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ORIGINAL

NON-TRADITIONAL MATERIALS IN TEACHER EDUCATION: A COMPARATIVE ANALYSIS OF BELIEFS AND ATTITUDES

MATERIALES ALTERNATIVOS EN LA FORMACIÓN DEL PROFESORADO: ANÁLISIS COMPARATIVO DE CREENCIAS Y ACTITUDES

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ABSTRACT

The main goal of this research project was to analyze the attitudes and beliefs of a group of Teacher Education students on non-traditional materials as an educational tool. A second goal was to assess the effects of these resources on the students' training as future teachers. In the subject "Motor Games for children 0-6 years old", students were asked to construct and assess non-conventional equipment made out of recycled materials. At the end of the project, they were asked to complete a 40 items questionnaire. Pre-postest analysis revealed that these Teacher Education students valued positively the use of these non-traditional materials as a pedagogical tool, as an interdisciplinary strategy, to educate on values, and as an assessment tool. Students valued the experience as being very positive and they also highlighted several advantages.

KEY WORDS: Teacher Training, self-made material, recycled, non-conventional, low cost.

RESUMEN

El objetivo de este trabajo fue analizar las creencias y actitudes del alumnado de Magisterio acerca del uso de los materiales alternativos como herramienta educativa y valorar el efecto de una intervención didáctica relativa a estos recursos en su formación como futuros docentes. Durante el transcurso de la asignatura Juego Motor de 0-6 años se abordó el tema de los materiales no comercializados, y se involucró al alumnado en un proceso de construcción y evaluación de estos recursos a partir de materiales reciclados. Al término de la intervención, los alumnos completaron un cuestionario *ad hoc* compuesto por dos subescalas, con un total de 40 *ítems*. Las comparaciones pre-postests, permitieron constatar una tendencia a valorar más positivamente el uso de los materiales alternativos como herramienta metodología, como estrategia para trabajar la interdisciplinariedad, para educar en valores y como apoyo a la evaluación. La experiencia resultó muy positiva para los estudiantes, quienes enfatizaron múltiples ventajas.

PALABRAS CLAVE: Formación del profesorado, material autoconstruido, reciclado, no convencional, de bajo coste.

INTRODUCTION

Traditionally, teachers have used commercialized equipment to develop curricular contents and implement learning units in physical education. However, besides conventional materials, a wide pleiad of objects can be used to help teachers (Orlick, 1990; Werner y Simmons, 1990). Over the last decades, there have been an increasing number of articles trying to foster the use of low-cost, recycled materials among teachers (Corbin y Corbin, 1983; Davison, 1998; García y Ruiz, 2001; Jardi y Rius, 1997; Lichtman, 1999; Marston, 1994; Méndez-Giménez, 2003; 2008; Moss, 2004; Rovira, 2000; Sher, 1996; Trigo, 1992). They are considered valuable pedagogical instruments with enormous possibilities to increase students' motor development. Some articles have focused on Preschool students (Maeda y Burt, 2003; Maya *et al*., 2010; Tabernero y Marquez, 1995), a few on Primary Education (Velázquez, 1996), and others in Secondary Education (Méndez-Giménez, 2006). Finally, there are articles that describe how these materials can be used on students with special needs (Bradtke, 1979; Cowart, 1973; Pearson, 1973).

In an effort to clarify the existing terminology, Blandez (1995) classified the different resources used in physical education in two main groups: specific and non-specific materials. The first group included traditional materials that can be purchased in specialized sport stores, and it was separated into gym materials (wall-bars, benches, mats...), outdoor materials (swings, slides...), sport materials (balls, racquets, baseball bats...), and psychomotor materials (ropes, parachutes, bricks...). The second group (non-specific) holds all type of materials that can help physical education teachers in their daily activity. They could be natural objects (trees' sticks, leaves, seeds...), recycled materials (cardboard, paper, cans, tetrabricks...), hand-made materials (stilts, juggling balls...) or commercialized materials that can be bought in hardware stores (elastic bands, tape...). Jardi y Rius (1997; p. 8) denominate this non-specific material as "alternative", and defines it as: "material that is not produced or sold by sport stores, and if it can be purchased in those stores, it is used in a different way".

There is general consensus on the idea that the use of non-traditional materials has its roots on limited budgets and resources faced by teachers in many schools (Méndez-Giménez, 2008; Tabernero y Marquez, 2003). Different works by Blandez (1995, 2000) have showed that the way different resources are used in physical education can influence students' learning. Furthermore, a limited amount of equipment can negatively affect physical education programs. Unfortunately, this deficit is remarkable in many countries, even among the industrialized ones. Hardman (2008) showed that 36% of researched countries thought that the quality of their physical education resources was limited or insufficient. Only in North America, it was considered satisfactory. Moreover, 50% of the researched countries considered that the amount of equipment

available was limited or insufficient. Africa, Asia, South America and the Middle East were the regions most affected. Considering this data, programs that promote the use of non-traditional equipment could enhance the possibilities of many students that do not have access to physical activity due to limited resources.

Over the last decade, it has been suggested that the idea behind non-traditional materials can go beyond recycling thrown out objects to make them effective elements to promote quality learning based in active methodologies (Méndez-Giménez, 2005). The constructivist paradigm believes in the necessity of involving students in their own teaching process, in order to produce significant learning, which is rooted in the students' own knowledge. Therefore, involving students in the search of raw materials to build their own "toys" can activate them mentally, make them use those materials and learn from that use. Moreover, Trigo (2002) believes that using new materials develops pro-active reactions in those students. It promotes creativity and imagination. It generates feelings of adventure and it helps develop the ability to search and create.

On the other hand, the process of building those materials could have positive psychological benefits on the students, via an increase in their self-esteem and motivation. Modify, change or create new materials, which will later be used during practice, can generate feelings of usefulness and pleasure, similar to those experienced by potters or craftsmen when transforming raw materials into pieces of art. Camacho, Díaz and González (2006) believe that building and sharing equipment in physical education increases the builders' self-esteem, but also the users' respect for those materials. In a research project developed between two departments at a high school, physical education and technology, these authors highlight the importance of the cooperative work developed by teachers and students to build materials and to create activities shared with the rest of the community.

Other positive outcomes such as recycling wasted materials, developing environmental consciousness or responsible human consumption support the use of non-traditional materials (Méndez-Giménez, 2003). This ecological approach to the use of recycled materials tries to show students that many resources can be saved from being thrown away, if they are reused conveniently.

Despite the large amount of literature regarding the use of these non-traditional materials, research on their effects on students is very limited. Méndez-Giménez, Martínez-Maseda and Fernández-Río (2010) found, in a group of Primary Education students, high levels of interest, fun and motivation after experiencing an 8-session learning unit of paladós (net game) with recycled materials. Méndez-Giménez and Fernández-Río (2010, 2011) also studied the effects of these materials on Teacher Education students and their training. Sola *et al.* (2009) indicated that 40% of all teachers in Sevilla and Huelva have not received any type of training on non-traditional materials, and only 53%

uses them scarcely. However, they also point out a significant change among teachers when they use these materials systematically.

Based on the aforementioned, the goals of this work have been: a) study the impact of these resources in teacher training students and their attitudes and expectancies as future teachers, b) discover their feelings on these materials, and c) find out if there are any gender differences.

MATERIALS AND METHOD

Subjects

Students from the Faculty of Teacher Training and Education of a university in northern Spain agreed to participate. They were enrolled in a subject entitled: "Motor Games for children 0-6 years old". From the 106 initially enrolled students, 84 (79,25%) assisted regularly and agreed to participate. 9 were males and 75 females.

Context

During the length of the subject mentioned above, an intervention was designed to show the enrolled students self-made materials related to the topic. It consisted of 4 sessions (2 hours each) of theory and practice, the development of a group assignment (10 hours) and an optional individual task (5 hours). A quasi-experimental design was used with pre-post test group comparisons. Theoretical sessions consisted in a powerpoint slideshow with several videos showing different practical examples that were used as the basis for a debate. Group assignment required the search, selection or invention of 4 motor games for preschool children using self-made materials. Moreover, every group had to show at least 2 of their games to the rest of the class during the practical sessions. In this presentation, students had to explain how to build the materials, too. The whole process included the assessment of the materials built regarding their safety, robustness, difficulty, applicability, suitability.... It included a self-assessment process. In the individual task, students were asked to read three articles that reflected several experiences of the usage of non-traditional materials with preschool children to develop different contents. It demanded a written critical comment and a brief presentation to the rest of the class.

Questionnaire

A specially designed questionnaire was compiled for the research project. It consisted of two subscales with a total of 40 items and a few questions regarding gender, area of expertise and previous experience with self-made materials. The first subscale had 20 items, and it has designed to gather information on students' attitudes and feelings before and after the intervention program regarding self-made materials as a tool for teaching, to work on interdisciplinarity or students' values, and as an assessment tool. The second subscale had also 20 items, and the goal was to assess the intervention program and the self-made materials' effect on motivation or satisfaction. Each item used a 5-point likert scale ranging from 1= totally disagree, to 5= totally agree.

RESULTS

Data analysis

All gathered data was analyzed using the statistical program SPSS 19. Cronbach's α was 0.903, which indicated that the questionnaire had high internal consistency. Descriptive analysis was performed on all items. Tables 1 and 2 show means and standard deviations of both subscales.

66 subjects (78,6%) belonged to the Preeschool Teacher training program, 7 (8,3%) to the Music training program, 6 (7,1%) to the Special Education training program, and 5 (6%) to Primary Education training program.

70% of the subjects have little or no previous experience with self-made materials. Only 30% had previously worked with this type of resources. None had a lot of experience with them.

Exploratory analyses were conducted to establish whether data met parametric assumptions. The Kolmogorov–Smirnov test showed that most dependent variables were not normally distributed (*Sig.* < .05). Therefore, from this point, non-parametric tests were used to analyze gathered data.

Transversal analysis

The Mann-Whitney U test was used to analyze differences based on gender. In the pretest, only item 1.1 (They mean a teaching methodology that require more commitment from the teacher) showed a *Z*=-2,198 score, and a *Sig*.=.028. In the postest, significant differences were found only on item 5 (They allow to work on goals shared by different subjects), *Z*=-1,997, *Sig*.=.046. In both cases, scorers were higher in females. In the other variables, there were no significant differences based on gender (*Sig*. > .05).

Table 1. Pretest and postest means and standard deviations of the attitudes towards the use of alternative materials scale

	Pretest		Postest	
	Mean	Stand. Dev.	Mean	Stand. Dev.
1.1. They mean a teaching methodology that require more commitment from the teacher	3,98	,643	4,42	,864
1.2. They mean a teaching methodology that require more commitment from the student	3,80	,793	4,34	,718
1.3. They mean a teaching methodology that can nurse diversity better	4,04	,689	4,42	,695
1.4. They mean a methodology that includes students with special needs	3,89	,716	4,36	,724
1.5. They allow to work on goals shared by different subjects	4,02	,680	4,34	,681
1.6. They allow to work on the development of basic competencies	3,72	,686	4,22	,599
1.7. They allow different subjects' greater content knowledge	3,80	,676	4,03	,743
1.8. They favour students with special needs' curricular adaptations	3,88	,705	4,19	,708
1.9. They promote students' extracurricular activity	4,34	,668	4,53	,552
1.10. They help assess different subjects' content integration	3,68	,585	4,18	,643
1.11. They allow to work on values such as respect for one and other's materials	4,66	,502	4,82	,388
1.12. They allow to work on environmental education, recycling and waste materials	4,76	,508	4,84	,400
1.13. They favour students' creativity and imagination	4,82	,448	4,87	,338
1.14. They allow more coeducational activities than traditional resources	3,99	,707	4,26	,818
1.15. They help assess students' motor skills	3,88	,705	4,32	,715
1.16. They help assess students' attitude and commitment towards the subject	4,17	,695	4,61	,588
1.17. They help assess students' capacities	3,54	,704	3,99	,769
1.18. They allow for students' self-assessment and co-assessment	3,73	,766	4,42	,656
1.19. They allow to observe students with special needs' progress	3,86	,683	4,22	,700
1.20. They hold more advantages than disadvantages for teaching	3,88	,705	4,31	,748

The Mann-Whitney U test was used to analyze differences based on gender in the other subscale.

Table. 2. Postest means and standard deviation of the subscale on satisfaction, interest, motivation…. after the intervention

	Mean	Standard Deviation
2.1. It was easy to find the materials needed	4,52	,661
2.2. It was difficult to make the objects	3,29	1,105
2.3. Self-made materials have helped me learn new contents	4,29	,704
2.4. Self-made materials have made me improve my motor skills	3,77	,724
2.5. Self-made materials have been useful to learn in this subject	4,52	,528
2.6. Self-made materials are very time-consuming	2,84	1,077
2.7. Self-made materials have been beneficial for me as a student	4,09	,747
2.8. Self-made materials are profitable	4,36	,667
2.9. I am satisfied with this experience	4,53	,552
2.10. I expect to use them as a physical education teacher	4,66	,503
2.11. Self-made materials have helped my practical learning	4,21	,635
2.12. Self-made materials have allowed me to show different abilities	3,76	,709
2.13. Self-made materials have increased my interest on the subject	4,01	,769
2.14. Self-made materials have motivated me to learn the contents	3,97	,707
2.15. Self-made materials have allowed me to gain more significant knowledge	4,18	,663
2.16. Self-made materials have matched my style of learning	4,23	,724
2.17. Self-made materials have increased my commitment with the subject	3,91	,846
2.18. Self-made materials have promoted group work, increasing students' interaction	4,65	,556
2.19. I feel very proud of the materials I have built	4,58	,676
2.20. Now, I value more the materials that me or my classmates have built	4,55	,717

Significant differences based on gender were found in four items: "2.4. They have made me improve my motor skills", *Z* =-2,682, *Sig.*=,007; "2.10. I expect to use them as a physical education teacher", *Z*=-2,233, *Sig.*=026; "2.16. They have matched my style of learning" -2,071, *Sig.*=038; y "2.19. I feel very proud of the materials I have built" *Z*=-2,071, *Sig*.=,000. In all of them, the scores were higher in females.

Longitudinal analysis

Pre and postest scores were analysed using the Wilcoxon Rank test. The goal was to assess possible differences obtained within groups prior and after the intervention program. Table 3 shows Z scores and Asymptotic Significance of each variable studied. Significant differences were obtained in all items (*Sig.*<.05), except 9, 12 and 13.

Table 3. *Z* scores and bilateral asymptotic significance (*Sig. A. Bil.*) obtained in the Wilcoxon Rank Test.

	1. They mean a teaching methodology that require more commitment from the teacher	2. They mean a teaching methodology that require more commitment from the student	3. They mean a teaching methodology that can nurse diversity better	4. They mean a methodology that includes students with special needs	5. They allow to work on goals shared by different subjects
Z	-4,681[a]	-4,578[a]	-3,577[a]	-3,800[a]	-3,238[a]
Sig. A. Bil.	,000	,000	,000	,000	,001
	6. They allow to work on the development of basic competencies	7. They allow different subjects' greater content knowledge	8. They favour students with special needs' curricular adaptations	9. They promote students' extracurricular activity	10. They help assess different subjects' content integration
Z	-4,355[a]	-2,131[a]	-2,772[a]	-1,794[a]	-4,683[a]
Sig. A. Bil.	,000	,033	,006	,073	,000
	11. They allow to work on values such as respect for one and other's materials	12. They allow to work on environmental education, recycling and waste materials	13. They favour students' creativity and imagination	14. They allow more coeducational activities than traditional resources	15. They help assess students' motor skills
Z	-2,600[a]	-1,519[a]	-1,292[a]	-2,690[a]	-4,791[a]
Sig. A. Bil.	,009	,129	,196	,007	,000
	16. They help assess students' attitude and commitment towards the subject	17. They help assess students' capacities	18. They allow for students' self and peer assessment	19. They allow to observe students with special needs' progress	20. They hold more advantages than disadvantages for teaching
Z	-4,519[a]	-4,219[a]	-5,654[a]	-3,501[a]	-3,843[a]
Sig. A. Bil.	,000	,000	,000	,000	,000

a. Based in negative ranks
b. Wilcoxon Rank Test

DISCUSSION

a) Attitudes towards alternative materials

Prior to the intervention, results indicated that participants were close to a score of 4 on most items. However, the highest scores were obtained on items 12 (related to environmental education), and 13 (related to creativity). On the other hand, the lowest scores were obtained on items 17 (related to the assessment of students' capacities), and 10 (related to the integration of different subjects' contents).

Despite those high scores, after the intervention program, postest results were significantly higher in 17 out of 20 of the items. The other items (9, 12 and 13) also showed an increase, but it was not significant (probably due to high initial scores). However, results are higher than those obtained in a previous study (Méndez-Giménez y Fernández-Río, 2010). The different results could be explained by the fact that the intervention program reviewed in this article was very short, while the one assessed in the other article lasted a whole semester.
Methodology. Results indicate that this group of Teacher Education students believes that this methodology actively commits both students and teachers. In contrast with the passive role that teachers tend to adopt when using traditional resources, alternative materials require more active roles, and more energy. Certainly, among other roles, teachers must include these materials in their learning units, give students enough information on how to build them, check their safety and supervise them during practice (Méndez-Giménez, 2008). On the other hand, participants believed that the search for raw materials and the process of constructing each object make them become active participants in class.

Moreover, these students believed that this methodology allows the teacher to meet the needs of students with special needs. Conventional equipment is not usually adapted to fit each student's necessities; it is not individualized. Furthermore, if the school needs to buy pieces of equipment with especial features, these are usually very expensive. Self-made materials can be designed to meet each student's necessities, adjusting weight, size, texture, material… This open perspective was seen by the participants as very positive in their future teaching career to design curricular adaptations.

Interdisciplinarity. Despite the fact that this intervention was not designed to connect with other subjects, participants believed that self-made materials allow teachers to work on goals shared by different subjects, to work on basic competencies, and to learn other subjects' contents. This whole idea agrees with the current legislation (LOE), which promotes interdisciplinary educational projects to connect several subjects. Participants valued the potential of self-made materials to promote a significant learning for students through this connexion.

Educating in Values. The highest scores were obtained in items that assessed the potential of self-made materials to work on coeducation, respect, creativity or environmental issues. This is very important if schools want to develop students' basic competencies that could lead them to specific actions and behaviours. Participants viewed self-made materials as tools to work on values related to the respect for the environment and recycling in their future students. These values could also be developed and used in extracurricular settings, and positively influence students' leisure time.

Assessment. Participants believed that the regular use of self-made materials allows processes of self and peer assessment. They also allow teachers to assess students' basic motor skills, and be able to observe students with special needs improvements. Weaker results were obtained in items related to the assessment of students' capacities.

Global assessment. Participants considered the whole experience as being very positive. They believed that self-made materials are a good teaching tool. The last item of the questionnaire shows that the advantages of self-made materials for teachers overcome the possible disadvantages.

b) Assessment of the intervention program

Raw materials and the construction process. Participants found almost no difficulties finding the necessary raw materials to create the required objects. The construction process was also very simple, probably because the objects to make were meant for preschool students, they did not require complex skills and there was enough information available to build them (internet, videos, and written documents). Overall, the scores on the objects made were very high, increasing the feelings of self-worth of the participants.

Learning. Participants perceived the functionality of the objects made. Thanks to them, they were able to better integrate the contents of the subject (motor games for children 0-6 years) and widen their understanding. Participants were enrolled in a Teacher Education program. Therefore, learning was more theoretical (contents, games, objects) than practical (skills) regarding self-made materials. However, students improved their basic skills. Participants considered self-made materials to be very helpful, and the construction process not a task that demanded time that had to be used for other contents or tasks. Therefore, the whole approach was very effective, because students invested a limited amount of time and effort, and their learning was very effective. Participants also believed that the class setting promoted group work, which was beneficial for peer interaction and learning. This is in line with one of the main ideas of constructivism (Perkins, 1999).

Fun, interest, and motivation. Participants showed high levels of satisfaction after the intervention program. Their interest on the subject increased after the

construction process, and they also believed that their motivation to learn and practice had risen. The whole experience was considered very pleasant for males and females.

Expectancies. Participants rated very high the desire to use self-made materials during their teaching career. Therefore, the intervention program seems to have positively affected these Teacher Education students' professional development, not just their personal beliefs.

Attitudes towards materials. Students showed that the intervention program had made them value more their own and their peers' equipment. The process of constructing, assessing, and sharing self-made materials could be a good strategy to make students establish bonds with their equipment, and to show them that it is import to respect the materials. This type of interventions could be beneficial for many schools where resources have to be constantly replaced due to damage and/or robbery.

c) Differences based on gender.

Globally, gender differences found after the intervention were minimal and not very consistent, probably due to the low number of males among the subjects. In the first subscale, only two items, one in the pretest, and one in the postest, showed significant differences. Females considered that this methodology requires more commitment from the teacher and that self-made materials allow teacher to work on common goals from different subjects. However, these results must be considered carefully, since they should be strengthened via other studies. In the second subscale, females rated significantly higher several items (2.4, 2.10, 2.16, and 2.19) regarding self-made materials. These results agree with the ones obtained in a previous study (Méndez-Giménez and Fernández-Río, 2010), which indicates that females tend to value more the use of self-made materials in education.

CONCLUSIONS

1. Despite the fact that participants were about to graduate, their experience regarding self-made materials was limited. This finding agrees with data reported by Sola et al. (2009) about the limited knowledge and use of active teachers of self-made materials. Based on the positive effects of these resources, both studies seem to justify a change in Teacher Education to show how to use them in the schools.

2. This short intervention program was considered a positive experience by the participating students, that woke up their personal interest in self-made materials, and increased their intentions of using them in the future as a valuable teaching tool.

3. The process of building the different objects did not demand great effort on the students; neither was difficult to find the required materials. However, it required greater commitment from them. They increased their content knowledge and their practical skills, learned to appreciate their materials and their peers' materials, and discovered that they could teach coeducational or recycling values through this type of materials. Interdisciplinarity and competencies can also be taught using self-made materials.

4. Participants understood that self-made materials could be very useful to attend special education students' needs. They could fit each student necessities better than commercialized equipment.

5. In conclusion, according to the constructivist theory of learning (Perkins, 1999), self-made materials involve students as active learners while they use them; make them become social learners sharing, and assessing them, and, finally, they grow as creative learners making those objects.

Future research should assess the effects of self-made materials on students' perceptions regarding the length of the intervention or the amount of objects built (intensity).

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