	Non-conservation	Intermediary behaviors	Conservation	Total
1st CD	13	1	1	15
1st SD	13	1	1	15
Total	26	2	2	30

In Table 4 it may be perceived that 1st CD and 1st SD subjects show exactly the same distribution in different levels of Length Conservation Test. Thus, the 13 subjects of 1st CD and the 13 subjects of 1st SD are nonconservative. They perceive lengths by criterion of coincidence of extremes, or rather, after a change in one of the lines of safety matches, they deny that both have the same length. One 1st CD and one 1st SD subject have intermediary behaviors while one subject of 1st CD and one subject of 1st SD are conservative; that is, they state that both lines of safety matches have the same length even though the shape of both is different. Mann-Whitney test resulted in p = 1.000, demonstrating that there is no difference in performance in 1st CD and 1st SD subjects in the Length Conservation Test.

Table 5. Distribution of 1st CD and 1st SD subjects according to results in Mental Image Test

Levels Grades	I	II	III	Total
1st CD		15		15
1st SD		13	2	15
Total		28	2	30

According to Table 5, 15 1st CD and 13 1st SD subjects are in level II of the Mental Image Test, or rather, they do not use systematically external coordenates for judging water level but take the bottle as their referential. Therefore, water level is almost always perceived as perpendicular to sides, independently of bottle's inclination. It is interesting to note that generally these children draw the water parallel to the bottom of the bottle to represent their own thoughts. However, sometimes they draw correctly the water level, although in other circumstances they do so incorrectly. Only 2 1st SD subjects are at level III. This means that in their arguments they base themselves in a wider spatial reference and use, for instance, the level of the table as a guide to foresee the water level. Mann-Whitney test resulted in p = .1501. This fact shows that there is no significant difference with regard to performance in 1st CD and 1st SD subjects in the Mental Image Test.

Second Grade

Table 6. Distribution of 2nd CD and 2nd SD subjects according to results in the Classification Test

Levels Grade	I	II a	II b	III	Total
2nd CD		10	5		15
2nd SD		9	6		15
Total		19	11		30

Table 6 demonstrates that 10 subjects of 2nd CD are at level IIa and 5 at level IIb. There is a similar pattern in 2nd SD subjects since 9 are at level II a and 6 at level II B. Mann-Whitney test resulted in p = .7095. This fact indicates that there is no significant difference with regard to performance in 2nd CD and 2nd SD subjects in the classification test.

Table 7. Distribution of 2nd CD and 2nd SD subjects according to results in Class Inclusion test

Levels Grades	Absence of quantification	Intermediary behaviors	Presence of quantification	Total
2nd CD	13	1	1	15
2nd SD	10		5	15
Total	23	1	6	30

Table 7 shows that 13 subjects of 2nd CD do not have any notion of inclusive quantification, that 1 has intermediate behaviors and 1 has inclusive quantification notion. With regard to 2nd SD subjects 10 do not have any notion of inclusive quantification while 5 do. Mann-Whitney test resulted in p = .1590, which denotes that there is no significant difference in performance by 2nd CD and 2nd SD subjects in the class inclusion test.

Table 8. Distribution of 2nd CD and 2nd SD subjects according to results in Mass Conservation Test

Levels Grades	Non-conservation	Intermediary behavior	Conservation	Total
2nd CD	4	2	9	15
2nd SD	6	3	6	15
Total	10	5	15	30

Table 8 shows that 4 subjects of 2nd CD are non-conservative, 2 have intermediary behaviors and 9 are conservative. Six 2nd SD subjects are non-conservative, 3 have intermediary behaviors and 6 are conservatives. Mann-Whitney test resulted in p = .3069, which shows that there is no significant difference with regard to performance in 2nd CD and 2nd SD subjects in the Mass Conservation Test.

Table 9. Distribution of 2nd CD and 2nd SD subjects according to Length Conservation Test

Levels Grades	Non-conservation	Intermediary behavior	Conservation	Total
2nd CD	11	1	3	15
2nd SD	12	2	1	15
Total	23	3	4	30

According to Table 9 eleven 2nd CD subjects are nonconservative, one has intermediary behavior and 3 are conservatives. A similar pattern may be found in 2nd SD, since 12 were nonconservative, 2 have intermediary behaviors and 4 are conservatives. Mann-Whitney test resulted in p = .5748, which shows that there is no significant difference in the performance of 2nd CD and 2nd SD subjects in Length Conservation Test.

Table 10. Distribution of 2nd CD and 2nd SD subjects according to results in Mental Image Test

Levels Grades	I	II	III	Total
2nd CD		13	2	15
2nd SD		13	2	15
Total		26	4	30

Table 10 demonstrates that 2nd CD and 2nd SD subjects have exactly the same distribution at different levels in the Mental Image Test. Thus Level II comprises 13 subjects of 2nd CD and 13 of 2nd SD, while 2 subjects of 2nd CD and 2 subject of 2nd SD are at level III. Mann-Whitney test resulted in p = 1.00. This fact shows that there is no

difference in performance in 2nd CD and 2nd SD in the Mental Image Test.

Synthesis of results of operational tests. In the operational tests it has been established that statistically there are no significant differences among subjects of First Grade groups (1st CD and 1st SD) and of Second Grade ones (2nd CD and 2nd SD). However, in the Class Inclusion Test, between the groups of the first grade the value of p (.0786) was close to statistical significance (p = .05). It indicates a slight trend of group 1st SD differentiating itself from 1st CD group.

In evolution terms it has been verified that in the Classification Test 1st grade and 2nd grade groups show a predominance of intermediary level behaviors (IIa and IIb). Thus, no qualitative difference from the 1st to the 2nd grade has occurred.

In the Class Inclusion Test this pattern repeats itself since many children of the 1st and 2nd grades are in the most elementary evolution level (absence of inclusive quantification). There is a very slight difference from one grade to the other.

In the Conservation of Mass Test it has been established that subjects of 1st grade and 2nd grade groups show a more or less equal distribution among the various evolution levels. This denotes that construction is more advanced than the other ones. It has also been verified that in the 2nd grade there are more conservative subjects (15) than in the 1st grade (11). Data suggest that in evolution terms there exists a slight change from 1st to 2nd grade.

In the Length Conservation Test subjects of the 1st and 2nd grades were classified predominantly in the most elementary evolution level (nonconservation). From one grade to the other there are slight changes with regard to number of pupils with intermediary or conservative behaviors.

In the Mental Image Test the 1st and 2nd grade groups have preponderantly intermediary behaviors with slight changes from one grade to another in number of subjects with type III conduct. This fact suggests that there has been no qualitative difference from 1st grade to the 2nd one.

Final considerations

After the analysis of data we have verified that statistically there were no significant differences between the groups. Is there any relationship between schooling performance and operation performance ? Do the operational tests help us to understand difficulties in learning ?

Studies that try to answer these questions presuppose that intelligence is the base on which all learning lies and, consequently, that the pupil with the best operation performance should also exhibit a good schooling performance. This presupposition is not corroborated by our research work and, as expected, there are no significant differences in the subjects' performance among the different groups. The fact that some children have operational structures does not guarantee a good schooling performance.

Controversy among the various authors lies at this precise point. Research by Moro (1986), Camargo (1986) and Visca (1991) show that concepts of classification, class inclusion, serialization and conservation of quantities verified by Piagetian proofs are essential for the learning of mathematical operations. Similarly, other studies have shown the relationship between the surpassing of nominal logical realism and the learning of reading and writing (Carraher and Rego, 1981, 1984). Besides, no relationship between performance in class and operation level has been detected by other researches (Camargo, 1990).

Controversial results of the researches mentioned above and data from our own research pose a problem to a very common practice, especially among psychopedagogues and psychologists, with regard to the operational tests in psychopedagogical diagnosis. If there is no consistent relationship between operational performance and schooling performance, why are these tests still in use in clinics and schools as if they were pattern tests ?

It is useless to use operational tests as a tool in psychopedagogical diagnosis since, according to Corrêa and Moura (1991), Piaget's interest was different when he elaborated them. His concern focussed on the understanding of the process of the construction of knowledge and not in establishing the relationship between the presence of certain structures and the acquisition of schooling contents.

We are not stating that there is no relationship whatsoever between operational and schooling performance. Rather, we would like to insist that these relationships are not clear enough. In other words, we believe that operational competence is a necessary item to learning in school. However, the two should not be confused. Such statements are based on the arguments formulated by Coll (1992) who emphasizes that learning in school is the result of intentional activities. Nevertheless, we do not know exactly the procedures for the elaboration of these contents by the pupil. According to the same author, it would be important to undertake psychogenetic studies of school subject matters as

those worked out by Ferreiro and Teberosky (1986). Otherwise it would be difficult to determine the relationship between the subject matter and the constructions exploited by Piaget's tests.

As Carraher, Carraher and Schliemann (1986) rightly argument, failure in schooling cannot be wholly explained by backwardness in cognitive development. This last item points towards a search for other causes to explain the phenomenon which may manifest themselves within the school. We may thus ask, "Can the teacher's deficient training be contributing towards the production of failure in schooling and even towards the backwardness of the cognitive development of the pupils ?"

Within this perspective Mantovani de Assis (1992) states that the school does not teach subject matters that would take into account the necessities and the interests of the pupils but is solely concerned in transmitting ready made knowledge as if it were the absolute truth. Such a practice submits the pupil to an intellectual passivity, since it denies him/her the opportunity of elaborating and building knowledge by means of observation, experiments and research.

We believe that cognitive development is an important factor for learning school subject matters. However, the school has not exploited the stages of construction of cognitive competencies and thus it still has not undertaken a practice that would forward significant learning.

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