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How Do Education Students Learn Physics?

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Research in physics education has identified students' attitudes and beliefs that contribute to higher gains in learning. The study investigated the extent of change in education majors' attitudes, beliefs and cognitive expectations after going through an introductory physics course. Using the MPEX (Maryland Physics Expectations) Survey and the CLASS (Colorado Learning Attitudes about Science Survey), the students' responses were compared with the responses of "life-long learners of physics". In the MPEX, the students' post-instruction responses reflected high agreement with the experts' responses in the concepts, effort link, reality link and math link dimensions of the survey. The students posted high agreement with experts' beliefs in the CLASS categories relating to personal interest, real-world connections, sense-making/effort and problem-solving (confidence). The relationships among the attitudes, beliefs and cognitive expectations they held and their academic performances were also presented. The results of the correlation analysis revealed that providing opportunities for students to make sense of the information given to them leads to a deeper appreciation and interest in the subject matters and allows them to connect their real-world experiences with concepts and ideas learned in their physics class. Meaningful learning in a physics class is achieved when students have a firm grasp of the basic concepts in the discipline, allowing them to make sense of the information given to them, thus, leading them to exert the effort required of them. This eventually empowers them to create connections and relationships among the ideas they learned.

Keywords: attitudes, beliefs, education students, introductory physics, learning

Introduction

It is important to know what beliefs and attitudes bring about meaningful learning in our classrooms. Research in science education has identified that students' attitudes and beliefs shape their classroom experience (Bransford, Brown, & Cocking, 2002; Elby, 2001; Redish, 2003). Perkins, Adams, Pollock, Finkelstein, and Wieman (2004) examined the relationship between students' beliefs about physics and other educational outcomes, such as conceptual learning and retention, and identified a positive correlation between students' attitudes and beliefs, measured using the CLASS (Colorado Learning Attitudes about Science Survey), and normalized conceptual learning gains measured by using two standardized conceptual inventory tests, the "Force Concepts Inventory" (Hestenes, Wells, & Swackhamer, 1992) and the "Force and Motion Conceptual Exam" (Hestenes & Wells, 1992). Their analysis suggested that college-level students who come into a physics course with more favorable or expert-like beliefs are more likely to achieve higher learning gains.

During academic year of 2006-2007, De La Salle University, a private higher educational institution in Manila, Philippines, began implementing the Lasallian (general education) Core Curriculum. The new

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curriculum consists of a set of foundational, formative and integrative courses that aim to develop in students a critical appreciation of the diverse fields of human knowledge, their principles and science and their arts and methods of inquiry (Rapatan, Zamora, Malabanan, Limjap, Razon, & Mistades, 2005). The Lasallian (general education) Core Curriculum is rooted in a transformative learning framework—a process of acquiring knowledge by synthesizing what is known with something that is not known through questioning assumptions, beliefs and values and considering multiple points of view, while always seeking to verify truth and reason. This process aims to transform a student's beliefs, attitudes and emotional reactions by providing opportunities for the student to critically reflect on his/her learning experiences.

The Lasallian (general education) Core Curriculum aims to expand students' critical and creative thinking skills by engaging them in various modes of inquiry. In the new curriculum, students are envisioned to develop knowledge as a result of their inquiries, actions and experimentations. Included in the core curriculum is a three-unit course on physics offered to students as one of their natural sciences courses. SCIENVP (Introductory Physics-Energy and the Environment track) focuses on the relationship between energy and the environment. It covers the study of the various sources of energy, the effects of using each energy source on man and his environment and the pollution associated with energy consumption. The course aims to develop among students an awareness of their roles to help protect and conserve the environment through the wise use of energy resources.

The physics education research group of the University of Maryland (Redish, Saul, & Steinberg, 1998) posited that what students expect to happen in their introductory physics course plays a critical role in how they will respond to the course. Students' understanding of what science is about and what goes on in a science class affects what information they will listen to (and what they will ignore) given the often large amount of materials their teachers flood them with. The study conducted by Perkins et al. (2004) further suggested that students who come into a physics course with more favorable beliefs are more likely to achieve higher learning gains. In order to achieve the goal of increasing student's appreciation and understanding of physics, there is a need to look at how students view physics and physics learning, as these factors play a significant role in the learning process.

The objective of the current study was to present a profile of the attitudes, beliefs and cognitive expectations of 37 freshman education students (with specialization in early childhood education) towards their Introductory Physics-Energy and the Environment course. These attitudes and beliefs will then be correlated with their academic performance. The data that will be generated will be the basis for identifying what specific beliefs and attitudes are factors that influence meaningful learning in physics. The insights that will be drawn from the current study will be a valuable contribution to the growing body of physics education research.

Methodology

In this paper, students' cognitive expectations were documented using the MPEX (Maryland Physics Expectations) Survey. The MPEX is a 34-item agrees-disagree survey (using a five-point Likert-scale) that probes attitudes, beliefs and assumptions about learning physics. The survey was developed by the Department of Physics, University of Maryland. A description of the development, validation and calibration of the instrument may be found in the paper by Redish et al. (1998).

The freshman education students in the Introductory Physics (Energy and the Environment) class took the MPEX survey at the beginning of the term to generate the pre-instruction data and again at the end of the term

to generate the post-instruction data. The students' responses for each item in the MPEX was compared with the experts' response. During the development of the MPEX instrument, Redish et al. (1998) conducted consultations with lifelong learners (experienced physics instructors who have a high concern for educational issues and a high sensitivity to students) in order to develop the instrument's answer key. When a student's response to the survey item is in agreement with the response of the expert group, the response is described as favorable; otherwise, it is described as unfavorable.

The six dimensions of learning physics that were probed by the MPEX are: independence, coherence, concepts, reality link, mathematics link and effort link. The first three dimensions of the survey were taken from David Hammer's (1994) research on student's epistemological beliefs. These dimensions are:

(1) Independence—beliefs about learning physics, the learner takes responsibility for constructing her/his own understanding or the learner takes what is given by authorities (teacher and textbook) without evaluation;

(2) Coherence—beliefs about the structure of physics knowledge, the learner believes that physics needs to be considered as a connected consistent framework or the learner believes that parts of physics can be treated as unrelated facts or pieces;

(3) Concepts—beliefs about the content of physics knowledge, the learner attempts to understand the underlying ideas and concepts or the learner focuses on memorizing and using formulas.

The dimensions that the Maryland Physics Education Research Group (Redish et al., 1998) added are:

(1) Reality Link—beliefs about the connection between physics and reality, the learner believes that ideas learned in physics are relevant and useful in a wide variety of real contexts or have little relation to experiences outside the classroom;

(2) Math Link—beliefs about the role of mathematics in learning physics, the learner considers mathematics as a convenient way of representing physical phenomena or the learner views physics and math as independent with little relationship between them;

(3) Effort Link—beliefs about the kind of activities and work necessary to make sense out of physics, the learner makes the effort to use available information and make sense out of it or the learner does not attempt to use available information effectively.

The CLASS (Adams, Perkins, Podolefsky, Dubson, Finkelstein, & Wieman, 2006) is built on work done by existing surveys. The survey probed students' beliefs about physics and learning physics, and distinguishes the beliefs of experts from those of novices. Participants taking the CLASS inventory were asked to respond on a five-point Likert ("Agree"—"Disagree") scale to 42 statements, such as:

> "Learning physics changes my ideas of how the world works" (Item 28).
>
> "If I get stuck on a physics problem on my first try, I usually try to figure out a different way that works" (Item 15).
>
> "Reasoning skills used to understand physics can be helpful to me in my everyday life" (Item 30).

Scoring of the CLASS is calculated by determining the percentage of responses for which a respondent agrees with the experts' views (tagged as "percent favorable"). The average "percent unfavorable" is also determined by taking the number of responses for which the respondent disagrees with the experts' views. The survey is scored "overall" and for eight categories: (1) real-world connection; (2) personal interest; (3) sense-making/effort; (4) conceptual connections; (5) applied conceptual understanding; (6) problem-solving (general); (7) problem-solving (confidence); and (8) problem-solving (sophistication). Each category consists

of four to eight statements that characterize a specific aspect of thinking. Together, these categories include 27 of the 42 statements. The overall score includes these 27 statements, plus additional nine statements, all 36 of which passed the validity and reliability tests conducted by the University of Colorado Physics Education Research Group (Adams et al., 2004). In the current version of the survey (version 3, available through http://CLASS.colorado.edu), six statements do not yet have an "expert" response and are not included in the analysis.

Results and Discussion

The MPEX Survey

Table 1 shows the summary of the education students' agreements/disagreements with the experts' responses for the six dimensions probed by the MPEX.

Table 1

Education Students' Responses in the Dimensions of the MPEX Survey

Dimension	Favorable (%)		Unfavorable (%)	
	Pre-instruction	Post-instruction	Pre-instruction	Post-instruction
Independence	31.4	34.0	44.9	44.9
Coherence	27.0	36.2	45.4	41.5
Concepts	40.0	43.9	34.6	34.6
Reality link	65.4	66.4	23.1	19.2
Math link	53.9	55.4	26.9	26.2
Effort link	73.1	77.7	9.2	8.5
Over-all	49.1	51.7	30.0	29.0

Independence Dimension

As the learner matures, he/she takes responsibility for constructing knowledge, instead of simply relying on an authoritative source (the teacher or a textbook). For MPEX item 13, "My grade in this course is primarily determined by how familiar I am with the material. Insight or creativity has little to do with it", life-long learners (the experts in Redish et al.'s (1998) study) believed that students should disagree with this statement. At the beginning of the course, only 15% of the students exhibited the experts' responses. By the end of the course, 61% of the students said that creativity and insight are needed to learn physics.

The results obtained by the current study (34% favorable responses) for the independence dimension were similar to those obtained by van Aalst and Key (2000) for the liberal arts students (n = 102) they surveyed (32% favorable pre-course responses to 33% favorable post-course responses) and for the life sciences majors (n = 147) they surveyed (32% favorable pre-course responses to 35% favorable post-course responses).

Coherence Dimension

The experts interviewed by Redish et al. (1998) felt strongly that students should see physics as a coherent and consistent structure. Students who approach science as simply a collection of facts fail to see the integrity and coherence of the whole structure. For MPEX item 12, "Knowledge in Physics consists of many pieces of information each of which applies primarily to a specific question", 85% of the students agreed with this statement which is contrary to the experts' response. The students have not yet seen the connections among the different concepts they have learned.

The students' responses on MPEX item 29, "A significant problem in this course is being able to

memorize all the information I need to know", revealed that up to the end of the course, about one-third of the class (30.8%) still focused on memory work, rather than see the relationships among concepts.

Concepts Dimension

Learners who are aware of the fundamental role played by physics concepts in problem-solving view doing physics as more than the "substitute–the–givens–and–solve–mathematically" approach done in high school physics. The favorable shift in the students' responses to MPEX item 4, "Problem solving in physics basically means matching problems with facts or equations and then substituting values to get a number" (experts' responses are disagree; students' agreement with the experts shifted from a pre-instruction value of 7.7% to a post-instruction value of 46.2%) and MPEX item 26, "When I solve most exams or homework problems, I explicitly think about the concepts that underlie the problem" (experts' responses are agree; students' agreement with the experts shifted from a pre-instruction value of 73.1% to a post-instruction value of 80.8%) showed that the students have gone beyond the naive view of doing physics as simply using formulas and are now moving towards understanding the ideas and concepts that support the equations.

Reality Link Dimension

Students who believe that ideas learned in physics are relevant and useful in a wide variety of real contexts will give a high rating to this dimension. The link between physics concepts and real-life experiences was seen by 66.4% of the members of the class. This dimension recorded the second highest percentage agreement with the experts' responses which may be attributed to the use of real-life examples throughout the course. The results obtained in this dimension for the current study were much better than the results reported by van Aalst and Key (2000) where they noted that at the end of one semester, the percentage agreement with experts is 37% for both groups they surveyed.

Math Link Dimension

The math link dimension recorded a 55.4% favorable agreement with the experts' responses. As seen in the concepts dimension, the students were beginning to be aware of the value of understanding the underlying ideas and concepts and see the meaning of the physical quantities presented in the equations. The results reported for the current study are better than that reported by van Aalst and Key (2000) where they noted that at the end of one semester, the percentage agreement with experts is pegged at 35% for the liberal arts students and 34% for the life sciences majors.

Effort Link Dimension

About three fourths of the total number of students in the class have responded that the effort they exert in learning physics is similar to that exerted by the life-long learners (experts) interviewed by Redish et al. (1998). Although there is no statistically significant change in the percentage of the students agreeing with the experts when the pre-instruction data (73.1% favorable responses) and post-instruction data (77.7% favorable responses) were compared, the results obtained in the present study differs from the result obtained by Redish et al. (1998) who found a downward shift in the effort the students exerted. Similar to what the present study has reported, van Aalst and Key (2000) also reported a positive change in the "effort link" responses of the students enrolled in an introductory physics course.

The CLASS

Table 2 presents the summary of the favorable and unfavorable responses given by the education students

for each of the categories of the CLASS. The post-instruction profile of the students surveyed revealed that the respondents gave 58.2% favorable (over-all) responses (agreement with the experts) and 19.5% unfavorable (over-all) responses. The remaining 22.3% of the responses were rated as neutral (neither in agreement with nor in disagreement with the experts' responses).

Table 2

Education Students' Responses in the CLASS

Category	Favorable response (in agreement with experts)		Unfavorable response (in disagreement with experts)	
	Pre-instruction (%)	Post-instruction (%)	Pre-instruction (%)	Post-instruction (%)
Personal interest	57.1	73.7	10.9	2.6
Real-world connection	68.3	74.0	11.5	7.7
Problem-solving (general)	61.5	69.7	13.9	6.3
Problem-solving (confidence)	56.7	64.4	17.3	11.5
Problem-solving (sophistication)	32.3	46.2	32.3	18.6
Sense-making/effort	64.8	72.5	10.4	7.1
Conceptual connections	53.5	57.1	26.5	19.2
Applied conceptual understanding	34.8	37.4	43.6	37.4
Over-all	54.6	58.2	22.4	19.5

This over-all favorable response profile is slightly higher than the over-all favorable response profile for non-science majors taking up their first college physics course as reported by the developers of the CLASS instrument. Adams et al. (2004) reported that during academic year of 2003-2004, the 76 non-science students from an American state research university who were surveyed posted a 57% favorable (over-all) profile.

Personal Interest Category

This category probes whether the respondents exhibit a personal interest in or a "connection" to the study of physics. When asked if they "think about the physics (they) experience in everyday life" (CLASS item 3), only 12% gave an unfavorable response. This may lead us to hypothesize that the students see the role of physics in their personal life. Furthermore, we saw in the students' responses to CLASS item 14, "I study physics to learn knowledge that will be useful in my life outside of school" (81% favorable responses) and CLASS item 30, "Reasoning skills used to understand physics can be helpful to me in my everyday life" (85% favorable responses), there is an appreciation of the skills learned in a physics class and these skills are found to be helpful to the students' lives outside of school.

Real-World Connections Category

In the real-world connections category, the students were asked whether they think about their personal experiences and relate them to the topic being analyzed (CLASS item 37). Majority of the students responded favorably to this item. This positive outlook, combined with the 81% favorable response for CLASS item 28, "Learning physics changes my ideas about how the world works", revealed that the students believe that the ideas learned in a physics class are relevant and useful in a wide variety of real-world contexts.

Problem-Solving Cluster

The problem-solving cluster looks at three inter-related categories. The respondents were asked to state whether they enjoy solving physics problems (CLASS item 25) and whether they can usually figure out a way to solve physics problems (CLASS item 34). The students surveyed in the present study reported a

commendable favorable response profile (agreement with experts) in two of the three categories that dealt with attitudes and beliefs about problem-solving in physics—problem-solving (general) 69.7% favorable profile and a 64.4% favorable profile for the problem-solving (confidence) category. However, the students' levels of sophistication when approaching problem-solving in physics is an area can be improved further. Sixty-five percent of the students reported that if they want to apply a method used for solving one physics problem to another problem, the problems must involve very similar situations (CLASS item 22).

There are two statements that are found in the three inter-related problem-solving categories and for both statements, the students surveyed in the study reported a respectable favorable response. Sixty-four percent of the respondents reported that they can usually figure out a way to solve physics problems (CLASS item 34). Majority of the respondents (58%) reported that if they get stuck on a physics problem, there is still a chance they will figure it out (CLASS item 40), which is similar to the experts' views.

The average rating for the problem-solving cluster—problem-solving (general), 69.7% favorable response; problem-solving (confidence), 64.4% favorable response; and problem-solving (sophistication), 46.2% favorable response reported for this study follows the same trend noted by the Physics Education Research Group at the University of Colorado (Adams et al., 2006) for their students (n = 397) taking up a calculus-based physics 1 course: problem-solving (general), 58% favorable response; problem-solving (confidence), 58% favorable response; and problem-solving (sophistication), 46% favorable response.

Sense-Making/Effort Category

This category probes whether the learner makes the effort to use available information and make sense out of the information in learning physics. The Physics Education Research Group at the University of Colorado (Adams et al., 2006) reported 73% favorable responses for students who took a reform-oriented physics course. In the present study, the education students who were surveyed posted an average of 72.5% favorable responses (agreement with experts) for the seven questions included in the category. The respondents reported that "It is important (for them) to make sense out of formulas before they can be used correctly" (CLASS item 24, 88% favorable responses). Further, they articulated that they "explicitly think about which Physics ideas apply to a problem" (CLASS item 39, 77% favorable responses).

Conceptual Connections and Applied Conceptual Understanding Cluster

Life-long learners of physics strongly feel that students should conceptualize physics as a coherent and consistent structure (Redish et al., 1998). Students who emphasized science simply as a collection of facts failed to conceptualize the integrity and coherence of the whole structure of physics. The two categories discussed in this section probed how deeply the students conceptualized physics as being coherent and how the students drew out connections among the different ideas learned.

The conceptual connections' profile of the education students surveyed show a 57.1% agreement with experts, while the applied conceptual understanding profile revealed a 37.4% agreement with the experts' responses. Although 73% of the respondents gave an expert-like response to CLASS item 42, "When studying Physics, I relate the important information to what I already know, rather than just memorizing it the way it is presented", there seems to be a disconnect with how the students view their learning process because 65% of the respondents reported that "A significant problem in learning Physics is being able to memorize all the information I need to know" (CLASS item 1).

The results in these two related categories lead us to say that the students still need to gain a deeper

understanding of how the various concepts and ideas in the course are related to each other.

Relationship Between the Different Categories of CLASS and Students' Academic Performance

The study also investigated the relationship among the beliefs held by students in the different categories of the CLASS. As expected, the responses in the problem-solving clusters—problem-solving (general), problem-solving (confidence) and problem-solving (sophistication) were highly and significantly correlated with each other, as indicated in Table 3 (the *r*-values ranges from 0.527 to 0.883). The respondents gave a consistent response that supports their agreement (or disagreement) with the experts' responses in the "conceptual connections" and "Applied conceptual understanding" categories, as these two categories were highly and significantly correlated with each other ($r = 0.813$).

Table 3

Correlation Coefficients When Comparing the CLASS Categories With Each Other and With Students' Academic Performances

	Personal interest	Real-world connection	Problem-solving (general)	Problem-solving (confidence)	Problem-solving (sophistication)	Sense-making/ effort	Conceptual connections	Applied conceptual understanding	Over-all
Personal interest	1.0000								
Real-world connection	0.7309	1.0000							
Problem-solving (general)	0.3787	0.5044	1.0000						
Problem-solving (confidence)	0.1719	0.3145	0.8833	1.0000					
Problem-solving (sophistication)	0.0131	0.0731	0.3874	0.5270	1.0000				
Sense-making/ effort	0.5359	0.5519	0.3260	0.1727	0.0858	1.0000			
Conceptual connections	0.1828	0.0589	0.1521	0.0418	0.3217	0.2008	1.0000		
Applied conceptual understanding	0.2491	0.0825	0.0950	0.1462	0.6897	0.0139	0.8131	1.0000	
Over-all	0.5730	0.6844	0.7352	0.6094	0.3240	0.7613	0.4277	0.3169	1.0000
Academic performance	0.0747	0.0712	0.3706	0.2601	0.1725	0.1390	0.1970	0.4234	0.0955

It is noteworthy to point out that the applied conceptual understanding profile and the problem-solving (sophistication) profile were highly and significantly correlated with each other ($r = 0.689$). This leads us to posit that a student's level of confidence and sophistication when approaching problem-solving in physics is dependent on the level of coherence and understanding of the various physics concepts.

The correlation among the personal interest category and the following categories: real-world connection ($r = 0.731$), problem-solving (general) ($r = 0.379$), applied conceptual understanding ($r = 0.250$) and sense-making/effort ($r = 0.536$), revealed that a student's interest in physics is facilitated by these clusters.

When students actively make sense of the information given to them and exert the effort needed to understand physics ideas and concepts, they are able to approach word problems in a constructive manner, as reflected in the correlation between the sense-making/effort profile and the problem-solving (general) profile ($r = 0.326$). A student's sense-making/effort profile is mediated by his/her interest in the subject ($r = 0.536$) and his/her ability to connect real-world experiences with the ideas learned in the physics class ($r = 0.552$).

Table 3 also shows that expert-like beliefs in the applied conceptual understanding category and the problem-solving cluster correlate highly with good academic performance (r = 0.423 and 0.371, respectively).

Relationship Between the Different Dimensions of MPEX and Students' Academic Performances

Table 4 demonstrates that students who responded with expert-like views in the math link dimension also gave expert-like responses in the independence (r = 0.751), coherence (r = 0.512), concepts (r = 0.386) and reality link dimensions (r = 0.360).

The correlation between the independence and concepts dimensions (r = 0.523) leads us to posit that students who approach physics with a perspective of discovering the information by themselves (but not simply relying on an authority figure) are able to learn the physics concepts better. Students who see physics as a unified and coherent structure also tended to see the relevance of physics in daily life. This may be gleaned from the correlation rating of 0.538 between the coherence dimension and the reality link dimension.

Table 4

Correlation Coefficients When Comparing the MPEX Dimensions With Each Other and With Students' Academic Performances

	Independence	Coherence	Concepts	Reality link	Math link	Effort link	Over-all
Independence	1.0000						
Coherence	0.4927	1.0000					
Concepts	0.5230	0.5324	1.0000				
Reality link	0.3198	0.5380	0.1249	1.0000			
Math link	0.7507	0.5120	0.3855	0.3598	1.0000		
Effort link	0.0043	0.2258	0.0211	0.3826	0.0743	1.0000	
Over-all	0.7207	0.8364	0.5324	0.7086	0.6668	0.3782	1.0000
Academic performance	0.1649	0.0570	0.3864	0.0392	0.1492	0.2024	0.0709

Table 4 also shows that an expert-like belief in the concepts dimension leads to better academic performance as reflected in the correlation rating of 0.386 between the MPEX concepts dimension and the students' academic performances.

Synthesis

The education students taking up their Introductory Physics-Energy and the Environment course reported agreement with experts' beliefs in the following categories of the CLASS: sense-making/effort, (73%); problem-solving (confidence, 64%); real-world connections (74%); problem-solving (general, 70%); and personal interest (74%). Their responses reflected highest agreement with experts in the concepts (44%), math link (55%), reality link (66%) and effort link (78%) dimensions of the MPEX survey. The students' experiences in the physics course allowed them to appreciate the skills they gained through the various learning activities in the course and the effort they have exerted in learning the concepts involved. The students affirmed that the ideas learned in the classroom are relevant and useful in a wide variety of real-world contexts. The students likewise realized that the skills they gained in the course will be useful to their life outside of school. The study has also shown that an expert-like belief in the concepts dimension of MPEX and the applied conceptual understanding category of CLASS correlate highly with good academic performance.

The data gathered for the three other categories of the CLASS revealed that the students' beliefs in the

problem-solving (sophistication), conceptual connections and applied conceptual understanding categories, with favorable responses of 46%, 57% and 37%, respectively, can still be improved. The MPEX data on coherence dimension (36% favorable responses) support these findings. These results tell us that physics educators would have to work on these areas of the students' learning experience. The challenge to educators is how to lead the students to see the connections and relationships among the various ideas presented to them. Cognitive tools, like concept maps (Novak, 1990; Mistades, 2009), have been found to be useful in this area of the teaching-learning process.

The results of the correlation analysis revealed that providing opportunities for students to make sense of the information given to them leads to a deeper appreciation and interest in the subject matter and allows them to connect their real-world experiences with concepts and ideas learned in their physics class. Meaningful learning in a physics class is achieved when students have a firm grasp of the basic concepts in the discipline, allowing them to make sense of the information given to them, thus, leading them to exert the effort required of them. This eventually empowers them to create connections and relationships among the ideas they learned.

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Utilizing a Graphic Organizer for Promoting Pupils' Argumentation

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The purpose of this study was utilizing a GO (graphic organizer) for promoting pupils' argumentation. The method of case study was employed. A total of eight fifth grade pupils from two classes were assigned (n = 4, two high achievers, two low achievers) with GOI (graphic organizer instruction), and the others (n = 4, 2 high achievers, 2 low achievers) received no treatment. The instrument was composed of six open-ended questions based on Toulmin's Argument Pattern (Toulmin, 1958). Qualitative data were collected and analyzed through qualitative description. The results indicated that students with GOI performed better on recognizing data, claim, warrant and backing than the others. They can make main claims and justify them by data provided in the text and their claims were consistent with data, warrant and backing. Additionally, they all thought that GOI was an effective method for promoting argumentation. On the other hand, students without GOI made less important claims and supported them only by their own experience and opinions. Finally, the interviews showed that the low achievers benefited more from GOI than the high achievers and the GOI can facilitate both the comprehension and argumentation ability.

Keywords: argumentation, graphic organizer, graphic organizer instruction

Introduction

Kuhn (2005) stressed that argument is a way to comprehend and has the virtue of exhibiting its importance. An individual's potential would be decreased without the arguing ability. Siegel (1995) thought that argumentation is involved with the force of reasons. Rationality is essential for someone to solve problems effectively and live professional life. It links education and argumentation and provides educators to care about argumentation. Many scholars (Duschl & Osborne, 2002; Lewis & Leach, 2006; Nussbaum, 2002) mentioned that developing students' argumentation skills is an important component of developing their active learning, reasoning, critical thinking and assessment.

How to advance students' argumentation skills? Many investigations revealed that structured knowledge, the use of prior knowledge and cognitive ability, making thinking overt and GO (graphic organizer) are effective components for argumentation (Duschl & Osborne, 2002; Hyerle, 1995). Recently, there have been a number of studies found that argument mapping is an effective method for students to organize the arguments in text and facilitate logical reasoning (Butchart, Forster, Bigelow, Oppy, Korb, & Gold, 2009; Dwyer, Hogan, & Stewart, 2010; Twardy, 2004; Gelder, 2002). Dwyer et al. (2010) discovered that psychology students who

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studied the argument maps scored higher than those who studied on tests of memory. Butchart et al. (2009) observed that when the automated argument mapping exercises were used, undergraduate students showed a higher improvement in critical thinking. Twardy (2004) detected that argument mapping often showed precisely and made students fix their errors. Nevertheless, Hyerle (1995) pointed out that GO and simple maps for structuring information are a few tools being used to activate student learning. Lee, Hsieh, Lin, and Chen (2009) ascertained out that fifth and sixth competent readers can easily identify the conclusion and supported evidence that were hard to be persuaded by the counterparts. All good and poor readers liked underlining specific words or phrases to assist their comprehensions while reading. However, they did not make any mention of uncomplicated GO and maps in reading science argumentative texts.

Furthermore, based on Ausubel's cognitive theory, concept maps are generally graphical tools for organizing and representing knowledge, and showing the relationships among concepts. They are composed of concepts, link, and cross-link, linking phrases, hierarchical structure and example (Chang, Sung, & Chen, 2002). However, Anohina, Pozdnakovs, and Grundspenkis (2007) stressed that there were a variety of concept map tasks with different degrees of difficulty. At the first stage, the learner can request to reduce the degree of difficulty during the task-solving. Besides, Griffin, Malone and Kameenui (1995) said that GO was developed to translate Ausubel's meaning learning into practice. They examined that participants acquiring the GO instruction performed better on the measure of transfer than the control groups. It appeared that GO was a simpler instrument for a novice at reading science argumentative texts.

For these reasons, the purpose of this study was utilizing a GO for promoting pupils' argumentation. In this paper, the authors described the development and assessment to assist elementary school students in argumentation. Three research questions constructed the present study, which are: (1) Do students who use a GO perform better on the reading of science argumentative text? (2) For students who used a GO during reading, do they think GO helpful for their reading? and (3) Do students after GOI (GO instruction) have better perceptions in their reading?

Research Design

In present study, a quasi-experimental, pre- and post- test was used. The pretest was executed at the beginning of the research. The data collection during this study included a series of measurements from two testing situations: a pretest administered prior to the GOI and a post-test. The pretest attempted to assess students' prior abilities about reading science argumentative text. The post-test was performed as a measure of learning resulting.

Subject

A total of eight fifth grade pupils from two classes were assigned (n = 4, two high achievers, two low achievers) with GOI, and the others (n = 4, two high achievers, two low achievers) received no treatment.

Achievement level (high and low) is based on Mandarin course grades last semester. Grade percentages used for achievement categories were as follows: Low (less than 16%) and High (more than 84%), that is, the score of the low level was lower than one SD (standard deviation), and the high level was upper than one SD. One female student and one male student were included in each group.

Instrument

Both groups read the identical science texts and the same instruments were administered. The instruments

were executed in pretest and post-tests, which were composed of two parts, that is, the texts without titles about different topics and six open-ended questions followed the text based on Toulmin's Argument Pattern (Toulmin, 1958). The texts constructed by authors were about "nutrition of tomato" and "understanding earthquake", while the questions were:

(1) What is possible title of the passage? (Students were guided to write suitable titles with the passage.)

(2) What topic is the passage concerned? (Students were asked to completely describe the topics.)

(3) What are the key claims or ideas proposed in the passage? (Students recorded what they found appropriately from the passage.)

(4) What evidence will support author's claim in the passage? (Students interpreted claims by providing evidence for each claim.)

(5) Do you believe author's claim, why or why not? (Students justified claims by their backing, warrant or rebuttal.)

(6) Can you think of any associations with the passage? (Students compared their ideas with additional sources.)

Treatment

The treatment in the current study was GOI, and the participants were divided into the control group and the GOI group (experimental group). The study took place over five weeks. Each class lasted for 50 minutes. In week 1, all participants were asked for a pretest. From week 2 to week 4, experimental group was provided with an instruction on GOI. In the last week, all participants were asked for a post-test.

In view of the previous research, GOI in this study includes five principles of instruction for reading science argumentative texts. The instruction texts without titles constructed by authors were about "the contribution and harm of plants", "effective vision and safe driving", and "understanding of corrosion". We take the first instruction text, the contribution and harm of plants, for an example:

Important words and concepts were analyzed for students to understand. For example, seaweed, photosynthesis, carbon dioxide, oxygen, eutrophication, etc..

Students were asked to verbalize the relationships of concepts. The example is as in Figure 1.

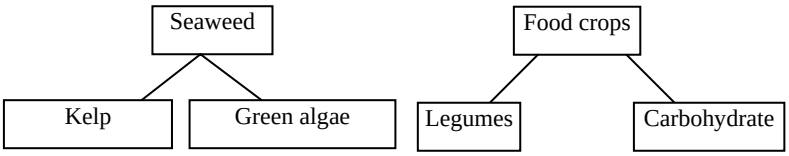

Figure 1. The interrelationships of concepts from Jack's (GOI—low achiever).

Students were asked to organize the concepts by visual GO. The example is as in Figure 2.

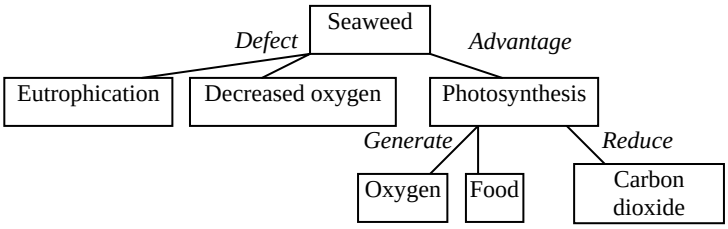

Figure 2. Demonstrate the relationships among concepts.

Students reflected on the information by responding to the questions in the instrument. For example, advantage of food crops (Jack's previous answer on the first question—title), and he had a quite different perception of the problem and said that "I think my answer is not good for the title".

Give feedbacks to students in accordance with their answers. For example, after reflecting the demonstrating figure, Jack (GOI—low achiever) modified the title "advantage and defect of the plant".

Data Collection and Analyses

After reading the text, students were asked to answer the six open-ended questions. At the end of the task, a semi-structured interview was conducted. Two questions were identical for both groups, for example: "Were the texts difficult for you? How did you think when completing them?". Two questions were different to think about the treatment; for example, for the control group: "Do you use any effective way in reading the text? How?". The corresponding question for the GOI group: "Do you think the GO is an effective way to help you to read? Why?".

Data from the instrument and interview were accumulated on a spreadsheet to develop the main categories. The two researchers then met to discuss differences in categories and grouping criteria. Through discussions, a scoring mechanism was used to organize the explanations students provided for their responses under the appropriate category. Then, qualitative data were collected and analyzed through qualitative description.

Findings and Discussions

Assertion 1: Students with GOI performed better on recognizing data, claim than the others. They can make main claims and justified them by data provided in the text and their claims were consistent with evidence.

Students without GOI could not make main claims and justify them by data provided in the text (see Table 1). Tom (control—low achiever) answered to the third and the fourth questions on the post-test, "What will happen during earthquake and an earthquake strike in many places (the third question—claim); Earthquake epicenter occurred near Taiwan for nine times (the fourth question—evidence)". Mary (control—high achiever) wrote: "The earthquake in Taiwan caused serious damage (the third question—claim); The earthquake caused serious damage (the fourth question—evidence)". The low and the high achievers only underlined few keywords and no more strategies used during reading. They were discordant opinions on claim and evidence. Because the frequencies of the earthquake could not be the evidence of what would happen during the earthquake. In addition, the high achiever wrote the same on claim and evidence. These data showed that the students in control group could not explain the claim by applicable evidence and got confused, even though a high achiever.

Table 1

Students' Performances on Claim and Evidence

Students	Third question—claim	Fourth question—evidence
Control (low)	What will happen during earthquake and an earthquake strike in many places.	Earthquake epicenter occurred near Taiwan for nine times.
Control (high)	The earthquake in Taiwan caused serious damage.	The earthquake caused serious damage.
GOI (low)	The earthquake caused serious damage and fright.	The earthquake is too impossible to anticipate when it will happen and to prevent damage.
GOI (high)	The earthquake is only a natural phenomenon which is the result of a sudden release of energy in the Earth's crust.	A larger earthquakes release greater energy and influence coverage hugely.

Within the GOI group, however, students performed better on recognizing data and claim than the others. Jack (GOI—low achiever) replied: "The earthquake caused serious damage and fright (the third question—claim); The earthquake is too impossible to anticipate when it will happen and to prevent damage (the fourth question—evidence)". Pam (GOI—high achiever) also saw the distinctions, "The earthquake is only a natural phenomenon which is the result of a sudden release of energy in the Earth's crust (the third question—claim); A larger earthquakes release greater energy and influence coverage hugely (the fourth question—evidence)". While interview, Jack said: "Because the earthquake does not precisely anticipate through technological devices nowadays, it did cause serious damage and fright". Pam considered that there is stupendous energy in the Earth's crust, when it is released, it would influence us.

In Figures 3 and 4, the experimental students constructed their own GO to help they understand the content. We can find that the low and the high achievers utilized different words and concepts. The low achiever employed the word which they were familiar with experience like "damage" and "fright", yet the high achiever paid attention to the new concepts like "coverage" and "Earth's crust". No matter what they noticed, they could figure out the texts by the GO they organized and found the consistence on claim and evidence.

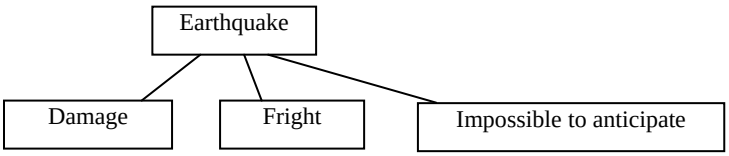

Figure 3. Parts of the interrelationships of concepts from Jack's (GOI—Low achiever)

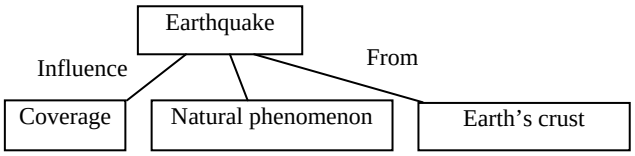

Figure 4. Parts of the interrelationships of concepts from Pam's (GOI—high achiever).

Assertion 2: Students with GOI all thought GOI was an effective method for promoting their reading abilities in argumentation. On the other hand, students without GOI made less important claims and supported them only by their own experience and opinions.

Table 2

Students' Perception on Reading Science Argumentative Texts

Students	Students' perceptions
Control (low)	The text was too long and hard to figure out… I did not know what the answers to the questions are.
Control (high)	The texts I perused are very difficult to understand, I did not grasp the main meaning of the all passage during I read.
GOI (low)	I thought that GOI helps me to understand the text because I had to relate each main concept together.
GOI (high)	GOI let me to find the data, claim, warrant and backing… then help me understand what we were learning.

Students' replies from the control group viewed the texts as puzzles with much trouble answering the questions (see Table 2). Amy (control—low achiever) complained during reading the texts, because "The text was too long and hard to figure out… I did not know what the answers to the questions are". Her answer to the fifth question, "I believed the author's claims, because the earthquake really happened (the fifth question—warrant)". Paul (control—high achiever) also said: "The texts I perused are very difficult to understand, I didn't grasp the main meaning of the all passage during I read". And he answered, "I believed the

author's claims, because the earthquake often occurred in Taiwan (the fifth question—warrant)". According to both Amy's and Paul's replies, they did mention of what the author had said, they justified by their own experience or opinions, not by evidence the author provided.

Within the GOI group, however, students felt that they had to think differently when completing the questions; Jean (GOI—low achiever) answered, "I believed the author's claims, because the author talked a lot of good sense about the earthquake (the fifth question—warrant)" and explained, "I thought that GOI helps me to understand the text because I had to relate each main concept together".

Adam (GOI—High achiever) also saw the distinctions, "GOI lets me to find the data, claim, warrant and backing… then help me understand what we were learning". And he responded, "I believed the author's claims, because the author gave lots of illustrations about the earthquake (the fifth question—warrant)". The experimental students used the GO to relate the main ideas in the text and viewed GO as an effective method for promoting argumentation. Besides, they justified by evidence the author supplied, not by their own experience or opinions.

Assertion 3: The interviews showed that the low achievers with GOI from which benefited more than the high achievers and the GOI can facilitate students' reading comprehension abilities.

The low achievers claimed and judged by the context incorrectly during pretest (see Table 3). Jack (GOI—Low achiever) answered to the third and the fourth questions on the pretest, "Every one should eat 30 milligram of tomato in a day (the third question—claim); To ease the damage of alcoholic drink and cigarette (the fourth question—evidence)". But as we know, eating 30 milligram of tomatoes in a day could not ease the damage of alcoholic drink and cigarette. That means that students did not understand the relationship of claim and evidence. After GOI, he replied more precisely with confidence on the post test: "The earthquake caused serious damage and fright (the third question—claim); The earthquake is too impossible to anticipate when it will happen and to prevent damage (the fourth question—evidence)".

Table 3

The Performance and Interviews With GOI Group

Test	Students	Interview	Third question—claim	Fourth question—evidence
Pretest	Low achiever		Everyone should eat 30 milligram of tomato in a day.	To ease the damage of alcoholic drink and cigarette.
Post-test	Low achiever		The earthquake caused serious damage and fright.	The earthquake is too impossible to anticipate when it will happen and to prevent damage.
	High achiever	GOI lets me to be clear about the context and give a better title to the texts.		

The high achievers made great progress in title. Pam's (GOI—High achiever) reply to the first question on the pretest was "advantages of tomato". But this title could not display the whole texts. After GOI, she understood clearly whether the title revealed the contents of the texts or not. Pam interpreted, "GOI lets me to be clear about the context and give a better title to the texts".

These revealed that students got different advantages from GOI, because they could not realize the components of the argumentation at the beginning of the instruction. During GOI, they needed to think the relationships of all concepts and phrases, seeing the claim should be supported by the evidence, and the title had to show the contents. At the end of the treatment, they made much greater advancement. Besides, the present study showed that the low achievers advantaged more than the high achievers in GOI group and they

thought GOI assisted their comprehension and argumentation.

Conclusions and Implications

The reports were positive in argumentation with the GOI on fifth graders in Taiwan. These findings indicated that answers which the students in GOI group replied consisted with the interview and they could relate the main ideas in the text and response to the questions more accurately than the control group. That is, the results from this experiment suggest that GO is an effective tool for all experimental participants to read argumentation texts, especially students with lower achievement . They attempted to use a simple GO to make the connections in perusing. Furthermore, the results are particularly meaningful when the subjects begin to utilize the GO for argumentation and cognitive learning.

The findings suggest that there are different apprehensions and outcomes in completing GO. Especially, the low achievers got more gains than the high achievers. The low achievers could understand the texts in spite of using simpler concepts and phrases. There are two possible reasons for this finding. First, they could figure out the relationships of concepts. Second, they could perceive that they could read and understand the texts. Thus, the relationships of concepts were the key factor for reading and understanding. These were supported by Ausubel's (1968) theory that cognitive structure is an important variable in learning.

As Yerrick's research (2000) displayed that the lower track students' arguments were improved with tentativeness of claims, use of evidence and viewpoints about the scientific authority. In the present results, the low achievers were less than 16% students on Mandarin course grades last semester. They had a few difficulties while reading a lot of texts, and in the beginning of the treatment, they felt more trouble during reading science argumentative texts. After GOI, they could use a GO and comprehend the texts more easily. It actually encouraged the researchers to apply a GO for aiding students' science learning, that is, it could be possible to make low achievers progress.

In spite of small sample in this study, it did support a little evidence that there is a necessity to attempt GOs while reading science argumentative text. When the concepts are linked, it can provide students meaningful understanding. To sufficiently use visual strategies, students need to have occasions to engage in mapping the relationships that require them to relate the conceptual ideas within the context. Overall, the results of the current study revealed GO as a very beneficial tool for organizing concepts and understanding.

Further research is needed before we understand the conditions that best foster argument comprehension through GO, and compulsory to observe the circumstances that influence levels of achievement and find other variables that might effect on comprehension, such as motivation and disposition. In addition, the effects in GO on general reasoning ability should be examined, based on the results that the construction of GO can assist deeper understanding. Such research would provide an important further test of the effect of GO on learning and critical thinking.

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One Teacher's Dilemma in Mediating Translation From Written to Symbolic Form in a Multilingual Algebra Classroom

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This study investigated how a teacher in a multilingual classroom attempted to support learners who are struggling to translate written/verbal mathematics into a symbolic form. Thirty-six Grade ten learners in one multilingual classroom in South Africa were given a written test involving one algebraic question and then a discussion on the solution ensued. The results of the written test by learners, analysis of class discussion and the interview with the teacher all revealed the complexity of discerning or situating learners' difficulty due to either language limitation or lack of understanding of the mathematics concept or both.

Keywords: multilingual mathematics classroom, mathematics symbolism, algebraic equation, equivalence

Introduction

The debate surrounding the relationships that exist between language and mathematics and between language and mathematics learning is not new in research on the teaching and learning of mathematics. Most researchers and scholars are, however, in agreement that proficiency in the LoLT (language of teaching and learning) and to some extent, in the home language of learners (where it is different from the LoLT) plays an important role in the mathematics acquisition of learners (Adler, 2001; Barwell, Barton, & Setati, 2007; Cummins, 1979a; Essien, 2010; Setati, 2008). In South Africa, even though the constitution and the language in education policy give provision for learners to study in any of the 11 official languages of their choice (DoE (Department of Education), 1997; 2002), research has shown that economic, political and ideological factors compel learners to prefer to learn mathematics in English (Setati, 2008). Underachievement in mathematics in (some) multilingual classrooms has generally be attributed to the language limitations experienced by learners. Little attention has been paid to the interrelationship between understanding the mathematics concept and linguistic limitation with regards to the translation from written to symbolic form in multilingual classrooms. Yet, this is what teachers in multilingual classrooms have to deal with each day, as they teach mathematics problems involving the translation from written/verbal to symbolic forms. It is the author's contention that not only is the language of the mathematics at playing in such mathematics problems, but also the mathematics in the language is of essence. Understanding the mathematics in the language entails that one is able to correctly interpret the demands of the questions and appropriately engage with it. Such an understanding requires a deep rooted understanding of the concepts and the linguistic nuances within the mathematics problem.

Given the complexity of language structures and the confusion that might arise from the translation from verbal/written mathematics to symbolic form, the mathematics in the language is not without its difficulties.

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This study explored this intricate relationship between conceptual understanding and linguistic limitation, and the difficulty in translating written (or verbal) mathematics into a symbolic form in algebra. It focused specifically on how a teacher mediates this difficulty. The key question the study seeks to address is: In a multilingual classroom, how can a teacher ascertain whether learners' difficulties in algebra are due to language difficulties but not conceptual limitation of the learners? A teacher who understands where the difficulty of the learners stems from with regards to the above would be better able to assist learners.

Mathematical Symbolism

In the relationship between language and mathematics, language serves as a medium through which mathematical ideas are expressed and shared (Brown, 1997; Setati, 2002). As Rotman (1993; as cited in Ernest, 1994, p. 38) argued that mathematics is an activity which uses "written inscription and language to create record and justify its knowledge". Language, thus, plays an important role in the genesis, acquisition, communication, formulation and justification of mathematical knowledge and knowledge in general (Ernest, 1994; Lerman, 2001). Pirie (1998) and Driscoll (1983) contended that mathematics symbolism is the mathematics itself and language serves to interpret the mathematics symbol. They both argued that even though brevity is strength in symbolism, this symbolism in itself can be the root cause of misunderstanding as many research have revealed. To deal with difficulties associated with mathematics symbolism, Lesh, Post, and Behr (1987, p. 648) contended that there are five steps involved in translating a problem (to a symbolic form): (1) simplifying the original situation by ignoring irrelevant characteristics in order to focus on more relevant factors; (2) establishing a mapping between the original situation and the "model"; (3) investigating the properties of the model in order to generate predictions about the original situation; (4) translating (or mapping) the predictions back into the original situation; and (5) checking to see whether the translated prediction is useful. In the author's view, what is back grounded in the above steps is recognition of the complex process of learning mathematics in an additional language. Learners who come from homes where the LoLT is the only language spoken are to some extent familiar with the linguistic structures they encounter in the mathematics classroom (Barwell, 2002; Cuevas, 1984), even though they still have to deal with the mathematics language (Pimm, 1987). Researches (Adler, 2001; Barwell, 1998; Barwell et al., 2007; Clarkson, 1991; Gorgorio & Planas, 2001; Halia, 2004; Setati, 2002) have shown that it is not the case with learners whose home language is not the language of teaching and learning. These learners need to deal not only with learning mathematical concepts, but also the language in which these concepts are embedded (Barwell et al., 2007). In multilingual classrooms of learners whose home language is not the LoLT and who are not yet proficient in the LoLT, teachers are faced with the triple challenge of striking a balance among attention to mathematics, attention to English (LoLT) and attention to mathematical language (Barwell, 2009).

Research Method

Research Design

In order to address the critical questions that this research sought to explore, a qualitative case study approach was adopted. Case studies involve detailed contextual analysis of a limited number of events and their relationships that can strengthen what has already been known through previous research (O'Leary, 2004; Soy, 1997; Van der Merwe, 1996). The author's choice of a case study was motivated by its ability as a research method to bring new variables or understanding to the fore.

Sample

Thirty-six Grade ten learners and their teacher were involved in the research. Twenty-five of the learners have Zulu, Xhosa or Setswana as their first language. Their conversational English was, however, fairly fluent. Eleven of the learners have English as their first language. The teacher, Miss Bonga, is fluent in Zulu, Sesotho and English. Miss Bonga's class was chosen for data collection for two reasons: First, Miss Bonga had undertaken a course on teaching and learning in multilingual classrooms earlier in the year and was, thus, conscious of the challenges involved in teaching in such a context; Second, there was a high level of teacher-learner and learner-learner interaction in her class compared to other classes in the school. Furthermore, Miss Bonga believed that the greater part of the difficulty experienced by learners is due to language difficulties. This belief is not uncommon amongst teachers in multilingual class in South Africa.

Data Collection

Data were collected through observation involving the implementation of the research instrument below.

There are eight times as many boys as there are girls in a school which represents learners in the school in an algebraic equation.

There were several other mathematics problems posed by the teacher during the period of observation by the researcher. The above particular question was chosen because it deals directly with translating from written to symbolic form in mathematics. It was also chosen for analysis because it is a word problem requiring learners' correct interpretation and understanding of the language to adequately engage with it. The question also requires a good grasp of the equal sign as a relational symbol indicating quantitative sameness, that is, a good grasp of the concept of equivalence (Essien & Setati, 2006). Learners were given ten minutes to write down the algebraic equation. Then, they were asked to discuss their solutions in groups of four. This was followed by a whole class discussion for 20 minutes where the teacher tried to probe learners' thinking and requested justification of solution processes. At the end of the class, the teacher was also interviewed.

Analysis and Findings

All the learners represented the number of boys with a variable and the number of girls with another variable. For the sake of this paper, the author will represent the number of boys with *b* and the number of girls with *g*. Table 1 shows how learners engaged with the question in their individual test.

Table 1

Learners' Solution to the Maths Problem

Solutions given by learners	Number of learners with this solution
$8b + g$	11
$8b = g$	24
$8g = b$ or $b = 8g$	1

As shown in Table 1, more than half of the learners interpreted the question literally, as it is written in English. Thirty-one percentages of them interpreted the question as asking how many learners were in the school. In the class discussion that ensued, the teacher tried to get learners to justify their solutions.

> Teacher: Mabel, what was your answer to the question?
>
> Mabel: $8b + g$, ma'am.

Teacher: How did you get that?

Mabel: I said, if *b* equals boys and *g* equals girls, then there would be $8b + g$ learners in the school.

Teacher:Read the question again. What does the question require of you?

Mabel: There are eight times as many boys… (Read the question).

Teacher: So what do you think? What is the question asking of you?

Mabel: It is asking that… that I… I…

Teacher: Can someone else help her? Yes, Tsiki.

Tsiki: It is asking that we represent the above statement as an algebraic equation.

Teacher: Can you say it in your own words?

Tsiki: It wants us to write an equation for eight times as many boys as there are girls in a school.

Teacher: And what do you think?

Tsiki: I think it would be that eight times boys equal girls. So, if *b* stands for boys and *g* for girls, it would be $8b = g$.

Teacher: What do others think? Temi, what do you think?

Temi: Eh … eh… I…

Teacher: What did you write?

Temi: I… I… I… (she was one of those who wrote $8b = g$).

Adler (2001) advocated that in a participatory-enquiry approach, such as the one used by Bonga, a high demand is placed on learners' communicative competence. The learners in Bonga's class have been tackling non-routine problems in diverse areas of the curriculum. As a part of their participation in such a learning environment, learners are usually urged to express/justify their thinking and critically examine one another's solution as evident in the above excerpt. Bonga has noticed that some learners were usually quiet in class and had attributed their lack of participation to their English language competence level or timidity. She made it a point of duty to call on these learners to speak in class. On watching the video-tape of her lesson with Bonga, she explained that:

> Even though I was not surprised that learners wrote $8b = g$, I was struck that only one person was able to write the correct equation, and he is a Zulu first language speaker. I then thought to myself that they may be something more than language at stake here. But before trying to figure out what actually could be the problem, I tried to get learners to understand the key words in the question to see if that would help them understand the question better.

After noticing that learners did not understand the question well, Bonga decided that dissecting the question would help:

Teacher: I still need someone to explain to me his/her answer. Yes, Dave.

Dave: The equation, would it not be $8b = g$? It is there in the question and it's easy to see: eight times the number of boys equals girls.

Teacher: Let us look at the key word or phrase in the question. What is it or what are they? Think. Yes, Luandile.

Luandile: Is not it "as many"?

Teacher: What do others think?

Mabel: I think it is "eight times as many boys as there are girls".

Teacher: Let's take it from there:What does that mean? Eight times as many boys as they are girls.

Dave: Eight times the number of boys equals girls.

Teacher: Which is greater? Number of boys or number of girls.

Learners: (Chorus) boys.

Teacher: How? Who can give me a reason?

Hlengiwe: Eight times as many boys as there are girls. There are more boys.

Even the attempt to analyse the key words or phrases did not help much in the understanding of the question. As Driscoll (1983) argued, the difficulties that learners experience in symbolic formulation of the mathematical written/verbal problem is not due solely to the confusion about words or vocabularies in the question. During the interview, the author asked the teacher why she thought that the English first language speakers did not answer the question correctly:

Bonga: You know, any interpretative activity, such as the question above requires a sort of understanding of language in question. There is understanding of the language; there is also understanding of the mathematics.

Researcher: In the question, would it be possible to engage with it if you do not understand the language? And would it be possible to engage with it if you do not understand the maths?

Bonga: I believe that the two are much related to each other. Learners need to understand both the language and the maths to correctly solve the problem. They need the language to interpret the words into algebraic equation, and the maths to check if their answers are correct. You see, that was why when I noticed that grasping the key words and phrase in the question did not work well, I switch to numerical representations hoping this would help.

Teacher: Consider the question again, assuming there is only one girl in the class, how many boys would there be?

Thandi: Eight boys.

Teacher: if there are two girls, how many boys would we have?

Thandi: Sixteen boys.

Teacher: Now, if there are g girls in the class, how many boys are there? Yes, Koko.

Koko: 8*g*.

Teacher: Now, if *b* represents number of boys and *g* the number of girls, write and equation relating number of boys and number of girls in the class.

Even after this tactics of using numbers, the learners still did not fully grasp the explanation. The confusion inherent in translating the question above to symbolic form as Clement et al. (as cited in Driscoll, 1983) pointed out, is due to the direct translation or mapping of words in English into algebraic symbol. Bonga seemed to believe that learners' confusions of believing that "8*b*" represented the larger group and "*g*" indicated the smaller group (Driscoll, 1983) was due solely to language difficulty. As Pirie (1998) pointed out, mathematical symbolism in a way is the mathematics and is interpreted through the medium of oral/written language; but within the mathematics register, verbal/written expressions do not always match symbolic forms.

From the above excerpts, it can be observed that learners used the word "times" in the expression "as many times as" to mean "times" as in a time "*b*" equal "*ab*".

Discussion

Any teaching or learning of mathematics involves activities of reading, writing, listening and discussing (Pimm, 1991). Language serves as a medium through which these mathematical activities are made possible. By asserting that mathematical activities are essentially interpretative in nature, we give primacy to the interpretative ability of learners and by consequence, their linguistic ability in the language in question. But to what extent can it be deduced that the difficulties experienced by learner are primarily due to the language competency level? In other words, when can we know that the difficulty is due to the English but not to the mathematics itself—not the difficulty of translating from written to a symbolic form. Bonga struggled with this dilemma. She could not understand why none of the learners with English as first language could correctly engage with the question. She then surmised that the difficulty in the concept of equation could be at stake here. Still not convinced of her conjecture, she then decided to use numerical values to gradually help her learners to understand the question. Using numerical values to facilitate mathematical algebraic thinking in learners can help mediate language and conceptual problems. But is this tactic always successful? Can letters in all algebraic word problems be substituted for numbers? Are there cases where the use of numbers can aggravate rather than alleviate difficulties in the translation from written mathematics to symbolic form? Could code-switching have helped in easing the language problem? If code switching had been used, would learners have still recognized that $8b = g$ was wrong? These are the questions that should plague the minds of any teacher desirous of mediating the translation from written/verbal mathematics to symbolic form. The present study (even though small scale) is a clear indication that language problems are inherent in mathematical problems for both first language and additional language learners.

Conclusions

Language is a key component in the construction of mathematical knowledge in the classroom (Gorgorio & Planas, 2001). In algebra, as in some other aspects of mathematics, this relationship is a very complicated one and can pose problems to learners in the interpretation of questions. At times, understanding the mathematics in the language is not a straightforward matter, and the teacher's role of mediation, when it comes to symbolic formulation from written expression (where it is not clear that what is at stake is the understanding of the English or the understanding of the math) in a multilingual classroom, is a daisy one. This paper has posed more questions than proffer solutions to Bonga's dilemma. It is hoped that these questions would induce further research into the intertwinement of language and mathematics in the teaching of the concept of equivalence when learners are first introduced to algebra at Grade eight level.

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The Cultural Aspect of Foreign Languages Teaching at Primary School in Turkey

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Learning a foreign language is a new concept at primary school in Turkey. Even if the Minister of National Education has been thinking of it for a long time, it has only been compulsory since 2006. Pedagogues are still doing research on the way to teach a new language to children. One of the ideas is to base this new learning on cultural contents. This method respects the close link between language and culture. Moreover, using a cultural base is an efficient way to interest children and open their minds. This method can be efficient if we join together some parameters: a motivated teacher (who works alone or with a staff), cultural contents adapted to the age and the interests of children, a frequent use of foreign language as a way of communication, a work in link with other subjects of the primary school and the use of genuine and varied supports. Such a work helps pupils to build their personalities and progress with the foreign language.

Keywords: language, language and culture, cultural content, foreign language education

Introduction

What is understood generally by saying the concepts “culture” and “language”? The term of culture is described as many lives styles and one of the most used terms in all societies. As to language, it is a complete system of signs according to Ferdinand de Saussure (1916). But these two terms have been a controversial subject regarding their interaction. Which one affects the other one? This can be thought of as a dilemma question which cannot be answered yet and also will not be answered. When we look at the relationship between the language and culture, it is a fact that a close relationship occurs between them (Klippel, 1995). Pulverness (1999) emphasized this relationship by putting stress on social circumstances which shape language. A similar view was expressed by Bassnett-McGuire (1980) to indicate the inseparability of language and culture:

> No language can exist unless it is steeped in the context of culture; and no culture can exist which does not have at its center, the structure of natural language. Language, then, is the heart within the body of culture, and it is the interaction between the two that results in the continuation of life-energy. (p. 14)

According to Akarsu (1988), culture and language cannot be separated from each other and both terms develop in a unity. A society being superior in one area is bound to be superior in another, too. In fact, the relationship between language and culture becomes obvious when the definitions provided for them are carefully examined.

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Torop (2002) wrote that culture has its own languages or sign systems which members of the culture use to communicate. According to Peterson and Coltrane (1995), language reflects culture and hence cultural knowledge is a must in learning a foreign language. Klippel (1995) drew attention to the same point by stating that "learning a language therefore implies learning something about culture as well" (p. 25). Students can have a better command of the foreign language if they gain background knowledge and understand about the cultures using the language they learn.

The language does not exist apart from culture. For this reason, different people learning each others' languages are actually creating a mutual understanding among themselves regarding culture. From this definition, we can clearly see the relationship between language and culture when a language learner tries to understand any situation or transmit any desire to others and when he/she cannot succeed it although his/her all grammatical phrases are correct (Courchêne, 1996; Vogel & Cormeraie, 1996). As a conclusion, we can state that the history of language is basically the history of culture.

Over the last two decades, with the increase of the studies related to the relationship between culture and language, a lot of researches have been carried out on the subject of making language courses with cultural contents of a new language (Singerman, 1988; Galisson, 1991; LeBlanc, Courtel, & Trescases, 1990; Flewelling, 1994; Courchene, 1996; Laforge, 1993; Mitchell, 1995). Over the last decade, Turkish researchers have made many studies supporting language education based on cultural contents (Bada & Genç, 2005; Elyıldırım, 2008; Türkan & Çelik, 2006).

Cultural Content in Language Teaching Process

It is often mentioned by researchers that designing language courses with cultural contents can be a new approach in foreign language education. Actually, when we looked at the other factors accelerating this new approach as a new language teaching method, the existing language teaching methods take their places on the first order. Today, in literature publications, the most used language teaching methods tested their applicability are mentioned as translation method, natural method, auditory-linguistic method, contact method, selective method and audio-visual method. Many other methods are mentioned besides these. It is said that there have been 40 language teaching methods across the world (Tarcan, 2004). However, many of these methods fell behind in practice (Tarcan, 2004). It was stated that these deficiencies in language teaching are as a result of anthropology studies in USA, especially during the period of World War I and II, and it was seen obviously the relationship between language and culture (Demircan, 1990).

Understanding and comparing cultures have been a significant part of language teaching and a new language cannot be taught in isolation from its culture (Rivers, 1981, p. 315). In Europe, when we looked at the cultural studies developed in foreign language teaching, and in the 1990s, the cultural syllabus was supported by research in the National Core French Study of Canada (Flewelling, 1994).

Cultural Content in Language Skills

According to Xue-Wei and Ying-Jun (2006), accounting for the roles that cultural contents play in language learning and teaching, it is necessary to demonstrate the functions it may perform in the components of language learning and teaching, such as listening, speaking, reading and translating. They said that listening activity is closely related to the culture, politics, and economy of the language which students learn. For example, if a student hears a sentence like: "ll conduit comme un Marseille" which means in English "He

drives the car like a native of Marseille", he will not find it difficult to understand the structure of the sentence. But, if he does not know that a native of Marseille sometimes does not obey the traffic rules by driving, he cannot understand the exact cultural meaning.

They explain the influence of cultural contents on speaking skills by giving an example as mentioned follow:

> There is a young interpreter whose pronunciation is standardized and natural. The first time he was appointed to accompany a foreign guest, he tried to do everything he could to show he was enthusiastic, kind, considerate, and competent. He tried to be attentive as possible by saying "You come this way." "You sit here." "Don't go too fast." "Follow me." "Don't be late." But the next day, it came to him as a shocked surprise that the foreigner didn't want to go with him, because the foreigner thought the young interpreter was not polite. In the foreigner's eyes, the interpreter is not helping him, but scolding him as scolding a child. There is no problem in the interpreter's English, but the lack of the cultural background knowledge makes him incompetent for this job. (p. 4)

The story is simple, yet it says something important. In the course of oral communication, speakers should pay a lot of attention to the context, i.e., what you are saying, to whom you are saying it, when and where you are saying it, etc..

They explained the influence of cultural contents on reading skills by giving a meaningful example as mentioned follow:

> After dinner, when I was thinking on the croquet lawn with Mr. Churchill, he reverted to this theme, and I asked whether for him, the arch anti-Communist, this was not bowing down in the house of Rimmon. Mr. Churchill replied, "Not at all. I have only one purpose, the destruction of Hitler, and any life is much simplified thereby. If Hitler invaded Hell, I would make at least a favorable reference to the devil in the House of Commons". (p. 5)

In the above paragraph, Churchill quoted three religious allusions: The first one is "bow down in the house of Rimmon" which comes from the *Bible* meaning "Doing things against one's willingness"; The second one is "Hell"; and the third one is "the devil". If we do not know the three allusions, we can not fully understand that Churchill likened Communist USSR (Union of Soviet Socialist Republics) to "Hell" and the Soviet Communist to the "devil".

As to the effects of cultural contents on translating, for example, "je n'étais pas Pygmalion, j'étais Frankenstein", there are two points that may puzzle us: One is "Pygmalion" and the other is "Frankenstein". We can see that they are the names of two persons, but who are they? In fact, Pygmalion is the King of Cyprus in Greek fairy tales. Once he carved a statue of a very beautiful young lady and fell in love with "her". Because of his pious love, Aphrodite, the Goddess of Love gave the statue life, and at last, Pygmalion married her. Frankenstein was a character in Mary Shelley's *Frankenstein*, who was a young medical college student. He invented a monster, but that monster destroyed him. From the above background knowledge, we can see that "Pygmalion" means "to enjoy one's own creation", while "Frankenstein" means "to suffer from one's own actions". So, the success in translating this sentence does not solely depend on understanding its structure but is determined by the knowledge of the cultural load of the two terms carried respectively.

When we look at the effects of cultural contents in foreign language teaching, the question becomes very meaningful to ask that whether a new language can be learnt without being familiar with its culture.

Culture is perceived as a means of communication among societies. And it is an important key for international cooperation (Byram, 1989). According to him:

(1) The one learning a foreign language must learn required information and get communication skills in

terms of communication;

(2) Learning the cultural elements of communication does not mean to get rid of his/her own culture. That type of transformation can be facilitated by state policies. For instance, cultural studies in Germany are so-called but for providing cultural communication;

(3) The foreign language needs of Turks are not cultural but technical.

In a conference named The Meaning and Role of Culture in Foreign Language Teaching at Georgetown University (USA) in Institute of Linguistics in 1961 and in a text "Report on Results of French Group Work Session" written by a professor, Alphonse V. Roche from Northwestern University, it was stated that the necessity of cultural contents will be a language teaching approach. Roche showed how the French language can be learned by this approach. By taking into consideration about the age range of students, he has arranged subjects related to the culture of that society for teaching French with this approach:

(1) Age 1-7: Life in Paris, rural and urban life, French nationality, history of France, etc.;

(2) Age 8-13: Structure of French society, the clergy, middle class, national education, the community, the past and today France.

On analyzing the cultural contents prepared by Roche for teaching French, it can be said that prescribed subjects for students have been chosen according to the interests and age of the students. According to the report prepared by the French ministry of education (ONISEP, 2003), cultural contents contribute to the development of general formation of learners. These contents facilitate the information and make the thoughts restructure. That is to say, they enable learners to acquire diversity in their thoughts.

When we looked at language teaching in Turkey, foreign languages which have been taught in school curricula are Arabic, German, Chinese, French, English, Spanish, Italian, Japanese, and Russian. Though English language does not seem as a compulsory one, many students learn English. Percentage of foreign languages taught in Turkish primary schools are German (0.036%), French (0.005%), English (99.9%), and Russian (0.013%), and in Elementary schools German (0.507%), French (0.109%), English (99.3%), and Russian (0.019%).

It has long been a matter investigated by researchers that foreign languages have not been taught properly for years in educational institutions. The most significant point remarked by experts in this matter is that general education is mostly based on teaching grammar. According to Demirel (1999), this is a big mistake in foreign language teaching. He added that he has been studying this subject for 30 years and witnessed many problems in language teaching, and for these reasons, a new approach must be applied in solving these language teaching problems.

From this point of view, it can be said that new approaches can be applied for teaching foreign languages in Turkey. Moreover, by beginning to teach children a foreign language with the help of the Neurolinguistic approach and selecting appropriate cultural contents according to the age and interest of children, learners can be motivated to learn. For example, according to Tseng (2002, p. 2), reading a foreign language text and having the cultural background of that language not only motivates the learner but also enables him/her to understand the text easily and rapidly. According to Rosberg (1995), the foreign language courses with cultural contents and a motivated teacher motivate the students to learn. For this, foreign language courses must be actual and meaningful. He also emphasized that students could be more inclined to learn a foreign language only if the teachers are more attentive in choosing course books which do not include stereotype views of that language but ones including supplementary cultural contents (Rosberg, 1995, p. 6).

When we look at the situation in Turkey, cultural content is often neglected in the textbooks. To illustrate the cultural content of an English foreign language textbook for Turkey, "Spotlight on English" by Dede and Emre (1988) is totally Turkish. The main themes include Turkish food, history and weather, and all topics discussed in English. When the textbook characters travel, this is done only in Turkey, even though some characters are English-speaking visitors to the country. The implication is that students learn English to talk with visitors who come to their country, but they are not expected to travel to English-speaking countries or learn about English-speaking cultures. If they speak with visitors, they can only do so within their Turkish cultural framework, because they have not encountered cultural alternatives, and are, therefore, likely to carry their home culture with them in their use of English. Thus, paradoxically, unless native speaker visitors are already familiar with the Turkish culture, they may have problems understanding the Turkish speakers of English due to potentially conflicting cultural norms. In other words, native and non-native speakers use the same language, but communicate on different cultural wavelengths, uninformed about each other's cultural views and values—a classic setup for miscommunication.

According to Çakır (2006), some teachers in foreign language courses are hardly aware of the necessity of cultural contents in Turkey. Communication is seen as the application of grammatical rules in oral and written practice. In some case, learning about the culture contents of a new language is taken as a threat to the native values and the importance of linguistically relevant information is neglected. Since having close contact with the cultural contents of the new language and its speakers is a rare opportunity for all language learners in our country, learners cannot appreciate the importance of learning the cultural aspects of communication unless they visit a foreign country and experience the difficulties (Çakır, 2006).

One other parameter paying attention to foreign language education realized by cultural contents is an interdisciplinary approach. For example, in a text taken from "Bridging the Cultural Gap" by Carté and Fox (2008), it is stated that:

> It is normal when the children discover many way of live of other countries adopting a transdisciplinarity attitude. The connection established between learning foreign culture and assembly of the program can be beneficial at the same time for other disciplines and knowledge of the countries. (p. 60)

As to Turkey, there could be four reasons why not teach foreign language education with cultural contents of that language.

(1) Selected books: In selecting the course books, most being inadequate on cultural contents and two phenomena occur in our mind, either the state hesitates that the students will be affected by other cultures and they will lose their own culture. For this reason, the state consciously selects these books or the state cannot figure out the significance of cultural factors in language teaching. When we think of how many people have academic skills among the state's staff who are responsible for selecting these books, the second option seems less possible;

(2) Teachers: Many teachers being educated from their childhood in the Turkish education system apply their early methods to their students. As a result, the teachers overlook the cultural contents in their lessons. Moreover, teachers have no opportunity to go abroad and communicate with a native person speaking the target language they aim to teach. Hereby, it needs extra effort for teachers who cannot experience the importance of cultural contents via real life. It will be difficult for them to be aware of this cultural awareness;

(3) Point of view: Understood by students, teachers, parents, and many people learning a foreign language

and those thinking of learning a new language, this false point of view in Turkey is perceived as if a new language were learned by vocabularies and grammar rules.

The results of inadequate cultural contents in lessons appear like making fun of people being different from them, perceiving the others as if they were horrible ones and being misunderstood when doing someone a favor. It seems that there are many examples related to this situation:

(1) Our people make fun of men coming from abroad because of their earrings, long hair or clothing styles;

(2) Our people are prejudicial to women coming from abroad because of their clothing styles perceived as ordinary in their culture;

(3) Our people want to give a seat to an old lady when abroad, and as a result, they are blamed for being rude;

(4) Our people leave the tray on the table in a fast food restaurant, but abroad they have been warned for this, because that is self-service custom in abroad.

Some significant points for transferring the cultural contents effectively in foreign language classes are:

(1) Teachers should make their students watch films including natural situations and native people and then those situations taking place in films must be staged by the students;

(2) Though course books are sometimes deficient, teachers must bring to the class materials including cultural items for a discussion among students, and as a result, the awareness of students can develop.

According to Dunnett, Dubin, and Lezberg (1986, pp. 157-160):

> (1) The top management should lay stress on transferring the cultural contents as well as in other subjects like teaching grammar and vocabularies; (2) Foreign language courses should be ordered in order to transfer cultural contents effectively or other courses should be organized for this transferring out of official courses; (3) The concept of culture must be also stated in teacher training programs; (4) Teachers should investigate whether cultural contents are transferred successfully or not while selecting the course books.

Conclusions

Learning a foreign language is compulsory at primary school in Turkey since 2006. If experts come to an agreement on how the courses can be organized for fourth and fifth grades and how and which lessons can be taught, if teachers improve the foreign language teaching strategies and if the foreign language teaching approaches in abroad aiming at teach cultural contents are supported by pilot studies, it can minimize the problems to some degree in foreign language education in our country.

For the culture in which a person lives is different from another, having knowledge about that culture for communicating will make communication easy and prevent potential misunderstandings and problems. For this reason, while teaching a foreign language, cultural contents must be the first order. Otherwise, it is possible that students will have difficulties because of not having enough knowledge of cultural contents. In order to avoid these situations, it can be said that the foreign language courses books used in instruction should be overviewed again and books conveying the cultural contents efficiently should be selected.

Cultural contents in foreign language education will increase motivation of students as well as grammatical rules of that language. Doing this, the new language will be more meaningful for learners, but also it will be more enjoyable and takes no more time to learn. Furthermore, having knowledge about the other cultures will make students aware of the other point of view in the world. This will motivate the students and

increase their learning speed. Also, it will contribute to the student's interaction with the other people. In sum, language learning cannot be detached from the cultural content and it inherently carries to the language classrooms.

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An Inquiry-Based Linear Algebra Class

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Linear algebra is a standard undergraduate mathematics course. This paper presents an overview of the design and implementation of an inquiry-based teaching material for the linear algebra course which emphasizes discovery learning, analytical thinking and individual creativity. The inquiry-based teaching material is designed to fit the needs diversified student body consisting of students majoring in engineering, mathematics education and mathematics.

Keywords: inquiry-based teaching, critical thinking, independent learner

Introduction

The study of linear algebra has a long history. The linear algebra is a required mathematics course for undergraduate students majoring in pure mathematics, secondary mathematics education and physics, engineering and computer science at Southeast Missouri State University. It is an upper level mathematics course, and it covers topics, such as determinants, matrices, vector spaces, systems of linear equations, similar matrices, eigenvalues, eigenvectors, diagonalization, orthogonalization, and quadratic forms.

Many students find the material in linear algebra class very difficult. They feel some of the concepts such as bases, vector spaces and linear transformations are very abstract and disconnected from the mathematical materials they learned previously. In order to bridge the gap between concrete and abstract concepts and help the students overcome the difficulty in the theoretical aspects of the class, many instructors have tried different teaching strategies. In this paper, we present an overview of the design and implementation of an inquiry-based teaching material for the linear algebra course which emphasizes discovery learning, analytical thinking, and individual creativity. The inquiry-based teaching material is designed to fit the needs of a diversified student body consisting of students majoring in engineering, mathematics education and mathematics. In particular, a summary of the comments and the feedback from students are included.

Method

As instructors, we realize that the character of mathematics changes sharply between lower level and higher level mathematics courses. In the lower level mathematics courses, the procedures, computational algorithms and algebraic manipulations are essential and greatly emphasized. In the higher level mathematics courses, the role of computation diminishes and the logical or deductive reasoning are much more emphasized. That is one of the reasons why some of the students find the theoretical approaches in the higher level mathematics courses very difficult. In particular, the non-mathematics major students or students with little

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training in abstract mathematics may not have enough mathematical maturity to handle the theoretical concepts of the linear algebra course.

Each semester, at least one half of the students enrolling in linear algebra class are physics, engineering and computer science majors at Southeast Missouri State University. A common concern among many of these students is whether they should be concerned with a lot or some about proofs since they only need to apply the materials in their fields. The author's advice to them is: A real life engineer may not need to work on the rigorous mathematical proofs, but in general, a good engineer should know where things come from, some fundamental concepts that allow him to see what is right and what is wrong, and the logical reason behind. Therefore, the basic proofs are necessary. Moreover, one cannot understand linear algebra properly without some simple proofs. If one knows the context and knows how to logically deduce one from another, then one has a better understanding of the statement of the formulas and the reasons behind the computational algorithms, and will be able to better apply the algorithm to simplify their computational tasks.

Similar to the question raised by the physics, engineering and computer science majors, some of the students majoring in secondary mathematics education question whether it is necessary for them to know the detailed proofs. For them, a linear algebra course should emphasize on providing an opportunity to give extensive practice with algebraic manipulation, so that they, as future teachers, can be assured to "know how" in high school algebra. The author's answer to them is: The theoretical components of linear algebra help us better understand the mathematical structures which are the foundations of algebraic manipulations. Therefore, to ensure the future teachers "know why" the algorithm works; it is a must for the secondary mathematics education majors to know how to conduct basic proofs. This requirement is particularly important since too many prospective high school teachers unfortunately fail to understand connections between those theoretical concepts and the topics of school algebra.

To choose an appropriate teaching style, construct suitable teaching materials and help the students learn and develop their critical thinking skills, one needs to understand the different levels of cognitive reasoning. The recent research by Anderson and Krathwohl (2001) stated that there are six categories:

> (1) Remembering is the retrieval of knowledge from long-term memory;
>
> (2) Understanding occurs when meaning is constructed from the collected information;
>
> (3) Application means carrying out a procedure;
>
> (4) Analysis involves breaking down the information and determining the relationship among different parts;
>
> (5) Evaluation is the process of making judgments, based on criteria or standards;
>
> (6) Creating is the process of putting elements together to form a coherent or functional whole, or reorganizing elements into a new pattern. (p. 31)

The critical thinking includes analysis, evaluation and creating.

Seymour wrote, "You cannot teach people everything they need to know. The best you can do is to position them where they can find what they need to know when they need to know it". Inquiry-based teaching has proven to be far more effective than the traditional lecture approach in the classroom according to the current research in learning theory. The concept of inquiry-based learning has appeared numerous times throughout history as a part of the educational philosophy of many great educators. Based on the researches by

Oliver (2007) and Prince and Felder (2007), the inquiry-based teaching style presents students with a problem to be solved and it increases students' motivation. More importantly, the inquiry-based learning actively involves the students in the learning process and allows the students to learn the contents on their own, which provides more opportunities for the students to gain a deeper understanding of the concepts and become better critical thinkers. In order to fit the different needs of the diversified student body and help student learning, an inquiry-based teaching style is chosen for this class, and an inquiry-based linear algebra course material is designed to combine the heavy theoretical concepts and the basic linear algebra with proofs and algorithms.

The inquiry-based course material is written with the goal to present the topics clear and understandable to students. Each section of the course materials starts with the simple ideas, basic definitions, and if necessary, the concrete examples are given to illustrate the meaning of the definitions. Then the materials gradually move towards new or abstract concepts, such as lemmas, theorems and corollaries; the sections are ended by applications, examples and exercises. The class activities emphasize on inquiry-based learning, and the main learning goals for the students are:

(1) To know the definitions and theoretical concepts through interactive teaching and discussion;

(2) To discover computational algorithm, the theorems and proofs by discussion and group work;

(3) To know how to apply linear algebra in other fields, such as geometry, engineering or physics.

The method of instruction consists of two parts: (1) the mixtures of short presentations and discussion by the instructor and students; and (2) the large amount of time in problem-solving among students either in groups or independently with hints provided by the instructor. Before introducing the new topics, the short presentations and discussions start with some relevant real-life applications to help students understand why the topic is important. Then the ideas, definitions and concepts are introduced from simple to complex, familiar to unfamiliar, concrete to abstract with examples, figures or even translation to simple daily terms to help students internalize the materials. The flow of the materials or class activities are always from concrete to abstract with the aim to present the new materials clear and understandable to the students so that they may reason inductively and draw the logical conclusions. The theoretical part of the materials are presented by extensive discussions lead by the instructor via thought-provoking questions, formulated by the response by the students and written formally on the board based on the final conclusions drawn from the students. Once the main theoretical concepts are clear and understood, then the sequential results or application problems will be proved or solved by the students in groups or individually. The students are encouraged to express their own diverse points of any problem, different approaches of proving the same result or solving the same problem will be presented on the board.

Assessment

Throughout the semesters, the instructor observed the students' progress. First, the instructor identified the students with different mathematical backgrounds, and then identified the level of their understanding of basic definition, their abilities of carrying out computational algorithm and conducting proofs.

The course materials started with linear equations and row reduction, and then on to the other subjects of linear algebra. The flow of the materials in the course is as follows:

(1) A standard treatment of linear equations, Gaussian elimination and its application;

(2) Matrix algebra including transposition, matrix inverse and the relationship of matrix algebra and linear equations;

(3) Determinants and their properties;

(4) Vector spaces, subspaces, basis, dimensions, and linear transformations;

(5) Eigenvalues, eigenvectors, similar matrices, and diagonalization;

(6) Orthogonality, symmetric matrices, and quadratic forms.

During the semester, there were two tests in class exams. Each exam contains about ten questions involving both computations and proofs. There are two proofs on the first exam and three proofs on the second exam. The grade distribution of the two in class exams are listed in Table 1.

Table 1

Grade Distribution of the Two In-class Exams

	A (~90%)	B (89~80%)	C (79~70%)	D (69~60%)	F (59%~)	Total
Test 1	5	9	5	3	7	31
Test 2	9	12	1	3	5	31

Based on this data, the number of the students achieving grade letters “A” and “B” increased by about 12% and 12% respectively from test 1 to test 2. The number of the students who failed test 2 decreased by 6% in comparison to the number of the students who failed test 1. It is very interesting to note that four students who obtained a grade letter of “C” on the first exam improved to a grade letter “A” on the second exam.

The survey questions that were designed for the class were answered by each student in class. A summary of the students’ responses to the reflective questions designed for this project are presented below:

Question 1: Classify all the theorems you learned and indicate the percentage of the theorems you feel were: (a) very difficult; (b) difficult; (c) average; (d) easy; and (e) very easy. There are different percentages according to students’ backgrounds, but in general, students considered 10% very easy, 15% easy, 50% average, 15% difficult, and 10% very difficult.

Question 2: What is the most difficult thing about this class? Definitions? Computations? Proofs? Why? The majority of the feedbacks considered the definitions and proofs are very difficult. According to the feedbacks, there are so many definitions, they are very abstract, and some of them are very similar and hard to differentiate. Moreover, the confusion of the definitions leads to the difficulty in proofs. One student stated: “… the hardest thing is the proofs because it is hard to remember definitions to use for the proofs. I also have a hard time starting the proofs”. Another student stated that:

> The definitions and the proofs are the most difficult. I find it easy to work out problems but perform proofs is difficult. I believe it is because I have difficulty translating the material terminology into something I can understand. As soon as I understand the definition, in everyday terms, I find it easy to understand and apply it. The proofs are difficult many times because they seem too general. I feel as if the proofs do not prove anything. It may be related to my problems of understanding the definitions.

Question 3: Do you feel that you have a clear understanding of the definitions? Do you know the connections between the definitions and computational algorithms? Most students responded that they understood the definition for the most part, and felt somewhat confused on a few materials related to linear transformations and change of bases. Most of the students expressed that over the course of time, their understanding of definitions got clearer; once they understood the definition, they saw the connections between the definitions and computational algorithms, and they did not have problems in solving problems.

Question 4: How much have you learned in all aspects? List the most difficult one and the easiest one, and

indicate why so. The majority of the students stated that they have learned a lot. Although the definitions and proofs are the hardest thing about this class, they felt that the algorithms are not that hard to pick up. One student commented, “I have learned a lot in all aspects. I think the most difficult are proofs because of their abstract nature, while the easiest is the computational part because they are the most straightforward”. Another student stated that:

> The most difficult aspect has been starting a problem, and figuring out how to use a definition is challenging. The easiest thing I have learned is row reduction. After the matrix algebra, the column space and null space problems are the easiest for me since I understand their physical significance. Transformations tend to be the most difficult to me because it is difficult for me to follow what all the elements in the definitions are.

Question 5: How do you like the course materials, especially the materials posted online? Do you think they are in a good order? Can you use the previous theorems to work out the exercise problems? The common feedback is that “I like them a lot. They are in good order, and I can use the previous theorems to work out the exercise problems”.

Question 6: As a student, do you feel you learned a lot in this class? If you are a teacher, what would you do to help your students to learn the material? Most of the students positively identified that they learned a lot in the class. One student said:

> We started off with something we all knew how to do, such as solving a linear system, but did that using a new matrix method. Then we continued to use matrices to allow us to do other applications. As a teacher, I would make it clear how important the definitions are, and then keep hammering the concepts.

Another student stated that:

> I feel I have learned a great deal about a topic that I was previously not too familiar with. I love how you allow us to ask homework questions and do a short review at the beginning of the class. If I were a teacher, I would try to show the connections with previous material with the old and continually recap on past material.

Conclusions

Based on the instructor, in this inquiry-based learning class, the students’ mathematical maturity increased greatly. This reflected on their abilities to read the abstract definitions and construct logical mathematical proofs. In particular, more and more students could distinguish two similar concepts by carefully examining the conditions and could understand the logical implications and the relations of multiple concepts. Sometimes, the proofs they constructed may not be completely polished, but their approaches are correct, and many times, they can provide a variety of solutions. Especially, they learned to analyze each other’s work, either verifying the validity of their own proofs or providing counter-examples.

In addition to helping students grow mathematically mature, the inquiry-based learning provided an opportunity to the students to fall in love with problem-solving. During the semester, there were three students who applied the materials they learned to solve a real-life problem and presented it during the IL-MO Regional Undergraduate Mathematics Conference. Also, eight students participated in the journal problem-solving activities. They solved and submitted solutions to several mathematical journal problems which were proposed in college mathematics journal and crux mathematic rum with mathematical mayhem. In particular, the students grew more mathematically independent, a benefit of inquiry-based learning, that helped students to conduct research and solve more complicated journal problems on their own without prior background knowledge.

Based on the materials and data collected, the following conclusions can be made for students in this Linear Algebra class:

(1) Students felt that they were challenged and stimulated to learn;

(2) Students developed a deeper understanding on abstract concepts;

(3) Students learned to recognize patterns in the course materials;

(4) Students gained confidence in their own problem-solving ability;

(5) Students made progress in becoming independent learners.

From this project, the author concludes that the inquiry-based teaching approach is suitable for students who have: (1) good mathematical background; (2) good reading and comprehension ability; (3) independent learning ability; (4) logical thinking ability; and (5) persistence.

As instructors, the effect of this inquiry-based Linear Algebra class is that we learned to be open to different teaching approaches and committed to apply appropriate teaching approaches to meet the needs of our students.

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Visual Basic Applications to Physics Teaching *

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Derived from basic language, VB (Visual Basic) is a programming language focused on the video interface component. With graphics and functional components implemented, the programmer is able to bring and use their components to achieve the desired application in a relatively short time. Language VB is a useful tool in physics teaching by creating educational programs with him. This study aimed to exemplify the applications used during training in physics by using VB programming language. To increase efficiency of teaching and learning, teaching and assessment strategies involve the use of diverse teaching methods. Also, differential treatment of students during the training process should be took into account both their educational profile and the quality and level of language which are interpreted and presented in curricular contents. In this sense, this study presents the evaluation matrix of students' learning styles and computer programs for rapid determination of physical parameters. Advantages of using programs made with VB are that it shortens the time and develops interactive training component during phases of study and assessment of physical phenomena.

Keywords: physics teaching, educational profile, computer programs, VB (Visual Basic), teaching-learning-assessment

Visual Basic Applications to Physics Teaching

The main objective of training is directed to form human personalities with operational skills required in various fields of activities. The teacher's role is to achieve target with maximum efficiency. For this, he/she must take into account not only the human components which interact, but also the adjacent materials component to the training environment.

On the human component, we must regard many typologies of individual students and educators involving in teaching-learning-assessment process (Cucos, 2006).

A genuine process of training will be initiated through a diagnostic test, highlighting the factors involved in education, educational profile of the sample of students and individual profile of each student. The results of these investigations will be indicators to consider using teaching strategies and most effective teaching methods (Malinovschi, 2003).

We consider that assessment of student learning styles is one of the starting points for identifying the skills and multiple intelligences of students (Gardner, 2006).

Data obtained from the application of tests and questionnaires with diagnostic role can be processed acceptable in terms of rigor, by introducing relatively simple mathematical models. The result of theoretical modeling is to develop a matrix for assessing students' preferred learning styles, matrix with diagnostic and

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analytical role.

The right software evaluation matrix is created in the programming language VB (Visual Basic), and corresponding interface is easy to be used by the teacher.

When investigating a relatively small group of subjects, such as a class of students can apply the results of determinations made in the assumptions category. There is an element rescuer for the correct application of statistics, namely the number of response items fell in the statistical sample. Learning style assessment practice has the advantage that is relatively independent of the nature of the discipline considered (Bostrom, Olfman, & Sein, 1990). Proposed analytical methods can be useful in this regard.

Training as a teaching process should consider diversifying teaching and learning methods, assessment and both the cognitive level and the action level. Framework of teaching laboratory experiment mixes theoretical and experimental content in a balance way. A differentiated instruction process is found in ordinary physics lesson and continues the themes of deepening and extending the concepts. Pedagogical strategies to the gradual increase in degree of difficulty in physics lessons may include alternative approaches as a mean of differentiated training (Florian, 2004).

To the groups of students interested in the study of physics can be grouped and arranged some physics experiments. In this regard, to determine the same physical parameters, experimental methods can diversify. Recall the alternative methods for measuring dynamic and static physical parameters, kinematics and energy alternatives methods or alternative methods that refer to extreme conditions that occur during the conduct of certain physical phenomena studied in laboratory.

Developing educational software requires continuous collaboration with pedagogical competence skills. Building a training environment based on computer requires pedagogical design and implementation of computer software and running into a concrete framework for learning, under controlled conditions (Miron, 2008).

Using the computer in classic laboratory experiment improves the quality of training physical discipline. In this sense, it can be made useful educational software for calculating certain experimental physical parameters. Using the VB, this software determines values of physical parameters in a short time and gives users information on the conditions imposed by the experiment in progress.

From programs which diagnose the cognitive acquisition or the student’s educational profile, continuing with programs for calculating the physical parameters and ending with programs to assessment knowledge and practical skills, are particularly useful for a quality and interactive learning process.

The authors estimated that feedback training help partners in choosing teaching methods for which they have shown special skills. Physical discipline differentiated instruction causes feelings of involvement, engaging students’ motivation to compete for personal and collective goals.

Theoretical Notions

Computer-aided analysis of a phenomenon simplifies mathematical calculations, graphics development easier and reduces work time allowing students to focus on physical phenomena studied.

VB is a programming language produced by Microsoft, derived from basic language programming. It is widely popular because this program has the graphical interface that is available to the user. This interface is relatively simple to be done. Using Microsoft Visual Basic 2008 Express Edition can perform standard Windows-based interfaces, such as windows, buttons, lists, etc. (retrieved from http://msdn.microsoft.com/en-us/default.aspx). VB has also a library of visual components: lists, calendars, menus, etc., which has already

graphics and functional parts implemented. But the programmer is able to enter and use its components.

VB can be used to make simple educational software and achieve more complex applications such as computer games.

Application (project) is made up of (retrieved from http://filelist.ro):

(1) Forms—windows that you create for user interface;

(2) Controls—graphical features drawn on forms to allow users' interaction (text boxes, labels, scroll bars, command buttons, etc.), forms and controls are objects;

(3) Properties—every characteristic of a form or control specified by a property. Example properties include names, captions, size, position and contents. VB applies default properties. You can change properties at design time or run time;

(4) Methods—built in procedure that can be invoked to impart some actions to a particular object;

(5) Event procedures—code related to some objects. This is the code that is executed when a certain event occurs;

(6) General procedures—code not related to objects. This code must be invoked by the application;

(7) Modules—collection of general procedures, variable declarations and constant definitions used by application.

There are three primary steps involved in building a VB application:

(1) Drawing the user interface;

(2) Assigning properties to controls;

(3) Attaching code to controls.

After realized the software program, it can improve or modify both working on the interface and inside the main program.

Thus, you can make text changes to the interface program by opening solution file (.Sln) and acting on properties that correspond to appropriate forms in the project. Also, you can reposition the values associated to the text and font used in their writing.

To change into programs line, opens again solution file (.Sln) and used the instruction "View Code". After the appearance of programs lines, we shall realize their corresponding modification and act the "Start Debugging" button from VB menu to check the program run. Finally, the project must be saved by acting on the buttons "Save All" and "Build" respectively, which are located in the menu bar from the VB program. This study aimed to present several programs conducted by platform Microsoft Visual Basic 2008 Express Edition, programs that are used during laboratory training in physics lessons (retrieved from http://www. dreamincode.net; http://filelist.ro).

The Assessment Matrix of Learning Styles

Based on a mathematical model, performed quantitative analyses were to identify preferred learning styles of students in physical discipline.

The theoretical model defines measurable parameters that verify certain invariance equations (Kudryavtsev & Demidovich, 1981; Nastasescu, Nita, Andrei, Radutu, Vornicescu, & Vornicescu, 2002). Thus, all parameters are introduced:

(1) Index of competence in relation to a particular learning style (visual, auditory and practical)

$$i_{N(v)} = \frac{n_v}{n_v + n_a + n_p} \quad , \quad i_{N(a)} = \frac{n_a}{n_v + n_a + n_p} \quad , \quad i_{A(p)} = \frac{n_p}{n_v + n_a + n_p} \ ;$$

(2) Multiplication-index of learning styles in the selected sample

$$m_N = \frac{n_v + n_a + n_p}{N};$$

(3) Multiplication-index specific to a particular learning style

$$s_{N(v)} = \frac{n_v}{N} \quad , \quad s_{N(a)} = \frac{n_a}{N} \quad , \quad s_{N(p)} = \frac{n_p}{N}.$$

Analysis of preferred styles of learning and learning conditions to increase efficiency was introduced by a matrix of assessment.

Corresponding software evaluation matrix was developed with Visual Basic 2008 Express Edition program.

Using the interface created, the user assigns values to variables and the corresponding matrix displays as soon as the parameters of interest.

Further processing of these parameters leads to interpretation of results and conclusions training.

For a good functionality, GUI (Graphic User Interface) contains buttons with roles: reset, save and calculate (retrieved from http://msdn.microsoft.com/en-us/default.aspx).

Assigning new values to variables of program will act on “RESET” button and saving the “image” matrix in an Excel file will act on the “SAVE” button. If the data entered by the user are incorrect, the program displays warning messages like: “Impossible to calculate because the amount of skills has to be at least equal to the number of subjects for each sample”.

The Limit Angle Method and the Minimum Deviation Method for Determining the Refractive Index of an Optical Prism

Keeping differentiated instruction method of students, the teacher may propose alternative experimental methods for determining the same physical parameters.

Thus, determining the refractive index of glass can be chosen to line the limit the angle method to total reflection phenomenon of light (see Figure 2) and the minimum deviation method of light across the optical prism to refraction phenomenon (see Figure 3).

Mathematical relation for calculating the refractive index for a homogeneous optical medium to the total reflection of light phenomenon is:

$$n_{glass} = \frac{1}{\sin l}$$

and to the minimum deviation of light phenomenon is:

$$n_{sticla} = \frac{\sin \frac{\delta_{\min} + A}{2}}{\sin \frac{A}{2}}$$

Using VB 2008 Express Edition Program has made software corresponding to these experiments. Values of the refractive index are calculated and these values are displayed via graphical interface.

Also programs run on constrained input variables, displaying warning messages if the experimental measurement errors exceed a certain threshold value.

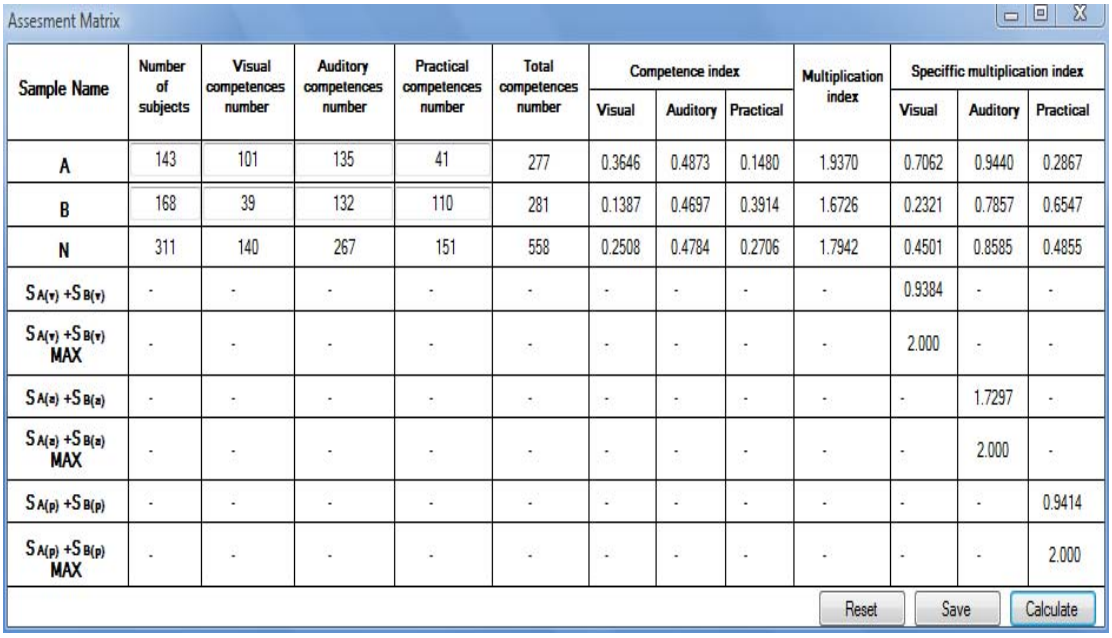
These messages can be for an example: “The Limit Angle, l, FOR The Glass-air Refraction Phenomenon Cannot be Below 38 Degrees” or “The Minimum Deviation Angle, $\triangle_{\min}$, Cannot be Above 50 or Below 30 Degrees!”.

Experimental Results

Interactive educational software was used during the training process to physics discipline (Miron, 2008). Software interfaces have been used successfully by students and teachers. Theoretical contents were complemented by experimental results.

The Experimental Results Obtained to the Assessment Matrix of Learning Stiles

Figure 1 shows the image of assessment matrix interface. This includes parameters, such as "number of subjects", "visual competences number", "auditory competences number", and "practical competences number". Variable belonging two subgroups A and B from N samples has been studied.



Sample Name	Number of subjects	Visual competences number	Auditory competences number	Practical competences number	Total competences number	Competence index			Multiplication index	Specifffic multiplication index		
						Visual	Auditory	Practical		Visual	Auditory	Practical
A	143	101	135	41	277	0.3646	0.4873	0.1480	1.9370	0.7062	0.9440	0.2867
B	168	39	132	110	281	0.1387	0.4697	0.3914	1.6726	0.2321	0.7857	0.6547
N	311	140	267	151	558	0.2508	0.4784	0.2706	1.7942	0.4501	0.8585	0.4855
$S_{A(v)}+S_{B(v)}$	-	-	-	-	-	-	-	-	-	0.9384	-	-
$S_{A(v)}+S_{B(v)}$ MAX	-	-	-	-	-	-	-	-	-	2.000	-	-
$S_{A(a)}+S_{B(a)}$	-	-	-	-	-	-	-	-	-	-	1.7297	-
$S_{A(a)}+S_{B(a)}$ MAX	-	-	-	-	-	-	-	-	-	-	2.000	-
$S_{A(p)}+S_{B(p)}$	-	-	-	-	-	-	-	-	-	-	-	0.9414
$S_{A(p)}+S_{B(p)}$ MAX	-	-	-	-	-	-	-	-	-	-	-	2.000

Figure 1. The image capture of graphical interface to the assessment matrix of students learning styles.

Each button belonged to GUI is implemented by logic programming and the user is not interested in lines of code that are "behind" the interface.

Depending on the values calculated for the indicators introduced by the mathematical model, the user can deliver value judgments on the diagnosis and evolution of students' behaviors on preferred learning styles (Fritzsche, 1976).

The Experimental Results Obtained to the Limit Angle Method and the Minimum Deviation Method for Determining the Refractive Index of an Optical Prism

Images obtained during alternatives experiment for determining the refractive index of optical prisms are shown in Figures 2 and 3.

The image described in Figure 2 shows that the incident laser beam is directed so as to produce the phenomenon of total reflection of light. Also, the image that correspond to Figure 3 shows that the incident laser beam is passing through the optical prism by parallel direction with base of the prism. In Figures 4 and 5 respectively, there are examples of images of graphical interfaces corresponding to programs made in VB (retrieved from http://filelist.ro). These images were obtained during alternatives experiments for determining the refractive index of optical prisms.

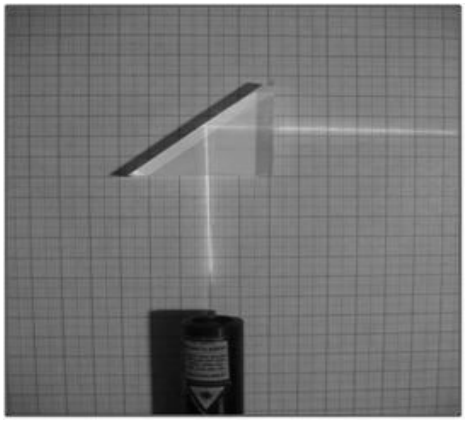


Figure 2. The experimental device in total reflection phenomenon of light.

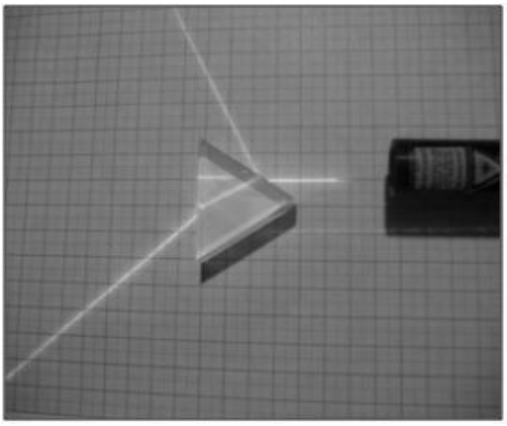


Figure 3. The experimental device in minimum deviation phenomenon of light.

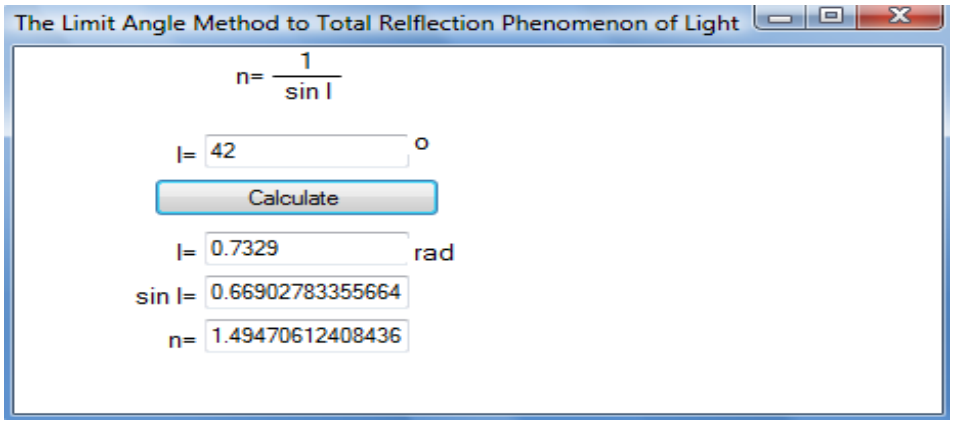


Figure 4. Image capture of GUI to total reflection of light phenomenon.

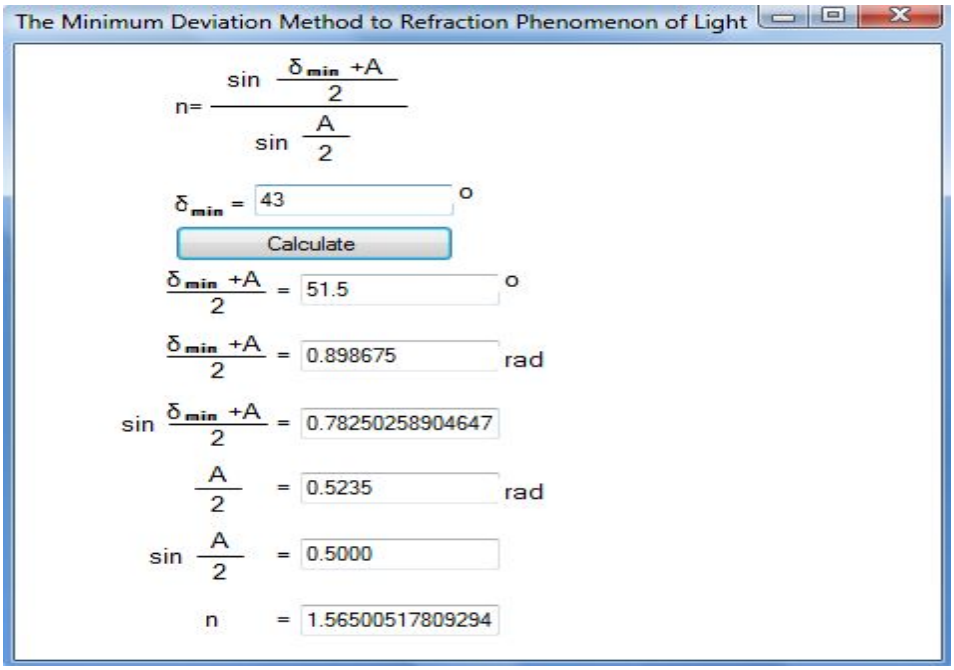


Figure 5. Image capture of GUI to minimum deviation of light phenomenon.

GUI on the laboratory scientific experiment offers students information on values and the order of magnitude of physical parameters measured.

Conclusions

In order to obtain a good correlation among objective, items and performance indicators, it can develop educational software that can be based on teaching scenarios. The goal was to identify the essential contents of each lesson time, emphasizing appropriate learning items, which implements the operational objectives of the lesson.

In order to achieve an operational objective, appropriate learning items were considered those that:

(1) Covering specific learning difficulties that occur when materials are taught traditionally;

(2) Providing an understanding of physical meanings and terminology;

(3) Raising and maintains students' interests.

Introduction of educational software can increase students' interests in the visual style of learning, and therefore, increase the efficiency of the teaching-learning assessment. Also, the consequences of using educational software are the developing of the digital skills and practical skills.

Whatever the methods are used by means of learning strategies, the school performances can be improved by employing a differentiated or individualized treatment to the themes of study and units of learning.

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Training Needs for Teachers in the Field of Education

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The significant technological progress in all areas of our age, which included the field of education, both in educational materials and disciplines of them, ways and methods of teaching and overall objective of the educational process, have gone through the educational methods and different labels to become aware of its ended importance, subsidiaries and objectives of the TMS technology education, where they adopted the labels of teaching aids in the early stages on the senses, such as education, audio visual aids and audio-visual, and then called to get an education and became known as audio-visual, media and then the introduction of technology education, information and care. The education processes as a whole since the beginning of development objectives of the educational reform, which is to take, even benefit from the proposals and also find that led the revolution in communications and information technology and systems on the sweep, which is very important changes in the world.

Keywords: training needs, teacher education, teacher training, professional development, in-service training, educational methods and techniques

Introduction

Training is an urgent need for the functions of all of this continuous growth in the human elements, so that you can keep up with rapid changes and evolve area of work, as it is the case of the teaching profession and the basic education sector condition, because the scope for specialization and materials preparation of the profession, which continue to evolve through scientific facts, are new. Learning the basics of approaches and ideas, trends in education and psychology and meeting those trends of education and the challenges of new technology will depend directly on improving the training programs.

With the global changes of globalization and economic openness and the challenges imposed on the ground, the states launched change and improvement in their educational systems to increase their effectiveness and quality.

Witnessing a considerable development of effective schools and coming to be seen as the basic unit of planning and change, it is able to control and change control processes, providing teachers a basic and integral operation of school improvement based on these changes which has become a function of the modern educational system: the preparation of individuals has been the research tools for knowledge derived from

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sources, how to deal with the information content and how to understand and critique self-learning and continuous learning, cooperative learning, scientific thinking, creativity and innovation through the skills they possess. It has become the teacher in front of the functions and responsibilities who require new skills, knowledge and experience which is unable to provide a training system for teachers in its traditional form, which showed the new forms of training based mainly on the school (Najjar, 2007; Mansour, 2003).

It is the teacher preparation and training method that can establish supervisory efficiencies of teacher education, development of performance, development of schools, and development in general (Abdeen, 2008).

Abu-Russ (2001) reported that teacher training is just a prelude to a whole series of events and activities and professional growth, which must continue with the teacher as long as life and as long as there are science and knowledge, new ideas and technologies, and therefore, the concept of in-service training of teacher is linked to the concept of continuous growth and continuing education. This requires that teacher preparation is seen as a continuous process which is stopped and become professional growth and continuous training to be necessary to renew the experiences and increase effectiveness of teachers, because the curriculum developed and renewed teacher requires is advanced and renewable (p. 19).

Teachers, as a part of the education system, need to be ongoing support and development of permanent to perform the tasks assigned to them, authors of educational policies, in accordance with the philosophy of the state and society, in order to keep up pace with life in a consistent manner and adapt technological changes and advances in knowledge. The teachers are also an important element in the educational system where nations have been turning its development. The renaissance of united and people through the development and reform movements in the various areas of educational, social, political, etc. should start from the teacher, which is the basis for the architecture, give priority attention to it and upgrade the scientific and social as the essential foundation on which repairs any educational system, so it must be raising the issue of teacher objectively in order to know the positions of the imbalances and problems affecting them, stand on the needs and desires and meet in order to reach results that will contribute to the development and improve teacher performance (Samour, 2006).

Training is an urgent need in all the jobs that the growth of the ongoing is in the human elements so that they can keep pace with the rapid changes and evolve in the field of work, as it is in the teaching profession and the education sector is a fundamental requirement, because the area of specialization and professional preparation materials is constantly evolving through new scientific facts that show the basics of learning approaches, ideas or trends in education and psychology, and then meet those educational trends and the challenges of new technology and will depend directly on the improvement of training programs (Abu Russ, 2001).

Also, the training needs of trainees should be in the light of identifying and good training must be based on identifying training needs of targeted individuals training to identify existing and anticipate their needs in training. The challenge of identifying the training needs is the cornerstone in the success of training process and represents the essential starting in the series which are interrelated in a whole training program.

The process of identifying training needs is the first step of the preparation of plans and training programs for teachers and school design, which will be difficult to achieve the objectives of training plans efficiently by the identification of training requirements. It is also the process of identifying training needs to be essential to any successful training process and a pillar of the foundations, so it is to accurately identify the needs assessment and then compare and measure scientifically accurate, which is also the best way to determine the amount to be provided with the teachers (as the quantity and quality) of information, skills,

attitudes and experiences designed to bring about development and raise the professional competence(Abu Russ, 2001; Ali, 2002).

Some educators have pointed out that determining the needs of teachers as an essential step for training programs is the application of the principle of psychology that human behavior is designed to satisfy the desires of certain identified by defining the needs (Abu Russ, 2001, p. 23).

It is also determining the training needs of the most important things that pay the training activity to achieve its goal, whenever possible, identify them and identify where is possible to meet and raise the efficiency of workers through training, measured by the success of any design qualification training program for teachers and managers that how to identify training needs and account for and collected (Sharif & Sultan, 1983).

The Training Needs

Khatib (2006) has stated that:

> Information, skills and attitudes and knowledge of a particular development to be amended or changed as response to changes or regulatory developments, technological or human or as a result of functional change to meet the developments or expansions or a desire to solve the problems of existing or expected. (p. 39)

As defined by Abdeen (2008, p. 195) that training needs “are a set of changes and developments to be created in the teacher information and behavior, and trends with a view to raising the level as it overcomes the problems that are impeding the process and productivity had”.

The Importance of Identifying Training Needs

The identification of training needs is the cornerstone in the planning of training programs for professional development for teachers, although knowledge of training needs and identified will help planners to design successful training programs according to scientific bases of training programs, considering that the knowledge and training needs identified along these lines pave the way for more precise formulation of targets and the nearest realistic.

The importance of the process of identifying training needs of several considerations is as follow (Sharif & Sultan, 1983; Al Harbi, 2004; Abdeen, 2008):

(1) Training needs are the basis for all elements of the training process;

(2) Identifying training needs helping to improve performance is the main objective of training in organizations;

(3) The identification of training needs of the shows is the individuals to be trained and the type of training and expected results;

(4)The identification of training needs of working real teachers is to raise the efficiency in performing the work assigned to them;

(5) The failure to identify training needs in advance leads to loss of time, money and time spent on experimentation;

(6) Identifying the training requirements of the basis for any training program, knowledge of training requirements prior to any training activity, comes before the program design and implementation;

(7) Done through training needs analysis of the work of teachers, we find out their duty responsibilities priority and skills necessary for them.

Educational Methods and Techniques

Learning tool known as “each tool used by teachers to improve teaching and learning process and to clarify the ideas, skills training and development of desirable values and attitudes, without the teacher relies primarily on words, symbols and numbers” (Alakalpy, 2003, p. 35).

It is a tool of teaching aids in the heart of the educational process which is an essential tool to help conduct education and increase suspense and motivation of pupils, although many of the educators are experiencing an ongoing that it is possible to do without teaching aids so that most of them believe that the successful teacher is the only one who has the capacity to teach his disciples and educational material, and sometimes, refers to a teacher who supports the teaching of experimental methods in the selection of teaching aids, stating that time is wasted in worthless to him/her and he/she can not quit the program because of the annual use of such means.

As the world faces Arabic countries, in particular the challenges of increasing and accelerating as a result of rapid developments in various fields, particularly scientific and technological world has witnessed during the last quarter century, which is expected to continue a significant acceleration. The reason for this scientific and technical progress is dominated at all walks of life that accompany the development of education, the renewal of teaching methods, the machine and the means to enter the field of education, becoming a cornerstone “essential” in the educational process but not some sort of luxury, and therefore, should not be a choice of means and technical education in vain “but must be driven” from the importance of using. If the purpose of learning is the knowledge of the oral that refers to audio-visual media which is a waste of time and money, the choice of educational methods use them appropriately requiring the teacher to be familiar with the following aspects (Saad, 2007, p.12):

(1) Learning tool is a part of the classroom building and related components and parts of the rest of the classroom sharing with them in achieving the objectives of the position that cannot achieve the goals optimally by only using the means of education;

(2) Characteristics appropriate means to age in terms of mental abilities, skills and past experiences;

(3) To be an exciting way to rouse the work motivation of students and motivate them to learn;

(4) Accuracy of the information that you are viewing means and accuracy;

(5) Account the technical characteristics of good learning tool;

(6) Taking into account the time way in the classroom;

(7) Distance from the formal and routine in the use of teaching aids.

Given the significant technological progress in all areas of our age, which includes the education field, both in educational materials or specialties them, ways and methods of teaching and the overall objective of the educational process, educational aids have gone through the different designations to become a science which has its significance, offshoots and objectives of a pedagogical technique or technology education, where labels adopt educational methods in its early stages on the senses, such as education, audio visual and audiovisual aids, and then call for teaching or education that become known as an audio-visual aid and then is the introduction of information education technology and care which the educational process as a whole, since the beginning of setting targets educational calendar, and even benefit from the feedback (Mansour, 1989).

Techniques of education as reflected in educational technology centers as a “systematic process in designing teaching and learning process, implementation and evaluation in the light of specific objectives on the basis of research findings in different areas of knowledge and use of all human resources and other resources available to reach more effective learning and adequate” (Gady, 2007, p. 22).

It becomes a kind of educational methods or means aspiring educational technology, where e-learning includes various types of educational methods and forms of texts, films, pictures, etc.. This is what makes the computer revolution in 1990s. Rapid progress is invaded by all inclusive areas of the process teaching and learning and became teachers at all stages of education in developed countries using the Internet. Classrooms lab with multi-media education in the learning process and if we move on to schools and universities in the Arab countries, we will find that the educational process is still in the classroom and the teachers base on the source of information, traditional methods book, a blackboard as well as some old educational means (Al Jarf, 2001; Barakat, 2009).

The most important benefits of e-learning are (Al-Shammari, 2007):

(1) Increasing the possibility of communication among the students and between students and the school;

(2) Easy access to the teacher;

(3) Suitability of different learning styles;

(4) Providing a curriculum throughout the day and every day of the week;

(5) Ease and multiple methods of assessing the development of the student;

(6) Access to information easy and fast;

(7) Taking into account the individual differences between students.

The World Summit on the Information Society held in Geneva in December, 2003 to increase the contribution of ICT (information communication and techniques) in achieving the goal of education for all over the world and put a plan of action included the following (Amogdoy, 2008, p. 124):

> (1) Develop domestic policies to ensure the integration of information and communication technology fully in education and training at all levels, including curriculum development, teacher training, administration and management of educational institutions, support the concept of lifelong education;
>
> (2) Develop distance learning and other forms of education and training as a part of capacity-building programs, with special guidance to developing countries, especially less developed countries in different levels of development of human resources.

Malkawi and Nejadat (2007, p. 150) confirmed that the revolution in communications and information technology and systems have brought about sweeping changes which are very important in the world, and begin to know the relative values of the rise, enter a key element in knowledge production and decrease the importance of traditional factors of production, raw materials and information that are becoming more important. The knowledge capital has become more important and deeper impact on physical capital in the world which is moving towards knowledge-based economy plagued symbolism, and the new goal of education is no longer the acquisition of knowledge, but more important, the ability to collect access to their original sources which is used to solve problems and the ability to ask questions in this changing world. Rich possibilities and alternatives outweigh the importance of the ability to answer a collection of knowledge and mastery and also require a secure life in the information age, and the availability of high capacity and awareness of the renewed Arab teacher in dealing with the information and requirements, helping to develop

the capacity that the teachers make the best use of information by searching for efficient ways to deal with and make the best use of them.

There are also many studies that have focused on training programs for in-service teacher education in various stages of study on the use of technology in teaching and learning processes, including the study carried out by Fletcher and Atkinson (1972). They compare 44 pairs of identical children in first grade with two equally house males and females and the computerized teaching children experimental group of 5×10 minutes per day for five months, except that it was the curriculum that they use similarity to approach the experimental group which has learned a part-time computerized earlier from the group control equivalent to five months in the level grades for reading. One year after the experimental group was superior to the control group, equivalent to four months, although it has not been computerized in the second year (Abu Alam, 2004, p. 25).

As study conducted by Domi (2008) that the e-learning or the use of educational technology does not mean the abolition of the role of the teacher, his/her role becomes even more important and more difficult. It is a creative person with a high efficiency of the educational process that runs successfully and works to achieve the aspirations of progress and technology (p. 165).

Al-Shammari (2007, p. 28) noted that there are three major roles to be performed by the teacher during the use of e-learning, namely: (1) the role of the interpreter by using technical means; (2) the role of encouraging interaction in the educational process; and (3) the role of encouraging the generation of knowledge and creativity.

The effect of the new roles of teacher-mail also provides a number of training needs that contribute to increase professional and technical competence of the teacher and help him/her to perform his/her various roles and deal with technology and the use of modern skills in the education process for teachers in the field of e-learning as follows:

(1) Computer needs related to their culture: needs related to the skills of computer use and needs related to culture information;

(2) Needs in how to deal with programs and network services;

(3) Needs on how to prepare decisions electronically, including needs in the planning and design, needs in the calendar and needs in the management decision on the network.

The researchers believe that the role of the teacher in e-learning is different from that in traditional education. Education-mail requires the presence of qualified teachers trained to deal with their good employment in education, and it also requires them to do the roles and functions commiserating with the new requirements, as there are traditional methods that used by the teachers during the era of meaningful information and technological developments, but the teachers should develop the same capabilities to cope with the variables of the current era.

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Private University Librarian's Experience on Procurement of Books in Bangladesh

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The private universities in Bangladesh are playing an important role in modernizing the higher education system in the country and the role of librarians is also different and challenging. Specially, procuring books and monographs is an exigent function being this lost its demand very quickly. In some cases, titles bear only one semester necessity. Suppliers frequently fail to supply books needed in a semester and late arrival of books is another phenomena which frustrate private university librarians in the country. In these circumstances, IUB (Independent University, Bangladesh) is trying to establish a method for working with the best book suppliers. Experience shows that apparent goodwill or gorgeous showrooms of vendors sometimes mislead the librarians. The best way is to determine some criteria and each criterion should be weighted. The weight may differ from criterion to criterion. Performance in the latest year may receive maximum number in the weighted formula. Goodwill, interest to work with the university, up-to-date-ness, availability of resources, maximum discount, etc., may be included in the weighted formula. Performance of the consecutive three years would guide one to select a vendor from the old panel of suppliers. This paper describes the situation of procurement and the crisis faced by the private universities particularly the IUB.

Keywords: book procurement, acquisition process, vendor evaluation, university library, foreign resource dependency, timely procurement

Introduction

The author is working in a private university which intents to produce globally competitive graduates within the local environment, with knowledge and skills to provide leadership at different levels and in different fields of the country. This university offers courses related to business, development, science and technology under its four schools. The private universities are the pioneers to establish the American style of education in Bangladesh. Inevitably foreign books and journals are the main ingredients to develop courses and to use as text in the university. The librarians of the private universities are facing some confrontations that are new in the country.

Background

The author may share some of his experiences here. When joining in this private university in 1993, the author was alone in the library. The authority advised him to set up the library such a way so that one man can run it easily. The private university concept was new to many of us at that time. Eventually, we understand that

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this is USA type education. The semester completes within 17 weeks, which is, we seem, very short. Our experience in DU (Dhaka University), where the author studied, was different. One-year course at DU used to complete in 18 months. Being an American type university, IUB (Independent University, Bangladesh) follows syllabus of the US universities, mostly and accordingly, teachers referred students to American books for their texts. At that time, it was so hard to have US books from our local market. The author was alone in the library. The author had to stay in the library from morning to evening. What only the author could do was to request the local vendor to send the book(s). Sometimes, they failed to supply. When a teacher found that his/her referred book(s) was not on the shelves, they had immediately become upset.

The author can portray two incidents here. Some books author could not procure due to unavailability at our local market. In the initial stage, the university had a position of secretary general. One faculty reported to the secretary general about the author's failure. He (secretary general) was sad and came to and told the author "What are you doing? Why are you not procuring books according to teachers demand?". The author tried to explain his position. But he did not give the author chance. Moreover, he added, "We do not want to listen anything. We want to see the books to be here in time whatever happened in the world that is not our headache". Then, he moved to his room. The author was struck, but did not get time to think about that much, because he had to face students rushing as a class near to library which was just been off, though later he got opportunity to explain the situation and he was convinced. Some other professional friends working in different other private universities also told the author their experiences. All of us in fact are facing almost identical problem.

Another day, maybe it was the author's fault, a very senior professor suggested him to procure some copies of a book which is yet a very popular title throughout the world and also available at our local market at that time. But his library had two copies of that particular title and that course had only five students at that time. As he checked the copyright year, the author thought new edition already published and after three/four months, we might get new edition from our market and students could share the existing two copies in the meantime. So he delayed. But the professor became annoyed and reported to the then president of the university. In the evening, the president came to and quietly asked the author why he did not procure the professor's book. The author explained him his stand. The president, though the author thought he was convinced, told him with a soft voice that if once those were gone out of market then the author might not add more copies in his library in time. But on the basis of his connection, the author was almost sure that it would be available within a few months at our market and he delayed. The author was lucky because he could add new edition in multiple copies before the next semester commence.

The author has both experiences of special library and public library. He worked about five years in special library and about two years in public library and has never faced above type of situation in those places. There procurement moved in structured way and users were not pressuring librarians for their particular items that much. Users of those places were always happy if they got their required items, if even those who did not arrive timely. But in private universities time, it is an important factor. If some titles do not arrive timely, sometimes that might become useless. Because, teachers have their own way of teaching method and they referred to different titles. In the private universities, it was very high at the initial stage, teachers used to switchover from one place to another place. Almost in every semester, we saw some course teachers were changed and new titles were referred for the texts. There were chances to loss the usability of books.

Let's think a case. One faculty member, who stayed for only one/two semesters only in the university, requisitioned for some titles to be procured in multiple copies. He/she did not get them within his/her stay

period. New instructor joined. New teacher referred to new titles. But library received the books ordered earlier at the beginning of the new instructor's phase. Such situation used to appear several times in the author's university and the books were mostly found untouched. Note that our libraries need to keep some text books for supporting both students and faculty. The book market is not smart enough to collect books from abroad timely and the students have little opportunity to have their own book, even the text books.

We procured multiple copies of textbooks due to scarcity of books in our local market. We value usefulness of a title. Accordingly, timely arrival of learning resources is the central issue of the private university libraries. Other sector libraries may not need to take so much stress for procuring information materials. Of course, some have high workload, but not mental stress.

Private universities are not only giving the librarians stress, but also they are opening opportunities to take new challenges which can change the shape of library services in the country. The leading private university libraries of Bangladesh do not hesitate to invest money for information resources procurement if that can be proofed useful. The author's experience is that his authority gave him autonomy to procure learning resources as per student and faculty need, either for study or research. But it makes him more economic, because he has to think his performance evaluation which is done at the year end. Of course, he regularly takes permission for buying learning resources from the Vice Chancellor. Even so, it does not mean that he can avoid the responsibility.

Timely arrival of materials is not easy in Bangladesh. Book vendors of Bangladesh are basically able to supply those books which are popular. We also found that sometimes they even failed to supply popular books. In fact, it depends on the relationship between the vendor and the publisher. Recently, vendors are failing to supply Prentice Hall books. Most of the suppliers are not interested to receive orders for the Prentice Hall books. Selecting vendor becomes a great challenge. Merely through competition, best vendors cannot be selected. The vendor providing maximum discount on catalogue price may not be able to supply books timely, and even they fail to supply many titles, some of which might be very important at that time. One can apply mechanism to control through forfeiting their caution money. But only it cannot ensure the supply of books. At the same time, our main focus is students, their suffering cannot be removed. So trial and error will not solve the problem, rather it will increase the burden.

Gorgeous launch of a new book vendor in Dhaka once impressed the author, who collected catalogue from them and distributed catalogues among the respective teachers of our university. Teachers selected many books. On the basis of teachers' request, the author placed two orders to them. From first order, they supplied only one third of the books and informed the author that others were on the way. He placed another order to them on good faith, but did not receive any more books from those orders. Eventually, the author understands that they have relation with specific publishers only. They cannot establish good connection with others. Of course, the author did not black listed them, because they might be found useful for the specific publishers and later the author has really found them good for some definite publishers. Of course in the meantime, this vendor established as a prominent supplier of the country.

Again, once the author visited a well-known book supplier's office to know about their stock situation. He found many titles relevant to our purpose and selected them. They supplied them immediately and provided us maximum discount. The author was again impressed with their service. They convinced him to select some books from a particular publisher's catalogue. With the help of concern faculty, the author selected some titles and placed order for importing those books for us. Such a large supplier and importer cannot supply even a single item from his order.

So, what should be the process for procuring books? Who should get preference? The author's opinion is to depend on experience of librarians. The best way is to determine some criteria and each criterion should be weighted. The weight may differ from criterion to criterion. Performance, in the author's opinion, may receive maximum number in the weighted formula in the latest year. Then goodwill, interest to work with the university, up-to-date-ness, availability of resources, maximum discount, etc., may be included.

Complicacy of Procurement and Probable Solution

In most cases in Bangladesh, large purchases are done through tendering process. Books procurement is not an exception. The vendor(s) who can provide maximum discount on the list price usually selected for book supply. This process makes lots of obstacle for procuring appropriate books. In many cases, vendors failed to supply appropriate titles due to unavailability at the local market. For tendering the libraries usually collect list of books readily available from the local suppliers. Finalization of order list usually takes time. In the meantime, some important books may go to other libraries. Besides, it is almost impossible for the government sector to place an order for import books. Government libraries neither can give vendors sufficient time for procuring books, nor proceed for direct import. Once a vendor selected and if he/she fails, then those titles procurement in that particular library would have very little possibility. The short period given the vendors for book supply discourages them for importing the appropriate titles. The LAB (Library Association of Bangladesh) has been demanding the withdrawal of tendering process for procurement of learning resources. Some international organizations pay service charge to confirm timely receipt of the appropriate titles. Private university may follow the system, but the audit may not approve the system at the year end.

Sometimes, some leading private universities of Bangladesh try to procure books from abroad directly. But without license, only a limited amount of foreign currency can be spent for book procurement. This limited amount is not sufficient for a university. Customs recently imposed different types of charges, and sometimes, this amount reached at half of the list price. It means that procurement cost rose (not only for custom duties, but also for adding shipping and handling charge by the foreign suppliers) and the cost of books comes in an average of 170% as per the author's experience. Single volume procured is very costly, sometimes, it may reach 250%. In the present market, a vendor charges less than 30%. Even so, it cannot be imposed because audit will say that some are giving discount, why this particular vendor is charging for service instead of discounting. In some places, this vendor is giving discount why this particular vendor has been allowed for service charge for book delivery. Yes, we can give explanation and audit will note that. Even so, we have to resolve the question on vendor selection process. Probably private university librarians of Bangladesh have to mostly depend on their previous years' experience, because they cannot take the risk of choosing new vendor as main supplier who may lead to make the respective title(s) unavailable at due time. At least, the author does so. A weighted method for performance evaluation would be a great help. The appendix contains a method which the IUB intents to follow. It is not very hard and fast rule practiced in the university, but it gives us a guide with which we should deal in the coming year. Instead of keeping one vendor, we always keep at least three suppliers active as main vendors throughout the year to get the best result. Some new suppliers may also be kept active along with old suppliers.

Conclusions

The process needs more attentions and dialogues among the librarians to make an acceptable general

evaluation method to accelerate the import-based procurement process of the libraries, especially in Bangladesh. The author does accept his ignorance about vendor evaluation practiced in libraries elsewhere. Due to inadequate access to literature of the author's, he failed to review literature on the topic but found some management articles which support this view. Babu and Sahrma (2005) mentioned that the most important measure of the supplier service is that his/her record of past performance. Though they mentioned some factors to be considered for evaluating vendors, such as financial aspects, quality, price, technical compatibility, capacity of the firm, reputation, quality certifications, management outlook and delivery performance mainly. Dickson (1966) also gave importance almost on same factors (Demirtas & Ustun, 2006). Barbarosoglu and Yazgac (1997) used three broad factors for evaluating vendors' performance assessment, capability assessment and quality management assessment. Weber, Current, and Benton (1991) and De Boer, Lebro, and Morlacchi (2001) gave an extensive literature review on supplier selection on the light of business management (De Boer & van der Wegen, 2003). Several factors are taken into account by the researchers and the performance indicators are summarized into one score (Roodhooft & Konings, 1996). Many management researchers have addressed the strategic importance of the evaluation process of vendors (Banker & Khosla, 1995; Burt, 1984; Burton, 1988; Dobler, Burt, & Lee, 1990; Tullari & Narasimhan, 2003). In the author's opinion, the librarians also need to address to this management strategic issue to ensure timely service to our patrons.

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Appendix

Weighted Formula for Vendor Selection

Criteria and weights:

Stock availability	5
Import performance	15-20
Relation with publishers	
Comparing with supplied items and total items	15-20
Comparing with ordered items and supplied items	10
Supplied items and Total items received ratio	10
Discount rate—depends on supply	
Handling charge—score deducted according to supply	
Delivery Time average	20
Goodwill	1-3
Work Interest	1-3

Formula:

$$R_S / S_B * 5 + (R_I / I_R + P_V / P_T) * Y_S + \{(R_S + R_I)/ T_Y + P_V / P_O\} * 10 + \{(D_R * M / 10000) + (D_R * M / 10000) + \ldots\ldots\ldots\} - \{(H_R * M / 10000) + (H_R * M / 10000) + \ldots\ldots\ldots\} + T_A + G + W$$

Where:

/ Division

* Multiplication

S_B Books selected from stock

R_S Received from stock

I_R Books import request

R_I Received from import request

P_T Total number of publishers of books received in a year

P_V Number of publishers of books received from a vendor

P_O Number of publisher related to orders of a vendor

Y_S Score of year (Latest year = 20; One year earlier = 18; Two years earlier = 15)

T_Y Total books received in a year

D_R Discount rate

H_R Service charge or hiring rate

M Money on the bill or value of the books delivered

G Goodwill—Librarian will allocate weight maximum 3

W Work interest —Librarian will allocate weight maximum 3

T_A Delivery Time Average, i.e., average of - $200/\{(D_D - D_O) + 10\}$

D_D Delivery Date

D_O Date of Order

Note: The figure 10000 is taken to keep the weight within the limit of 20 in IUB at this moment, being discount value from a single vendor did not yet exceed Tk.100000 in a year. IUB do not have experience of giving service charge for books.

Final Performance for selection $(P_S) = (P_{Y\,1} + P_{Y\,2} + P_{Y\,3} + \ldots) / Y_N$

Where:

$P_{Y\,1}$ Latest year of evaluation

$P_{Y\,2}$ One year earlier performance

$P_{Y\,3}$ Two year's earlier performance

Y_N Number of Years taken for calculation

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Strategic Examination on and Thinking of the Systematic Reform of Chinese Teacher Education[1]

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The strategic transformation from traditional formal education to modern teacher education starting in mid-1980s has been initially realized in China, meanwhile, some problems still exist, which can be seen from the following five aspects: (1) The teacher educational function of normal universities or colleges has been more or less decreased; (2) The teacher educational task of comprehensive universities has not achieved completely; (3) The teacher educational resources of secondary normal schools have been lost seriously; (4) The level of teacher education of colleges in charge of teacher further education needs to be improved urgently; and (5) The teacher education model of all levels of colleges and universities remains outdated and simplistic. It is necessary to consult the process and trend of foreign teacher educational reform and development, seek countermeasures, lay emphasis on the system innovation and explore the modern teacher system of Chinese characteristic that aims to combine internationalization and localization, directionality and openness, professionalizing and generalization, teacher education's specialty-based feature and its realization in universities, stage-by-stage education and lifelong education, teacher education system's standardization and multiplicity, so that it can make some new historical contributions to the scientific development of China's education cause.

Keywords: normal education, teacher education, modern system of teacher education, reform, innovation

Introduction

Since the end of 1970s, the reform of teacher education in China has made tremendous achievements which caught the attention of the world. Along with the ever deepening of the reform in teacher education system and optimization of teacher education structure and its resources, the once closed and independent teacher education system becomes more and more open, a comprehensive and pluralistic pattern of teacher education has gradually come into being, and the transition from traditional teacher education system to a modern one has been initially realized, thus, making historical contributions to Chinese education, especially to the development of the elementary education. Of course, there are still many problems which need to be seriously reflected on and summarized.

[1]The term "teacher education", evolved from the Japanese term "normal education", gradually became a term generally used in China at the beginning of 20th century. In late 1990s, the term "teacher education" was finally adopted in Chinese academic circles. In May of 2001, in the "Decision on Reform and Development of Basic Education" promulgated by China's State Council the term "teacher education" was officially used. In February of 2002, in its "Opinion of Teacher Education Reform and Development during the 11th Five-year Plan Chinese Education Ministry pointed out explicitly that "teacher education" is the generalized term for a teacher's pre-service education, education right after his or her entering teaching profession and in-service education.

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Several Major Problems Existing in the Process of Reforming Teacher Education System

Relevant documentation retrieval has led to the conclusion that the Chinese Communist Party and central government began to formulate and publicize a series of laws, regulations and policies of teacher education in mid-1980s according to the strategic concept of "opening the system of teacher education and maintaining the leading position of normal universities and colleges in the system at the same time" (General Office of the State Council of PR China, 1986). In September of 1986, the General Office of State Council of the PR of China in its announcement of transmitting "On Several Opinions of Implementing the Compulsory Education Law", jointly issued by National Education Committee and other ministries, pointed out that "The higher education institutions that possess relevant conditions should fully tap their potentials and shoulder the task of educating and training teachers of primary and middle schools in an active and initial way" (General Office of the State Council of PR China, 1986). In December of 1996, the National Education Committee[2] in its "Several Opinions of the Reform and Development of Teacher Education" raised the task of that (Education Committee of PR China, 1996):

> Completing and perfecting the normal education system in which independently existing normal universities and colleges of various kinds and levels are the main stream while other kinds of universities and colleges join their hands in educating and training teachers in a coordinated way.

In December of 1998, the National Education Ministry in its "Plan of Facing the 21st Century and Rejuvenating Education" pointed out that "The higher education institutions of relatively high capacities should make contributions to the cultivation of new teachers and teacher training" (Education Committee of PR China, 1996). In March of 1999, the National Education Ministry in its "Several Opinions of Adjusting the Deployment and Structures of Normal Universities and Colleges Throughout the Country" made the call "to further widen the channel for the source of elementary and middle school teachers, encouraging a batch of high level comprehensive universities to take part in educating elementary and middle school teachers" (Education Committee, 1998). In July of 1999, The Central Committee of the Chinese Communist Party and the State Council in their "Decision to Deepen the Education Reform and Push forward Quality Education in an All-round Way" made the proposal "to encourage comprehensive universities and non-normal universities or colleges to take part in the work of cultivating and training of elementary and middle school teachers, and to explore ways of opening up normal colleges within comprehensive universities with good conditions" (The Central Committee of Chinese Communist Party and State Council, 1999). In March of 2000, the national Education Ministry in its "Program of the Elementary and Middle School Teacher Further Education Project (1999-2000)" made the proposal "to encourage normal universities or colleges at all levels as well as comprehensive universities to participate in the further education of the elementary and middle school teachers actively" (Education Ministry, 2000). In May of 2001, the State Council in its "Decision on the Reform and Development of Fundamental Education" proposed "to consummate the open system of teacher education in

[2] Since the founding of the People's Republic of China in October of 1949, a number of terms have been used to name the department in its central government in charge of education. In 1949, Education Ministry was established to lead and administer national education in a unified way. In 1952, Higher Education Ministry was established to be in charge of higher education. In 1958, Higher Education Ministry was annexed to Ministry of Education. In 1964, Higher Education Ministry was restored. In 1966, Higher Education Ministry was once again annexed to Education Ministry. In 1970, Education Ministry was replaced by Science and Education Group of the State Council. In 1975, Education Ministry was restored again. In 1985, Education Ministry was replaced by the State Education Committee. In 1998, the name Education Ministry was again adopted. The name has been used till now.

which the existing normal universities and colleges are the main stream, other higher education institutions join their hands in making a coherent linking between pre-service education and in-service training" (Important Documents on Education of PR China (1998-2002), 2003, pp. 887-892). In May of 2007, in its announcement of transmitting the National Education Ministry's "Outline of National Development of Education in the Eleventh Five-year Plan", the State Council proposed "to form an open, flexible, standard and orderly teacher education system gradually" (State Council of PR China, 2007). It is not difficult to find that the general strategy and policies of China's teacher education reform remain persistent, explicit and conform to both the international mainstream and China's own situation within 30 years. The problems lie in the links of implementing them and are reflected in the following five aspects.

The Function Played by Normal Universities and Colleges in Teacher Education Has Been Weakened

In the process of changing the enclosed type of normal education into an open type of teacher education, a great number of normal universities and colleges were upgraded into multi-disciplinary or comprehensive universities by internal or external means, such as expansion, annexation or transformation, with the result that the number of the normal universities or colleges dropped sharply. According to the statistics from 1992 to 2001, 169 nationwide normal universities or colleges were involved in the adjustment (retrieved from http://www.Moe.edu.cn). Among them, some were merged to other normal universities or colleges, some were reshuffled to perform a combined function of providing both the pre-service and in-service trainings, some were annexed to comprehensive universities, some absorbed other kinds of schools, some were upgraded into comprehensive universities, etc.. As a result, the relatively independent and specialized normal education system was basically broken up. During the giant leap of Chinese higher education's transitioning from the elite-type to popularized one, normal universities and colleges played a huge and unique role. However, because this kind of reform and transition was carried out at quite a rapid speed, a large number of normal universities and colleges, attempting to get quick success, blindly upgraded or expanded themselves. This kind of collective action not only jumped over certain necessary phases of historical development, but also made schools lack their distinctive features and vitality. Because schools were involved in repetitive and disorderly competitions like a swarm of bees, not only was the chief role played by normal universities or colleges in teacher education weakened, thus, hindering the process of the reform of teacher education and stagnating its healthy development, but also the source of primary and middle school teachers with high quality as well as the development of national basic education were directly affected.

For a period after some normal universities or colleges were upgraded into comprehensive universities, they exerted all their efforts to fulfill the task of teacher education. However, their initiatives of doing this soon started to wane away. They have become a secondary college or department subsidiary to a university. The basic professional function of teacher education of such universities is downgraded into that of educational college, teachers' college or education department subsidiary to them. Since annexation to or combination into each other, some normal universities or colleges have put their main efforts into external expansion trying their best to develop themselves into multi-disciplinary and comprehensive universities, showing a lack of interests in and paying little attention to making use of their solid foundation and rich experience in the respect of cultivation of primary and middle school teachers. In these normal universities, teacher education, likewise, is assigned to their teachers' colleges or education departments subsidiary to them. What's more, although the names of such schools are changed and their school types are transformed, their obsolete teaching modes which

are mostly based on the traditional normal education remain unchanged. Statistics showed that more than over 30 nationwide key normal universities of the provincial level or above have been embarked on the road of turning themselves into comprehensive universities. They have shown great interests in non-normal specialties, continuously expanded their scales of recruiting and cultivating students of non-normal specialties and tried their best to upgrade themselves and promote their comprehensive influences in the country. In such universities, the ratio of normal specialties and non-normal specialties has approximately reached 1:1. The original purpose of the national government's leading normal universities and colleges in making their transformations was to open and strengthen teacher education, further consolidate and expand the force engaged in teacher education, make them fully display their traditional advantages and characteristics in teacher education and further develop their abilities to train high qualified teachers on a higher academic and multi-disciplinary platform. However, in practice, the main professional functions these schools are supposed to fulfill are weakened, or, even, show a trend to be marginalized (Zhu, 2006).

The Duty of Teacher Education Has Not Been Fulfilled Completely by General and Comprehensive Universities as It Is Assumed to

In the process of transition of the type of teacher education from what is provided single-handedly by normal universities or colleges to what is jointly fulfilled by all kinds of universities and colleges so long as they have conditions and abilities to do so, some comprehensive universities set up education colleges or departments within them successively to take part in teacher education, annex to them some normal colleges or universities or construct secondary-level colleges to assume the task of teacher education. However, they are far from having a comprehensive understanding of the national reform of normal education system and the related policies of opening up teacher education. Their aims of setting up teacher education in their schools is to fill up the blanks in their lists of specialties so as to make them consummate, speed up their process of becoming more comprehensive in specialties, promote their comprehensive level and then push themselves into the rank of famous or first-rate comprehensive universities, but not to promote the level and the qualities of teacher education by taking the advantage of their possessing disciplines and specialties of comprehensive universities and their profound influence on liberal arts and sciences.

At the same time, their school-running tradition, which puts the academic and theoretic studies at the first place, also decides that they do not want to exert many efforts in the training of teachers of kindergartens, primary and secondary schools. Therefore, whether the teacher education's disciplines, specialties, curriculums, preparation of textbooks, promotion of teachers, or teaching research and accumulation of the practical resource are concerned, they have not made full preparations and have long been detached from the basic education. They know little of the teaching reality in kindergartens, primary and secondary schools, and are especially ill-informed of the "new curriculum reform" which has been enthusiastically carried on since 2001. They also lack teacher education practice and experience. This situation bears some resemblance to what was going on with the US teacher education and curriculum reform in 1960s. According to Bruno's analysis, the dominant reason why US curriculum reform of basic education turned out to be a failure was that too little stress was laid on the training of teachers at the first teaching front so that teachers of primary and secondary schools failed to learn and understand fully the aims and contents of curriculum reform and lacked adequate abilities to lead curriculums and teach activities. What the lesson gives us is profound and worth our attentions and thinking.

From the course of global teacher education, it is found to be an inevitable developing trend of history that

the independently conducted teacher education system should be replaced by an open, plural, comprehensive and standardized one, in which teacher education is assumed by education research institutes, teachers' colleges, education colleges or education departments set up inside comprehensive universities on the basis of their colleges of liberal arts or sciences. However, the teacher education pattern of a nation is always restricted by its specific culture and is seasoned with the degree to which its society, economy and education are developed in a certain period. The teacher education of modern China, starting in the Westernization Movement in its late Qing Dynasty and undergoing several decades' changes in the Republic of China as well as the large scale of adjustment in the beginning of the People's Republic of China, was gradually built into a teacher education system, which took advantages of the teacher education in the late Qing Dynasty and the Republic of China, and was developing towards perfection by the mid-1980s. In recent more than 20 years, this system has been put into a reform. However, up till 2005, 65% of the primary and middle school teachers of the country were still cultivated by its 154 normal universities and colleges whose names remained unchanged, and only 35% of the teachers of these schools were graduated from 206 comprehensive universities. Most of these so-called comprehensive universities came into being by means of changing their original names or annexation. The comprehensive universities, which made changes in their curriculums and assumed teacher education in reality, were still far and few in between and far from being able to meet the demands of raising the teacher education quality and professional level.

Teacher Education Resources in Secondary Normal Schools Are Losing Greatly

During the transformation of normal education from the old three-leveled type to a new three-leveled or a two-leveled one, i.e., canceling normal education level and adding the post-graduate level, many excellent resources of teacher education were lost, which was highlighted by the way that the number of secondary normal schools was reduced greatly and new teachers of the primary schools were not so qualified as before. In mid-1990s, in order to raise the academic level of the teachers in the primary schools and kindergartens, great changes occurred in former secondary normal schools. Some of them were abolished, some were merged, some were upgraded to normal colleges, while some were changed into ordinary high schools, etc.. Almost all the secondary normal school resources, which started in the primary normal schools of late Qing Dynasty and were accumulated in the 100-year history, were depleted. What the primary school teachers need are broad and synthesized knowledge of humanities, sciences, arts and other aspects, as well as relevant abilities, personalities and cultivated emotional qualities. The requirement of a teacher's EQ (emotional quotient) is even higher than his/her IQ (intelligence quotient). It is especially in the aspects of arts. It is better for a teacher to have some special abilities, such as being good at dancing and chanting, adaptive to a child's active nature, understandable to kids' interests, full of love, caring for and kind to children, etc.. However, a normal college's nature of belonging to higher educational institutes, its curriculum, its profound-knowledge-oriented teaching objectives as well as its tradition, which highly regard knowledge-instillation but neglect the clinical practice and training of operational skills, are all quite different from the quality-oriented training mode of the secondary normal schools and contrary to the current international trend of advocating integrated education, unable to meet the requirements of education for primary school teachers and non-conducive to the cultivation of outstanding primary school teachers, either (Gu, 2006).

Although those who graduated from former secondary normal schools had not received enough education on basic knowledge, they were selected from the outstanding junior middle school graduates, underwent a series

of rigorous training at the secondary normal schools and obtained a relatively good mastery of knowledge and skills needed in the education of primary schools. Nowadays, students of normal colleges are those who have received relatively low scores in the entrance examinations held in the situation of popularized higher education and met only the low requirements set by such colleges. After they are admitted to the college, their learning ability, learning potentials, the degree to which they can be artistically cultivated, etc., are all lower than that of former secondary normal school students. When sent to work in primary schools, their professional skills and comprehensive quality related to education prove to be lower than the former secondary normal school graduates. Originally, the purpose was to raise the academic level and professional ability of primary school teachers, but the result turned out to be that a set of fine traditions formed in the long process of educating primary school teachers as well as very valuable resources related to this education, which should be combined in an organic way with higher normal education and the personnel-cultivation practice and made to be displayed and promoted further, were discarded. What is even more embarrassing is that the education adopted in normal colleges has been remaining at the initial stage, in which the basic knowledge education and the knowledge-applying education are employed in a mixed way. In a given period of time, the students should not only achieve enough credits related to the courses of liberal arts or sciences, but also finish learning the courses related to education specialty. Efforts are supposed to be put into both. However, the result is neither learned thoroughly. Not only the acquisition of knowledge of liberal arts or sciences can not be achieved satisfactorily, but also the ability to be engaged in education or actual teaching practice can not be trained fully. The education in these normal colleges has been remaining at an immature state, which is criticized by many people as “not fully developed specialty”, “developing specialty”, “semi specialty”, “quasi specialty”, etc.. No wonder many primary school principals say that the graduates from present normal colleges are even less adaptable to the education of primary schools than those from the former secondary normal schools.

The Educating Capability of the Schools in Charge of Teachers’ Further Study Needs to Be Developed Urgently

In the process of developing from the stage which teachers’ pre- and post- service training and in-service training were conducted in an isolated way and the emphasis was put on the former with a neglect of the latter to the stage when the two were coordinated and unified, many schools in charge of teachers’ further education were annexed to normal universities or colleges, with an attempt to reach a result that the two are equally paid attention to and joined to each other. However, the greater effort of such normal universities and colleges after annexation is still put on the exploration, broadening and upgrading of teachers’ pre-service training while teachers’ in-service training is to be charged of a college of further study for adults or section performing similar functions affiliating to such normal universities or colleges, whose work is always focused on the whole society’s academic credential making-up education including teacher education. The real in-service training for primary and middle school teachers is in a sideline status. The teaching plans, curriculums, teaching quality evaluations, etc., of such training are generally copied from those of the pre-service education and have no its special feature. The knowledge provided by such training is old-fashioned, with little practicality, and its form is closed. As a result, the previous training’s advantage of being linked closely to the basic education disappears. What’s more, driven by economic interests, such training usually takes on utilitarian feature. Because in such training, teachers’ further education unrelated to obtaining a higher academic degree has dropped to a second place and made little substantial progress in improving teaching quality, the original

intention of overall planning and step-by-step implementing pre-service education and in-service education have not been realized after the annexation. A considerably large number of schools in charge of teachers' further education have not been annexed to common universities or teaching universities, and continue to carry out the task of providing teachers' in-service training. At the county level, there are a large number of county-level teachers' further training schools, some of which have been integrated with teaching-related units in counties, such as teaching research institute, TV (television) colleges and teaching guiding offices, and some of which remain independent. Together, they take on most of the tasks of training the primary and middle school teachers and their principals. Undoubtedly, in China's first 20 years or more, the restoration and development of such kinds of teachers' further education schools contributed greatly to the raising of teachers' academic levels by granting teachers' academic credentials and degrees. However, with increasing requirements made by teachers, the capacity of running such schools cannot keep up with times and the continual improvement of the standard of these colleges can not satisfy the necessity, especially the overall quality of the teachers of such schools, whether their theoretical level or practical abilities appear to be legging behind day by day.

On the one hand, because of their nature of adult education, these kinds of schools lack ordinary colleges' or universities' width, solidity, depth and thickness of the scientific, humanistic and cultural base, vigorous atmosphere of doing academic research, strict and regulated tradition of both imparting knowledge and cultivating students and further study systems of teachers. Therefore, in such aspects, the current and potential capability of doing teaching and research work, renewal of knowledge and development of theories can not be compared with the latter. On the other hand, because of staying in a leading position and having not been engaged in teaching activities for a long time, organizers of further education courses are less familiar with subjects being taught and teaching reform going on in primary and middle schools than the trainees who are teachers of primary and middle school. In fact, soon after teachers of primary and middle schools take teaching posts, the education and other on-job studies taken by them in their long careers are closely related to their work and professional development, major links of pre- and post- educations of teachers and fundamental elements of life-long education of teachers. Compared to the pre-service education of the teachers, such post-service education takes longer time and is more difficult to organize, hence, making higher requests of the organizers and teachers of such studies. Looking back at the educational reform of the past few years, the result contrary to the original intention can be found. A large decrease in terms of capability has occurred in the organizers of teacher education. It should be mentioned in particularly that, according to the statistics revealed by Chinese Education Ministry in 2007, the total number of teachers in primary and middle schools is taking on a declining trend and that the percentages of qualified teachers in terms of their academic degrees obtained are above 96% and 98% respectively, the percentage of qualified high school teachers being approximately 90% (Education Ministry of PR China, 2007). Although considered from the world scale, China's requirements of its teachers' academic credentials and academic degrees are still relatively low and such a rapid rise in teachers' academic qualification rate enables the whole country to be emancipated from the plight of having to adopt make-shift measures to make up for the teachers' low level of academic credentials, provides a good condition for concentrating its efforts on raising its teachers' teaching proficiency and creates a good opportunity for most institutes offering teachers' further study to transform from the type of offering academic credentials education to that of offering post-service education, strength the cooperation with primary and middle schools, establish basic education unions and combine teachers' post-service education with their self-development in an organic

way. However, viewed from the general situation of all kinds and levels of the institutes for teachers' further study, they are far from being able to meet the needs of such challenges and requests.

The Teacher Education Mode Adopted by Schools of Various Kinds and at Different Levels Is Outdated and Simplistic

In the process of changing from the traditional type of teacher education to the modern one, there are no systematic and practicable design or corresponding measure to guarantee the realization of such designs in terms of the reform of teacher education curriculum system and mode, establishment of teacher education discipline and specialties, evaluation of teacher education proficiency and quality, admission and approval of teachers' professional standard and qualification, independent and continuous development of teaching specialty, etc.. Except a small number of normal universities, such as Beijing Normal University and Nanjing University, where a "4 + x" long curriculum system with a two-phase cultivating mode, i.e., according to the teacher-cultivating mode of ordinary universities, the first phase of four years are spent for the education of basic knowledge of liberal arts and sciences as well as specialties, the following phase of one, two or three years for teachers' professional training and teaching specialty education (of course, between the two phases of four and x, there is an issue of how to link and integrate to each other), with a purpose of strengthening the establishment of teacher education discipline and specialties. Most teachers' universities and colleges continue their originally adopted four-year bachelor's degree curriculum with a low-level mode of mixed education, i.e., finishing the general knowledge education, education of a specialty of liberal arts or sciences, education of teaching specialty as well as indispensable teaching probation and teaching practice within four years. Therefore, it can be said that there is no substantial achievement made or significant measures adopted in the reform of teachers' universities or colleges so far, as such aspects as the teachers' education curriculum reform and extension of study period of teaching specialty, setting up of specialties, teaching and learning mode. Especially in the establishment of teacher education discipline and specialties as well as building of practice courses, things are even more unsatisfactory. All these show that the reform of such universities and colleges can hardly keep up with the demand made by teachers in the development of basic education.

There are also a lot of problems accumulated in teacher qualification admitting and approving system which is adopted based on foreign experiences and open to the whole society, especially in the checking system of qualifications of teachers graduated from other normal universities or colleges. Since the stipulation that "nationwide the teacher qualification evaluating system should be established and qualified teachers proffered with qualification certifications" made in "the Compulsory Education Law" passed and publicized by the National Standing Committee of the People's Republic of China in April of 1986, a series of relevant laws and regulations have been passed and adopted, including "Experimental Measures to Be Adopted in Proffering Certifications to Qualified Primary and Middle School Teachers" issued by China's Education Committee in September of 1986, "The Teachers' Law of the People's Republic of China" passed in October of 1993, "Regulations of Teachers' Qualifications" adopted in December of 1995 and "Practical Measures of Applying Regulations of Teachers' Qualifications" adopted in September of 2000. However, since its starting in an all-round way, the work of admitting and approving of teachers' qualifications has not been effectively linked to the education of teachers' specialty. Standards of teachers' evaluation are set too low, the contents are made too narrow and simple, and the form is monotonous. Besides, once a teacher's certification is obtained in one place, it will remain valid everywhere and forever. The academic credentials that teachers are required to

possess remain at the level required in 1990s. Only a small number of subjects, such as “pedagogy”, “psychology” and “Putonghua” (Beijing dialect) are selected to be tested on to provide reference for teachers’ certification, and a limited number of forms of examination, such as interview, practicing teaching and talking on a lecture, are adopted. In such evaluations, there are no inspections on teachers’ teaching activities or comprehensive examinations on basic knowledge and abilities related to liberal arts and sciences, education specialty knowledge, educational philosophy and ideas, basic teaching skills and practical teaching abilities. There are still less special kinds of checks held according to conditions of different areas, different specialties and different levels of teachers. In teachers’ certifications, there are no distinctions indicated as to the level or type of a teacher’s qualification, nor are indications of their periods of validity. There are no systems of regularly holding evaluations and replacing certifications, either. In a word, the work of admitting and approving teachers’ qualifications have, so far, not played enough of its guiding and leering functions of helping to raise teachers’ professional abilities and promoting the development of teaching specialty. The system of admitting and approving teachers’ qualifications needs to be improved urgently.

The above-mentioned five problems reflect the fact that the teacher education reform currently going on in China has not only derailed from its original designs and ideas, but also been detached from the basic conditions of the country. The reform of teacher education system is a complicated and systematic project. Therefore, it can only be settled by applying new strategic concept and seeking scientific methods.

Exploration of Establishing a Modern Teacher Education System With Chinese Characteristics

Education is a great project, of which teachers constitute the core. The hope of a nation’s thriving lies in education, while the hope of education’s thriving lies in teachers. Teachers are the primary source of education development, while teachers’ education plays the function of a machine-producing machine. If the mid-1980s can be said to be the period in which the emphasis was put on the breakthrough from the old teacher education system and the slogan of transitioning from traditional teachers’ education to modern teachers’ education was raised timely, after the great reform practice and rational reflection of more than 20 years, it is very necessary now to explore how to establish a modern teacher education system with Chinese characteristics, emphasizing the system’s reform, getting rid of its current warts misfits, strengthening teacher education’s such features as being the base and guidance of the education development in accordance with “the Law of Education” and “the Law of Teachers”, putting priority on the development of teacher education and deepening teacher education reform.

The Teacher Education System of Combining Internationalization and Domestication

Looking around the teacher education practice, you can find that whether in major developed countries, such as US, Japan, UK, Germany, France, and Australia or in the vast majority of developing countries, including Brazil, Russia, India and China, which are called “BRICS” by American Sachs, the so-called “four Asian little dragons”(South Korea, Hong Kong, Singapore and Taiwan that became famous because of rapid economic development within a short period of time) as well as some African countries such as, South Africa and Nigeria, education shares a common feature, i.e., the optimum jointing point also called the golden jointing point between two extremes, namely internationalization and domestication, which has been sought. The internationalization means expanding one’s own vision, paying full attention to reforms of other countries’

teacher education, trying to follow or even lead the world's trend and actively learn others' methods and experience. The domestication means selecting the road for teacher education development suitable to the actual condition of one country or district. For example, since 1990s, US, a country paying special attention to the market's modulating function and check-and-balance of powers, has been making reference to the administrative modes of teacher education in European countries, such as France and Germany, endeavoring to strengthen the federal government's guidance to and control over macro policies of teacher education, showing great concern for the improvement of teacher education quality listed into one of its legislative objectives. In their processes of opening universities for cultivation of teachers, UK, France and other countries have both paid attention to learning from the US type of open system of teacher education and adopted a mixed type of teacher education system, preserving a large percentage of and a big scale of teachers' education institution. From these, it can be seen that to explore an organic integration of internationalization and domestication is both a trend of global teachers' education development and of great significance to the establishment of modern teacher education system (Mei, 2007).

As a subordinate concept of the modern education system with Chinese characteristics, the modern teacher education system should necessarily be a collection of items, such as internationally advanced concept, information, teaching mode and resources of teacher education with Chinese teacher education tradition, teaching organizations, teaching practice and experience, a unity of policies, laws and regulations, procedures, norms, principles, modes, systems and organizations related to teachers' education, which has the linkage of the teachers' education system unifying pre- and post- service education to the system of admitting and approving teachers' qualification and replacing regularly certifications of qualities, such as its base and the promotion of professionalism of the teaching career as its core, system series including such systems which are coherently integrated as professional education system, specialty education system, oriented education system, open education system, comprehensive education system, college education system, practical education system, life-time education system, multi-component education system, their respective academic programs, discipline-building system, course-exploring system, teaching and learning management system, quality-evaluating system and academic qualification admitting and approving system. Therefore, in establishing the modern teachers' education system with Chinese characteristics, a close attention must be paid to the up-to-date trend of the development and reference to it must be made. For example, recently, governments of various countries are attaching more importance to teachers' education, regarding it as a public utility, placing it in a strategic position to be developed in a preferential way, making great efforts in reinforcing its legal system, ensuring its high quality, raising all of its levels, promoting such processes as making it become domesticated, open to the outside, comprehensive, higher-education-based, life-long time multi-faceted, standardized, information-rich and capable of unifying pre-service, in-service and post-service education, leading it to meet the reality in the elementary education, tightening its linkage with primary and middle schools and paying more attentions to the teaching practice before teachers taking on their job and their freedom of developing their own specialties after taking on jobs. All these good methods deserve to be imitated. However, full considerations should be given to the reality of Chinese social, economical and educational conditions, their different developing phases as well as specific and uneven features within each phase. The developing strategies to be adopted should be open and multi-faceted. In transplanting the foreign experience, the actual condition of China, its different provinces, districts or even different schools must be fully considered.

Foreign measures should be rooted in China as well as localized, thus, avoiding copying blindly from others and making fewest mistakes as possible.

The Teacher Education System Combining Closeness and Openness

Having an overview of 100 years of changing history of China's teacher training, you can find that this independent and special-aim-oriented training system has its profound historical and cultural basis. Although in recent years following the international trend we have been endeavoring to open our teachers' raining system and making a large-scale reform of the traditional teachers' training system, the result obtained from searching various websites showed that there were still 144 normal universities or colleges as well as 56 colleges mainly providing teachers' further education programs in the country up till the end of 2007 (retrieved from http://www.huaue.com/gxmd.htm). These normal colleges or universities, plus some comprehensive universities originally named normal universities, are precious resources for training teachers. No matter in the past, at the present or for a considerably long period in the future, or no matter to what degree our teacher education will be open, this huge and specialized system will remain the main force engaged in teacher training, the precondition and starting point of the reform of teacher training system as well as the basis and driving force of our nation' endurable teacher training development. The heavy task of training teachers will fall in a new form to the higher layer of the system. This system will also be endowed with a higher mission and duty, which is both a historical arrangement and a realistic choice, proved by more and more open international teachers' training practice. Relevant information shows that it even took such a country as US that adopted a typical open type of teacher-training system of 40 years to finish its process of making its teacher-training system completely open (Xu & Ji, 2007). From this, it can be seen that the process of opening a teacher-training system is rather time-consuming and that, as an important component of the modern teacher-training system of China, the teacher training system with its relatively specific aim will exist for a long period of time. Therefore, in addition to taking into consideration preserving in a selective way and perfecting the specially established teacher training system when the macro development strategies and policies are made, normal universities and colleges themselves should also see clearly various demands of the teacher training system made by the national and local governments in their development, seize every possible opportunities, hold their own ground steadily, take an objective view of themselves, give full play to their own traditional advantages, seek more space for their own development and try to provide services with their own characteristics.

Certainly, to emphasize the normal universities or colleges' independence, their specific orientation of aims and pedagogical functions do not mean to engage in regression or close the door of teacher education reform which has been already opened up. The essence of teacher education reform in the past 20 years can be generalized in one word, i.e., "opening-up", which means to change the teacher education of a low level and one dimension into one of a high-level and multiple dimensions. The opening-up of teacher education is an irreversible rector. There is no outlet for turning it back. Currently, among over 3,400 comprehensive universities in US, there are more than 1,200, each of which has an educational school or department attached to take the responsibility of training primary and secondary school teachers. In the 1990s, Australia began to abolish independent and specifically oriented normal universities or colleges and turned to comprehensive universities to recruit teachers the country needed, thus, making a fundamental change in its structure of teachers' sources. Therefore, we must stand at the highest position to have an overview high of the global development and reform of the teachers' education. While continuing to inherit the one hundred years old fine

tradition of teachers' education, follow the rules that make it function and have the existing teacher education system display its advantages, we must also further open this system, widen the channel for teacher education, adopt a policy of combining the specifically-oriented aim and non-specifically-oriented aim as well as integrating teacher education and other educations take place together, fully absorb and effectively integrate various resources of teacher education while facing society and basic education. While encouraging and guiding comprehensive universities to shoulder the task of training teachers, improving the teacher training structure and strengthening the cooperation with primary schools in educating teachers, we should also make a bigger investment in building and expansion of normal universities and colleges and establish an expanded, flexible and open teacher training system in which normal universities and colleges are the back bone.

The Teacher Education System Combining Specific-Professionalism and Comprehensiveness

Professions are products of social division of labor, while the teaching profession is a product of industrial civilization. During the long period of ancient society, a kind of education system was in practice in which the old, capable or knowledgeable were regarded as teachers, an official could be a teacher and a monk could be a teacher as well. So, in such an education system, teaching was not taken as a profession. It was only in the modern society, accompanied by the implementation of compulsory education system and establishment of classroom teaching that teaching gradually changed from a part-time job to a full-time one, from an activity taken by individuals separately to an enterprise taken collectively and further to an ordinary profession performing a specific mode of work in social life. In 1684, the French Catholic priest J. B. de Lasalle established his teacher workshop, marking the beginning of the professional teachers' training. In the following 300 years, the professional training of teachers developed gradually from that of a low degree to that of a high degree, from that based on experience to a scientific and specialized one, and the content and form of teachers' training as well as institutions organizing such training also underwent changes, the general developing trend being from one in the form of masters' passing experience to apprentices to that of systematic and theoretic training and finally to a life-time one in which the three kinds of education, i.e., pre-vocational education, education provided right after one took a job and incumbency education. However, the basic nature of such training remained unchanged. China's new teacher-training system was established one century later than the West. However, it also has shown an excellent tradition of professional training during its development of an odd 100-year. Especially since Zhan Jian founded Tongzhou Private Normal School in 1902, which has made great achievements in cultivating great deal of talents both in education and in other fields for the country and formed their own special features as well (Gu, 2005) because of adoption of the professional training system including consistent entrance examinations organized for selecting students, wide training calibers, as well as strict and integrated evaluations.

From this, it can be seen that a basic characteristic of teacher education is its professionalism. It is decided by the teachers' role that teachers' training and education must be of the nature of professionalism. In keeping up with times, the characteristic has gradually developed into some new mainstream characteristics, such as comprehensiveness. During the odd ten-year after the World War II, Western developed countries basically finished the process in education of making coexist the education-oriented by a specific subject and the integrated and comprehensive education, combining one-dimensional knowledge-passing activities and multi-dimensional activities in which teaching and learning sides learn from each other, enabling generalization and individualization to compensate each other, thus, realizing the strategic transition in education at a high

level. America is one of the countries in the world that initiated the educating mode of making teachers' basic knowledge of liberal arts and sciences mastered separately and in a different stage from abilities to apply skills into teaching practice. However, since 1990s, in order to solve such problems as the split between theory learning and teaching practice, the teachers' lack of systematic mastering of basic knowledge and the fall of their professional abilities, the country had to make the separated two items united again. The teaching profession, as a career in the modern society, bears the basic responsibility of passing knowledge and educating people. A teacher is supposed to possess his/her ideal, knowledge construction, norms to be consciously observed, skill and technology related to teaching profession. A teacher is required to master basic theories of passing knowledge, imparting instructions and helping to solve puzzling problems as well as teaching strategies and techniques of giving instructions to students in accordance with their individual aptitude. A teacher needs to know not only what to teach but also how to teach. As a teacher, he/she has to be an imparter of knowledge, an explorer of programs, an administrator of teaching and learning activities, a guide of morality, an edifier of methods, an opener of heart windows, conductor, a communicator of emotions and a cultivator of spirit, will and faith. Teachers training, as the first important thing of modern education, accordingly, should reflect these complex and comprehensive requirements of teachers and embody the direction of realizing a comprehensive integration in such areas as the setting up of disciplines and specialties, construction of curriculums and teaching plans, arrangement of teaching practice and practice and exercise and establishment of checking and evaluating system so as to raise teachers' scientific, humanistic and artistic qualities in a comprehensive way.

The Teacher Education System Combining Its Specialty-Based Property and Its Realization in Universities

Specialties were first separated from common professions in Europe in the 17th century. A specialty refers to a special profession that demands special professional training and education requires mastery of special scientific knowledge and skills, accords with special kinds of professional conditions and requirements, possesses independent and non-replaceable functions and features and has obtained its corresponding status quo and resources. To be of specialized property is not only the inevitable requirement of teaching profession in its development towards specialization, but also the natural extension of teachers' professional character in modern time. In 1930s, Chinese scholars once pointed out that teaching is not only an occupation, but also a specialty similar to that of a doctor, lawyer or engineer, etc.. In 1966, UNESCO (United Nations' Educational, Scientific and Cultural Organization) and ILO (International Labor's Organization) officially put forward that teacher is a professional occupation and teaching should be regarded as a specialty in proposals on teachers' status. In *A Dictionary on General Classifications of Professions in the People's Republic of China* published in 2000, teachers are classified as scientific and technical personnel. In summarizing 100-year experience of the development of Chinese teachers' education, one basic rule can be found, i.e., along with the development of the elementary education, professional specification of teachers education should be continuously raised just as a boat is raised when water carrying it rises. In the general survey of the evolution of teacher education of various countries in the world, there can also be found a general rule, that is, gradual shift from other kinds of schools to universities for realization of teachers' education is accompanied by escalations of degrees of compulsory education. During this shift, the cultivating modes are improved, steps for practice intensified and the whole teachers training system are developed from being of a middle-level to a high-level, from being of a single form to a synthesized form, thus, realizing the gradual rise of both teachers' academic degree indicating

their reception of formal education and their teaching proficiency. The report entitled “National Preparation for Teachers of 21st Century” published by American Carnegie Education Promotion in 1986 pointed out that the following measures should be adopted: (1) to cancel the bachelor’s degree in the education specialty; (2) to make obtaining a bachelor’s degree in sciences or liberal arts as the prerequisite of the training of teaching specialty; and (3) to divide obtaining a maser’s degree in education specialty in two stages that undergraduate stage during which the education of sciences and liberal arts as well as basic training for the completion of professional study are undertaken and post-graduate stage during which the training for education specialty is undertaken and master’s degree of education specialty is offered. Actually, by the end of the 1960s, 100% of the teachers of American elementary schools had obtained bachelors’ degrees and above 20% of them had finished postgraduate study. Among them, by 1996, 55% of its teachers in primary and middle schools had obtained master’s degrees. In 1989, “the Law of Guiding Educational Directions” was passed in France, according to which education of primary school teachers in France has been made into IUFM (Insitut Universitaire de Fomation Matres) education. In 2006, Japanese Educational Consultation Conference agreed to establish the system of graduate study system of teaching specialty in its universities so as to train teachers of high professional proficiency and make them become the ones of practical type.

For a long time, China has been adopting a mixed type of cultivating mode in its normal universities or colleges whether providing bachelor’s degrees or not. Because in such a mode, the basic knowledge of liberal arts and sciences and requirements of education faculty are mixed and there has been a debate over the issue whether priorities should be laid on its academic properties or educational properties. Being examined with the modern teachers’ educational view, both academic properties and educational ones belong to the teachers’ education specialty. The former is concerned with “what to teach”, that is, basic education of disciplines and their related specialties of liberal arts and sciences. The latter is concerned with “how to teach”, that is, the applied education of specialties of the education discipline. They are two indispensable components of the teacher education discipline. The first and second criteria required by US Federal Ministry of Education of teachers to meet in its 2005 annual report of the qualities of teachers are “to master thoroughly knowledge related to the discipline” and “to use appropriate teaching strategies”. If it can be said that, as a specific historical phenomenon, the mixed mode of teacher education in normal universities or colleges is an insurmountable stage in the development of teachers’ education, and then, in recent years, accompanied by the fall of China’s birth rate, decline in the number of in-school kids and teenagers, the unprecedented great demand of high-level teachers made by the rapid development in the basic education and the trend in which teaching profession requires teachers to obtain higher academic degrees and be more specialized, especially with the raising of the teachers’ own educational level and need, there is an urgent need to revise the standards for requirements of education levels and academic degrees of the teachers engaged in basic education teachers made in the end of the last century and raise the lowest requirements of their academic qualifications according to actual conditions of different places. At the same time, there is an urgent need to reform the existing educational systems for teachers, extend the training periods, adjust the professional structures, improve the curriculum, strengthen the practical teachings, lift the central part of the teachers’ professional education level, and make teachers obtain bachelor’s degrees or post-graduate academic degrees, so as to cultivate teachers of kindergartens and primary schools who are all-round developed as well as middle or high school teachers who have mastered many skills while being majored in one specialty (Li, 2007).

The Teacher Education System of Combining Stage-by-Stage Education and Lifelong Education

The combination of stage-by-stage education and life-long education is closely related to teachers' life and career. It embodies the idea of lifelong education and reveals the openness and unity of teachers' pre-service and in-service cultivation, the systematic property of the development of teachers' theoretic and practical trainings, the continuity and unity of teachers' education and professional development and so on. Early in the 1970s, an English scholar, named James Poter, divided teachers education into three stages: fundamental education, professional education and further education. In 1975, a resolution was passed in the 35th UNESCO conference, which emphatically pointed out the necessity of combining teachers' pre-service and in-service education. In 1985, a dictionary was published in Japan in which teachers' education is explained as a comprehensive concept of trinity of pre-service cultivation, induction training and in-service study. A school is a place for students' study as well as for teachers' development. Teaching is a learning profession. Teaching and learning process is one in which both students and teachers achieve success. The true value of teachers' development lies in its being the prerequisite for promoting students' development. Students grow in the development of teachers while teachers develop in the growth of students. According to sociologist on professions, there is a plateau period in the development of any occupation. Teachers who have gone through the pre-study and practice before taking up the new occupation and have a number of years of teaching experience which is officially admitted must be provided with further in-service education so as to promote them to improve their ability to practice introspection and make self-development, otherwise, their occupational character, their conception and cognition are very likely to become closed and conservative, which would in turn cause occupational fatigue, weariness and laziness. It would not only prevent them from fulfilling their duty related to their occupation, but also would have a direct affect on the quality of their teaching.

Teachers' knowledge is a kind of practical knowledge. It has its origin in practice and guides practice at the same time, which is testified time and again in teaching practice. Modern teachers' education is neither the one that occurs in school once for all in the traditional way, nor is it a one composed of two separated stages of pre-service training and in-service training. It is a life-time one, in which highly practice-oriented pre-service and post-service trainings are organically unified and pre-service training and post-service-training themselves are conduced according to different learning stages, principles, levels and types. Therefore, according to different degrees, types and requests on various education stages, it is necessary to strictly tick to the principles related to education and development of teacher education specialty and the principle of combining theoretic studies and practice, systematically design teachers' professional development plans, put the all-round series of teachers' education into practice step by step and establish a study-oriented, life-long teacher education mechanism, in which pre-service education and in-service education, degree education and non-degree education, school education and distance education combined well. Meanwhile, the contents of courses should be timely updated according to the modern philosophy, the latest achievement of researches in natural sciences, social and humanistic sciences, and educational science should be timely transferred into the contents of educational courses and a curriculum system in which post-service training, education received upon entering into a new post and in-service training should be coherently linked to each other and directed to a teacher's life-long education in which the teachers' own development is the main concern. In pre-service training, education on general knowledge of liberal arts and sciences, education on specialties, education on teacher education specialty, cultivation of teachers' ethics and beliefs and training of basic teaching skills should be

strengthened. In education upon a new teacher's entering his/her post, the teacher newly graduated from a teaching university or college should be given more chances for practical training so as to accelerate his/her transition from the role of a student to that of a teacher and to speed up his/her knowledge's transfer from subject-involved knowledge and conditional to practical knowledge, thus, shortening the period of his/her adapting to work and becoming qualified in teaching and suitable for his or her post. In the in-service education, the system of providing off-job training and on-job post-graduate programs should be made to perfection gradually, and communities for college teachers, middle school teachers and primary teachers should be made to have practice in a joint way established, so as to lead teachers in reflecting their own teaching processes, summarizing teaching experience, conducting teaching research, and improving teaching quality.

The Teacher Education System Combining Standardization and Multiplicity

Standardization is the core of a system construction, in while rich and various standardizations exist in every step of the modern teaching education system. It is a common practice adopted by the countries in the world to intensify the standardization of teaching education so as to guarantee its quality. In 1969, America published its "Law of Teachers' Further Study". Since 1980, each state of America has established its standards of teachers' education following one another. A working group of Carnegie Forum on Education and the Economy published a report on establishing the National Board for Professional Teaching Standards, so as to make sure in a high standard way what the teachers should know what to do and how to do them. The NCATE (National Council for Accreditation of Teacher Education) published the accreditation criteria of teacher education institutions and criteria of students' graduation. Meanwhile, NBPTS (National Board for Professional Teaching Standards) carried out the evaluating criteria of excellent teachers. In 1984, the Britain government established the National Council for Accreditation of Teacher Education and released "Teacher Education Curriculum Standard", teachers' certificate and tenure system in 1989. In 1998, its Department of Education and Employment published "the Requirements of Teacher Education Courses". In 1997, South Africa government published the "Norms and Standards of Teacher Education" to standardize teaching behaviors of its teachers and stipulate teachers' seven roles in education. In 2004, German Culture and Education Ministry published the resolution on teacher education standards, raising the requirement that a student's teaching proficiency in the teaching practice stage and in the stage of preparing for entering the teaching career should be able to be coherently linked to that after taking up a teaching post. In 2006, Japanese Education-Evaluating Council Conference announced the system of teacher qualification renewing system, stipulating that a teacher's qualification certificate be renewed after each ten years. Although, in recent years, the French government has been gradually releasing administrative powers from originally possessed by higher-level authorities to lower-level authorities, its control over teacher education standards has never been loosened.

The standardization of Chinese teacher education has its long cultural history. As early as in the West Han Dynasty, Yang Xiong, in his book *Rules in Teaching Practice*, raised his argument that "Teachers are models of human beings". From the late 19th century when contemporary education came into being till the beginning of the 21st century, the teacher education has been called normal education by the Chinese people. Because the emphasis of teacher education in China is put on the objectives of teacher education and the modeling character of the teaching profession, the teacher education system in China seems different from that in the above-mentioned countries where the teacher education is conducted in accordance with laws. However, in reality, the two kinds of teacher education systems have much in common. Modern teacher education is not

only the process of admitting and approving teachers' professional qualifications and promoting their professional qualities, but also the process of systematizing and standardizing of the teaching specialty. Therefore, great efforts should be made to inherit the fine traditions of teacher education of our country. Meanwhile, to revise and complete corresponding laws and regulations makes reference to measures in teacher education adopted recently by other countries and to strengthen the building of such basic and essential standards is related to teacher education as the specialty standard, curriculum standard, teaching standard, quality standard, evaluation standard as well as those standards related to teachers, such as standard of academic proficiency, standard required to be reached by general professional workers, standard of teaching profession and standard of assessing. Academic program system of teaching specialty should be deepened. It should be stipulated that obtaining the bachelor degree of liberal arts or sciences is the prerequisite for entering the study in teaching specialty or participating in teaching-qualification training and that testing on skills required by teaching profession should be held regularly and systematically and minimum requirement for entering this profession should be raised. At the same time, the system, in which formulation of teacher qualification standards and related examinations for approving and confirming such qualifications, conferring of teacher certificates and renewing such certificates as well as further education are linked and made to drive each other, is to be made to perfection gradually. The system of cultivating teacher-cultivators and training of teacher-trainers should be strengthened. And the system of approving and admitting qualifications of teacher education organizations and teaching education workers should be consummated (Wang & Tang , 2004).

Finally, it should be specially pointed out that history always develops forward and that things are of diversity. "The World Declaration on 21st Higher Education: Vision and Action", passed in World Higher Education Conference held by UNESCO in 1998 in Paris, pointed out that "Quality of higher education is a multidimensional concept" and that " The diversity should be taken into consideration so as to avoid adopting a unified standard to measure the quality of higher education". The modern teaching education, in essence, is of multi-dimensions, multi-levels and multi-specifications. It is personalized and differentiated. Its objectives and demands, structures and functions, contents and forms, evaluation and assessment, systems and regularities, etc. will all vary according to the changes of time and place. China is a developing country. There are current more than ten million primary and secondary school teachers in China. This teaching community is the largest professional body in China and bears the heaviest mission of teaching primary and secondary students in the world. The typical characteristic of the development of teacher education is its being non-balanced, especially in rural and underdeveloped areas, where the development of education is far behind that of cities and developed areas. Therefore, it should never do to apply standards and modes of urban and developed regions indiscriminately to rural and underdeveloped areas. Similarly, difference exists at different levels of schools, such as kindergartens, primary and secondary schools and in different types of education, such as general education, vocational education, special education and minority education. In different stages of education development, requirements for educational qualifications and qualities of teachers cannot remain the same. Teacher education institutions and schools are also different at aspects, such as their nature, type, level and division of functions. Therefore, it is important to reflect scientifically the differences existing in regions, such as that between urban and rural areas and at different levels and types of education, to have an over-all and coordinated plan for the general development of education but different guidance, district planning and step-by-step implementation for different districts, to consult publicized teaching paradigms of foreign countries, such as knowledge paradigm, ability paradigm, emotional paradigm, constructivist theory paradigm, critical theory paradigm and reflective paradigm

according to different training objectives, so as to actively explore and build a teacher education and development model in which standardization and multiplicity are unified.

Conclusions

To sum up, the system of teacher education in modern China set afoot in the late 1890s and is matured in the mid-1980s after undergoing changes on a magnificent scale for over 80 years. The passed 20 and more years have witnessed a new situation of China's modern teacher education. It is necessary to systematically look back into its course of the development, to consciously sum up its success and failure, gain and loss, in the way of not only having a foothold in reality, but also having the eyes on the future and taking the whole world in views, to build the system of modern teacher education with Chinese characteristics through exploration and creativity so as to promote the scientific development of national education, to construct a powerful nation with strong human resources, and to make great contribution to the rejuvenation of China.

In 2008, Chinese Education Ministry promulgated its "Revised Ethical Norms Related to Primary and Secondary School Teachers' Profession", its 6th norm being that a teacher should embark on a "life-long education".

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A Comparative Analysis of the Education Systems of Turkey and Canada: The Similarity and the Differences*

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A comparative study was made on the education systems of Turkey, a developing country, and Canada, a developed country with a comparatively high living standard and successful education systems. While education is governed at the national level in Turkey, it is the individual responsibility of the governments of the ten provinces and the territories in Canada. Consequently, for purposes of this study, the education system of the province of Ontario was chosen as representative of Canada as a whole. Comparisons were made of general goals, system administration and school structure. The systems were compared by documentation in tabular form. Their differences were clearly greater than their similarities in each of the categories examined.

Keywords: comparative education, Turkey's education system, Canada's education system

Introduction

The world is continuously changing and developing. It dictates reforms in every field including education. Countries which value education must invest in it just as they invest in scientific research and its applications. Investing in education is investing in a country's future. Curricula then must reflect the country's perception of its future.

Bereday (1964, p. 5) stated that comparative education seeks to make sense out of the similarities and differences among educational systems. Thus, comparative education reveals the similarities and differences between the education systems of the countries being compared. The aim then is to benefit by the comparison. Balcı (2007) defined the aim of comparison as to define, convince, inform and benefit in addition to showing similarities and differences.

Bray (2004) noted some of the purposes of comparative education identified by earlier scholars. He started with one of the great grandfathers of the field of comparative education, Sir Michael Sadler. According to Bray (2004), Sadler suggested that the practical value of studying, in a right spirit and with scholarly accuracy, the working of foreign systems of education is that it will result in our being better fitted to study and understand our own. Bray stated that the emphasis in this quotation is on an individual looking outwards and comparing patterns in other societies with those in his own.

In 1970, Katz drew attention to the importance of the examination of the educational relationships between the developed and the developing countries for comparative educators interested in examining the similarities and differences in the educative process of various groups (Bray, Manzon, & Masemoon, 2007).

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For over a century, researchers and writers have been eliciting features of different education systems. There is a preoccupation with educational performance, achievement and outcomes and a desire to know which countries are achieving faster economic growth and better learning outcomes. Close links between educational and economic performance were assumed (Dimmock, 2007).

UNDP (United Nations Development Program) is the UN's global development network, advocating change and connecting people to help them build a better life by publishing annual reports on their interests (retrieved from http://www.undp.org/). According to Human Development Report 2001, Norway was first among 174 countries followed by Australia, Canada, Sweden and Belgium with Turkey in 82th places (Sağır & Yüksel, 2002). In the corresponding report of 2007, Turkey ranked 79 and Canada ranked four among 182 countries. According to this data, Turkey was in the "high human development group" and Canada was in the "very high human development group" (HDR (Human Development Reports), 2009). Canada has always been ahead of Turkey at the UNDP's "quality of life" list. The ability of developing countries to make progress is directly related to their levels of education. Developing countries should follow the developed countries when building their education programs. Canada's success in education was published in the results of the international comparative tests (OECD (Organization for Economic Co-operation and Development), 2008; Bussiere, Knighton, & Pennock, 2006). While doing comparative studies less developed countries tend to look at more developed countries (Bray, 2007).

Thus, a comparison of the educational systems of Canada and Turkey as shown in this research is clearly useful.

The Purpose of the Study

The purpose of the study was to examine similarities and differences among the general goals, the system-administration and the school structure of the Turkish and Canadian educational systems.

Method

This study is a comparative educational research study. Comparative studies in education have principally been located in nature, examining educational phenomena in different places. Among the various purposes of comparison, two are remarkable because of the ways in which they shape research methods: One is interpretive and the other is casual-analytic. Concerning interpretive studies which seek to understand educational phenomena, Bereday's comparative method deserves comment. According to Bereday's model for undertaking comparative studies, there is a four-step method of comparative analysis, consisting of description, interpretation, juxtaposition and simultaneous comparison. A prerequisite for any comparative study is to establish the parameters for initial comparability of the chosen units of analysis (Manzon, 2007). This study adopted the classic model presented by Bereday (1964) for comparison of education in two countries. The document analysis for comparison of the considered countries (Turkey and Canada) was done by means of the general goals, the system administration and the school structure.

Comparisons taking the country as a unit of analysis are prominent in the field of comparative education, but the use of a nation-state as the dominant research framework has been continually challenged. There are regional variations in education within nation-states. In Canada, there are ten provinces and three territories. Each province is responsible for its own educational system (Manzon, 2007). For that reason, while analyzing the education system of Canada, making generalization could lead misleading conclusions. Thus, Ontario was

chosen as a sample for the country.

Hans (1967, p. 1) gave Marc-Antoine Julien's thought as education is based on the facts and observations as the other branches of science and should be classified with analytical tables to find out the principles, and thus, the comparison can easily be done. The results of the document analysis of the education systems of Turkey, Canada and Ontario are given in tables comparatively, similarities and differences are displayed.

Findings: Similarities and Differences

The analysis of the systems being compared here is done in tabular form under the titles: general goals, system administration and school structures.

The Similarities and the Differences in Terms of the General Goals

Before the comparison of the general goals of Turkey and Canada in tabular form, listing the general goals of their education systems is thought to be useful:

General goals of the Turkish education system. Turkish national education system's general goals were defined in Basic Law of National Education No. 1739 as (MoNE (Ministry of National Education), 2005):

The general goals of national education are:

(1) To raise all individuals as citizens who are committed to the principles and reforms of Atatürk and the nationalism of Atatürk as expressed in the Constitution, who adopt, protect and promote the national, moral, human, spiritual and cultural values of the Turkish Nation, who love and always seek to exalt their families, country and nation, who know their duties and responsibilities towards the Republic of Turkey which is a democratic, secular and social state governed by the rule of law, founded on human rights and the tenets laid down in the preamble to the constitution and who have internalized these in their behaviors;

(2) To raise them as constructive, creative and productive persons who are physically, mentally, morally, spiritually and emotionally balanced, have a sound personality and character, with the ability to think freely and scientifically and have a broad worldview, that are respectful for human rights, value personality and enterprise and feel responsibility towards society;

(3) To prepare them for life by developing their interests, talents and capabilities, providing them with the necessary knowledge, skills and attitudes and the habit of working with others and ensure that they acquire a profession which shall make them happy and contribute to the happiness of society;

(4) In this way, to increase the welfare and happiness of Turkish citizens and Turkish society, and support and accelerate economic, social and cultural development within national unity and cohesion, on the other hand, make the Turkish Nation a constructive, creative and distinguished partner of contemporary civilization (MoNE, 2005).

General goals of the Canadian education system. The general goals for the Canadian education system are not found as definite listed items in a single document. The goals are mentioned in different documents with different sentences. In Canada, education is a provincial responsibility. Despite of provincial diversity in educational policies, programs and organization, the common goal is an "educated citizenry". A shared priority is the development of the next generation as effectively and efficiently as possible given competing demands for limited resources (McEwen, 1995).

According to UNESCO (United Nations Educational, Scientific and Cultural Organization) (2010a) reports, education in Canada seeks to attain what are generally defined as the four major goals for schooling: (1)

Cultivation of mind; (2) Vocational preparation; (3) Moral and civic development; and (4) Individual development.

General goals of the Ontario education system. The general goals of the Ontario education system are defined in the frame of "educated citizenry" as consistent with Canada's. The Ministry of Education strives to promote a strong, vibrant, and publicly funded education system that is focused on three goals (OMoE (Ontario Ministry of Education), 2010a): (1) High levels of student achievement; (2) Reduced gaps in student achievement; and (3) High levels of public confidence.

Table 1

Comparison of the Education Systems of Turkey, Canada and Ontario in Terms of General Goals

General goals of education		
Turkey	Canada	Ontario
Turkish national education system's general goals were given in three items with very detailed sentences.	According to UNESCO reports, general goals were given in four items. The sentences for goals are not detailed. The common goal is an "educated citizenry".	The Ministry of Education focused on three goals which are mostly focused on "student achievement".

Table 2

Comparison of the Education Systems of Turkey, Canada and Ontario in Terms of System and Administration

System administration		
Turkey	Canada	Ontario
Education is free in the public schools. Education services are provided by both public and private schools. Primary education is compulsory. The Turkish education system is organized centrally. Education is on responsibility of the MoNE and all schools are administered by the MoNE except universities. The Council of Higher Education is responsible for the governance of all higher education system. The Ministry of National Education has provincial organizations in 81 cities and 924 districts. There is a directorate of national education in each province and district. City and district directorates consist of branches, bureaus, permanent boards and commissions according to the characteristics of the service.	Education is free in the public schools. Education services are provided by both public and private schools. The length of compulsory school attendance varies by province. In general, primary and secondary education is compulsory. There is no federal department of education and no integrated national system of education. There is not unique "National Education Ministry" for overall country. The CMEC (Council of Ministers of Education, Canada) was formed in 1967 by the provincial and territorial ministers responsible for education to provide a forum in which they could discuss cooperatively for shared goals in education. Thirteen jurisdictions have their own education policy and ministry. The ministries and their departments have responsibility from elementary education to postsecondary education. Some jurisdictions have two separate departments or ministries, one having responsibility for elementary-secondary education and the other for postsecondary education and skills training. Ministries are responsible for the operation of the departments. Local governance of education is usually entrusted to school boards, school districts, school divisions or district education councils.	Education is free in the public schools. Education services are provided by both public and private schools. Primary and secondary education is compulsory. The governance of education in Ontario is the responsibility of the provincial government, so in the responsibility of the Ministry of Education. The colleges and the universities are governed by the Ministry of Training, Colleges and Universities. Ontario's schools are administered by district school boards and school authorities. Ontario's school boards operate the province's publicly-funded schools.

As seen in Table 1, the basic structure of the Turkish national education system was defined in Basic Law of National Education No. 1739, in which the general goals of the Turkish national education system were given in three very detailed items. The general goals of the Turkish National Education System are especially concentrated on the prospective general features of the Turkish citizens, individual properties of the Turkish society and professional features of the individuals. The general goals for the Canadian education system are not found as definite listed items in a single document. The goals were mentioned in different documents with

different sentences. The common goal is an "educated citizenry". The general goals according to UNESCO (2010a) are given in four items briefly. Predominant focus of Canadian education is on progressive or child-centred education (UNESCO, 2010a). Because of the provincial structure of the country, the provinces have particular education policies, and each province has their own goals towards the general goals of the country. The Ministry of Education of Ontario has three goals which mostly focused on "student achievement". It is noticed that the general goals of the Turkish education system are stated with explicit and nationalistic expressions with very detailed sentences, while the goals of Canada's and Ontario's education system have more general statements.

Similarities and the Differences in Terms of the System-Administration

As seen in Table 2, there is a difference between compared countries for the duration of compulsory education. Compulsory education contains just primary education in Turkey. The ages for compulsory schooling in Canada vary from one jurisdiction to another, but most require attendance in school from age six or seven to age 16 that contains both primary and secondary education (UNESCO, 2010a).

The structure and administration of education systems of Turkey and Canada have big differences. The Turkish education system is organized centrally, while it is not centrally structured in Canada. The basic structure of the Turkish national education system was defined in Basic Law of National Education No.1739 (MoNE, 2010a). Education is on responsibility of the MoNE and all schools are administered by the MoNE except higher education institutions. The CHE (Council of Higher Education) is responsible for the governance of all higher education system (CHE, 2010). The Ministry of National Education has provincial organizations in 81 cities and 924 districts. There is a directorate of national education in each city and district. City and district directorates consist of branches, bureaus, permanent boards and commissions according to the characteristics of the service (MoNE, 2005). Administration of education is different in Canada. There is no federal department of education and no integrated national system of education. Within the federal system of shared powers, Canada's Constitution Act of 1867 provided that "In and for each province, the legislature may exclusively make laws in relation to education". In the 13 jurisdictions, ten provinces and three territories, departments or ministries of education are responsible for the organization, delivery and assessment of education at the elementary and secondary levels, for technical and vocational education and postsecondary education. Some jurisdictions have two separate departments or ministries, one having responsibility for elementary-secondary education and the other for postsecondary education and skills-training. Each province and territory has one or two departments/ministries responsible for education, headed by a minister who is almost always an elected member of the legislature and appointed to the position by the government leader of the jurisdiction. The CMEC was formed in 1967 by the provincial and territorial ministers responsible for education to provide a forum in which they could discuss matters of mutual interest, undertake educational initiatives cooperatively and represent the interests of the provinces and territories with national educational organizations, the federal government, foreign governments and international organizations. Although the ministries are responsible for the education in jurisdictions, local authorities have important responsibilities on the governance of schools. Local governance of education is usually entrusted to school boards, school districts, school divisions, or district education councils (CMEC, 2008).

In Ontario, education is governed principally by the Education Act and its regulations. There is a Ministry of Education for the governance of Ontario's education. The Education Act and its regulations set out duties

and responsibilities of the Minister of Education and the duties and responsibilities of school boards, school board supervisory officers, principals, teachers, parents and students (OMoE, 2010b). Ontario's education system is organized at three levels, within which the Ministry of Education, school boards and schools form the nucleus of the system. Two additional government agencies are in place to measure the effectiveness of the education system (the Education Quality and Accountability Office, the provincial testing agency) and administer self-regulation of the teaching profession of the Ontario College of Teachers (Zegerang & Franz, 2007). The Minister of Education in Ontario is also responsible for developing curriculum; setting policies and guidelines for school trustees, directors of education, principles and other school board officials; setting requirements for student diplomas and certificates; and preparing lists of approved textbooks and other learning materials. Ontario's schools are administered by district school boards and school authorities. Ontario's school boards operate the province's publicly-funded schools (OMoE, 2010b).

In Turkey, curriculum and any other subjects in education are common for all over the country. In contrast of Turkey, while there are a great many similarities in the provincial and territorial education systems across Canada, there are significant differences in curriculum, assessment and accountability policies among the jurisdictions that express the geography, history, language, culture and corresponding specialized needs of the populations served (CMEC, 2008).

Similarities and the Differences in Terms of the Schooling

As shown in Table 3, in Turkey, pre-primary education is the level of non-compulsory education for children of ages 36-72 months. The education is offered in nurseries, practice classes and kindergartens. According to Regulation on Pre-school Education Institutions, the institution established with the purpose of offering education for children of ages 36-72 months is denominated as nurseries/practice classes, while the institution established with the purpose of offering education for children of ages 60-72 months is denominated as kindergarten (EURYDICE (Information on Education Systems and Policies in Europe), 2010).

Table 3

Comparison of the Education Systems of Turkey, Canada and Ontario in Terms of Schooling—Pre-Primary Education

Pre-primary education		
Turkey	Canada	Ontario
Covers the education of the children age of three to six. It is a non-compulsory education. The education is offered in nurseries, practice classes and kindergartens.	Covers the education of the children up to age of six. Pre-school programmes or kindergartens, non-compulsory education for five-year-old, with the exception of Prince Edward Island, where it is compulsory. The education is offered in preschools, kindergarten and daycare and childcare centers.	Covers the education of the children up to age of six. It is a non-compulsory education. The education is offered in preschools, kindergarten, daycare and childcare centers. Ontario provides Junior Kindergarten for four to five years and senior Kindergarten for five to six years.

In Canada, pre-school programmes or kindergartens, which are operated by the local education authorities and provide one year of pre-first grade, non-compulsory education for five-year-old, are offered by all provinces and territories with the exception of Prince Edward Island, where kindergarten for five-year-old is considered as a basic part of the elementary programme and is compulsory. The intensity of the programmes also varies, with full-day and half-day programmes, depending on the school board. Ontario provides "junior kindergarten" for four to five years and "senior kindergarten" for five to six years. Ontario provides a full day

of learning to four- and five- year-old in nearly 600 schools, as a part of the province's plan to build a stronger school system and a well-educated workforce. The program will be offered in almost 800 schools in 2011 (OMoE, 2010c).

Table 4

Comparison of the Education Systems of Turkey, Canada and Ontario in Terms of Schooling—Primary Education

Primary education		
Turkey	Canada	Ontario
Involves the education and training of children in the age group of six to 14. Compulsory for all citizens and is free at State schools. Primary education institutions are schools that provide eight years of uninterrupted education.	Involves the education and training of children in the age group of six to 14. Compulsory for all citizens and is free at State schools. In most jurisdictions, elementary schools cover six to eight years of schooling. The point of transition from elementary to secondary school varies from one jurisdiction to another, and even within a particular jurisdiction.	Involves the education and training of children in the age group of six to 14. Compulsory for all citizens and is free at State schools. School structure may vary within the Ontario. Elementary schools provide junior kindergarten and kindergarten programs for children aged four and five, and programs for Grades one through eight.

As shown in Table 4, in Turkey, Canada and Ontario primary education is compulsory. In Turkey, primary education institutions are schools that provide eight years of uninterrupted education (MoNE, 2010a). In Canada, most jurisdictions and elementary schools cover six to eight years of schooling. The point of transition from elementary to secondary school varies from one jurisdiction to another, and even within a particular jurisdiction. Some school boards break up the elementary-secondary continuum into schools that group together, for example, kindergarten to Grade six, Grades seven to nine (junior high), and Grades ten to 12 (senior high) (UNESCO, 2010a). School structure may vary within the Ontario. Some schools involve just grades K-6 (elementary school) while some of them have also seventh to eighth (middle school) grades. Some of them can be structured as grades only six-seven-eight or just seven-eight (middle grades). There are two publicly funded school systems, public and Roman Catholic, in addition to private and independent elementary and secondary schools throughout the province. There is a big difference in the schooling structure of the compared countries. For Turkey, there is a unique structure of schooling overall the country, for Canada and Ontario, structure of the schooling varies.

Table 5 shows that while secondary education is compulsory for Canada and Ontario, it is not for Turkey. Secondary education level in the Turkish education system encloses all general, vocational and technical education institutions offering minimum four-year education. Secondary education comprises of high schools with four years of education and implementing various curricula. It is handled in two categories as general secondary education and vocational-technical secondary education (EURYDICE, 2010). In Canada, generally secondary education programmes include ninth and 12th grades. It is very difficult to make generalization for school structures of secondary education in Canada. A great variety of programmes, vocational (job training) as well as academic, are offered at the secondary level, usually within the same school. Canada has generally moved away from separate secondary institutions for vocational or work-related training and academic or university preparatoy streams. Vocational courses are typically offered during the last two years of secondary school, though some specialization courses may be taken earlier. Short programmes preparing students to practice various trades are also offered, for students who do not wish to prolong their studies or who do not

want to obtain specialized vocational training. The first two years at the secondary level usually offer a core of compulsory subjects supplemented by some optional subjects. In the final two years, there are fewer compulsory subjects so that students can choose more optional courses in specialized programmes that prepare them either to enter the job market or meet the entrance requirements of the postsecondary college, university or institution of their choices. Students who pass the required number of both compulsory and optional courses graduate with a secondary school diploma.

Table 5

Comparison of the Education Systems of Turkey, Canada, and Ontario in Terms of Schooling—Secondary Education

Secondary education		
Turkey	Canada	Ontario
Secondary education schools last minimum four-year including ninth and 12th grades. Free but not compulsory in state schools. Handled in two categories as general secondary education and vocational-technical secondary education. Secondary schools named as "high schools". General Secondary Education Instutions: General High Schools, Science High Schools, Anadolu High Schools, Anadolu Teacher High Schools, Social Sciences High Schools, Fine Arts High Schools and Sport High Schools; Vocational-Technical secondary education Institutions: Technical and Industrial Vocational High School, Girls Technical and Vocational High School, Hotel and Tourism Vocational High School, Commerce Vocational High School Imam-Hatip Vocational High School, Special Education Vocational High School, Health Vocational High School, Multi-programed High School, Vocational and Technical Training Centers.	After six to eight years of elementary education, pupils proceed to a secondary education programme which includes ninth and 12th grades. Compulsory for all citizens and is free at State schools It is difficult to make generalization for school structure. Grade system for the schools can vary in jurisdictions, even in the same province. Secondary schools named as high schools or secondary schools. A great variety of programmes, vocational (job training) as well as academic, are offered at the secondary level, usually within the same school. Canada has generally moved away from separate secondary institutions for vocational or work-related training and academic or university preparatoy streams. Vocational courses are typically offered during the last two years of secondary school, though some specialization courses may be taken earlier. The first two years at the secondary level usually offer a core of compulsory subjects supplemented by some optional subjects. In the final two years, there are fewer compulsory subjects so that students can choose more optional courses in specialized programmes that prepare them either to enter the job market or meet the entrance requirements of the postsecondary college, university or institution of their choice.	Covers the education of after elementary schooling and includes ninth and 12th grades. Compulsory for all citizens and is free at State schools Grade system in schooling varies for the schools in Ontario. Secondary schools named as high schools or secondary schools. A great variety of programmes, vocational (job training) as well as academic, are offered at the secondary level, usually within the same school. There are three categories of secondary school courses: academic, applied and locally developed compulsory courses. Students must complete 30 credits during the four-year secondary school programme, 18 compulsory and 12 optional. They must also pass the Ontario Secondary School Literacy Test in order to graduate. Students must complete six Ontario academic credit courses in order to be admitted to a university programme. This can be accomplished during the four-year secondary school programme, or during an additional year after completion of Grade 12.

In Ontario, there are three categories of secondary school courses: academic, applied and locally developed compulsory courses. Students pursuing academic courses are generally thought to be destined for post-secondary studies at a university. Those pursuing applied, are generally thought to be destined for post-secondary studies at a college or in an apprenticeship program. Students must complete 30 credits during the four-year secondary school programme, 18 compulsory and 12 optional. They must also pass the Ontario secondary school literacy test in order to graduate. Students must complete six Ontario academic credit courses in order to be admitted to a university programme. This can be accomplished during the four-year secondary school programme, or during an additional year after completion of Grade 12 (UNESCO, 2010a).

In Turkey, the ninth grade in vocational and technical upper secondary education institutions is common in all branches. The pupils are separated to selected branch curriculum in the tenth grade and field curriculum in 11th grade. The practical training of the students attending to vocational and technical upper secondary education institutions is conducted in real work and servicing environment according to the provisions of Vocational Education Law. The education is conducted as theoretical education in schools for two days in a week and practical training in enterprises for three days in a week. In the senior class, the pupils attending to practical training in enterprises are also introduced to business life. For graduation from a secondary school in Turkey, there is no extra test like in the case of Ontario. Also in Turkey, no educational stage or school type exists between secondary education and higher education.

Table 6

Comparison of the Education Systems of Turkey, Canada and Ontario in Terms of Schooling—Post-secondary Education

Post-secondary education		
Turkey	Canada	Ontario
Higher Education Council administrates all higher education institutions. Available in both government-supported and private institutions. Higher education is provided by universities, high technology institutes, higher vocational schools and other off-university higher education institutions (higher police and military schools and academies, advanced technology institutes and conservatories). Graduates of vocational and technical secondary education institutions enroll to the vocational higher education institutions considered sequel or proximate to the graduated branch free of examination, if desired. There are totally 166 higher education institutions in Turkey.	There is no unique national body in the country for administration of postsecondary education institutions. Available in both government-supported and private institutions, which offer degrees, diplomas and certificates. Postsecondary education is provided by universities, colleges or programmes offered by different education institutions. Universities usually offer undergraduate (bachelor's) and graduate (master's and doctoral) programmes. The term "college" in Canada refers to career-oriented post-secondary institutions. University degrees and applied degrees are offered in some colleges and institutes, and others provide university transfer programs. Canada has 163 recognized public and private universities and 183 recognized public colleges and institutes including those granting applied and bachelor's degrees.	The Minister of Training, Colleges and Universities is responsible for the administration of laws relating to postsecondary education and skills training. Available in both government-supported and private institutions, which offer degrees, diplomas, certificates. Postsecondary education provided by universities, colleges or programmes offered by other educational institutions. The term "college" in Ontario refers to career-oriented post-secondary institutions. They issue diplomas and certificates, unlike universities which issue degrees, e.g., BA, BSc and graduate degrees. Colleges offer certificate programs, which take one year or less, diploma programs, which take two or three years, apprenticeship and certification programs for skilled trades, such as a carpenter, chef, or welder and programs that lead to a bachelor degree. Some programs offered with universities can give a degree and a diploma. Universities generally issue degrees, e.g., BA, BSc and graduate degrees with mostly theoretical courses and some of them also have applied courses. There are 19 universities and 24 colleges of applied arts and technology,

As shown in Table 6, in Turkey, higher education system consists of universities, high technology institutes, higher vocational schools and other off-university higher education institutions (higher police and military schools and academies, advanced technology institutes and conservatories) (EURYDICE, 2010). In Canada and Ontario, postsecondary education is provided by universities, colleges or programmes offered by different education institutions (UNESCO, 2010a). In Turkey, Canada and Ontario post-secondary education differs in structure. Although in Turkey, Higher Education Council (Website http://www.yok.gov.tr/en/) administrates all higher education institutions, in Canada, there is no unique national body for administration of postsecondary education instructions. In Ontario, The Minister of Training, Colleges and Universities (retrieved from http://www.edu.gov.on.ca/eng/tcu/) is responsible for the administration of laws relating to postsecondary

education and skills training. In Turkey, on behalf of the Council, the Higher Education Supervisory Board supervises and controls the universities, the units attached to them, and the teaching staff and their activities. The Centre (ÖSYM Student Selection and Placement), established in 1974 and affiliated to the Council of Higher Education in 1981, is primarily concerned with the selection and placement of students in higher education programmes. The ÖSYM also offers services to higher education institutions for the administering of examinations, which are either inter-university in nature or being held in a large scale (UNESCO, 2010b). Graduates of vocational and technical secondary education institutions enroll to the vocational higher education institutions considered sequel or proximate to the graduated branch free of examination, if desired (EURYDICE, 2010).

In Canada, colleges, such as technical and vocational institutions, community colleges, cégeps and other institutes of technology, offer programmes for continuing education and developing skills for careers in business, the applied arts, technology, social services and some health sciences. Programmes vary in length from six months to three years. There are also private vocational or job-training colleges in some provinces. In general, colleges award diplomas or certificates only; they do not award academic degrees. The term "college" in Ontario refers to career-oriented post-secondary institutions. They issue diplomas and certificates, unlike universities which issue degrees, e.g., BA, BSc and graduate degrees (UNESCO, 2010a).

In Turkey, the number of the higher education instructions is 166, 102 of which are state universities, 52 have foundation status and 12 are vocational schools (GDHE (General Directorate for Higher Education), 2010). Canada has 163 recognized public and private universities and 183 recognized public colleges and institutes. That is totally 346 postsecondary education institutes. There are 19 universities and 24 colleges of applied arts and technology in Ontario, totally 43 postsecondary education institutes (CMEC, 2008). When we look at the population of the countries, Turkey's population is almost 2.3 times of Canada's. If we consider this fact, it can be said that the numbers of Turkey's higher education institutes is very less comparing to Canada's. But, it should be noted that in Turkey, new higher education institutions have been building and the number is increasing every year.

Results and Discussion

When the findings of document analysis are evaluated at the end of the research, it is observed that Turkish and Canadian (Ontario) overall education systems have major differences, although there a few similarities. The similarities can be summarized as follow:

(1) In both of the countries' general goals, educated citizenry is a dominant feature;

(2) Education is free in State schools;

(3) For both of the countries, primary schooling is compulsory;

(4) Completeness rate of a full course of primary for both countries are close each other. For Canada gross intake rate to last grade of primary is 96% and for Turkey it is 93% (UNESCO, 2010c).

It is noticed that the structural differences of educational administrations lead some differences on the implementation of education. According to the results of this study, the similarities are fewer than the differences. However, these similarities form the foundation of the education system. So, it can be easier for Turkey to develop her education level. The main differences in terms of the general goals of the educational systems, the structures of the administrations and the school organization can be summarized as follow:

(1) The general goals of the Turkish education system are stated with explicit expressions, with very

detailed sentences, while the goals of Canada's and Ontario's education system have more general statements;

(2) In Turkey, administration of education is central and it is constructed in common standards and benchmarks. In Canada, administration of education is provincial. Although in Canadian, education common standards are also important, there is more focus on the provincial and institutional administration and also interests and potential of each student are very important. In federal systems, major differences exist among provinces in the structure and contents of education. In Canada, a 1992 report commissioned by the Economic Council made explicit comparisons across both countries and provinces. The report noted wide variations in available resources for education in different provinces and recommended measures to promote greater coherence in systems of education (Bray, 2007);

(3) Turkey is a developing country, so education policy is searching for the best. The schooling rate for pre-primary education has reached 38.55% in the academic year of 2009-2010 (MoNE, 2010b), while it was 33% in the academic year of 2008-2009 and 11% in 2003. More strategies have been developed to expand pre-primary education and increase the quality of educational programs (MoNE, 2008). Recent data showed that at a pan-Canadian level, 95% of five-year-old attended pre-elementary or elementary school (UNESCO, 2010a) in Canada. Last years, in Turkey studies have been done for compulsory education in the pre-primary education. The MoNE is planning for compulsory education all over the country in the pre-primary education for 2013-2014 education years;

(4) In Turkey, secondary education is not compulsory yet, although it is compulsory in Canada. There are continuing studies for that in Turkey. At the 18th General Assembly of the National Education Council (November 1-5, 2010), implementation of compulsory education to 13 years, including one year of pre-school education, in the form of 1 + 4 + 4 + 4 model, was adopted by a majority vote (MoNE, 2010c; CNNTurk, 2010);

(5) In Turkey, secondary schools handled in two categories as general secondary education and vocational-technical secondary education. Canada has generally moved away from separate secondary institutions, it has different programs in the same secondary schools. It can be another study to examine these programs. The society related courses of secondary schools in Canada are also interesting;

(6) In Canada, vocational education is very popular and individuals have a chance of possessing a good profession even if they could not go to a university. In Turkey, vocational education needs to be improved. In one aspect, the revival of the country's economy is directly related to the development of vocational education. The young people who could not go to university should be directed to take vocational education in the early period of their life. So that, these people are trained as technical staff and can be employed in the industrial field. In this way, the unemployment rate could be reduced and the money spent on education could be gained again as trained people in the country's economy. To heal the vocational education in Turkey, it is recommended that a detailed research should be done and vocational education in Canada can be a model for Turkey;

(7) In Turkey, prospective university students have to take university entrance exam which is applied centrally by OSYM. In Canada, there is not a central exam for cross-country;

(8) If the populations of the countries are compared, Turkey's population is almost 2.3 times of Canada's.

The researcher stayed in Ottawa, ON and Canada for one year between the year of 2004 and 2005. During this period, she found an opportunity to make observations at a public school and audited the science and technology classes of sixth and seventh grades. She was able to observe the one-to-one differences of both countries' classrooms. In her Ph.D. theses (Güven, 2009), she compared the science education systems of Turkey and Canada, and science and technology programs of Turkey and Ontario.

From her observation, it can be derived (Güven, 2009):

(1) The population of Canada, according to Turkey, is not much. And, this increases the quality of schools in Canada. Because, the number of the students in the classrooms in Turkey is much higher than the ones in Canada (about 38 in Turkey, while 28 in Canada);

(2) The quality of the equipment of public schools in Canada is not similar to the public schools in Turkey. The public schools in Turkey have less equipment and visual material;

(3) Generally, there are classrooms for the courses in Canada, while there are only classrooms for the students in Turkey. The teachers have their own classrooms in Canada, so they can conduct the related activities better, such as experiments. These classrooms have many tools to make the experiments more attractive. Additionally, the teacher can use this classroom as his/her office and prepare the course materials much better. In Turkey, some public schools began to construct this type of classrooms, but they do not have enough material in yet. It is recommended that Turkish schools should increase the number of this kind of classrooms with enough equipment in it.

In the last years, some development and improvement efforts have been attempted in the education system of Turkey (Bulut, 2007). For example, with the implementation of eight-year compulsory education in 1997, the education system has been restructured and education programmes for primary education, general secondary education, vocational secondary education, vocational courses and private schools and institutions have been reorganised (UNICEF (United Nations International Children's Emergency Fund), 2010). New curricula for primary and secondary schools have been developed and are being implemented for primary and secondary schools with ongoing changes since 2004 in Turkey (Bulut, 2007). Although these are good progresses for Turkey, there are continuing problems in education. UNICEF (UNICEF, 2010) declared in the web page about Turkey that: "Turkey is one of the world's fastest-growing economies, but the benefits are not shared by all". This case is important if the subject is education. The quality of education is directly relational to the social and economical levels of the countries. So, the budget for the public education should be increased.

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A Comparison of Educational Systems of Turkey, Malta, Ireland, Spain, Sweden, Portugal, Finland, Greece, Belgium, the Netherlands and Denmark*

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Managing people requires ongoing living in a harmony and to educate citizens who would support this status. It is not easy to continue the existence of management which can perform different cultures. The different management style is different educational systems. The management style also directly affects the country's educational philosophy. Countries have differences in respect to economic, social and educational boundaries. In addition, globalization affects countries' management styles. Thus, governments of different cultures and educational systems need to recognize their own education system to compete with the world. In this study, Malta, Ireland, Spain, Sweden, Portugal, Finland, Greece, Belgium, the Netherlands, Denmark and Turkey, of which the educational systems structuring, financing, training programs, the school principal to choose the format of formal education objectives, admission requirements and funding are compared. In this study, education and training related to different education system managers will be introduced, and it is intended to gain different perspectives.

Keywords: educational system, management, comparison, principal

Introduction

It is not possible to isolate a country's education system from its social, political, economic and cultural structure. Therefore, it is possible to say that countries' educational systems differentiate according to their economic and social conditions. In addition, coherence of the countries educational procedures, political understanding and legislation with the general educational principles are important for educational activities. Besides, holding instructional purposes with the scientific developments together is of great importance in terms of consistency in educational systems.

Similarly, educational management activities have far-reaching consequences throughout the societies, as it is a kind of global enterprise. Educational management systems include many issues, such as setting a suitable organizational structure, planning educational finance, curriculum creation, evaluation, training and employee appointment criteria. Surely, it is impossible to take these configurations regardless of the countries' political, economic and cultural characteristics. For example, political structure determines forms of educational organizations at the regional, local and school levels of the countries. Another example is that

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Belgium's federal management structure has led to the creation of three different Ministries of Education. Similarly, Finland education system has six ministries at six states, while some countries' education systems even have not any regional-level management structuring.

In this study, European Community countries' educational systems, which are at the highest levels of democratic and economic development, and Turkey educational system, which has tried to reach democratic and economic developmental achievements, are to be compared. After a review of the literature, this study showed that examined countries' educational systems are mostly different according to their economic, political and cultural characteristics.

Table 1 shows the differences of the educational structures among the examined countries, which are Malta, Ireland, Spain, Sweden, Portugal, Finland, Greece, Belgium, the Netherlands, Denmark and Turkey, at the central, regional, local and school levels of educational management systems. As Table 1 demonstrates, organizations and functioning of these structures and levels of participation at decision-making process are varying.

The name "national" is prominently labeled in Turkey's and Greece's Ministry of Educations. Besides, school-level of management in Turkish and Greek educational systems has least effect on the other countries' systems. On the other hand, the total quality management and performance evaluation studies directed by school principals and vice principals lead to participation of all educational staff in the management system at schools in Turkey. Nevertheless, it is difficult to say that the school-level decision-making participation has been implementing successfully in practice for years in Turkey. Moreover, the local authorities have almost no effect on educational management system which is highly centralized in Turkey.

Table 1

Educational Structures of the Countries at the Central, Regional, Local and School Levels

	Central level	Regional level	Local level	School level
Malta	Ministry of Education	Have education districts.	Local council has limited effect on educational management system.	School council (assigned chairman, school principal, three teachers and three parents).
Spain	Ministry of Education and Science	Autonomous communities have their additional rules along with the national standards. There is an agency to coordinate these communities.	No any municipal level administrative unit for educational activities. But education related duties, such as restoration of educational institutions are fulfilled.	Educational institutions have organizational, pedagogical and economic autonomy. School council, teachers' board and management team.
Ireland	Ministry of Education and Science	There is not any educational administrative unit at the regional level.	Dioceses affect educational administrational activities.	Administrative board (stakeholders, parents, teachers and priests).
Sweden[1]	Ministry of Education and Research	There is not any educational administrative unit at the regional level, but there is a central level management agent.	Municipalities have great autonomy related to educational activities. Municipality council assigns committees for educational management[2].	School principals manage schools through work plan with municipality[3].

[1] There are four Educational Ministries, and two ministers in Sweden.

[2] All municipalities have to have a "school plan". Besides, financial, organizational, developmental, and evaluation, related aspects of the schools have to be cleared in these plans. Furthermore, strategies for goal achievements have to be stated in these plans.

[3] School principals have to have "local work plan" in line with the "national and local school plans". Teaching methods, course contexts, organization related issues have to be involved in this plan. This plan has to be done in collaboration with teachers and the other educational staff. Teachers decide educational stuff at schools. Local work plan has to clarify activities to achieve central decisions.

(Table 1 continued)

Portugal	Ministry of Education	There are five directorates of regional education.	Municipality councils work as both advisory and coordination units.	Schools have autonomy for strategic, administrative, financial and organizational decision-making[4].
Finland	Ministry of Education	Each state has its own Ministry of Education and Culture.	Most of the compulsory education institutions are administered by local level authorities and municipality committees.	Autonomy boundaries for the schools are decided by local level authorities.
Greek	Ministry of Education and Culture	There is not any educational administrative unit at the regional level.	Governors manage and coordinate schools.	Schools are administrated by school principals, vice school principals and teachers.
Belgium	Not any national level Ministry of Education	Each community has its own Ministry of Education for governance of educational institutions.	Public schools are governed by local authorities, and the others are administered by their own directories.	Schools are administrated by the school principals, who are assigned by the school boards.
Netherlands	Ministry of Education, Culture and Science	There is a province level educational governance structure.	Province level educational units govern all managerial and financial matters.	Schools are administrated by school boards, who can assign school principals or vice school principals.
Denmark	Ministry of National Education	Ministry organize course plan frame.	Local authorities adapt the course plan frame to the local levels.	School principal, school board, teachers' board and students' board manage school in mutual understanding.
Turkey	Ministry of National Education	There is not any educational administrative unit at the regional level.	There are provincial and district national education directorates.	Schools are administrated by school principals.

Finance

Schools are financed by government in Malta, Ireland and Portugal. Regional authorities provide 83% of the total funding, while the government provides 12% and the local authorities provide 5% for the education system in Spain. Schools are funded by both municipalities and the government in Sweden. Besides, in 2002, 85.1% of the pupils attended the public primary and first stage of secondary schools, which were funded by public, while 14.9% of the pupils attended private schools, 85% of which were funded by the government in Denmark. Responsibility for funding of schools is shared by the state and local officials in Finland. In addition, proportion of government funding is 57% for primary and secondary education, while municipalities fund around 43%. Besides, 93.55% of the pupils attended public schools and 6.45% attended private school. Finally, 93.55% of the pupils attended public schools, while 6.45% enrolled at private schools in the academic year from 2002 to 2003.

Curriculum

There are differences in curriculum instruction and development among the countries' educational systems. While all countries' educational systems have the national core syllabus, schools, teachers and local authorities have autonomous for curriculum development in some nations. For instance, curriculum frame is constructed at the national level in Spain educational system. Moreover, schools and autonomy groups can add courses they need along with the national curriculum frame. Similarly, municipalities and schools have the right of decision-making about curriculum development and making school work plans in Swedish educational system. On the other hand, Ministry of National Education and Ministry of Religious Affairs have responsibilities for

[4] School Board, Pedagogy Unit, and Management Unit are school level administrators in Portugal.

constructing curriculum and implementing regulations into the curriculum activities in Greece.

Employment of School Principal

All countries have different employment processes for hiring school principals. A person has to graduate from educational administration department of a university and has four-year vice school principal experience to apply for school principalship in Malta. Similarly, someone should have five-year teaching experience and school management education degree to apply for school principalship in Spain. Besides, schools can participate in decision-making process for hiring school principals in Spain. Teachers, school staff and educational authorities can participate to decision-making process commonly for recruiting school principals. Similarly, school principals are to be appointed by school management board in Portugal. A person should have five-year teaching experience and school management education degree to apply for school principalship in Portugal. Besides, having five-year teaching experience and degree of school management education are two prerequisites to apply for school principalship in Ireland. As the schools are managed democratically, a principal, school board, teachers' board and students' board manage the schools commonly in Denmark. In addition, the school board that is consisted of five to seven parents, two stakeholders and two senior teachers can control the schools in Denmark.

In Turkey, school principals are to be appointed by the Ministry of National Education. A person should have at least two-year school management experience for applying school principalship in Turkey. This period differs from two to four years. When compared to the other countries, ignorance of educational management degree is a main drawback for appointing school principals in Turkish educational management system.

Pre-school Education

Enrollment

While it is not compulsory, children attendance rate of pre-school education is high in European countries.

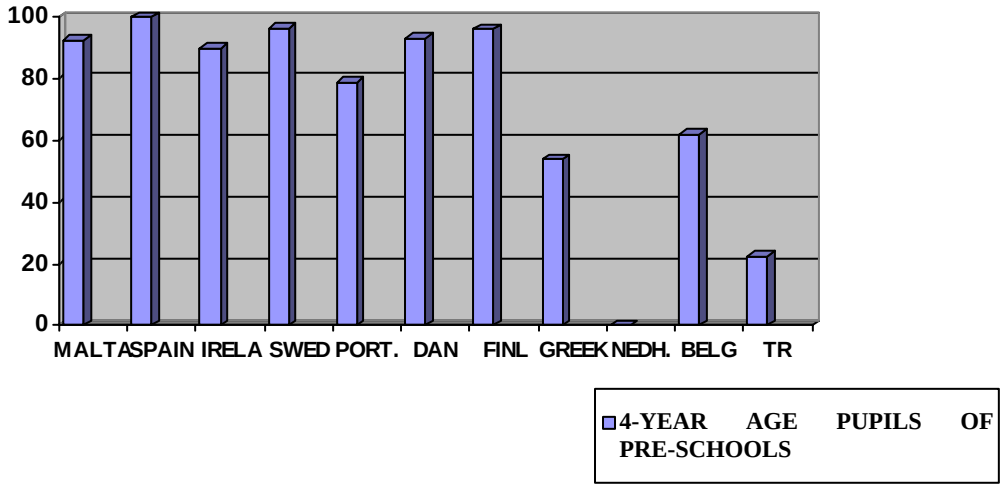

Figure 1. Percentages of aged four pupil enrolment to pre-school education.

All of the four-year old children attend nursery schools in Spain, while 96.4% enroll these schools in Sweden and 92.6% attend the schools in Malta. Besides, 93% of the four-year old children attend nursery schools in Denmark and 96% enroll the schools in Finland. In addition, 90% of the four-year old children attend nursery schools in Ireland and 78.7% enroll the schools in Portugal. On the other hand, 62% of the

four-year old children attend nursery schools in Belgium, while 22.36% enroll these schools in Turkey. Finally, the Netherlands has not pre-school level in the education system. When it is compared, Turkey has the least rate of pre-school enrollment among the other European countries.

Goals

The current educational systems are constructed around the goals of developing children with cognitive, emotional, social and physical aspects. Goals of pre-school education prioritize the children who grow up in under developed regions in Turkey and Portugal. On the other hand, "public interest" is considered in Ireland pre-school education goals. Besides, goals of pre-school education tend to protect equal opportunities in education in Finland. In addition, giving children sense of independence and regard is stressed in Spain and Malta pre-school education goals. While pre-school education objectives categorized as cognitive, social, moral and physical developments in Malta and Belgium, religious development is considered in Malta and Greece. Furthermore, compatible, balanced, self-confident, fit, esthetic and multidimentional developments are emphasized in Greece goals of pre-school education system (see Table 2).

Table 2

Goals of Pre-school Education

	Pre-school education goals
Turkey	1. To develop children with cognitive, emotional, social and physical aspects. 2. To prepare children to compulsory education. 3. To provide good growing environment for children who grow up in under developed regions. 4. To teach children speaking Turkish correctly.
Denmark	1. To games and education are combined at these schools. 2. To children learn alphabet and rhyme, sing songs and play games. 3. To giving children ideas about compulsory, education is aimed in these schools.
Belgium	1. To prepare children for society and compulsory education. 2. To develop children with cognitive, emotional, social and physical aspects.
Netherlands	Pre-school education regulation was repealed in August 1985.
Greece	To help compatible, balanced, self-confident, fit, esthetic and multidimensional developments for children.
Finland	1. To prepare children to compulsory education. 2. To enhance educational conditions of country. 3. To keep equality of opportunities in education.

Compulsory Education

Enrollment

Entering age for primary education changes five to seven years old in the examined countries (see Figure 2). The Netherlands and Malta primary education systems have the least starting points with the five years old pupils, while Sweden, Spain, Finland, Belgium and Turkey primary education systems have higher entering age levels with the seven years old. On the other hand, six years pupils can enter primary schools with their parents' demands in Sweden. In addition, six year-old students enroll the compulsory education in Spain, Ireland, Greece and Portugal.

Goals

Goals of Malta compulsory education system emphasize "communication and information technologies with religious education", while "foreign language" is considered in goals of Portugal and Malta compulsory education systems. Besides, goals of Greece compulsory education system tend to develop moral, religious,

national, humanistic and esthetic values. In addition, goals of Finland compulsory education system aim to educate responsible, independent, creative, social and peaceable citizens. Finally, "public interest" and "educating good citizens" are emphasized in goals of Turkish, Irish and Swedish compulsory education systems. Only in the goals of Sweden compulsory education system emphasize "gaining democratic values and family collaboration" for the students. Besides, "national values" are regarded in the goals of Portugal and Turkey compulsory education systems (see Table 3).

Duration

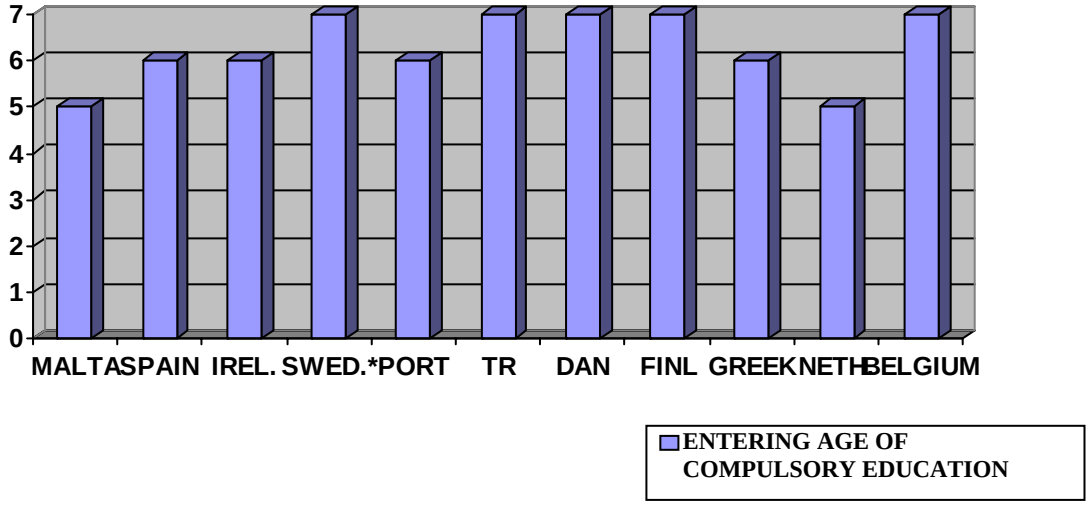

Figure 2. Ages of entering compulsory education.

Table 3

Goals of Compulsory Education

	Compulsory education goals
Turkey	1. To develop basic information, abilities, behaviors and habits of children for being good citizens; 2. Moreover, To develop students' national morality; 3. To train children according to their interests and abilities, prepare them for upper education.
Denmark	1. To develop students' knowledge, skills, studying methods and forms of expressions, collaboration with parents; Thus, students' personality may be developed in multi-directional manner; 2. To provide convenient conditions for students to develop students' understanding, thinking and learning motivation to do activities confidently; 3. To teach students Danish culture and contribute their understanding to be tolerant against other cultures. Prepare students for public decision-making, joint responsibility, rights and responsibilities in a society in which freedom and public administration. Therefore, education and day life at schools should be based on freedom of mind, equality and democracy.
Belgium	1. To raise self-reliant children with strong character; 2. To make children gain skills and habits required in the process of socialization; 3. To prepare students for democratic culture contributing their civic consciousness, and understanding of multi cultural values; 4. To train individuals in their professional life. Educate self-confident children who contribute changes in society.
Netherlands	1. To educate respectful students for different ideologic and social values; 2. To contribute students' cognitive, emotional and psiko-motor development during the basic education.
Greece	1. To primary education aims students' multidirectional mental and physical development; 2. To teach students to have self-actualization. Teach ethical, religious, national, humane, aesthetic and social values to the student.
Finland	1. To teach children to carry sense of responsibility, independence, creativity, peaceful relations with people and be compatible with the Finnish society; 2. To set good relationship between school and parents.

Kinds of Schools

Duration of the schools is changed between eight and eleven years (see Figure 3). In almost all countries, Malta has the highest compulsory educational attainment levels (11 years), while Turkey has the least with the eight years primary education period. Schools types are different from public schools, to private schools, schools under the government supervision and independent private schools (see Figure 4).

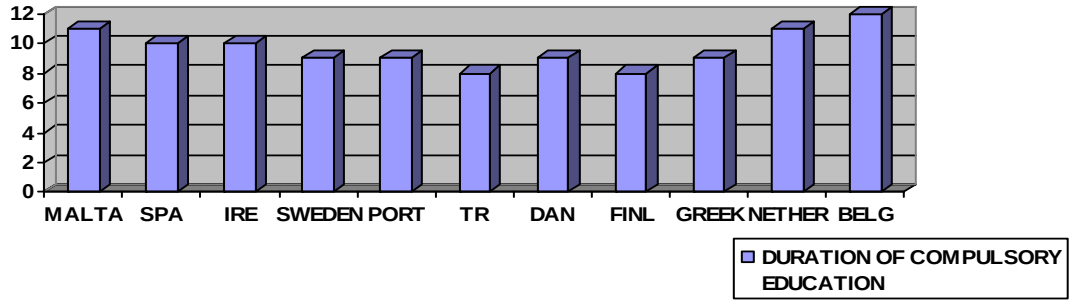

Figure 3. Duration of compulsory education.

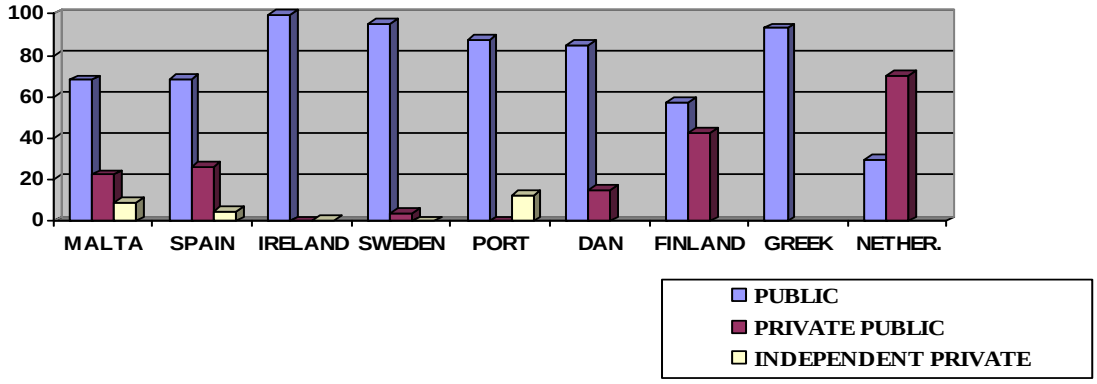

Figure 4. Rate of the schools according to the being public, private and independent.

Compulsory education systems include primary education and lower secondary level of education in the examined countries. In addition, duration of the primary education changes by countries. Duration of the primary school system is five years in Turkey, eight years in the Netherlands and six years in the other examined countries. Finally, duration of lower secondary education differs five to three years.

As it is shown in Figure 5, six to eight grades are involved in compulsory education system, namely upper primary education. Even though lower secondary education system includes schools for only girls or only boys, Malta has a coed primary education system. In addition, religious education is elective in the examined countries, while it is compulsory in Malta and Ireland.

Graduation

Graduation criteria for compulsory education are demonstrated in Table 4.

Upper Secondary Education

Enrollment

Upper secondary education differs according to the school programs and school types, and these diversity affect education period in the countries. Figure 6 indicates the starting and completing age for upper secondary education and Figure 7 shows pupil enrollment percentages of upper secondary education, after the compulsory education.

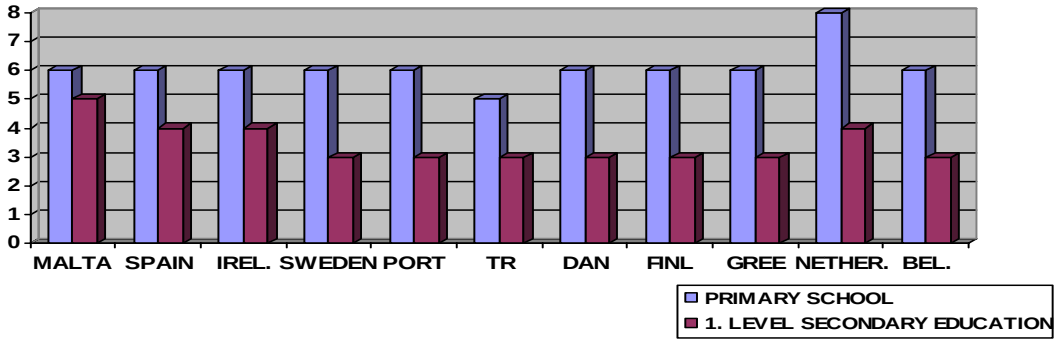

Figure 5. Primary and lower secondary education under the compulsory education.

Table 4

Graduation of Compulsory Education

Graduation criteria for compulsory education	Malta	Spain	Ireland	Sweden	Turkey
	There is a secondary education certificate exam. Degree is given by grades.	Course grades are based on graduation. Students who have high scores are given "diploma", while others get "school leaving certificate".	Junior certificate exam.	Eligibility for the national exam is given to the schools. Teacher assessment is important for graduation.	Course grades are based on graduation.
	Denmark	Finland	Greek	Nederland	Belgium
	Primary school gives proficiency, and students should pass final exam.	Students have the chance for registering any schools they want. Passing skill exam is necessary for some vocational schools entrance.	Certificate (Apolytrio Gymnasiou)	Central exam, school recommendation and parent requisition.	Teacher assessment and students' preference.

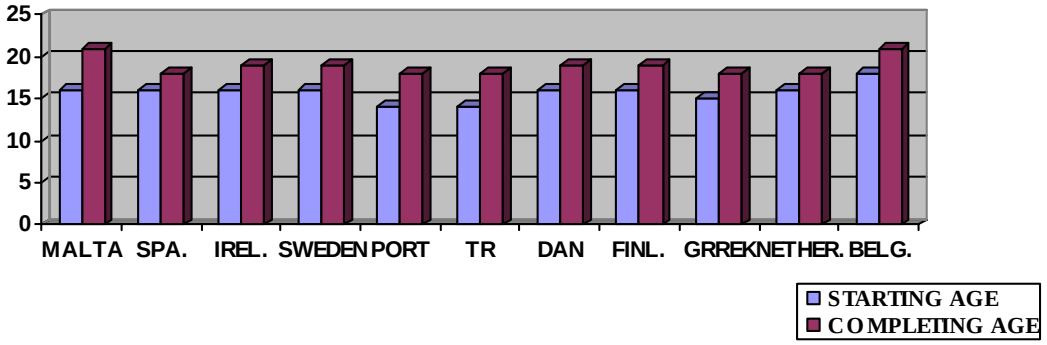

Figure 6. Starting and completing age for upper secondary education.

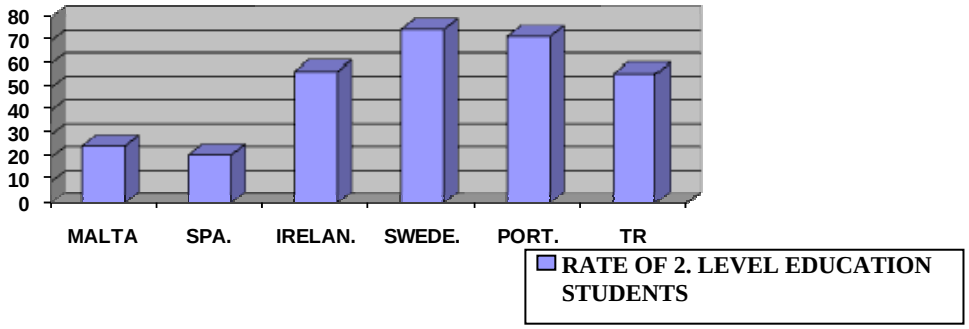

Figure 7. Pupil enrolment percentages of upper secondary education, after the compulsory education.

Admission Criteria

Admission criteria are changed according to the school types in the countries. For instance, admission requirements depend on the particular type of school concerned in Turkey. Besides, general and vocational secondary education schools offer their students direct enrolment. Furthermore, some privileged schools which are generally categorized as Anatolian schools accept their students via centrally organized examination in Turkey. On the other hand, pupils accept to the upper secondary education schools via graduation degree in Malta. Similarly, grade point average is asked for secondary education enrollment in Sweden. However, upper secondary education schools offer their students direct enrolment in Ireland.

Goals

Upper secondary education schools aim to develop students with general culture and prepare them for upper education level in all countries, except for Sweden. While "social issues" are emphasized the goals of upper secondary education in Spain and Turkey, "information technologies" are highlighted in the goals of the education in Malta. Besides, "general culture" is stressed in the goals of upper secondary education in Spain and Portugal. On the other hand, goals of Swedish upper secondary education system have not any national level objective (see Table 5).

Table 5

Goals of Upper Secondary Education

	Secondary education goals
Turkey	1. To make students gain awareness for solving personal and social issues and make them support economic and cultural developments; 2. To prepare students for both tertiary education and vocational education contributing their needs and concerns.
Denmark	1. To education emphasizes good manners, personal development and maturation; 2. To secondary education orients to both labor market and higher education.
Belgium	Secondary education stresses higher education, academic and vocational training.
Netherlands	——
Greece	Second education emphasizes understanding of the society, choosing the right academic career, supporting economic and cultural development.
Finland	——

Finance

While poor students are privileged from payment, pupils have to pay symbolic fee for upper secondary education in Portugal. While upper secondary education is free for all students, pupils have to buy course books in Malta, Ireland, Spain and Turkey. Besides, students do not have to pay fee for education and meal while they have to buy course books in these countries. Governments pay education grant and loan for the students in these countries. Besides, there are three types of secondary education foundations in Sweden. While pupils have to pay fee for education at independent schools, they do not have to pay it at municipality schools.

Graduation

Students gain the "leaving certificate" after the secondary education in Ireland, which is essential for university or job entrance. While there is not any "final exam", municipalities organize exams for raising grades in Sweden. There is "Matriculation Certificate Exam" in Malta. On the other hand, there is not any "final exam" in Spain, Portugal and Turkey upper secondary education.

Higher Education

Goals

There is not any tertiary education national level objective in Ireland. Universities have to have strategic

plans involving their objectives and three-year development plans, in which "developing solutions for national and world wide issues" are aimed in Portugal and Turkey. On the other hand, using information technologies to compete with global economic conditions is purposed in these plans in Malta. While universities highlight scientific research and instruction, technical schools emphasize "practice" in their strategic plans in Finland. Unlike other countries, communicating with people who work other areas is stressed in tertiary education plans in Sweden. As a result, providing proper conditions for scientific researchers and education for the students is the main mission of the universities in the all countries (see Table 6).

Table 6

Goals of Tertiary Education

	Tertiary education goals
Turkey	1. To educate students for labor markets depending on the scientific and social needs of the society; 2. To provide scientific education for different grades; 3. To conduct studies to solve scientific, technical and cultural problems; 4. To conduct studies to solve national problems and contribute the society collaboration with the government; 5. To publish results of the scientific studies; 6. To spread scientific data to the society to contribute social development.
Denmark	———
Belgium	Providing theoretical and practical education, develop and spread science in the society.
Netherlands	———
Greece	1. To take measures for effective use of qualified and scientific human capacity in Greece; 2. To providing theoretical and practical education for students to enhance their scientific, technical and artistic knowledge, and develop their vocational skills; 3. To develop students' knowledge, skills and power to contribute economic, social and cultural development of the country within a democratic view; 4. As stated in the constitution, to provide free education opportunities for students.
Finland	1. The basic mission of universities is to conduct research and provide education that is based on research; 2. The basic principle of university education is providing conditions for free and autonomous studying; 3. Students are trained by predominantly application in the vocational high schools.

Admission Criteria

Admission criteria changes according to the countries. For example, Matriculation Certificate which is given at the end of the secondary education is required to enter universities in Malta. Similarly, students are accepted by universities according to their graduation exam scores in Ireland. However, students are accepted by means of university entrance exam in Spain. In addition, students should have secondary education certificate and be successful in university entrance exam in Portugal. Besides, secondary school graduation point is asked for university entrance in Denmark. Universities select students by holding their entrance exams including two levels in Finland. But students, who want to enter university exam, have to have baccalaureate in Finland. Students, who have high-school certificate, are received by direct enrolment to the universities in the Netherlands.

Finance

Students have to pay for tertiary education in Turkey, while it is free in Malta and Ireland. Amount of the university fees changes according to the students' socio-economic conditions and type of educational programs in the countries. For instance, while tertiary education is free, students have to pay fee for Student Union in Sweden.

Conclusions

There are differences and similarities between Turkish and European Community countries' educational systems according to their economic, political and cultural characteristics. While Finland, Belgium and

Netherlands have decentralized educational management systems, both Turkish and Greek Ministries of Education are centralized pro-naming "national". Besides, schools are financed by government in Malta, Ireland and Portugal, while responsibility for funding them is shared by the states and local officials in Sweden, Spain and Finland. Frame of curriculum and activities are constructed at the national level in both Turkey and Greece, while municipalities, schools and autonomy groups participate to curriculum development process in Spain and Swedish. The rate of pre-school enrollment is higher in Spain, Sweden, Denmark, Finland, Ireland, Malta, and Portugal while Turkey has the least rate of pre-school enrollment. The Netherlands and Malta primary education systems have the least starting points. On the other hand, primary education systems in Sweden, Spain, Finland, Belgium and Turkey have higher entering age levels. As the primary education, upper secondary education system differs according to the school programs and school types among the countries. Thus, this diversity affects education period of the upper secondary education in the countries.

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The Role of Urban Primary and Secondary Schools in Minimizing Disease Outbreak Caused by Environmental Contamination: A Case of Chinhoyi, Zimbabwe

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Waste management is a major challenge facing urban councils in Zimbabwe and Chinhoyi Municipality is no exception. Lack of resources and technical and administrative know-how is hindering proper waste management. Raw sewage and industrial waste flow into streams and rivers and uncollected rubbish bins and strewn litter is a common feature in the municipal area. The city has had serious cholera outbreaks that affected adults, school children and children before school age. The primary school environmental studies syllabus and the secondary school health education syllabus have been in place, but preliminary findings indicate that these syllabi do not equip learners with knowledge and skills to combat the outbreak of diseases like cholera. The Department of Curriculum and Instruction sought to establish the role that schools play in minimizing disease outbreaks in their environments through environmental studies and health education. The case study included three primary schools and three secondary schools under the Chinhoyi Municipality. Data were collected using observation guides, questionnaires for secondary pupils and teachers, excursions, documents and interviews with primary school pupils, school heads, health inspectors and municipality officials. The data were then presented qualitatively aided by graphs and pie charts. The study indicated that school pupils were not active in waste management in the urban areas. It was also found that teachers were not making any reference to disease outbreaks during lessons on environmental studies. The teacher education programme should include a course on waste management, so as to develop in learners a positive attitude towards proper waste disposal behavior.

Keywords: waste management, environmental contamination, disease control

Introduction

Dumping of waste is a common practice everywhere in Zimbabwe and schools are no exception. Waste management is a major challenge facing urban councils in Zimbabwe and Chinhoyi Municipality has a mammoth task to meet environmental requirements in this regard. Of all environmental problems that have come into focus in Gweru, institutional solid waste management has been the slowest to develop in either direction or regulatory mechanisms (Jeri, 2006). In Chinhoyi, all forms of waste management seem not to have a regulatory mechanism (paper, raw sewerage and solid waste). Although laws for managing waste are in

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existence, they are not implemented. Foul smell and smoke linger around residential areas, raw sewage and industrial waste are being disposed into streams and rivers, undesignated dumping sites along streets and school fences are a cause for concern. The city has had cholera outbreaks since 2008 affecting adults, school children and children before school age. In this situation, the education sector appears not to have been actively involved in minimizing the outbreak of the diseases or improving waste management. It is evident that the school curriculum in both primary and secondary school comprises of subjects that have health related topics. Environmental science for primary school is an integrated subject which seeks to make pupils aware of themselves and the physical environment around them. Guidance and counseling syllabi for form one to six have topics that are meant to conscientize students on promotion of health and taking care of the environment. The invisible nature of the schools in waste management prompted by this research with an attempt to establish the role that schools play in waste disposal and minimization of disease outbreaks.

Literature Review

The past five years have been very challenging on local authorities' management systems. The challenges were a result of the unstable political situation in the country. Proceedings of the Emerging Issues in Urban Waste Management Workshop organized by Practical Action Newlands, Harare, on February 10, 2006, observed that there had been a deterioration of service delivery, such as water and sewerage reticulation systems, roads and refuse removal and equipment. Waste management is one of the most pressing challenges facing urban councils throughout Zimbabwe. Currently, more than 2.5 tones of household and industrial waste are produced per annum in urban areas, and this continues to raise annually in the absence of waste management strategies (Practical Action, 2006).

Throughout Zimbabwe, urban waste collection rates have dropped from at least 80% (mid-1990s) of the waste generated to as low as 30% in some large cities and small towns. Areas which are worst affected by erratic waste collection are low income residential areas, such as Mbare in Harare, which receive no formal waste collection services at all, and this is alluded to by Tevera et al. cited in Practical Action (2006). The same is observed in high density areas under the Chinhoyi Municipality where piles of dirt are seen along streets, school fences and raw sewerage/blockages left unattended for days or weeks on end. Residents resort to creating their own dump sites in the streets after council fails to collect refuse. The low waste collection levels and rudimentary disposal methods employed are a cause for concern because they trigger widespread illegal open dumping and rampant waste burning which threaten public health and pollute the environment (Practical Action, 2005).

In an effort to minimize environmental degradation, Zimbabwe has implemented the following measures:

(1) Draft Waste Management Strategy (2006) aimed to improve the cleanliness and restore the glamour of Zimbabwe by promoting sustainable waste management practices in all areas in the country. The strategy identifies all problem areas that make the environment dirty and unsightly, including littering, illegal and improper dumping/disposal of waste, vending, sewage problems, air pollution and overgrown vegetation on roadsides. The strategy proposes an action plan involving all stakeholders for solving these problems. This strategy in this research triggered some ways as the researchers observed that the education sector was a stakeholder and was taking a backseat in solving this societal problem;

(2) The Science and Technology Policy (2002) acknowledged that pollution of the country's environment is increasing and requires urgent attention. The policy singles out industrial waste as an adverse effect on the

environment and encourages the adoption of cleaner production technologies as a solution;

(3) The Draft National Environmental Policy (2003) emphasized that a clean and healthy environment is the right for every Zimbabwean. It calls for development of an integrated waste management strategy to address the growing problem of waste.

Through its interventions and working with communities in waste management, Environment Africa identified the following challenges inhibiting proper waste management: lack of community awareness of environmental rights as provided in legislation; lack of access to information on environmental information, poverty resulting in waste management being lowly prioritized; lack of adequate resources to expand and initiate new projects, negative attitude by communities as well as poor or non-enforcement of laws. These challenges are not only peculiar to the area of study, in which environment Africa visited, but are quite applicable to this research.

Waste generation rates in low and middle income countries reflect their socio-economic development, urbanization and industrialization. In general, urban population produces two to three times more than rural population per capita and year, according to Hogland, Visvanathan, Marques, and Manahdhar (2005). This may imply that Zimbabwe is in the category where more waste is generated in urban centers, hence need to call for all stakeholders including schools to work together in enforcing proper waste disposal practices. Significant amount of horticultural waste is generated in schools and adopting the nearest open site for dumping waste has been the easiest means of managing the waste. Canteen and vendors are also major contributors of waste in schools. Here, a good amount of plastic disposables are thrown with the leftover food, which makes resource recovery difficult. While giving a wrong notion of waste management to the students, it also increases the problem of waste. Apart from the biodegradable paper and plastic wastes, e-wastes like tube lights, bulbs, paint containers, etc., are found in the waste bins from schools as noted by Hogland and Marques (2002). Therefore, it has become indeed very essential for educational places to look into the matter and participate in the move for sustainable waste management. Schools are known for their enthusiasm in adopting various educational programmes and moving in tandem with the current wave to protect environment, these educational places are also trying to contribute their best. Few schools have set examples by initiating waste management system within their premises.

Aim of the Study

The study sought to establish the role of the school in minimizing diseases caused by environmental waste in urban areas.

Research Questions

The research questions are as follows:

(1) What is the role of the school in inculcating proper waste management behavior among pupils and communities?

(2) How is the school teaching on waste management being translated into practice?

(3) How can the teaching of waste management be strengthened to minimize disease outbreak in urban areas?

Methodology

Chinhoyi urban has eight primary schools and four secondary schools that are catered for refusing

collection by the city council. Of these, two are under Chinhoyi Municipality, two are private schools and seven are government schools with a total enrollment of 6,803 boys and 6,948 girls in the primary schools pupils and 3,622 boys and 3,729 girls in the secondary school pupils. The sample comprised 195 school pupils, 74 teachers, one environmental health officer from Chinhoyi Municipality, one environmental health management officer from EMA (Environmental Management Agency), one health officer from the MoHCW (Ministry of Health and Child Welfare) and one education specialist for the MoESAC (Ministry of Education Sport Arts and Culture). Simple random selection method using the "pick a name" technique was used to select six (three primary and three secondary) schools. The same technique was used to select the classes that provided the researchers with subjects. All selected pupils presenting in classes comprised the study pupil sample for each school (n = 124 primary, n = 71 secondary). Teachers who responded to the research instruments were selected using the census method of sampling (n = 46 primary, n = 28 secondary).

Instruments

Survey research instruments comprised interview guides, FGD (focus group discussion) guide, questionnaires and observation guides. The teachers' questionnaires sought to establish aspects of school curriculum on waste management, awareness of waste disposal practices, the role played by the school in minimizing disease outbreaks and what schools could do to improve waste management in urban centers. Pupils' questionnaires were in three parts. The first part of the questionnaires focused on environmental awareness top checking how much children were aware of disease outbreaks and their links to environmental waste management. The second part looked at how much content children learnt on disease prevention and waste management. The last sections asked questions that responded to issues of how pupils translated in class learning to practice. The teachers' questionnaires comprise three sections, i.e., curriculum content, curriculum implementation and needs assessment. Focus group discussion guides were similar to questionnaires, but these were mainly used to augment data from questionnaires. The questionnaires were pilot tested with one class and ten teachers. They were also sent to the Ministry of Education regional office for approval. The process helped to ensure the reliability and validity of the instrument.

Data Collection Procedure

Physical access to schools was obtained in two ways. Firstly, permission was sought from the MoESAC to carry out the research. After that, telephone requests were made to school heads for permission to visit the selected schools. Cognitive access was made through introductory remarks by school heads to teachers and pupils. Mixed methods of data collection were employed having noted strengths and weaknesses of the instruments that were appropriate for this study. The data were collected using questionnaires, observation and interview guides and excursions and document analysis. Primary data were collected through questionnaires from pupils and teachers. Observations, FGD and interviews were held to verify questionnaires findings. Ethical considerations were strictly adhered to by the researchers. Face to face interviews were then conducted with relevant officials to get insight into how the Chinhoyi Municipality, the EMA and the Ministry of Health were working together with the schools on waste management. Documentary analysis provided information on school curriculum, subject content and what had been taught (schemes of work and progress records).

Data Presentation

The data were presented qualitatively aided by graphs, pie charts and photos.

Presentation of Findings

The findings presented are from data collected using questionnaires, interview, observation and FGD guides as well as the document analysis. Table 1 shows the distribution of respondents according to level and gender, and Table 2 shows teachers' questionaires.

Table 1

Distribution of Respondents According to Level and Gender (n = 195 Pupils, 74 Teachers (269))

Group of respondents			
	Gender	*No.*	Percentage (%)
Pupils-primary	Females	67	34.4
	Males	57	29.2
Secondary school pupils	Females	44	22.6
	Males	27	13.8
Total No. of pupils		195	100
Teachers-primary	Females	32	43.2
	Males	14	18.9
Teachers-secondary	Females	20	27.0
	Males	8	10.8
Total No. of teachers		74	100

Note. The role of the school in inculcating proper waste management behavior among pupils and communities.

Table 2

Teachers' Questionnaires (n = 74)

What is being done			What was done during cholera outbreak			What can be done		
	No.	Percentage (%)		*No.*	Percentage (%)		*No.*	Percentage (%)
Teaching pupils to wash hands after visiting the toilet and before handling food	74	100	Emphasizing on hygienic habits e.g., washing hands, fruits and vegetables	74	100	Providing bins in each class and more bins around school premises	35	47.3
Teaching pupils to sweep and put litter in bins	74	100	Supplying clean treated water	74	100	Having common site for dump collection	20	27.0
Teaching pupils to burn litter	60	81.1	School played no role	4	5.4	Reminding pupils of good health habits	48	64.9
Providing bins	30	40.5	Giving pupils information on cholera	65	87.8	Information dissemination or awareness campaigns using drama, poetry, etc.	62	83.8
Teaching on types of diseases	74	100				Involving pupils in taking care of waste disposal	36	48.6
						Competitions on cleanliness of the environment	23	31.1
						Engaging industry in waste disposal e.g., paper manufacturers, environmentalists and business community	12	16.2

(Table 2 continued)

						Serious teaching of health issues under guidance and counseling and environmental science	49	66.2
						Teacher training to equip teachers fully on environmental management	58	78.4

From the questionnaire, findings showed that the teaching in both primary and secondary schools centered on hygiene, picking litter, sweeping and teaching types of diseases and theory on preventing the spread of contaminable diseases. Focus group discussions revealed that pupils knew contaminable diseases, as they cited dysentery, typhoid, diarrhea and cholera without hesitation. However, understanding of causes, prevention and what was actually being done by the school pupils, their teachers and administration to minimize disease outbreak were minimal. Hygienic practices carried out were washing hands after using the toilet, sweeping classrooms and picking litter in school premise. Pupils and staff members agreed that not enough was being done in the schools in promoting proper waste disposal practices. Four teachers admitted that the teaching of health topics in environmental science (primary school) and guidance and counseling (in secondary school) was not effectively done and called on heads of schools to supervise the teaching of these subjects. Speaking to the education officer on this issue, the officer alluded to the fact that teachers were not doing justice to this section and the officer planned to embark on school supervision to enforce teaching of these subject areas not only theoretically, but also practical results were required.

Table 3 revealed that in theory, pupils are taught mainly personal hygiene and keeping the school yard clean (75.8%), especially the primary school pupils and disease outbreak due to poor waste disposal systems (77.9%). Although teachers confirmed that school pupils were involved in waste management (see Figures 1 and 2), such as sweeping classrooms, it was found that only primary school teachers were consistent in monitoring the cleaning (85.7%), while secondary school teachers did not really monitor this aspect (68.8%).

Table 3

Pupils' Questionnaire Findings, on the Role of the School (n = 195)

Role played by the school(s)	*No.*	Percentage (%)
School plays no role, no teaching on waste management	37	18.9
Teaches hygienic habits—washing hands after use of toilet, before handling food, sweeping and cleaning toilets, to be smart	148	75.8
Diseases spread due to waste disposal	152	77.9
Referring sick students to hospital	38	19.4
Taught to pick litter and not to throw litter everywhere	160	82
Teachers don't care about the environment	86	44.1
What they teach is not what they/we do	129	66.1
No response	36	18.4

This result was confirmed by 44.1% of the pupils who argued that teachers did not practice what they taught and 18.9% of the pupils who also argued that teachers were not teaching them on waste management. FGD revealed that the teaching of disease outbreaks came after the cholera pandemic and most pupils were very knowledgeable on cholera but a few on other contaminable diseases. It is saddening to note that 18.9% of

the pupils alleged that schools are doing nothing about waste disposal and disease outbreaks, 66.1% of the pupils said that what is taught is not what they and their teachers do while 18.4% of pupils failed to give a response on this issue. Interviewing with officials from Chinhoyi Municipality, the Environmental Health Management Agency and the Ministry of Health indicated that they had no programmes related to waste management with schools. Observations in some schools dropped litter at school entrance, refuse dump sites along school durawalls and in the school yard (see Figure 3). Most of the litter in sight is from food outlets, as observed by OECD (2002). Bins in the classrooms were not common in the six schools visited except for two, and no bins is sight around school grounds, even the girls toilets which were sanitary bins were expected. It is indicated that little was done to enable learners to put into practice the theory learnt.

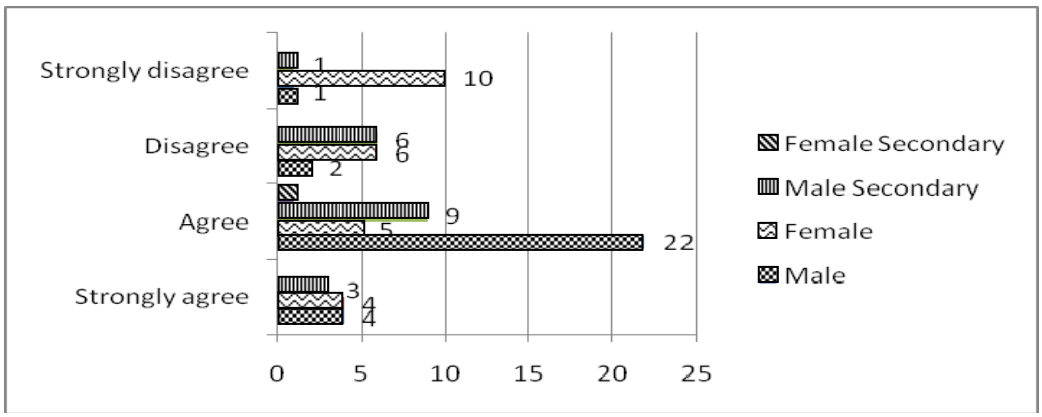

Figure 1. Toilets are kept satisfactorily clean.

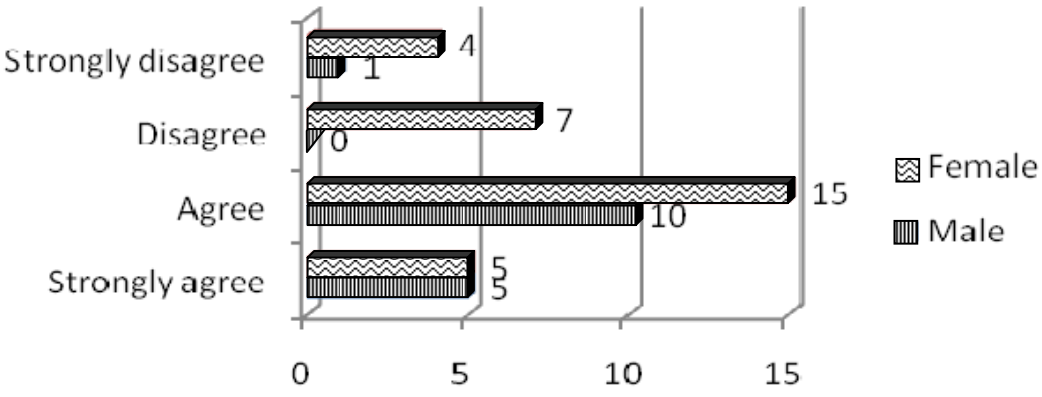

Figure 2. Pupils empty waste bins.

Teachers were asked on their knowledge of policies put in place by government to help alleviate the problem of waste and environmental pollution and 89.8% of them were not aware of the policies though they knew that they were in place. Four percent of those who responded fairly well identified the science and technology policy and the remaining 6% cited the national environmental policy. Further probing showed that the 6% were geography teachers and environmental teachers, some working with EMA on environmental awareness issues (in a low scale). Chinhoyi Municipality explained that they did not work with schools in educating pupils or the community, but had recently embarked on a clean-up operation throughout the residential areas including schools. A health official in the town council explained that they had started an inspection of schools with the aim of a competition for the cleanest school coming up in July 2010. If this

succeeds, then it would be the beginning of involving schools in waste management.

How Is the School Teaching on Waste Management Translated Into Practice?

Questionnaire findings revealed (as shown in Table 2) that very little of what is being taught has translated into practice. Document analysis showed that environmental science aims to develop an appreciation of a well managed environment, develop a positive interest in the environment. The objectives expect pupils to apply concepts and skills to improve and manage the environment. None of these aspects was given or shown by the pupils, teachers and officials or observed by the researchers. No school indicated involvement in any environmental awareness activity, club or action.

Figure 3 was taken at one of the schools and clearly showed that what was taught is not practiced.

Figure 3. A picture showing the practice of schools.

The secondary school guidance and counseling syllabi is not being implemented at all and has environmental issues to be addressed. Teachers indicated that health issues are included in various school subjects: physical education (n = 5), HIV/AIDS (Human Immune-virus/Acquired Immune Deficiency Syndrome) education (n = 26), home economics (n = 4), environmental science (n = 33) and social studies (n = 7). The study however found that teachers were aware that their specific subjects contained issues on environmental waste management: HIV/AIDS education (n = 13); health and safety (27); environmental science (n = 4); and home economics (n = 5). Students noted that they were not being taught waste management (18.9%). Teachers, however, expressed the need to be staff developed on waste management (n = 42). Areas of special need mentioned included proper waste disposal (n = 43); types of diseases related to poor waste disposal practices (n = 23); and disaster preparedness including warning signs of a disaster outbreak (n = 11). Teachers actually needed this aspect of training when they noted that environmental waste management should be mainstreamed into the present subjects (n = 30) and during assemblies by school head (n = 15).

Observations revealed high standards of hygiene being observed at two schools that containers of hand washing water are strategically positioned for pupils and coming from the toilets to wash hands. This was

highly commendable. Toilets were fairly adequate at the schools, unfortunately, water is a problem but efforts are made to store water for flashing toilets. Teaching of this aspect is theory and this makes matter abstract. Teachers revealed that they were not very conversant with waste management theories, but hygiene issues were not a problem. Lecturing such areas is not effective as compared to participatory methodologies, where learners have hands on and do the planning of their activities in waste management. The fact that some students noted that teachers do not practice what they have taught (see Table 2) is an indicator that little of what was taught is practised.

Although there were mixed opinions about how the schools were putting into practice what they taught, they were conscious of the need for adequate toilet facilities (see Figure 4). Some teachers felt that the toilets in the schools were not adequate (n = 36). Observations by researchers noted that each school had some toilets but there was no effort to look at gender population and other aspects of the toilet facilities.

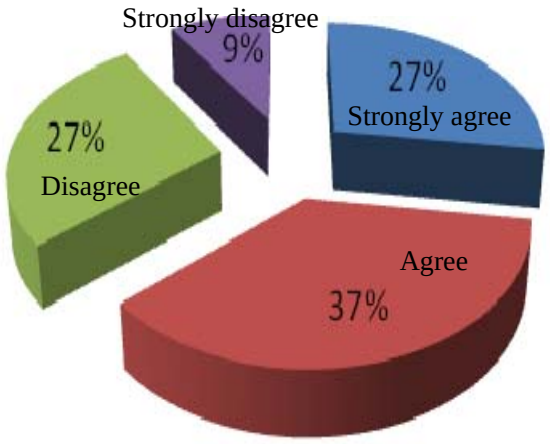

Figure 4. The school has adequate toilets.

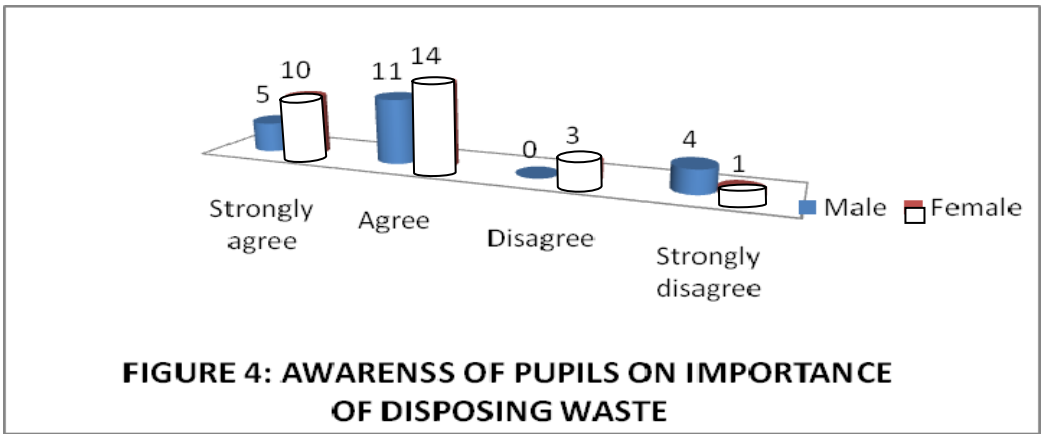

Figure 5. Awareness of pupils on importance of disposing waste.

Teachers confirmed in theory that pupils were aware of what to do with waste (see Figure 5). Teachers themselves were also aware of how to deal with waste, such as broken glasses which they (74.3%) said that they would dig a pit and through the bottles. Teachers, however, were of the opinion that broken furniture should be stored by some who felt that they should be kept under sheds (31.1%) or storerooms (20.3%), or burn it as fuel. Some believed that broken furniture should be repaired (0.08%), while the majority said that they

would burn waste paper (93%).

Recommendations

The study strongly recommends staff development or in-servicing of teachers, so that they acquire in-depth knowledge, teaching methodologies and skills in environmental issues, especially on waste management and disease control so as to transfer the knowledge and skills to pupils and communities in which they work. Workshops to conscientize educators on environmental policies, waste disposal strategies and clubs can be initiated in their schools, communities and organizations at their disposal for assistance and guidance on such matters. For example, schools need to spearhead formation of waste disposal clubs and clusters with the assistance of officials in the Ministry of Health, Municipal Council and those from the EMA. This helps communities to own the projects or clubs, hence changes mind sets of leaving waste disposal as someone else's responsibility. There is need for schools to use chemicals to clean toilets so as to prevent breeding of flies and other micro-organisms, strategically position bins around the school premises preferably, which should be opened at the top for easy throwing in of litter. Some people find it taxing to lift bin lids resulting in them throwing litter around the bin and not in the bin. Each classroom should have a bin.

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The Living Cognition Paradigm: An Application to Computational Modeling of Drivers Mental Activities*

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This paper was dedicated to the living cognition issues which concern the ability of a cognitive model to simulate human operator's mental activities, while dynamically interacting with the external environment. After introducing the theoretical foundations of this paradigm, an integrative cognitive simulation model of the driver was presented i.e., COSMODRIVE (cognitive simulation model of the driver). The central process that supports the living cognition in this model is the deployment of a cognitive schema, corresponding to the driver's mental representation of the driving situation as instantiated in the working memory. This dynamic mental model, defined as the driver's situational awareness, is used by the driver for perceptive exploration of the road scene, decision-making, anticipation and action planning, in order to interact with the road environment. This dynamic process of regulation is based on both implicit and explicit mental simulations and illustrated through an example in the last section of the paper.

Keywords: cognitive simulation, computational model, dynamic cognition, car-driving, mental representation, operative schema, implicit and explicit situational awareness

Theoretical Foundation of the Living Cognition

Although a familiar task of everyday life, car-driving is, however, a complex activity that involves every level of human cognition. Indeed, driving a car requires: (1) to select relevant information from the environment; (2) to understand the current situation and anticipate its progression in the more or less long term; (3) to take decisions in order to dynamically interact—via the vehicle—with the road environment and the other road users; and (4) to manage own resources (physical, perceptive and cognitive) in order to satisfy the time constraints of the task, inherent to the dynamic nature of the driving situation. The selective dimension of information collection is especially important as drivers cannot take in and process all the information available in the road environment. As we shall argue in this paper, this information is not selected haphazardly. It

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depends on the aims the drivers pursue, their short-term intentions (i.e., tactical goals, such as "turn left" at a crossroads) and long-term objectives (i.e., strategic goals, such as reaching their final destinations within a given time), the knowledge they possess (stemming from their previous driving experience) and the attentional resources allocated to the driving task. Information selection is the result of a complex process whose keystone is the driver's mental representation of the driving situation. Indeed, from their interaction with the road environment, drivers build mental models of the events and objects that surround them (Johnson-Laird, 1983). These mental representations are circumstantial constructions (Richard, 1990), formulated in working memory on the basis of perceived information on the one hand, and from activated permanent knowledge (stored in long-term memory) on the other. These mental structures are cognitive emergences, dynamically produced through a matching process between pre-existing operative knowledge (Ochanine, 1977) and the external information. They are formulated by and for the action and they provide interiorized models of the task (Leplat, 2005). A core function of mental representations is to support anticipation, through cognitive simulations, providing expectations of future situational status. Drivers continually update their mental representations when they carry out their activities. This dynamic process, based on both implicit and explicit mental simulations (Bellet, Bailly-Asuni, Mayenobe, & Banet, 2009), is the central focus of the "living cognition" (Bellet, 2010) as investigated in this paper. At a theoretical level, the living cognition is jointly based on three scientific traditions: (1) the cybernetics and the human information processing theories; (2) the Russian theory of activity; and (3) the ecological approach of human perception.

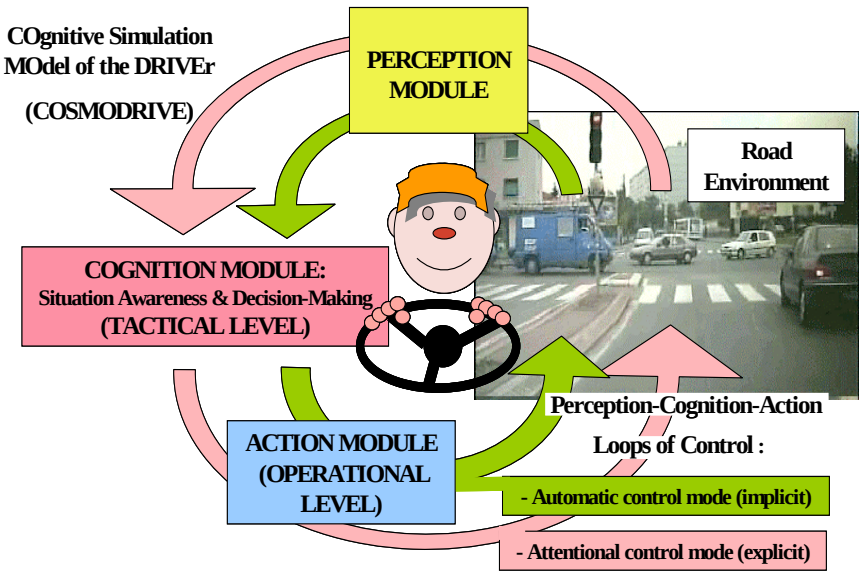

Figure 1. The car-driving activity as a dual regulation loop.

According to Wiener's (1948) cybernetics theory, human being can be defined as a self-adaptive system which regulates its interactions with the external environment through a feedback regulation mechanism. Humans' mental activities are then described as a black box owning information processing mechanisms and able to generate outputs from environmental perceptual inputs, in order to adapt itself to the situation. When this cycle repeats itself recursively, the human cognitive system perceptually assesses the effects of its action on the environment, and then determines which new action is needed to achieve the state of the surrounding world that he/she would like to reach. This iterative process will continue until the expected state-goal is

obtained. Although cybernetics has finally introduced an epistemological break with the behaviorist approach in psychology, the initial model proposed by Wiener was fully compatible with the Skinner's "S-R" approach, until the Pandora's black box was opened. However, with the development of the human information processing theory, the internal mechanisms implemented into the black box, such as mental representations elaboration, reasoning, decision-making or behavior-planning, became the new central topics of the modern cognitive sciences. Nevertheless, according to the experimental method used in laboratory for investigating cognition in well-controlled conditions, the cybernetics "loop logic" has been progressively lost in more recent researches for two main reasons. First, the experimental paradigm applied in cognitive sciences requires artificially segmenting the human cognition into several functions to be individually investigated. Moreover, maybe more critical from the living cognition point of view, in-laboratory investigation of human cognition is based on repetitive measures collected for similar artificial tasks, in similar conditions. Therefore, the story must restart after each new stimulus, as if it was a totally "new story", in order to allow the scientists to rigorously control their experiments. After each S-R sequence, the experimental task is, thus, completed, without any expected feedback effect. Consequently, by using the experimental method, cognitive sciences ended up losing the notion of "cycle", however, so important in the cybernetics through the feedback process and supporting the dynamic of the living cognition, in favor of a sequential string of information processing, from perception to action.

Like cybernetics, the Russian Theory of Activity considers human operators through their dynamic interactions with the external environment. But in this approach, activity is the starting point and the core topic of the scientific investigation of human cognition, because it is argued that activity directly structures the operator's cognitive functions. The fundamental postulate of the Theory of Activity was well summarized by Smirnov (1966) that human becomes aware of the surrounding world, by acting and by transforming it. From this point of view, human is not a passive cognitive system which undergoes the stimulus given by the external environment. She/he is an active observer, with inner intentions, able to voluntary act on the world and to modify the current situation by their own activities, in accordance with their own needs. Indeed, behind activity, there is always a need, which directs and regulates concrete activity of the subject in the objective environment (Leontiev, 1977, p. 88). Such a consideration, so essential in our everyday life as psychological subjects with needs, intents and will, has been nevertheless progressively forgotten by the modern cognitive sciences, when based on the experimental paradigm. Through laboratory experiments, inner needs and spontaneous motives disappear, as well as the dynamic "life cycle" of the natural living cognition.

The same criticism against the destructive effect of experimental method applied to human cognition study has been formulated by Neisser (1976), through his ecological approach of human perception. Neisser's work was initially based on the direct perception theory of Gibson (1979), who postulated that some invariants or affordances, corresponding to properties of the objects available in the environment, are directly perceived by the organism. By contrast with the Gibson "un-cognitive" theory of perception, Neisser admitted the existence of mental subjective functions, even if he criticized the sequential vision of cognitive processes that dominated the human information processing theory during the 1970s. In a synthetic way, Neisser considered perception, including attention, as a skilled and iterative process. Like the Russian theorists of the operative activity, he argued that human beings are not passive receivers of perceptual inputs, but that they are active in the world, in accordance with their own motives, their abilities and their expectations. His approach describes perception as a

dynamic cycle focused on the relationships between pre-existing knowledge and the human information-gathering activity. According to this perceptive cycle, the perceiver actively explored the surroundings, and then constructed a dynamic understanding of the current environment. The mental structure that supports such processes of perception, attention and categorization, was described as an active schema of the present environment, which is continually modified by the new perceptual information, and also contains anticipatory expectations. This mental schema includes a "cognitive map" of the world, and therefore, directing perceptual explorations of the environment, or preparing the mind for perception of anticipated events. It can be consequently considered as a kind of control structure of the perceptive processes (from "bottom up" information integration and processing to "top down" active exploration of the external environment).

An Integrative Model of the Car Driver

In this section, a comprehensive model of the human driver, called COSMODRIVE (cognitive simulation model of the driver) (Bellet & Tattegrain-Veste, 1999; Bellet, Bailly, Mayenobe, & Georgeon, 2007; Bellet, Mayenobe, Bornard, Gruyer, & Mathern, 2010), will be presented, which combines the several theoretical approaches presented in section 1 in an integrative way.

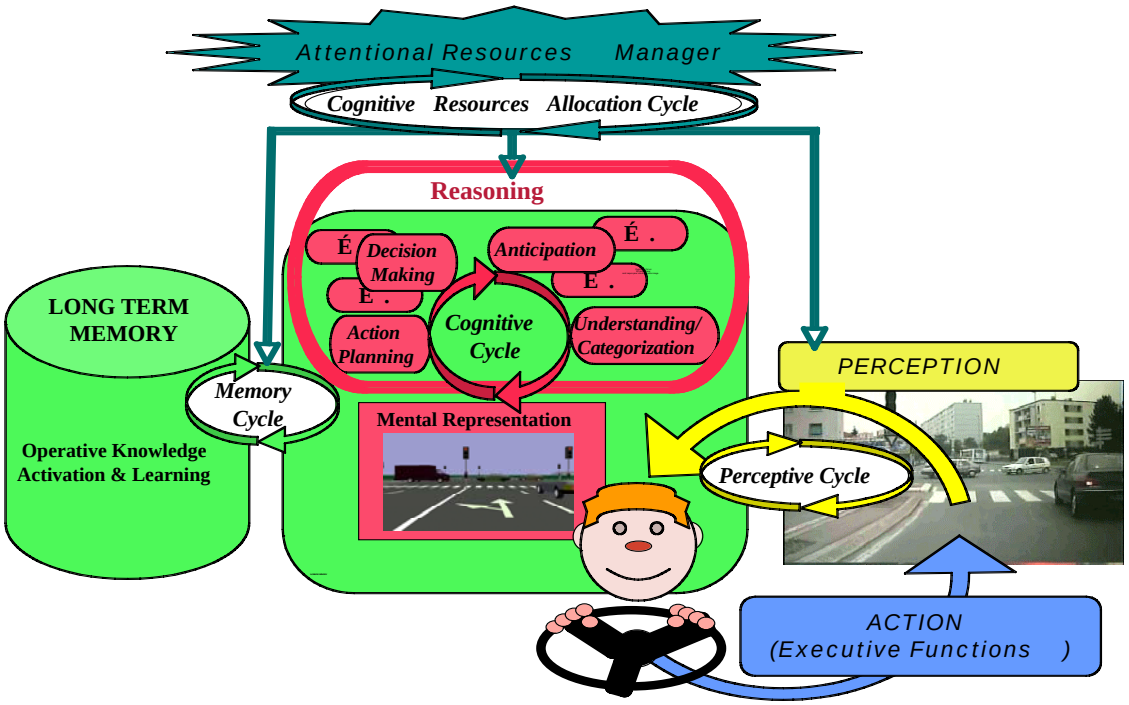

Figure 2. Cognitive architecture of COSMODRIVE.

Figure 2 provides a synthetic overview of the cognitive architecture of COSMODRIVE. The heart of the model are the drivers' mental representations of the driving environment, corresponding to the driver's situation awareness according to Endsley's (1995) definition of this concept: the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future. These mental models were built in working memory. At the tactical level (Michon, 1985), mental representations provide an ego-centered and a goal-oriented understanding of the traffic situation, including anticipations of the future changes of the current driving situation, liable to be

mentally investigated by the driver at an explicit level. At the operational level, which generally corresponds to the driver's implicit awareness of the situation, driving activity is implemented through operative know-how for vehicle lateral and longitudinal controls (Bellet et al., 2009). This dichotomy between implicit and explicit cognition was well established in scientific literature, for example, with the distinction proposed by Schneider and Schiffrin (1977) between controlled processes, which require cognitive resources and can only be performed sequentially, and automatic processes which can be performed in parallel without any attentional efforts. In the same way, Rasmussen (1986) distinguished different levels of activity control according to whether the behaviors implemented rely on: (1) highly integrated sensorial-motor reflexes (skill-based behaviors); (2) well mastered decision rules for managing familiar situations (rule-based behaviors); or (3) more abstract and generic knowledge that is activated in new situations, of which the driver have not any prior experience (knowledge-based behaviors).

Four main dynamic cycles regulate the internal functioning of the COSMODRIVE model. The perceptive cycle supports the human perception functions, allowing the driver to actively explore the road environment, according to their current needs and objectives (top down perceptive exploration processes) and/or integrate new information into their mental representations (bottom up cognitive integration processes). The memory cycle plays a central role in pre-existing knowledge activation (based on categorization and matching processes permitting to fit knowledge with the reality) (Bellet et al., 2007) as well as in terms of new knowledge acquisition. The cognitive cycle corresponds to a set of cognitive agents (like mental representation elaboration, understanding, anticipation, decision-making or action-planning) which collectively handled the internal mental representations, in order to take appropriate decision, and then, act into the current environment. Lastly, the cognitive resources allocation cycle is in charge to dynamically regulate and control the life cycle of the driver's cognitive system, in accordance with the attentional resources that are currently available.

The central structure supporting to the living cognition in this cognitive architecture is working memory. Working memory of COSMODRIVE stems as much from the "operational memory" concept formulated by Zintchenko (1966) and as from Baddeley's (1986) working memory classical model. For Zinchenko (1966), the operational memory is a cognitive structure, main function of which is to serve the real needs of the (current) activity. Thus, it is a transitory rather than permanent memory. However, it should also be distinguished from the short-term memory, in so far as the information it contains remains available as long as it is useful to perform the activity in progress.

Through COMSODRIVE approach, car-driving is modeling as a dynamic process of interaction between the driver and the environment through a dual iterative regulation loop, supporting the living cognition.

In accordance with the cybernetics theory, human activity was defined here as a continuous loop of regulation between inputs coming from the road environment and outputs corresponding to the driver's behaviors implemented into the real world via the car, which generate feedbacks, in the form of a new inputs, requiring new adaptation from the driver. From this general point of view, the first iteration of the perception-decision-action regulation loop corresponds to the moment when the driver starts up the engine, and the last iteration comes when the driver reaches the final trip destination and stops the car.

In accordance with the human information processing theory, human was not described here as a closed black box, but as a set of perceptive, cognitive and behavioral functions allowing the driver to dynamically regulate their interactions with the surrounding environment. In terms of cognitive activities, mental representation of the driving situation plays a key-role in the cognitive system functioning. This mental model,

based on perceptive information extracted into the road environment, corresponds to the driver's awareness of the driving situation, and therefore, determines directly all their decision-making concerning the relevant adaptive behaviors to be carried out in the current driving context.

In accordance with the Russian theory of activity, this mental representation is based on operative knowledge practically learnt "in situation". Moreover, the driving task was performed by using an artifact (i.e., the vehicle) and the driving situation was directly transformed by the human operator's activity (e.g., car position on the road depending of the driver's action on the vehicle controls), as well as the situation modifies the driver's cognitive states (in terms of mental representation updating or new operative knowledge learning).

In accordance with the ecological theory of Neisser (1976), driver's perception in Figure 2 is based on a dynamic perceptive cycle when an active schema directs gathering-information activity (i.e., top down processes) and focus driver's attentions on a sample of pieces of information currently available in the environment. Then, this active schema provides a mental model that is continuously updated by dynamic integrating the new pieces of information collected into the road scene.

Computational and Dynamic Simulation of the Driver's Mental Activities While Driving

By considering this theoretical background, the COSMODRIVE model is composed of three main functional modules (i.e., the perception, the cognition and the action modules) in order to drive a virtual car into a virtual environment through two synchronized "perception-cognition-action" regulation loops (Bellet et al., 2010): an attentional control mode (mainly focused on Rasmussen's rule-based behaviors and simulated through driving schemas) and an automatic control loop (corresponding to the skill-based behaviors simulated through the envelope zones' concept and the pure-pursuit point method).

Modeling the Explicit Cognition: The Driving Schemas

Based on both the Piaget's (1936) concept of operative scheme and the Minsky's (1975) frames theory, driving schema is a computational formalism defined at INRETS (Bellet et al., 1999) in order to implement operative driving knowledge at the tactical level of COSMODRIVE. They corresponded to prototypical empirical situations, actions and events learnt by the driver from practical experience. From a formal point of view (see Figure 3), a driving schema is composed of: (1) a functional model of road infrastructure; (2) a tactical goal (e.g., turn left); (3) a sequence of states; and (4) a set of zones. Two types of zone are distinguished: Zi (driving zones) corresponding to the driving path of the vehicle as it progresses through the crossroads and exi (the perceptive exploration zones) in which the driver seeks information (e.g., potential events liable to occur).

Each driving zone is linked to actions to be implemented (e.g., braking or accelerating, in view to reach a given state at the end of the zone), the conditions of performing these actions and the perceptive exploration zones that permit checking these conditions (e.g., color of traffic lights and presence of other road users). A state was defined by a vehicle position and speed. The different sequences of the driving zones make up the driving paths that progress from the initial to the final state (achievement of the tactical goal).

Once activated in working memory and instantiated with the road scene, the active driving schema becomes the tactical mental representation of the driver, which will be continually updated when he/she progresses into the current environment. Tactical representation corresponds to the driver's explicit awareness of the driving situation and provides a mental model of the road functionally structured, according to the tactical goal pursued by the driver in this particular context (e.g., turn on the left).

Modeling the Implicit Cognition: The Envelope-Zones and Pure Pursuit Point Regulation Strategies

At the operational level (corresponding to the automatic control loop presented in Figure 1), the COSMODRIVE model regulation strategy is based on two implicit regulation mechanisms: the envelope zones and the pure pursuit point. From a theoretical point of view (Bellet et al., 2007), the concept of envelope zones recalls two classical theories in psychology: the notion of body image proposed by Schilder (1950) and the theory of proxemics defined by Hall (1966), relating to the distance keeping in social interactions with other humans. Regarding car-driving activity, envelope zones also refer to the notion of safety margins. At this last level, COSMODRIVE model approach (see Figure 4) is more particularly based on Kontaratos' work (1974), and distinguishes a safety zone, a threat zone and a danger zone in which no other road user should enter (if this occurs, the driver automatically activates an emergency reaction).

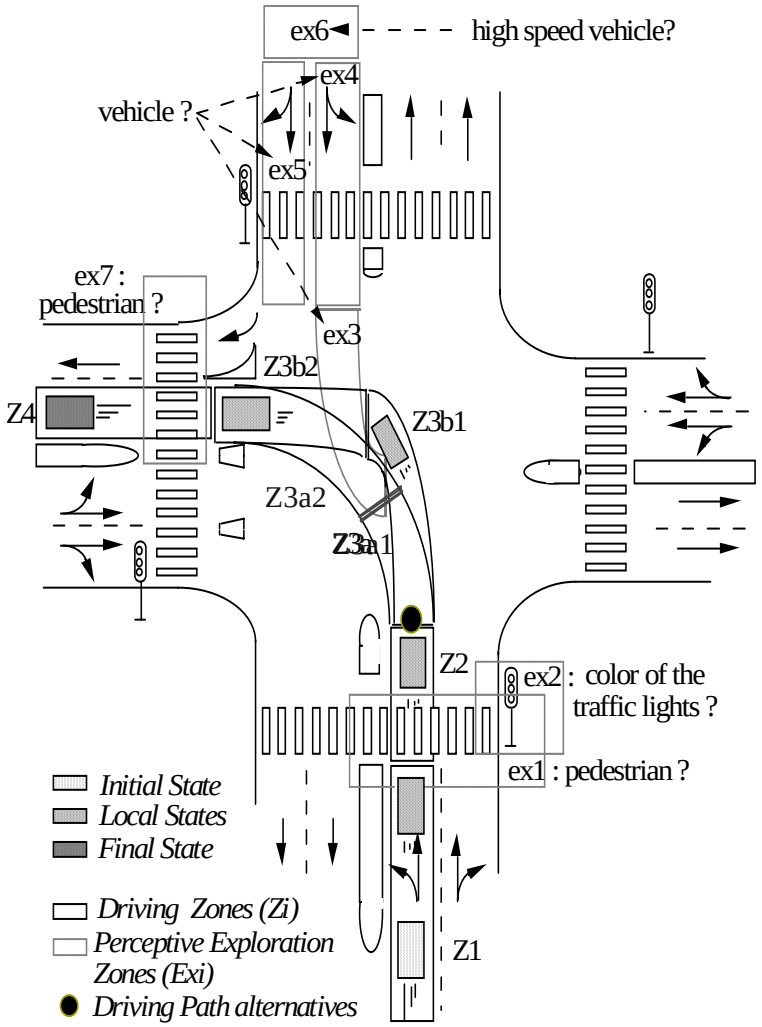

Figure 3. The driving schemas formalism.

The envelope zones correspond to the portion of the path of driving schema to be occupied by the vehicle in the near future. Moreover, as a "hidden dimension" of the social cognition, as suggested by Hall's theory (1966), these proxemics zones are also mentally projected to other road users and then used to dynamically interact with them as well as anticipate and manage collision risks. This "virtual skin" is permanently active

while driving, as an implicit awareness of our expected allocated space for moving. As with the Schilder's body schema, it belongs to a highly integrated cognitive level (i.e., implicit regulation loop), but at the same time, favors the emergence of critical events in the driver's explicit awareness. Therefore, the envelope zones play a central role in the regulation of social as well as physical interactions with other road users under normal driving conditions (e.g., inter-vehicle distance keeping), and in the risk assessment of path conflicts and their management if a critical situation occurs (commitment of emergency reactions).

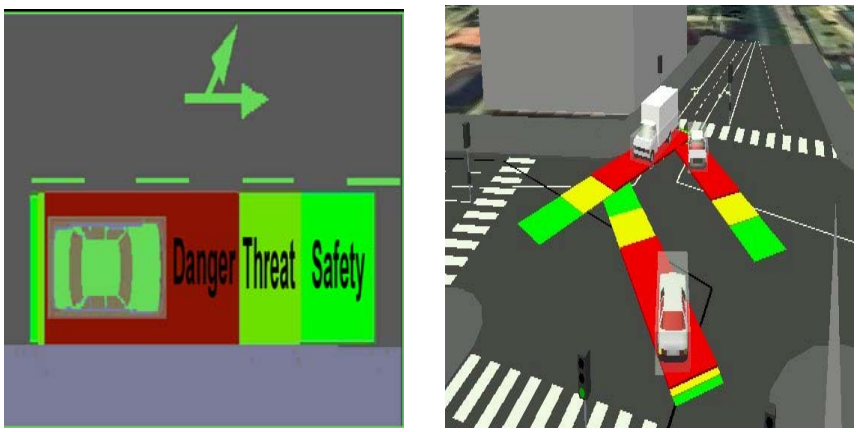

Figure 4. COSMODRIVE "envelope-zones" model.

The second hidden dimension of the implicit cognition implemented at the operational level of COSMODRIVE is the pure pursuit point method. This method was initially introduced for modeling in a simplified way the lateral and the longitudinal controls of an automatic car along a trajectory (Amidi, 1990), and has been adapted by Sukthankar (1997) and Mayenobe (2004) for driver's situational awareness modeling. Mathematically, the pure-pursuit point was defined as the intersection of the desired vehicle path and a circle of radius centered at the vehicle's rear axle midpoint (assuming front wheel steer). Intuitively, this point describes the steering curvature that would bring the vehicle to the desired lateral offset after traveling a distance of approximately l. Thus, the position of the pure-pursuit point maps directly onto a recommended steering curvature: $k = -2x/l$, where "k" is the curvature (reciprocal of steering radius), "x" is the relative lateral offset to the pure-pursuit point in vehicle coordinates, and "l" is a parameter known as the look-ahead distance. According to this definition, the operational control of the car by COSMODRIVE can be seen as a process of permanently keeping the pursuit point in the driving path to a given speed assigned with each segment of the current tactical schema, as instantiated in working memory.

The Emerging Living Cognition

By using the functional architecture and the cognitive agents of COSMODRIVE described in Figure 2, the driving schemas as operative knowledge activated and then dynamically updated in the form of a functional mental representation matched with the road scene, and the operational skills corresponding to the pure-pursuit point and the envelopes zones regulation process, it becomes thus possible to dynamically simulate of the driver's "living cognition". The central process that supports the living cognition is the deployment of the active driving schema, as instantiated in working memory through the current mental representation. This deployment consists in moving the car along a driving path (see Figure 3), by successively traveling through the different driving zones of the schema, from the initial state (i.e., Z1) until reaching the tactical goal (i.e., Z4).

This deployment process may occur at two levels: (1) at the representational level (explicit and implicit mental simulations of the future activity to be carried out), when the drivers anticipate and project themselves mentally in the future; and (2) through the activity itself, during the effective implementation of the schema while driving the car. This twofold deployment is not performed by a specific process in COSMODRIVE. It is an emergent collective product, resulting from the combined effect of several cognitive processes (like anticipation or decision-making) and merging with the computations based on the envelope zones and the pursuit point regulation laws. As a result, the deployment process generates a particular instance of the active schema execution, composed of a temporal sequence of mental representations, causally interlinked and corresponding to the driving situation, as it is progressively understood and anticipated, then experienced, and lastly acted by the driver, along the driving path progression.

Figure 5 provides an example of COSMODRIVE simulation results, permitting to visualize the mental representation evolution of a novice driver (who has the intention to turn on the left), while approaching of an urban crossroads with traffic lights. In a first time (i.e., first left view, corresponding to the driver's mental representation at a distance of 30 meters of the traffic lights), the driver's situation awareness is centered on the near traffic and on the traffic lights color, that directly determine the short-term activity to be implemented. Then, as he/she progresses towards the crossroads, the driver's attention is gradually focused on the area ahead, and the traffic flow occurring in the intersection center is progressively integrated into the driver's mental representation (i.e., second left view, at a distance of ten meters of the traffic lights).

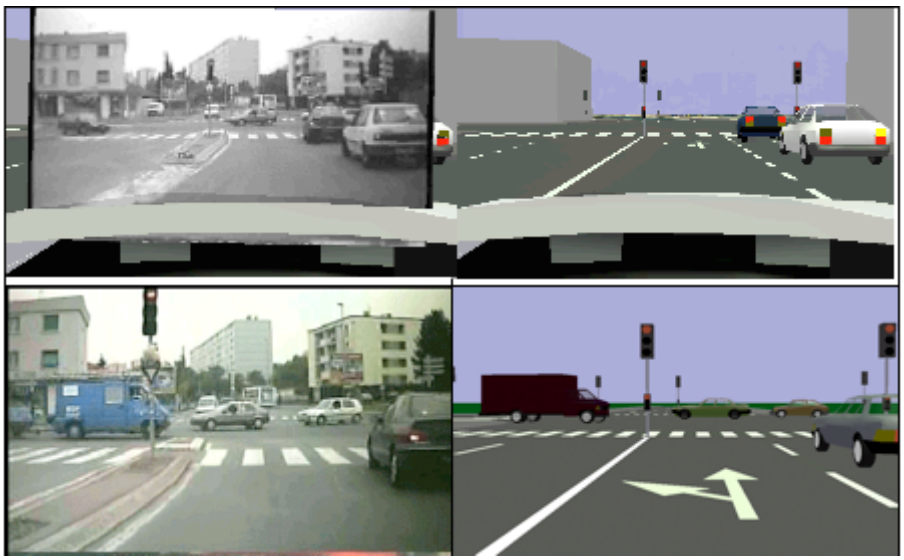

Figure 5. Virtual simulation of a driver's mental models.

The advantage of the driving schema formalism as defined in COSMODRIVE is to combine declarative and procedural knowledge in the unified computational structure. When associated with the operational regulation processes linked with the envelope zones and the pursuit point strategies, it is then possible to use such driving schemas as a structure of control for both monitoring the operative activity, as well as supervising the mental derivation of the "schema deployment", as this process is implemented by the human cognitive system in order to anticipate future situational status, or mentally explore the potential effects of an action before applied it. In accordance with the activity theories, these cognitive structures guarantee a continuum

between the different levels of awareness (implicit versus explicit) and the activity control (tactical versus operational), thereby taking full account of the embedding of operative know-how (i.e., the level of implementation) in the explicit and decisional regulation loop of the activity.

Conclusions: "In Silico Veritas"

By considering the challenge of the living cognition study, it is needed to apprehend the dynamic functioning of the human cognitive system in interaction with the environment where he/she is currently immersed. Thus, computational models able to virtually simulate the human mental activities on computer are required. One of the key issues of the living cognition is mental representation simulation that is dynamically elaborated and continually updated in the working memory of the human operator before (i.e., action-planning) and during the activity, when practically carried out. Indeed, mental representations and operative activity are intimately connected. In the same way as the human activity fuels itself directly with mental representations, the operator's mental representations are also fuelled by and for the activity, according to a double deployment process: cognitive and representational on the one hand and sensorial-motor and executive on the other.

The key mental structure supporting both drivers' mental representations and their activities is driving schemas. From a metaphorical standpoint, such schemas can be compared to a strand of DNA (Deoxyribo Nucleic Acid). They genetically contain all the potential behavioral alternatives that allow the driver to act within a generic class of situations. Nonetheless, only a tiny part of these genotypic potentialities will finally express themselves in the current situation (with respect to the constraints and specific characteristics of reality) during the cognitive (i.e., mental deployment), and then executive implementation of this schema (i.e., effective activity carried out to drive the car). And it is only through this dynamic process of deployment of operative mental representations involving a collective effort of several cognitive processes that certain of intrinsic properties of the living cognition will emerge. From this point of view, the scientific investigation of the living cognition cannot forego the use of computer simulation of the human mental activities, without taking the risk of being largely incomplete.

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A Study of the Relationship Between Students' Anxiety and Test Performance on State-Mandated Assessments

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This study examined whether relationships exist between Hispanic fourth-grade students' anxiety and test performance on a state-mandated writing assessment. Quantitative methodologies were employed by using test performance and survey data from 291 participants. While no significantly direct relationship exists between students' levels of anxiety and their performance on the TAKS (Texas Assessment of Knowledge and Skills) writing assessment, other findings indicate that greater time spent on the writing assessment, result in higher scores as well as greater levels of anxiety.

Keywords: test-anxiety, writing, performance-assessment

Introduction

For the past two decades, the Texas Education Agency has collected data on students' learning and academic achievement for accountability ratings of districts and schools. This was a result of state adopted students' learning standards and statewide testing in grades three to 11 using the TAKS (Texas Assessment of Knowledge and Skills) test. The TAKS measures students' learning through complex, open-ended performance and multiple-choice testing. These tests are mostly multiple-choice in format while the writing test includes an open-ended question in which students must write a response.

These state-mandated tests have become increasingly important to make decisions that have important consequences on students and teachers. For students, test results are used for promotion, tracking and graduation. However, this focus on the TAKS also affects the daily behavior of teachers, especially the teachers who teach in tested grades. The assumption is that these state-mandated tests will indicate the quality of instruction received (Popham, 2001). So, if students score well on the state-mandated test, we will assume the students have been well taught. Conversely, if students score poorly, we will assume that they have been poorly taught.

Making schools transparent in this nature often places a tremendous amount of stress on the schools and the children since all achievement data are made available to the public and all its stakeholders.

Assessment Practices

There has been much debate about state assessments as an instrument for measurement-driven reform. Proponents of measurement-driven reform feel that the recent development of performance-based assessment offers a technology for assessing higher-order skills and deeper understanding of contents (Vogler, 2002).

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Performance-based assessments test students' knowledge differently than multiple-choice and basic-skills tests. Multiple-choice tests only require students to choose an answer from ready-made responses and fill in an oval, while performance-based assessments require students to show their knowledge by constructing a response, such as writing an essay or showing how to solve a mathematical problem. Performance can be disaggregated by a number of criteria (i.e., ethnicity, socioeconomic status, dropout rate and attendance rate) to determine a performance rating for schools and school systems.

The TAKSs are multiple-choice in format for students in grades three to 11. The fourth grade and seventh grade TAKS, however, contains a writing section that includes an open-ended question to which students must write a response in an organized and essay composition format (Texas Education Agency, 2010). The written assessment portion of the TAKS is scored in a four-point scale with a minimum passing standard score of two.

Opposition to state testing has come from various stakeholders involved in public education during the past two decades. Valenzuela and McNeil (2000) emphasized that state tests do not insure a quality education. Popham (2001) claimed that because of unsound high-stakes testing programs, many students are receiving ineffective educational experiences. He went further to say that high-stakes testing, as used today, is causing serious educational harm to children. Other opponents of measurement-driven reform asserted that high-stakes assessment creates negative side effects, such as dumbing down the curriculum, de-skilling teachers, pushing students out of school and generally inciting fear and anxiety among both students and educators (Darling-Hammond, 2007). Furthermore, Valenzuela and McNeil (2000) believed that state testing is especially harmful to language minority students and that "the pressure to raise scores is greatest in our poorest, historically least well-funded schools" (p. 20).

Test Anxiety in Children

Anxiety disorders, one of the most common mental disorders affecting children, can negatively affect attention and concentration, self-esteem, peer relationships and social behaviors (Costello, Mustillo, Erkanli, Keeler, & Angold, 2003). Research has focused on anxiety in children in areas of achievement attributes, achievement motivation, learned helplessness and motivational dynamics that negatively influence achievement (Hill & Wigfield, 1984). Even subclinical and undiagnosed levels of anxiety can impact the future academic achievement and developmental outcomes of children (Grover, Ginsburg, & Ialongo, 2007).

One manifestation of anxiety is test anxiety, an important aspect of negative motivation that influences school performance. Many definitions of test anxiety exist in the literature. Dusek (1980) defined it as "an unpleasant feeling or emotional state that has physiological and behavioral concomitants, and that is experienced in formal testing or evaluation situations" (p. 88). Hancock (2001) posited that most prominent researchers view test anxiety as "a relatively stable personality trait that prompts an individual to react to threatening situations with sometimes debilitating psychological, physiological, and behavioral responses" (p. 284).

Some researchers found that test anxiety does not lead to low test scores while others find that test anxiety can have serious consequences to the academic performance of students (Grover et al., 2007). Yet, No Child Left Behind Act requires that states assess students from grades three to eight in reading and mathematics at least yearly. Students of all academic achievement levels can be affected by test anxiety and each child displays test anxiety differently to varying degrees. Some may become fearful in achievement situations or concerned about how their parents will react to their successes and, more specifically, to their perceived failures (Hill, 1980). As children move and progress through elementary school, they begin to experience more frequent

testing situations and test anxiety, even teachers recognize and express concern about the heightened anxiety in children as testing in schools increases (McDonald, 2001).

Children also encounter other factors that contribute to their test anxiety, such as pressure from their teachers and parents to be successful. Barksdale-Ladd and Thomas (2000) found that elementary students experience high levels of anxiety, concern and anguish about high-stakes testing. More recently, Triplett and Barksdale (2005) investigated students' perceptions of testing and concluded that elementary students were anxious and angry about aspects of the testing culture, including the length of the tests, extended testing periods and not being able to talk for long periods of time. Furthermore, the authors contend that anxiety increases when children sense that their teachers are also anxious or stressed about testing.

Children of dissimilar ethnic backgrounds may experience test anxiety differently. For example, research involving Hispanic or Latino children often examines relationships among anxiety, prejudice, discrimination, acculturative stress, stigmatization and other related fears and worries (Hovey & Magaña, 2002; Icard, Longres, & Spencer, 1999). In a comparison of white and Hispanic/Latino children who had been referred to an anxiety disorder specialty clinic, researchers found that diagnostic rates of anxiety disorders and self-rated levels of depression and anxiety were similar between the two groups (Ginsburg & Silverman, 1996).

The purpose of the current study was to examine factors associated with the writing portion of the TAKS and determine whether relationships exist among performance, the time it takes to complete the assessment and anxiety in a group of Hispanic fourth-grade students. The following research questions guided this study: (1) Is there a relationship between the amount of time a student takes to complete the writing portion of the TAKS and the score they received? (2) Is there a relationship between the amount of time a student takes to complete the writing portion of the TAKS and his/her level of anxiety about writing? (3) Is there a relationship between students' level of anxiety and the score received on the writing portion of the TAKS? (4) Does taking a break during the writing portion of the TAKS help or hinder student performance? and (5) Is there a relationship between taking a break during the writing portion of the TAKS and students' levels of anxiety?

Methods

A sample of 291 Hispanic children, aged nine to ten, participated in this research. The target population in this study was fourth grade students who transitioned from bilingual to English-only classes in one of nine elementary schools in South Texas, a geographic area along the Texas-Mexico border. This area of Texas is labeled as the Region One ESC (Education Service Center), in which 97% of all students in the region are of Mexican-American/Hispanic/Latino decent and approximately 37% are labeled as limited English proficient (Region One Education Center, 2010). Once approval from district superintendants was acquired and the research procedures were described to principals and teachers at the elementary schools, data collection occurred.

Data Collection and Measures

Between February and May of 2008, quantitative data were gathered and survey methodologies were employed. Quantitative data were collected using a form entitled Start/Stop Time during the TAKS fourth-grade writing assessment in February 2008. Teachers were asked to indicate the start and end time for all participants. The time it took students to complete the assessment was labeled as follows: 120 minutes or less, 121 minutes to 240 minutes, 241 minutes to 360 minutes, 361 minutes or more. Also noted on the Start/Stop Time form was whether students were given a break lasting more than 15 minutes. These data were then matched with results

from the TAKS writing assessment, which were available a few months later in May. Assessment scores ranged from zero to four, with four being the best score. All data were entered into SPSS (Statistical Package for the Social Sciences) 15.0 for analyses.

TAKS TAA (Assessment Anxiety)

After the TAKS writing assessment, a survey titled TAKS Writing Test Survey was administered to 137 of the participants during regular class time to measure students' attitudes toward the TAKS writing assessment and their perceptions about taking the test. The main purpose of this survey was to measure students' level of anxiety as it relates to the TAKS writing assessment. The four-item subscale measuring TAKS TAA is comprised of four "yes/no" questions, ranging from zero to four, has a mean of 1.55, a standard deviation of 1.21 and a Chronbach's alpha of 0.56, indicating that there is adequate internal consistency among the four items. Sample questions include: Did you feel scared while taking the TAKS writing test and a reverse-coded item, did you feel confident about your writing skills before taking the TAKS writing test.

Results

Prior to examining whether relationships exist among performance on the TAKS writing assessment, the time it takes to complete the assessment and anxiety associated with the assessment, descriptive statistics for the sample are provided. Ninety-two percent of the fourth-grade students met the minimum passing standards for the writing assessment, which is consistent with the geographic area—n Region One ESC, approximately 92-93% of the students passed the assessment each year (TEA, 2010). The current sample exhibited a mean of 2.35 (SD = 0.69) on the TAKS writing assessment with an average time to complete the TAKS writing assessment of just under three hours, at 179.50 (SD = 109.03) minutes. As mentioned earlier, students' average TAA score was 1.55 (SD = 1.21), indicating that students typically exhibited mild levels of anxiety on the TAKS writing assessment since the midway point is 2.0 in the four-point scale.

To address the primary research question of this study, a correlation analysis was conducted to determine whether a relationship exists between students' levels of anxiety and their performance on the TAKS writing assessment. The correlation analysis yielded no significant relationship among these particular variables. However, as explained in the following sections, disaggregating the performance data by completion time and whether students received a break during the assessment yielded interesting, noteworthy findings with regard to performance and anxiety.

Completion Time

To determine if there is a relationship among the amounts of time it takes a student to complete the writing portion of the TAKS and the score he/she receives, an ANOVA (Analysis of Variance) was conducted with time as the grouping variable. When students were grouped into categories based on the length of time it took them to complete the TAKS writing assessment, there was a significant difference in mean scores for the assessment (see Table 1). A Scheffe post hoc comparison and review of group means showed that students tended to receive a higher score if they spent more time on the writing assessment. Conversely, if they rushed through the assessment and spent less time on it, their score was lower.

To determine if there is a relationship among the amount of time it takes a student to complete the writing portion of the TAKS and his/her level of TAA, an ANOVA was conducted with time as the grouping variable.

When students were grouped into categories based on the time it took to complete the TAKS writing assessment, no significant difference in mean scores for TAA was found. However, it is worth nothing that the level of anxiety is higher for students who took longer to complete the writing assessment (see Table 2).

Table 1

ANOVA Results for TAKS Writing Assessment by Completion Time

Time to complete the TAKS writing assessment	*N*	Mean	Standard deviation	
120 minutes or less	102	2.22	0.73	
121 to 240 minutes	133	2.39	0.61	
241 to 360 minutes	32	2.44	0.62	
361 minutes or longer	24	2.63	0.88	
Source	Sum of squares	Degrees of freedom	Mean squares	*F*-ratio
Between groups	4.12	3	1.37	2.98*
Error	132.42	287	0.46	---

Note. $^{*}p < 0.05$.

Table 2

ANOVA Results for TAKS TAA by Completion Time

Time to complete the TAKS TAA	*N*	Mean	Standard deviation	
120 minutes or less	54	1.44	1.31	
121 to 240 minutes	52	1.58	1.16	
241 to 360 minutes	10	1.70	1.25	
361 minutes or longer	11	2.00	0.89	
Source	Sum of squares	Degrees of freedom	Mean squares	*F*-ratio
Between groups	3.06	3	1.02	0.69
Error	182.13	123	1.48	---

Taking a Break During the Assessment

To determine whether taking a break during the writing portion of the TAKS helps or hinders a student's performance, a *t*-test and two ANOVAs were run. The *t*-test yielded no significant difference in means for the two groups—those who received a break and those who did not receive a break. An ANOVA was then conducted for each of these groups and revealed that students who did not receive a break while testing scored similarly to one another, regardless of how long they spent on the writing assessment. The ANOVA yielded no significant differences in group means when students were grouped by the amount of time it took to complete the assessment. However, students who did receive a break while testing exhibited significantly different means on the writing assessment when they were grouped based on the amount of time it took to complete the assessment (see Table 3). A review of group means and Scheffe post hoc comparisons show similar results to those found in Table 1 (the entire sample) that as students spend more time on the assessment, performance on the TAKS writing assessment goes up.

To determine whether a relationship exists between taking a break during the writing portion of the TAKS and students' level of anxiety, two correlation analyses were conducted: One for students who did not receive a break during testing and one for students who did receive a break. Students who did not receive a break during testing exhibited a significant negative correlation between TAA and their scores on the writing assessment ($r = 0.259$, $p = 0.001$). Such a relationship did not exist for students who received a break during testing.

Table 3

ANOVA Results for TAKS Writing Assessment by Completion Time

Time to complete the TAKS writing assessment	*N*	Mean	Standard deviation	
120 minutes or less	52	2.19	0.74	
121 to 240 minutes	71	2.37	0.59	
241 to 360 minutes	30	2.43	0.63	
361 minutes or longer	20	2.80	0.83	
Source	Sum of squares	Degrees of freedom	Mean squares	*F*-ratio
Between groups	5.46	3	1.82	3.99*
Error	77.12	169	0.46	---

Note. $^{*}p < 0.01$.

Conclusions

While high stakes testing has a place of note in our educational world, the reality of how standardized state tests added to student anxiety requires a commitment from all stakeholders to address and minimize children's emotional consequences. Results from the current study indicated that students exhibit mild levels of anxiety related to the TAKS writing assessment, but that anxiety is higher for students who take longer to complete the assessment. To address anxiety, counselors and teachers should coach students on how to de-stress by providing outlets for verbal or non-verbal expressions before and after the writing assessment. Creating opportunities for personal expressions can help students better process this and other stressful experiences and situations.

Though mean scores on the writing assessment tend to increase as students take longer to complete it, allowing more time will not necessarily result in a greater portion of students achieving beyond the minimum passing score of two. Most students in this study and in the Region One ESC geographic area are already passing the fourth-grade writing assessment which indicates that increased time simply allows students to improve their writing beyond the minimum passing requirements. However, more time on the assessment could help raise students' expectations so that they consider a rating of three or four as an attainable goal and do not accept the minimum score of two. Clearly aligned and defined writing expectations and curriculum by grade level would help students prepare for formal testing situations. It is recommended that such curriculum include the teaching of a writing process prior to the fourth grade so that students' writing habits can be refined during the testing year.

In addition to students' writing, stakeholders and policy-makers should further examine the testing procedures of state-mandated writing assessments. Students who received a break while testing exhibited significantly different means on the writing assessment when they were grouped based on the amount of time it takes to complete the assessment. In the current study, receiving a break while testing occurred very randomly, depending on that when the assessment was started and very inconsistent across schools and districts. While there were no significant differences in scores between students who received a break and those who did not, this was a limitation and possible confounding variable. Another limitation of the current study pertains to the sample size when data were disaggregated based on whether students had a break (or no break) while testing. A larger sample would allow for more accurate comparisons between these two groups. It is recommended that testing administrators schedule sufficient and consistent breaks for students while taking the writing portion of the test.

Ultimately, increased research examining anxiety in test situations and the role it plays on the psyche of school children would be useful for bringing awareness to the need for policy review at the state and national level. It might do more to help policymakers reassess the need to use such instruments in determining school's accountability. A call for public action is imperative for the youth of the future. Further review may lead to finding other ways to maintain the school's accountability while sheltering the children in the process.

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Progressive Education Standards: A Neuroscience Framework

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This paper proposes a coherent and unique set of 12 standards, adopting a neuroscience framework for biologically based on school reform. This model of educational principles and practices aligns with the long-standing principles and practices of the Progressive Education Movement in the United States and the emerging principles of neuroscience. Progressive educators may now adopt the progressive neuroscience education framework to design and deliver effective programs in systematic ways. Research of the brain confirms how individuals attend, process, organize, remember, apply and use information. That research enables educators to identify the pedagogies that enhance rather then inhibit learning.

Keywords: neuroscience, progressive education, standards

Introduction to Neuroscience Education

As advanced brain imaging studies detail cognitive function more precisely, the new neuroscience serves to confirm the long-standing principles of the progressive education movement. Key features of progressive education principles are now empirically validated by ongoing studies in neuroscience. Progressive educators emerge from advocates for the proposition that educational standards and practices should be derived from the emerging neuroscience. Progressive educators can easily and explicitly connect the core principles of progressive education to the core principles of neuroscience with the generally accepted neuroscience understandings that are the elaborations of the core neuroscience principles (Society of Neuroscience, 2010). From this intersection of disciplines emerges a framework for the development of new neuroscience progressive standards that structure more effective educational methods.

Early proponents of brain based on researches in education included a group of educators who initially transcribed the neuroscience literature for educators (R. N. Caine & G. Caine, 1994; Cohen, 1995; Jensen, 1998; Sousa, 1995; Sylwester, 1995; Williams, 1986). In the past decade, the interest in this aspect of education has increased significantly. Neuroscientists have been working to translate the biological science to teaching practice with more exactness (Davidson, 2001; Diamond & Amso, 2008; Fischer, 2009; Gardner, 2009; Goswami, 2009; Tsivlin, 1999). At the same time, neuroscientists suggested that educators also must begin to connect the neuroscience research to teacher action in more definitive ways (Breuer, 1997; Wolfe, 2001). Toward this end, a set of eight neuroscience principles were recently published (Society of Neuroscience, 2010).

The eight core neuroscience principles organize the general understandings of the new neuroscience research that are applicable to education practice. The understandings derived from the eight core neuroscience principles are: (1) The brain is the body's most complex organ; (2) Neurons communicate using both electrical and chemical signals; (3) Genetically determined circuits are the foundations of the nervous system; (4) Life

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experiences changing the nervous system; (5) Intelligence arises as the brain reasons and plans, and solves problems; (6) the brain makes it possible to communicate knowledge through language; (7) The human brain endows us with a natural curiosity to understand how the world works; and (8) Fundamental discoveries promote healthy living and treatment of disease (Society of Neuroscience, 2010).

Progressive Education

The progressive education movement emerged from the early writing of John Dewey (1898) and was introduced into the American public school system in the late 19th and early 20th centuries in response to a fragmented educational system with a singularly vocational mission (Dewey & McClellan, 1889). Progressive education challenged a status quo that emphasized cultural uniformity, societal compliance, authoritarian pedagogy, regimented instruction, utilitarian outcomes, dogmatic curriculum and curricular standardization to train labor for business.

John Dewey (Dewey & McClellan, 1889) introduced two fundamental concepts of progressive education: (1) respect for diversity; and (2) development of critical, socially engaged intelligence. Progressive educators who adopted Dewey's progressive philosophy of education consistently described the importance of a child-centered curriculum, the need for social reconstruction/justice, the value of active engagement, the need for critical thinking, a community-oriented focus, a democratic pedagogy, a developmental approach, a respect for diversity, individual capacity, cooperative effort and creative and artistic expression (Dewey & McClellan, 1889; Albjerg-Graham, 1967; Addams, 1912; Boyd, 1921; Counts, 1935; Dewey, 1902; Eliot & Neilson, 1926; Flexner, 1916; Gilman, 1901; Haley, 1904; Johnson, 1931; Kilpatrick, 1925; Mann, 1868; Naumburg, 1928; Parker, 1883).

Through the 20th century and into the early 21st century, progressive educators dedicated themselves to democratic approaches grounded in psychology (Bruner, 1966; Hall, 1891; Piaget, 1951). Progressive educators translated the psychological principles into specific educational inventions including ungraded schools (Goodlad, 1984), alternative schools (Goodman, 1962), child centered curriculum (Meier, 2002; Pratt, 1948) and responsive environments (Mitchell, 1950; 1954). Excellence in education for poor children (Haberman, 1995; Kohl, 1967; Kozol, 1991) and social and emotional learning for all children (Dubinsky, 2010; Goleman, 1998) were important considerations. Connecting developmental research and practice (Antler, 1982), emphasizing self-efficacy and self-motivation (Blackwell, Trzesniewski, & Dweck, 2007) and focusing on cooperative learning with individualized programming (Cremin, 1980; Hammond-Darling, French, & Garcia-Lopez, 2002) were hallmarks of progressive education contemporary practice. Progressive educators also embraced whole language instruction (Abbott, 1996; Cavanaugh, 1994; Kline, Moore, & Moore, 1987; Israel & Monaghan 2007; Shannon, 1990; Smith, 2002), social change (Zilversmit, 1993), democratic process (Soder, 1996), meaningful content (Jervis & Montag, 1991), experiential education (Kolb, 1995; Winsor, 1973), mastery learning (Washburne, 1953), arts-based programs (Greene, 1987) and community programs (Zacharakis, 2008). Kohn (1999) translated the key elements of progressive education to specific recommendations for best practice. Sizer (1973) described the essential component of progressive schools, essential schools, as the joy of learning. While progressive education was never fully embraced in the American public school system, it persisted.

In 1919, the AAPE (Association for the Advancement of Progressive Education) established seven general principles of progressive education. Recently, at the PEN (Progressive Education Network) annual conference,

a set of 15 contemporary principles were introduced (Little, 2007). The PEN (1995) 15 general principles were organized into an aggregated framework. The progressive education framework easily cross-referenced to the neuroscience core principles and provided the structure and impetus to organize a set of common new neuroscience/progressive standards to inform the reform of educational practice. Little (2007) said that "Isn't it our imperative to revitalize the practices of progressive education's past, and to marry them with what we recently have discovered about learning theory, human development, science, and technology?" (p. 1).

The New Neuroscience Progressive Standards Framework

The principles of progressive education can be directly aligned with generally accepted neuroscience understandings—the elaborations of the core neuroscience principles. The understandings offer a cohesive framework that deploys the philosophy, psychology and biology of learning. The new progressive neuroscience standards have important implications for the design and delivery of effective instruction to all students. Furthermore, the standards also encompass other contemporary progressive school models proposed by the Edutopia Foundation (1991) that emphasized the importance of project-based learning, authentic assessment, technology infusion and social emotional learning. The whole school movement also promotes a model that integrates authentic assessment, space for all democracy and authentic multi-level instruction, including all partnership, community and support (Whole School Consortium, 2000).

There are 12 progressive neuroscience education standards proposed:

Standard 1—unique learning child: understanding that differences in genes and environments make the brain of each organism wholly unique;

Standard 2—learning community and transactional learning: understanding that languages are acquired early in the development of the brain and facilitate information exchange and creative thought in future brain development;

Standard 3—learning cooperation and collaboration: understanding that communication that is a complex function of brain activity can create and solve many of the most pressing problems humankind faces;

Standard 4—emotional learning: understanding the development of the inhibitory control circuits of self-regulation;

Standard 5—active, experiential, service and social learning: understanding that curiosity leads us to unexpected and surprising discoveries that can benefit humanity;

Standard 6—intrinsic motivation: understanding that human brains demonstrate plasticity and that transactions with our environment can change the structure and function of the brain and that we can change our own brain;

Standard 7—social justice, democratic and critical thinking: understanding that emotions are value judgments made by our brains and are manifested by feelings as basic as love and anger and as complex as empathy and hate;

Standard 8—discovery learning and scientific inquiry: understanding that the brain grows new synapses in learning and that new learning turn on genes (gene expression);

Standard 9—project-based and problem-solving curriculum: understanding that the salience of an event determines the ability of the brain to remember it;

Standard 10—integrated, artistic, creative and flexible curriculum with thematic units: understanding that all perceptions, thoughts and behaviors result from combinations of signals among neurons;

Standard 11—authentic assessment: understanding that the brain learns from experiences and makes predictions about best actions in response to present and future challenges;

Standard 12—lifelong learning: understanding that the brain is organized to recognize sensations, initiate behaviors, and store and access memories that can last a lifetime.

Dewey (1898) stated that "Education thus conceived marks the most perfect and intimate union of science and art conceivable in human experience" (p. 80).

Conclusions

Progressive education allies with the new neuroscience to advance historic ideas. Progressive educators have long been proponents of the democratic educational practices that are now grounded in the new understandings of neuroscience. Progressive educators now use the progressive neuroscience education framework to design and deliver effective programs. For many years, progressive educators promoted education as art form that was informed by the psychological sciences. In the new century, progressive educators promote education as art form informed by the biological sciences. Developing and utilizing a common set of new progressive neuroscience education standards empowers teachers to choose creative expression over scripted curriculum, authentic assessment over standardized testing, inquiry over regimented learning, diversity over homogeneity, meaning over mechanization, individual discovery over collective recitation, guided practice over authoritarian management, experiential projects over routine repetition, problem solving over memorization, critique over compliance and adaptation over conformance. If progressive education has long propagated education as an art form, then the science now punctuates the art (Kilpatrick, 1951; Smith, 1979; Sousa, 1998; Cobb, 1974; Wood, 1992; Cremin, 1961; Woodworth, 1926).

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Software GOLUCA: Knowledge Representation in Mental Calculation*

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We present a new software, called Goluca (Godinho, Luengo, & Casas, 2007), based on the technique of Pathfinder Associative Networks (Schvaneveldt, 1989), which produces graphical representations of the cognitive structure of individuals in a given field knowledge. In this case, we studied the strategies used by teachers and its relationship with the perception expressed about their own abilities for mental calculation. First of all, the participants, 14 primary teachers, were asked what opinions they had about their own capabilities of mental calculation, classifying them as good, bad or moderate. Using the software Goluca, representations were obtained in the form of Pathfinder Associative Networks and the cognitive structure of these teachers concerning to the mental calculation strategies they used and calculated the consistency of such networks, denoted as "coherence". The results obtained allowed to identify which were the main strategies used by teachers and specify that teachers, who feel they have good skills in mental calculation, have more consistent cognitive structures.

Keywords: educational software, cognitive structure, pathfinder associative networks, mental calculation

Techniques for Knowledge Representation

Knowledge Representation

In our present state of knowledge about how the human mind works, it is widely assumed that the information and the concepts are stored in the memory according to a certain organization.

Of great importance in this context is the concept of cognitive structure. By this, it is meant the hypothetical construct that refers to the organization of the relationships between concepts in the semantic or long-term memory (Shavelson, 1972). During the learning process, with the formation of new relationships between existing knowledge and new knowledge, the cognitive structure is modified and becomes more comprehensive and coherent.

The graphical representation of the cognitive structure usually takes the form of what are known as semantic networks. These consist of nodes connected by different relationships and links (Norman, Gentner & Stevens, 1976). The nodes are concepts and groups of concepts (usually represented by words). For

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constructing these networks, we use its semantic similarity. Semantic similarity is a function of the number of properties that the concepts have in common. The more properties they have in common, the more strongly they will be linked.

In these techniques, it is assumed that someone can make a spatial representation of the concepts which describes the pattern of the relationship between those concepts in the memory. This representation can be constructed on the basis of a numerical score assigned to the similarity that a subject perceives among concepts and corresponds to their semantic distance.

Many researchers agreed that this procedure makes it possible to define the cognitive structure in an operational way (Fenker, 1975; Preece, 1976; Shavelson, 1972; Wainer & Kaye, 1974) and reveal the key concepts in a pupil's cognitive structure and the most important relationships between them (Jonassen, Beissner, & Yacci, 1993; Bajo & Cañas, 1994; Casas & Luengo, 2004; Davis & Yi, 2004; Da Silva, Mellado, Ruiz, & Porlán, 2006; Clariana & Wallace, 2007).

Pathfinder Associative Networks

The techniques used to construct these semantic networks include the use of questionnaires, protocols of thinking aloud, interviews with teachers and pupils, concept maps, card sorting, multidimensional scaling, cluster analysis and Pathfinder Associative Networks, amongst other similar approaches (Jonassen et al., 1993).

Pathfinder Associative Networks (Schvaneveldt, 1989) are representations in which the concepts appear as nodes and their relationships appear as line segments joining them. The line segments range their length depending on the weight or strength of their semantic proximity.

The way to assign a similarity score between concepts is the following: One begins by choosing the concepts; the subject is then presented in a random order with all the possible pairs of words that represent those concepts and asked to assign a score to each pair's similarity or difference. Then, it is calculated a correlation matrix like the following (which refers to a specific example), which represents the weights of the links between concepts.

	water	living b.	animals	plants	molecul.	motion	heat	phases w	solid	liquid	gas
water	1										
living beings	0.7567	1									
animals	0.6833	0.7833	1								
plants	0.6767	0.7733	0.6900	1							
molecules	0.2500	0.3333	0.2433	0.3167	1						
motion	0.3433	0.5733	0.3633	0.3167	0.4000	1					
heat	0.2800	0.2000	0.4067	0.3033	0.5967	0.7767	1				
phases of water	0.7833	0.3300	0.1700	0.2700	0.6833	0.7100	0.7933	1			
solid	0.2667	0.2467	0.2833	0.2667	0.3467	0.2267	0.3333	0.7100	1		
liquid	0.8767	0.2500	0.3033	0.3200	0.1867	0.3267	0.3100	0.7833	0.6200	1	
gas	0.3167	0.1967	0.1767	0.1467	0.3267	0.3067	0.2633	0.7833	0.3800	0.6033	1

Figure 1. Correlation data matrix.

Since all the concepts are related to a greater or lesser degree in the data matrix, there is a corresponding geometrical network in which they all are also linked to each other. The criterion, used by the Pathfinder Associative Networks to determine which links will be included, is that a given link is only incorporated

into the network, if there is no indirect path through other nodes whose sum of weights would be less than the direct link.

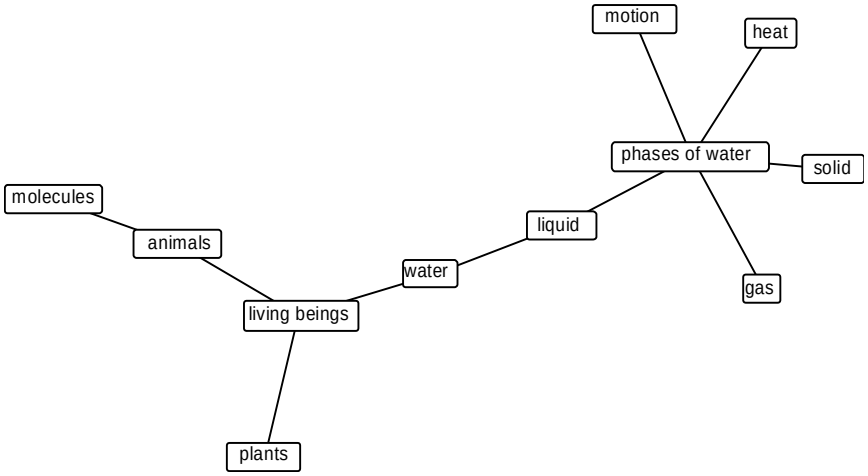

Figure 2. Network of the relation between concepts.

A detailed account of the above can be found in Schvaneveldt (1989), Casas (2002a; 2002b; 2004) and Casas and Luengo (2004).

Pathfinder Associative Networks are used in a wide variety of fields of research (Jonassen et al., 1993; Gonzalvo, Cañas, & Bajo, 1994; McGaghie, 1996; Eckert, 1997; Chen, 1999; Ramey, Smith, Barile, Bihm, & Poindexter, 2001; Moya-Anegón, Vargas-Quesada, Herrero-Solana, Chinchilla-Rodríguez, Corera-Álvarez, & Muñoz-Fernández, 2004).

Software for Knowledge Representation: GOLUCA Software

The procedure described above can be accomplished using the KNOT (knowledge network organizing tool) computer program (KNOT Software, 1989). There are two versions of this program: for Macintosh and for Windows operative systems. The Macintosh version is not yet available and there is a trial version, called Pathfinder, which has been sent us by its author, Roger Schvaneveldt, but only available for PC. This version fixes some shortcomings of the previous version and offers new possibilities, but it continues with two limitations we believe very important.

The first limitation is that it does not allow assign proximity values continuously, but only integer values between one and ten, which means that when calculating the paths values, many ties occur, making it appear that the networks obtained more complex. This problem did not occur with the Macintosh version.

The second limitation is that the program does not have a user-friendly interface. This aspect, which may not be important for the researcher, is important for the experimental subjects that use them. Again, this problem was not the case with the Macintosh version, which was more comfortable to use.

In view of these limitations and to improve possibilities of Pathfinder and KNOT programs, we designed a kind of software called Goluca (Godinho, Luengo, & Casas, 2007) which will be described briefly and with which we have done the research presented in this work.

Mental Calculation

As a result of our teaching and after reviewing the scientific literature (Thompson, 2009; B. Clarke, D. Clarke, & Horne, 2006; Gómez, 1995), we have found that there are students who demonstrate good mental

math skills from an early age, just as there are adults who also have regardless of their level of education.

As we have also seen, there is a limited number of strategies for mental calculation that are commonly used for the good calculators, which are discovered at an early age, most often self-taught, apart from formal education.

The difference between novices and experts and between good and bad calculators lies not only in the knowledge of these strategies, but in the best organization of such knowledge into their cognitive structure (Chi, Feltovich, & Glaser, 1981; Ferguson-Hessler & De Jong, 1990).

Abundant research agrees that among these strategies are the following: count forward, count backward, count the missing to reach to, do the double, do the half, etc..

Our hypothesis is that these strategies can be identified and efficiently taught to all students. In order to teach them, it was selected a set of activities that were conducted during a school year with a project of educational innovation aimed to improving outcomes for students in mental calculation.

Method

Our study sample consisted of 14 primary school teachers who taught in various courses from first to sixth. These teachers participated in an educational innovation project, whose goal was to teach mental calculation strategies to their students.

They were asked first to rate subjectively his own capacity for mental calculation, choosing among three levels: “Bad (1)”; “Moderate (2)”; and “Good (3)”.

Then, we conducted a test using the software Goluca, so that similarity scores were assigned to each pair consisting of the following 16 terms which correspond to strategies used for the mental calculation: collect, remove, count forward, count backward, count the missing to reach to, do the double, do the half, subtract as opposite to add, divide as opposite to multiply, seek complementary, count by tens and hundreds, ..., compensate, add, subtract, multiply and divide.

These terms were selected because they corresponded to the most frequently used strategies for mental calculation and had been previously identified in the context of the educational innovation project.

Using the Goluca software, the representations were obtained in the form of Pathfinder Associative Networks to reflect the cognitive structure of teachers about the importance of different strategies and the relationship among them.

By using the Goluca software, we calculated the value of the coherence of each network of participants. The coherence measure of a set of data reflects their consistency. In particular, given two concepts A and B, if they are both related in the same way with the rest of the set of concepts, they must be very similar concepts. The way to compare the type of relationship between A and B is by obtaining the correlation coefficient between the proximity values (from the data matrix) of A with all the other concepts (except itself and B) and the proximity values of B with all the other concepts (except itself and A). If this is done for all the concepts, one obtains an indirect measure of the proximities. This measure is again correlated with the original proximity data, yielding a new correlation coefficient in the range of -1 to +1. The greater the value of this correlation, the more consistent the data and thus the greater the coherence are. It often corresponds to the level of experience (or level of learning) and also indicates whether the values of proximity are assigned conscientiously or at random.

Results

We obtained 14 graphic representations in the form of Pathfinder Associative Networks of the teachers involved. Graphic representations are as the following.

In these networks, we can see how some strategies are more important than others, which are corresponded to what in our theory (Casas & Luengo, 2004) called “Nuclear Concepts”. In the networks shown in Figures 3 and 4, these strategies are clearly highlighted with a logical relationship established with the other strategies, while in other networks, as in Figure 5, appear more intricate and relationships do not seem logical. The value of coherence for the first network corresponds to what we considered as coherence “good (3)”, while the second and third correspond to networks with values of coherence “moderate (2)” and “bad (1)”, respectively.

The summary of the data obtained, in terms of capacity for mental calculation perceived by participants (mental calculation skills), coherence of Pathfinder Associative Networks and degree of coherence, was as follows (see Table 1).

With these data, using the SPSS statistical program we calculate the Spearman’s correlation (see Table 2).

As previous results indicate, there is a statistically significant association (p = 0.000) between the degree of capacity for mental calculation perceived by the participating teachers and the coherence calculated for its Pathfinder Associative Networks. This partnership is important, as indicated by the value of 0.839 in the Spearman’s Rho.

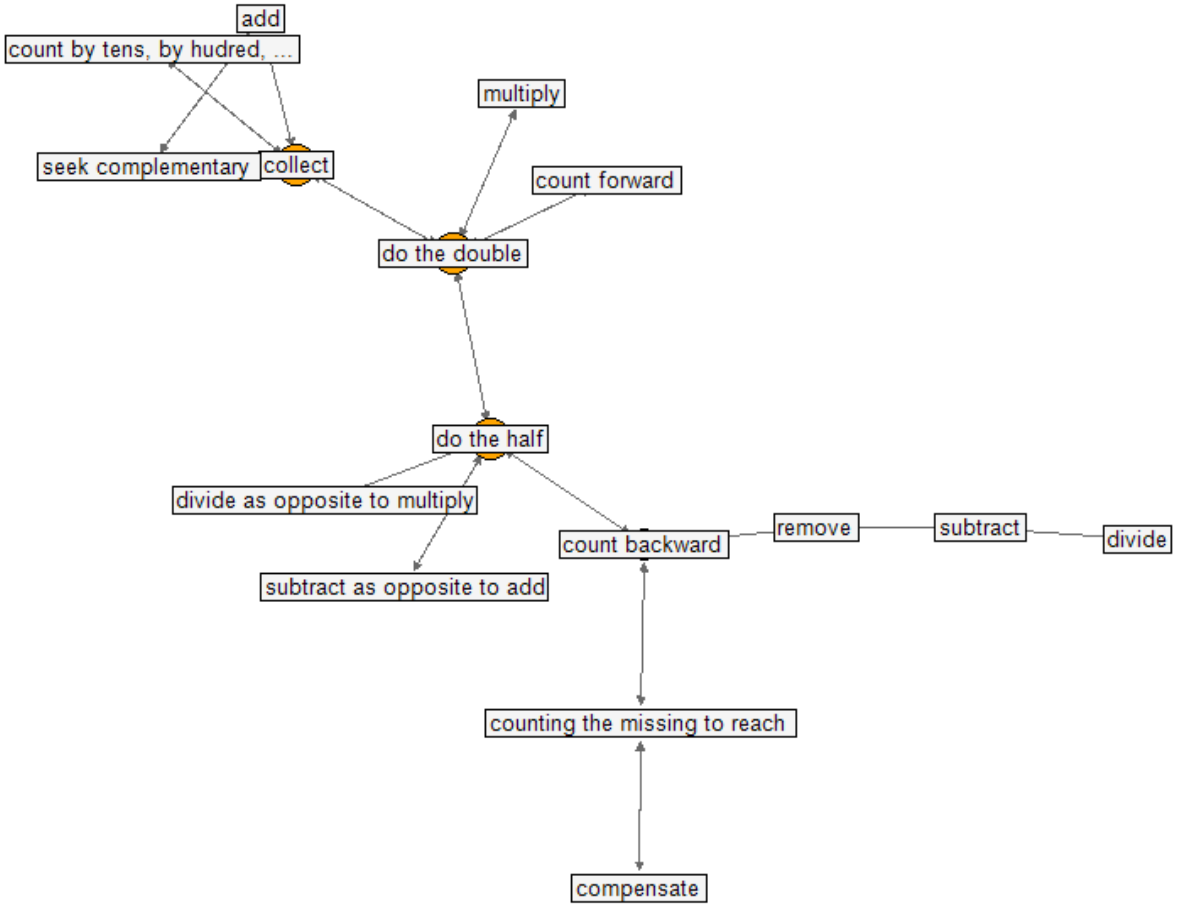

Figure 3. Pathfinder Associative Network (Subject 5).

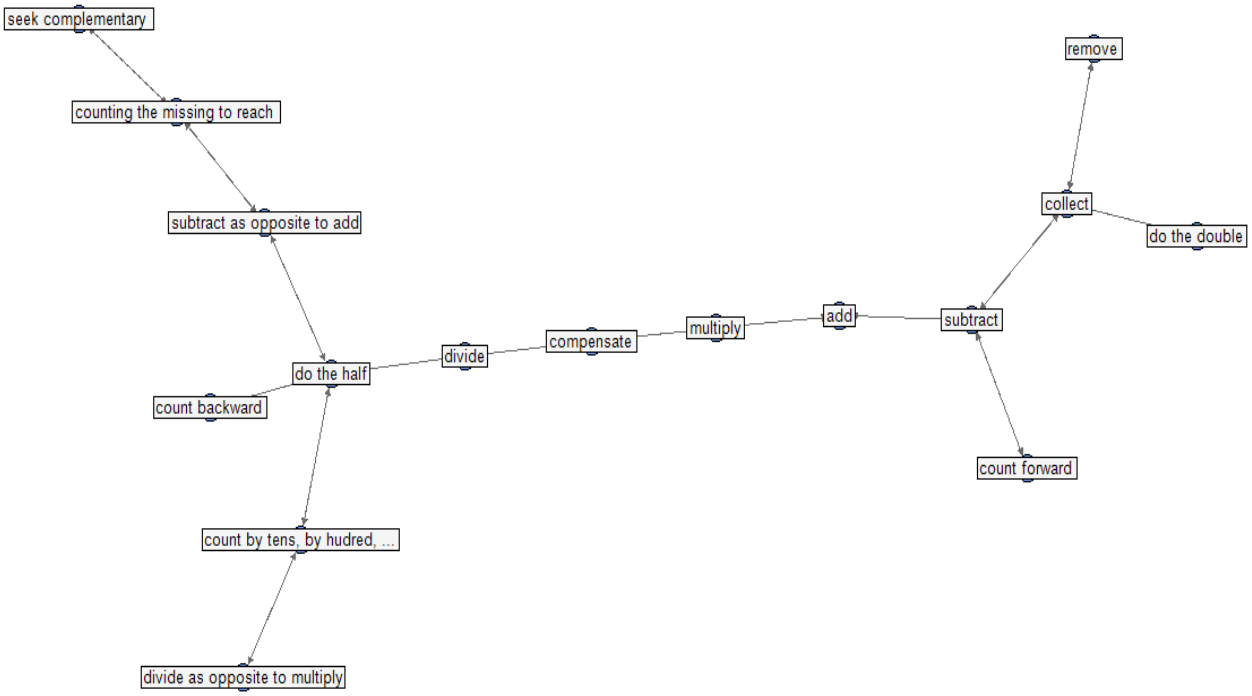

Figure 4. Pathfinder Associative Network (Subject 10).

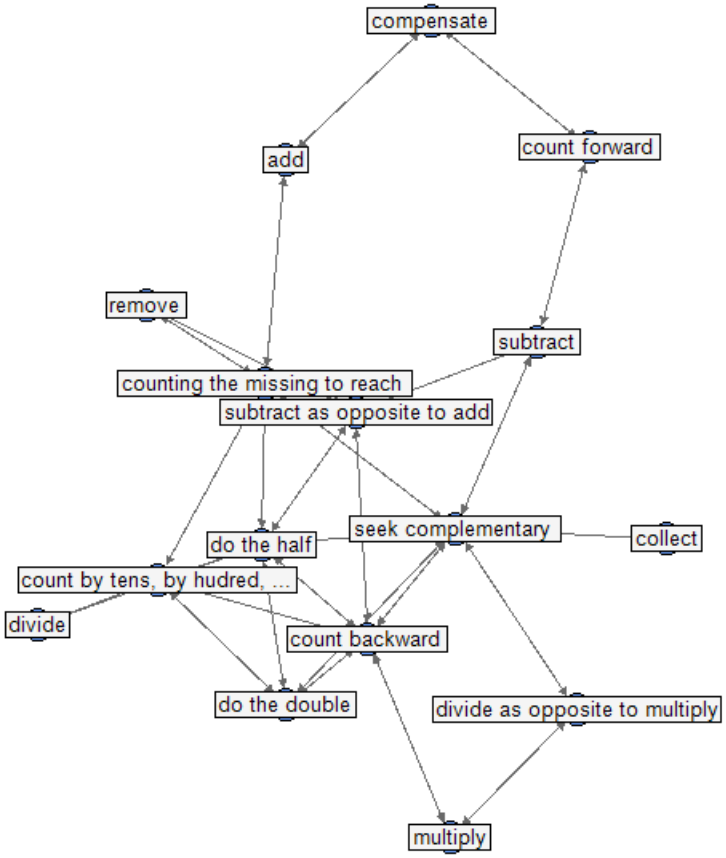

Figure 5. Pathfinder Associative Network (Subject 11).

Table 1

Coherence and Mental Calculation Skills

Subject	Mental calculation skills	Coherence
Subject 1	Bad	0.213
Subject 2	Good	0.564
Subject 3	Good	0.614
Subject 4	Moderate	0.395
Subject 5	Moderate	0.421
Subject 6	Bad	0.250
Subject 7	Good	0.491
Subject 8	Moderate	0.519
Subject 9	Bad	0.434
Subject 10	Good	0.678
Subject 11	Bad	0.284
Subject 12	Bad	0.326
Subject 13	Moderate	0.311
Subject 14	Good	0.569

Table 2

Spearman's Rho Correlation Test

			Mental calculation skills	Coherence
Spearman's Rho	Mental calculation skills	Correlation coefficient	1.000	0.839
		Asymptotic Sig. (bilateral)	.	$p = 0.000$
		N	14	14
	Coherence	Correlation coefficient	0.839	1.000
		Asymptotic Sig. (bilateral)	$p = 0.000$	.
		N	14	14

Discussion and Conclusions

The results obtained allow us to ensure that the technique of Pathfinder Associative Networks can represent the cognitive structure of the subjects in different fields of knowledge. Our results are in line with other studies using similar techniques (Jonassen et al., 1993; Eckert, 1997; Chen, 1999; Moya et al., 2004).

The graphical representation of knowledge structure allows us to recognize what its main elements are and also evaluate important features of this structure. The applications of this technique, as we showed in our work, can be extended to areas, such as mental calculation.

In our case, we have shown that teachers, who believe they have good capacity for mental calculation, have cognitive structures more coherent, centered around a few strategies for calculation, but well-organized. These results are in line with those obtained by Chi, Feltovich, and Glaser (1981) in connection with problem solving.

Our proposal is that recognizing these strategies in the most competent individuals, we can convey students to learn them more effectively.

As for the software Goluca that we used to represent the Pathfinder Associative Networks allows a similar way to other programs, such as Knot and Pathfinder, it represents the cognitive structure of the subject and get data from it, but it has other possibilities including that we emphasize its greater ease of use, friendly interface, potential in working with different data types (verbal, graphic...) and different modes of acquisition of proximity values, so that the process of acquiring information about the cognitive structure can be extended to many different themes and subjects.

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