

## **Integration of environmental education in science curricula in secondary schools in Benin, West Africa: Teachers' perceptions and challenges**

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### **Abstract**

The first purpose of this descriptive study was to provide information regarding implementation of the compulsory science curricula in secondary school settings in the Republic of Benin in West Africa in which were infused elements of environmental education (EE). The second was to investigate science teachers' attitudes towards teaching environmental topics, as well as specifics regarding self-efficacy, teaching practices, and perceived barriers in teaching EE. A Likert-style survey was administered to a total of 537 secondary school science teachers composed of two subpopulations. Ten teachers (5 SPCT and 5 BES teachers) were interviewed. A mixed methods research design was utilized to provide a fuller understanding of participants' responses. The findings of this study showed that: (1) all teachers indicated strong support for the importance of EE for secondary science students; (2) BES teachers reported significantly greater *Personal Efficacy* than did their SPCT colleagues; no significant difference between BES and SPCT on the Teaching efficacy scale; (3) teachers indicated use of a diverse set of instructional strategies; (4) teachers had a mean response in the moderate range to perceived barriers; and (5) the BES teachers had a statistically significant lower mean for perceived barriers than did the SPCT teachers. Science teachers' empowerment to teach EE issues in their class and the requirement for these topics in teacher education and professional development programs are the major implications derived from the study. Finally, suggestions for further research related to these topics are offered.

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### **Introduction**

At the beginning of the twenty-first century, the nations of the world face a host of environmental issues that demand attention. For generations, some of these issues have troubled the world and continue to defy easy solutions. At the 1972 United Nations Conference in Stockholm on the Human Environment, the recommendation was made that every nation promote and develop environmental education (EE) programs (UNEP, 1972). Since that time, many nations have implemented various types of EE programs within schools. Wang et al. (2010) indicated that the fundamental way to resolve problems of the environment is by fostering

and raising public environmental awareness, enhancing people's sense of responsibility for protecting the environment, and promoting harmony between humankind's behavior and the environment by means of EE and training. EE increases people's knowledge and awareness about the environment and associated challenges, develops necessary skills and expertise to address the challenges, and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action (UNESCO, Tbilisi Declaration, 1978).

At its core, EE strives to engage the global citizenry in new ways of thinking and acting in, with, and for the environment—contributing to a more environmentally literate population. EE seeks to change the learner's cognitive, affective and participatory knowledge, skills and behavior (Carleton-Hug & Hug, 2010). In the 1960s and 1970s, introducing EE into schools was a complex undertaking involving instruction across a range of disciplines, including science, geography, economics and social sciences. Bregman and Fisher (1999) indicated that during this period in Europe, EE was taught mainly by science teachers. In fact, of the subjects taught in secondary schools, science is often perceived as one that can make a significant contribution to EE (Ko & Lee, 2003). In science education, traditions such as science-technology- society (STS) and socioscientific issues (SSI) have been associated with EE (Amirshokoohi, 2010), suggesting the role EE can play in integrating both environmental science content and sociopolitical issues.

Researchers and institutions have promoted many ways to teach EE in formal school systems. Environmental Education and Training Partnership (2004) identified four broad approaches and techniques that are being used to incorporate EE into schools, and more specifically the curriculum. These include infusion, imposition, insertion, and framing. Infusion is the incorporation of environmental concepts, activities, and examples into existing curricular goals. Imposition refers to making environmental topics requirements within the curriculum. Insertion is the addition of an environmental unit or course to the class or curriculum. Framing refers to eliminating the subjective boundaries of traditional disciplines and instead creating a structure of study that integrates subject areas.

Bregman and Fisher (1999) state there are only two ways to deliver EE. Either it can be taught as a separate subject with “blocked” instruction time (similar to the insertion model), or it can be “infused” into other subjects in the curriculum. In reality, the blocked approach is rarely used, primarily because of the difficulties (including costs) inherent in adding one more subject to an already crowded curriculum. The solution has been to infuse environmental topics into a number of existing subjects, such as biology, physics, chemistry, and social studies. Thus EE has been launched into formal education settings as an all-embracing, cross-curricular theme. The infusion approach often involving students in project work, is well-suited to a student-centered classroom, where the teacher serves as a facilitator of student learning, but is less well-suited to a teacher-centered classroom.

Osin (1998), among others, supports the infusion approach of delivering EE, by providing several examples of developing countries that have infused EE across the curriculum. He asserts that students learn best by “doing” and thus schools should devote much more instructional time to project activities related to real-world issues, including environmental issues. Like other countries worldwide the Republic of Benin's educational leaders when

designing the Nouveaux Programmes d'Etude (the *New Study Programs or NSP*) (MEPS, 2000), a competency-based secondary curriculum, infused environmental concepts, activities, and topics into existing science curricula.

Researchers have investigated teachers' attitudes and perceived barriers to teaching EE after infusion of EE elements in the science curricula. Ko and Lee (2003) conducted an exploratory study of Hong Kong secondary Integrated Science teachers' perceptions of EE using both a 7-point Likert-style questionnaire and interviews to collect data. The participating teachers were questioned regarding attitudes, perceived barriers, and current emphasis on teaching EE. Teachers' attitudes were favorable; teachers' self-efficacy beliefs were moderate; and barriers to teaching EE were also moderate. Ko and Lee found that Integrated Science teachers' attitudes toward EE, skills of teaching EE, beliefs in the relevance of Integrated Science to EE, and intentions of teaching EE in Integrated Science classes were associated with their actual ways of teaching EE. Teachers tended to teach more EE if they held more favorable attitudes toward EE, had more skills in teaching EE, believed more in the relevance of Integrated Science to EE, and would actually teach more EE in Integrated Science classes if they had fewer constraints. Moreover, variations in EE teaching were reflected in teachers' personal emphasis on EE, use of a variety of teaching methods and out-of-school EE related practices.

Kim and Fortner (2006) explored issue-specific barriers to teaching environmental issues among 41 self-selected secondary science teachers attending national and regional conferences during 2003. Teachers' perceived current and preferred teaching levels for 23 environmental issues and perceived barriers to teaching the selected issues were studied using a paper and pencil survey. Barriers identified from the literature were appraised by the teachers and compared with their current and preferred teaching levels for the environmental issues. Among this group of teachers, barriers were issue specific rather than generally applied to every EE issue.

### **Environmental Education in the Republic of Benin**

The Republic of Benin is located in West Africa between Nigeria and Togo. It borders Niger and Burkina Faso in the north and the Bight of Benin in the south.

In the Republic of Benin, many documents deal with and encourage the protection and preservation of the environment. The Benin Constitution of December 11, 1990, article 27 (Journal Officiel de la République du Bénin, 1991) in particular, stipulates: "Every person has the right to a healthy, satisfactory and lasting environment and has the duty to defend it. The State watches over the protection of the environment" (p. 6).

The Benin National environmental action plan or PAE (Ministry of Environmental Habitat and Urban Planning, 1993) defines Benin policy goals concerning the environment. This plan includes seven programs which are: (1) education, training sensitization and communication about environment; (2) research action on soils; (3) management of the ecological diversity; (4) management of water resources; (5) improvement of the context of rural life; (6) improvement of

the context of urban life; and (7) institutional and legislative context, system of information on environment.

The National Agenda 21 was adopted by Benin during the Council of Ministers on January 22, 1997. This document, in accordance with the structure of the Agenda 21 (UNEP, 1992) adopted in June 1992 in Rio de Janeiro, is organized in four sections which are: (1) the social, economic and cultural dimensions; (2) the conservation and the management of resources in the intention of development; (3) the reinforcement of the role of principals group; and (4) the means of execution.

Benin's education system is based on a high level of financial, administrative, and pedagogical centralization. In accordance with the cited policy documents, the *New Study Programs (NSP)* (MEPS, 2000) was implemented in Benin primary schools in 1995 and in secondary schools in 2001. Benin educational leaders infused EE elements in the Science (physics, chemistry and technology or SPCT) and Biology and Earth (BES) curricula. The moral values included within NSP stress the significance of EE in schools. SPCT curriculum develops in learners the respect of the natural world, protection of the natural and cultural heritage of Benin; and the struggle against pollution. In short, it encourages enhanced overall quality of life by the sensitive utilization and responsible use of technology and applied research, which are the products of physics, chemistry and technology. BES develops in learners respect for individual life and for the environment, concern for health and security, a sense of responsibility, respect for public welfare, a sense of effort and personal discipline, and the quest for autonomy.

Overall, EE programs in SPCT and BES aim to (1) help students develop factual knowledge about the natural environment, particularly with regard to how ecosystems work and human impacts on the natural environment; (2) foster more positive perceptions about the value of the natural world; (3) develop eco-friendly habits, such as promoting recycling and producing less waste; (4) engage students in environmental reclamation projects and local action; and (5) develop students' psychological and spiritual relationship with nature. EE helps develop new knowledge, skills and values for attaining a better quality of environment and higher quality of life. It can bring about changes in the attitudes of citizens to do something concrete toward resolving current environmental problems and in preventing new ones. The Appendix presents the EE topics infused (Bregman & Fisher, 1999) in the textbook chapters or learning situations in SPCT and BES secondary curricula in Benin. In order to effectively teach EE topics infused into the science curricula, many teaching strategies aligned with the competency-based approaches have been proposed to teachers. These strategies encompass guided discovery, experiments, role-playing, value judgment, problem-solving and project development. The two later strategies include related process skills (such as: investigation, individual work, team work, debate, study of the milieu, etc.). Problem-solving and project development are two of the most important competencies to acquire and develop and should be used during EE as essential strategies of teaching and learning.

Despite the compulsory nature of the science and EE curricula, there are many logistical and personal barriers hindering the teaching of science and EE in the Republic of Benin. Logistical barriers (Ko & Lee, 2003) include lack of teaching materials, science laboratories and

equipment, textbooks, sufficient funding, and access to outdoor learning laboratories. Unqualified or under qualified teachers, overcrowded classrooms, heavy teacher workload, and an overloaded curriculum are also barriers. Personal barriers focus on teacher traits, such as teachers' attitudes toward teaching EE (Ko & Lee, 2003). Kim and Fortner (2006) asserted that environmental issues have various ranges in terms of complexity, uncertainty, and intangibility, and teachers may have difficulties in addressing more complex and uncertain issues.

### **Rationale for the Study**

Agenda 21 (UNEP, 1992) has exerted strong pressure on many governments to develop EE policies and curricula. The results of the current study may help decision makers at different levels to take actions in order to improve the teaching of EE topics in secondary schools in Benin and elsewhere. The results of this study could provide leaders in the Ministry of Primary and Secondary Education and in educational research institutions with some base-line information on effective elements of EE teaching. The findings of the study have the potential to inform education and policy leaders about how to empower teachers while implementing educational reform and could provide research institutions, such as the National Institute for Training and Research in Education in Benin, with "some research-based data needed for a new public discourse in education in the future" (Clinchy, 1996, p. 92). The findings can be of great use to other developing countries.

### **Self-Efficacy and Teachers Beliefs**

The concept of self-efficacy was clarified by Bandura (1997) who characterized self-efficacy as the extent to which individuals believe they can organize and execute actions necessary to bring about a desired outcome. Self-efficacy is fundamentally concerned with the execution of control rather than the outcome action produces. Bandura (1997) also identified four specific sources of efficacy beliefs: mastery experiences, vicarious experiences, verbal persuasion, and arousal. Mastery experiences are direct encounters with success through engagement in a behavior that brings about a desired outcome. For example, student-teachers who facilitate laboratory experiments in which students demonstrate conceptual understanding may believe their actions led to student learning. These judgments are likely to increase their efficacy for conducting lab experiments in the future. If student-teachers watch experienced teachers successfully facilitate laboratory experiments, they might also develop a sense of efficacy because they saw how to implement the actions necessary to bring about students' success. This would be an example of a vicarious or observed experience leading to higher efficacy. When student-teachers do not have opportunities to observe, their mentor teachers might remind them of the teaching skills they have developed and provide them with specific suggestions. This would be an example of verbal persuasion, which appeals to the teacher's ability to bring about success. Finally, arousal is a physiological state involving the release of hormones that signal an individual to prepare for action. Arousal can be interpreted as both pleasant and unpleasant. The body's natural release of hormones while teaching can help teachers feel alert or excited to take on the challenges of the lesson; whereas, heavy release of hormones (as in the case of extreme nervousness) can be paralyzing rather than helpful.

Ashton (1984) published a groundbreaking study that fundamentally expanded the concept of efficacy to include the extent to which teachers feel confident they are capable of bringing about learning outcomes. Ashton identified two dimensions of teaching efficacy: general, the extent to which a teacher believes his/her students can learn material; and personal, the extent to which a teacher believes her/his students can learn under her/his instruction. Ashton argued that teachers' beliefs about their ability to bring about outcomes in their classrooms, and their confidence in teaching in general, play a central role in their abilities to effectively serve their students. Tschannen-Moran, Woolfolk Hoy and Hoy (1998) developed a model of teacher efficacy by identifying the ways in which efficacy judgments arise as a function of the interaction between teachers' self-analysis of a contextualized teaching task and the teachers' self-assessment of their personal teaching capabilities as related to the specific task.

Teacher efficacy beliefs are one type of belief within a system of interrelated self-beliefs. Moreover, teacher efficacy beliefs emerge, in part, as a function of teachers' global and specific judgments about themselves within the context of their classroom. In the field of teacher beliefs, there has been debate about how best to study the relationship between teachers' beliefs about themselves and the impact of these beliefs on classroom learning. Reviews of the impact of teacher efficacy conducted by researchers (Goddard, Hoy & Woolfolk Hoy 2000; Labone, 2004; Wheatley, 2005) reveal consistent findings: teachers who report a higher sense of efficacy, both individually and as a school collective, tend to be more likely to enter the field, report higher overall satisfaction with their jobs, display greater effort and motivation, take on extra roles in their schools, and are more resilient across the span of their career. Teachers with higher levels of efficacy are more likely to learn and use innovative strategies for teaching, implement management techniques that provide for student autonomy, set attainable goals, persist in the face of student failure, willingly offer special assistance to low achieving students, and design instruction that develops students' self-perceptions of their academic skills. Moreover, Woolfolk-Hoy and Davis (2005) argue that teachers who feel efficacious about their instruction, management, and relationships with students may have richer cognitive and emotional resources available to press students towards completing complex tasks and developing deeper understandings.

### **Purposes of the Study and Research Questions**

The purposes of this study were to: (1) describe the current state of the teaching of environmental topics infused in the secondary schools science curricula; and (2) investigate teachers' perceptions of and practices in teaching EE science curricula.

Four research questions were addressed in this study:

1. What are SPCT and BES teachers' attitudes towards teaching EE topics infused in the science curricula?
2. To what extent do SPCT and BES teachers possess self-efficacy in teaching the EE topics infused in the science curricula?
3. What are SPCT and BES teachers' practices and methods in their classroom related to the teaching of the EE topics infused in the science curricula?
4. What are SPCT and BES teachers' perceived barriers to teaching EE topics infused in the science curricula?

The first question was raised to explore teachers' attitudes and perceptions related to EE topics infused in the science curricula. In other words, the researcher wanted to investigate how both groups of science teachers view and conceive the EE topics infused in their curriculum.

The second question was intended to investigate teachers' self-efficacy or their behavioral control. The researcher's query was related to whether both groups of teachers have the confidence to teach the EE topics infused in the curricula and how they think they can impact students' knowledge and behaviors. In this question, the researcher expects BES teachers to be more confident to teach EE than their colleagues of SPCT.

The third research question was framed to examine teachers' teaching practices in their classroom. In Benin secondary schools, physical science is regarded as a "hard science", dealing with abstract theories and computations; even though there are hands-on activities and experiments. Biology and earth science is considered as a "soft science" more concerned with topics related to nature, fauna, flora, and using more hands-on activities and inquiry experiments. Therefore, the researcher would like to know if both groups of science teachers are using diverse teaching strategies to help students learn.

The fourth question was to investigate the types of barriers and challenges teachers encounter in their daily practice, in regard to EE and how they overcome these difficulties. Both the presence of barriers and the perceived difficulty in overcoming barriers contribute to teachers' decisions whether or not to carry out EE (Ko & Lee, 2003). In that sense, based on the different topics infused in the SPCT and the BES curricula, it is important to study the kind of barriers each group of teachers perceive as the most important when teaching. Based on the reasons mentioned above and due to the topics studied during their teacher preparation, the researcher assumes that BES teachers will indicate fewer difficulties in teaching EE than will SPCT teachers.

## **Research Methods**

### **Research Design**

A mixed methods research design (Creswell, 2002) was utilized to provide a fuller understanding of participants' responses (Patton, 2002). The goal of mixed methods research is not to replace either (qualitative or quantitative) approach but rather to draw from the strengths and minimize the weaknesses of both in a single research study and across related studies (White, 2007). Moreover, in EE research, a combined approach adopting different research methods is advantageous, or even essential to our understanding of the world (Lee, 2000). In this research, replicating slightly Ko and Lee's (2003) study, the quantitative method used a questionnaire and the qualitative method utilized semi-structured interviews.

### **Participants**

The participants were a convenience sample of Beninese secondary school science teachers who were invited in different centers of the 12 provinces of the country to mark students' examination papers. In order to help the reader comprehend how the data were

collected, details of the context of the study are presented. In Benin, the secondary school is divided into two cycles: one lower cycle of four years called *Premier Cycle* or first cycle (middle school) and an upper cycle of three years called *Second Cycle* (high school). The first four years prepare students to take an examination called *Brevet Elementaire du Premier Cycle (B.E.P.C.)*. The second cycle of three years prepares students for the *Baccalaureat* examination (or the college-entry examination), the most important benchmark and the diploma needed to enter higher education. Therefore, after the written part of these examinations was completed, some selected certified teachers are gathered in 12 provincial centers to mark students' papers. Taking advantage of these two periods of grading, the researcher with the help of secondary school inspectors who were supervising the grading administered the survey to the middle and high school teachers during a break and collected it immediately upon completion. Therefore, it can be advanced that the data were collected at the same time nationwide and from teachers qualified to teach in secondary schools in Benin. The questionnaire was administered to 537 teachers [488 males (92%), 44 females (8%), and 5 non-responders]. Teachers are certified either in SPCT or in BES. Participants' average age was 38 years and their average number of years of teaching was 10.75.

### Data Instruments

**Questionnaire.** The use of a questionnaire was chosen as the most suitable method to measure teachers' attitudes, practices, self-efficacy and perceived barriers. A well designed questionnaire, used in an appropriate way, may provide extremely useful and important data in terms of both quality and quantity; and it can assure, to a high degree, the validity and reliability of the study (Kyridis, Mavrikaki, Tsakiridou, Daikopoulos, & Zigouri, 2005). The questionnaire was based on a previously validated instrument by Ko and Lee (2003). Ko and Lee's instrument comprises eight subscales: attitudes toward science (five items); relevance of science education and environmental education (four items); attitude toward EE (four items); self-efficacy in teaching EE (eight items); current and intended emphasis on teaching environmental knowledge, attitude, and skills (nine items); current and intended teaching approach (three items); teaching methods (13 items); and barriers to EE (13 items). The modified instrument used in the present study encompasses five intact subscales out of the previous eight subscales. The five chosen subscales are most relevant to Benin's compulsory science curricula and secondary schools realities. Finally, the adapted instrument had two parts. The general information part dealt with teachers' age, gender, academic diploma, subject taught, number of years of teaching, and number of EE classes taken (during the pre-service and in-service years). The second part was made up of five subscales of the Ko and Lee instrument: attitude toward EE (four items); personal self-efficacy in teaching EE (eight items); teaching self-efficacy (nine items); teaching methods (13 items); and barriers to EE (13 items). The modified instrument has kept the original constructs intact and the robustness of the survey has not been compromised. Cronbach's alpha was calculated for the adapted instrument as a whole and for each of the subscales supporting the robustness of the instrument (Table 1).

Table 1  
*Reliabilities of Original and Modified Instruments and Subscales*

<b>Instrument / Subscale</b>	<b>Ko and Lee (2003)</b>	<b>Modified</b>
Entire Instrument	N/A	.816
Teachers' Attitudes	.8484	.928
Personal Self-Efficacy	.9446	.914
Teaching Self-Efficacy	.8683; .9048;.9385	.892
Perceived Barriers	.8149;.7238	.876
Teaching Methods	N/A	.761

In all subscales except Teaching Methods, each item was rated by the respondents using a Likert range of 7 – 1, with 7 identified as “strongly agree,” 6 moderate agree, 5 agree, 4 neutral, 3 disagree, 2 moderate disagree and 1 strongly disagree. In the Teaching Methods subscale, respondents indicated if they had used the strategy or not. Data are reported for the Likert items as means and for the frequency items as percentages.

The research setting was a French-speaking country, translation and back translation (Brislin, 1970) techniques were used to translate the instrument using two bilinguals. Many researchers (e.g. Ahyoung & Eun-Young, 1999) utilized the back translation procedure and acknowledged its effectiveness in cross-cultural translations. The first bilingual was a native French-African instructor and professional translator who translated the instrument from the source (English) to the target language (French). The second bilingual was an African literature professor from Benin teaching at the college level in Connecticut who blindly translated the survey back from the target language to the source. Then, the researcher compared the two versions of the instrument, noticing if each statement was identical.

**Interview.** The researcher conducted a 45-minute tape-recorded semi-structured interview with ten randomly selected certified teachers (5 SPCT teachers and 5 BES teachers) at their schools. The purpose of the interviews was to gain a deeper understanding of teachers' attitudes toward teaching EE topics infused in the science curricula, and the challenges they are facing in their practice. The interviews were also conducted to get a sense of the teachers' self-efficacy to teach EE. Teachers answered questions such as: “What do you think about the EE topics infused in the science curricula,?” “Do you think that you have enough knowledge related to EE topics infused in the curriculum to be able to teach them?,” “Do you think that your teaching of EE topics infused in the curriculum help your student learn about EE,?” “Could you explain to us the methods you use to teach the EE topics?” and “Can you tell us about some of the challenges facing teachers when teaching the EE topics?”

### **Data analysis**

Data analysis represents “the process of systematically searching and arranging the interview transcripts,” (Bogdan & Biklen, 2007, p. 159) accumulated to enable the researcher to come up with findings. The data from the instrument were analyzed (SPSS v.22) using quantitative descriptive and comparative statistics, such as means and standard deviation, frequency, dependent sample 2-tailed t-test and Pearson correlation. In a holistic analysis of factors affecting teachers' likelihood of teaching EE, a correlation was run on the four subscales

of the EE survey. A post-hoc observed power analysis was conducted, using SPSS v.22, (O’Keefe, 2007) to strengthen the ability to interpret the significance of the results. (Table 2).

The analysis of qualitative data followed a procedure recommended by Miles and Huberman (1994). Science teachers’ interviews were transcribed. The transcriptions previously in French were translated in English using back-translation (Brislin, 1970) techniques. Using the research questions as a guide, the researcher carefully read the qualitative data and identified and categorized parts of the interviews to determine the quantitative findings. The letters A, C and D in the tables below are the items’ labels in the research survey. The letter A indicates “teachers’ attitudes,” C teachers’ barriers and D teaching practices and methods. They are mentioned to help the reader follow the description.

## Results

### ***Research Question # 1: What are SPCT and BES teachers’ attitudes towards teaching the EE topics infused in the science curricula?***

All teachers indicated strong support for the importance of EE for secondary science students. They also indicated the importance of EE in teacher preparation programs. Teachers agreed that EE should engender “values and feelings of concern” for the environment. In the subscale, *Teachers’ Attitudes*, both SPCT and BES teachers indicated strongly agree ( $M = 6.024$ ,  $SD = 1.31$ ) The analysis of EE subscales reported in Table 2 indicated that there was no significant difference between SPCT and BES teachers’ attitudes toward EE ( $t = -1.872$ ,  $p = .062$ ) (Table 2).

Table 2

#### *EE Attitudes, Beliefs and Practices by Subscales and by Subgroup*

Variable	Group	N	M	SD	Partial Eta Squared	Observed Power	t	Sign.
Teachers’ Attitudes	All Teachers	537	6.024	1.31	.007	.464		
	SPCT	249	5.909	1.34			-1.872	.062
	BES	287	6.1211	1.27				
Personal Efficacy	All Teachers	532	4.2734	1.43	.030	.981		
	SPCT	247	4.0146	1.40			-4.034	.000**
	BES	285	4.5092	1.41				
Teaching Efficacy	All Teachers	525	4.2334	1.34	.007	.488		
	SPCT	246	4.1154	1.28			-1.933	.054
	BES	279	4.3414	1.37				
Perceived	All Teachers	520	4.0677	1.11	.015	.794		

Barriers	SPCT	242	4.2140	1.08	2.785	.006**
	BES	278	3.9424	1.13		

\*\*  $p < .05$

As indicated in table 3, for both SPCT and BES teachers, item A3 had the highest mean. Surveyed teachers indicated that they should provide students with opportunities to gain actual experience in resolving environmental issues. Second, they indicated that pre-service teachers should be required to take an EE methods class (item A2). Third, teachers recommended that EE should help students develop a set of values and feelings of concern for the environment (item A4). Finally, respondents pointed out that EE should be considered a priority in secondary school (item A1). Overall, both subgroups of teachers demonstrated strong positive attitudes toward teaching EE and acknowledged the significance of taking EE method classes during pre-service years (Table 3).

Table 3  
*Teachers' Attitudes Subscale Items, by Subgroup*

Item	<i>M</i> (All teachers)	<i>SD</i>	<i>M</i> (SPCT)	<i>SD</i>	<i>M</i> (BES)	<i>SD</i>
A1 Priority	6.00	1.54	5.85	1.65	6.12	1.42
A2 Methods	5.95	1.44	5.91	1.46	5.98	1.44
A3 Resolve	6.12	1.37	5.98	1.43	6.24	1.32
A4 Values	6.03	1.41	5.91	5.91	6.13	1.36

Qualitative data analysis supported these quantitative results. The interviewed teachers acknowledged that EE should be regarded as important for secondary school students in Benin. Indeed, when asked to express the significance of teaching the EE topics in secondary schools, one teacher responded:

Students should learn to be aware of the issues related to their environment. I believe that teachers should have the obligation to provide students with opportunities to gain experiences in resolving environmental issues. We, as grown people are acting to damage the environment. So, school and particularly science class are good places to prepare students to preserve the fauna and the flora and their immediate surroundings. (BES teacher's interview, 30 June 2012).

Another science teacher, while stressing the importance of the EE topics infused in the curricula, pointed out the relevance of the latter regarding the problem students are facing:

I'm not saying that the topics we're already developing with students are not important. However, I think that it's well-timed within Benin context and based on environmental problems people are encountering in the world to help increase our students' awareness about issues like the use of fertilizer and pesticides in the development of farming, all

kind of pollution, the use of chemicals in the food industry, climate change, deforestation, desertification, etc. (SPCT teacher's interview, 30 June 2012).

These interviewees have indicated the importance for teaching EE to students. They signified that as children represent the future of human race, teachers have the obligation to raise their consciousness to preserve their immediate surroundings.

All five SPCT teachers interviewed raised the importance of having professional development in teaching EE topics in order to learn more about content knowledge and pedagogical content knowledge. One of them stated:

It is very unfortunate that we didn't get those materials during our pre-service preparation. I believe that our Direction de l'Inspection Pédagogique (Direction of Pedagogical Inspection) should design professional development programs on that subject and implement them appropriately. Also, I think it is important that in our Superior Normal schools, teachers should design a course dealing with those topics we are supposed to teach now. In other words, a course coping with EE activities should be a requirement for pre-service teachers. (SPCT teacher's interview, 30 June, 2012)

From this and other interviews, it is apparent that teachers would like professional development programs in order to be able to teach the EE topics infused in the science curricula. Professional development for preservice and inservice teachers in EE can provide a meaningful context for multidisciplinary instruction which could alleviate some pressures and concerns about the packed curriculum (Weiland & Morrison, 2013).

***Research Question # 2: To what extent do SPCT and BES teachers possess self-efficacy in teaching the EE topics infused in the science curricula?***

In this study self-efficacy comprises Personal Efficacy and Teaching Efficacy. Results showed that in the scale of self-efficacy, both *Personal Efficacy* ( $M = 4.2734$ ,  $SD = 1.43$ ) and *Teaching Efficacy* ( $M = 4.2334$ ,  $SD = 1.43$ ) were moderate (Table 2). These findings suggest that science teachers believe they have the personal ability to teach the EE topics (personal efficacy) and at the same time their students could learn under their instruction (teaching efficacy). In regard to *Teaching Efficacy*, BES means were more positive overall, as well as for each of the 9 items: however, there was not a significant difference between BES and SPCT means in this subscale (Table 2).

Overall, even though results suggested that both groups of science teachers demonstrated a moderate position regarding their *Personal Efficacy* in teaching EE topics, they tended to believe that they have enough pedagogical content knowledge to teach the subject matter and that they could impact their students' achievement regarding environmental issues. These results also showed that BES teachers were more positive about EE than SPCT teachers. A significant difference was found between SPCT and BES teachers personal efficacy ( $t = -4.034$ ,  $p < .001$ ).

Contrary to the quantitative results, interview responses showed teachers' eagerness to teach EE even though they didn't attend EE classes during their teacher preparation. Only

24.95% of the respondents attended some EE classes during their pre-service years and 20.48% during their in-service years. One of the more upbeat BES teachers, declared:

I believe that I have knowledge background on environmental issues to teach the EE topics infused in the curriculum even though I didn't receive any training in that sense. My subject matter which is Biology/Earth science includes that kind of topics. The only thing to do is to read a lot of information related to the topics and to keep informed in order to be able to explain to students. In other words, you have to be a self-taught person. However, we still need workshops or professional development programs to improve that teaching. (BES teacher's interview, 30 June 2012).

Interviewees showed that they possess enough self-efficacy to be able to teach the EE topics. This showed that the respondent has stressed the dimensions of *Personal Efficacy* and *Teaching Efficacy*. *Personal Efficacy* concept deals with the sentence: "I have knowledge background on environmental issues to teach the EE topics infused in the curriculum." This sentence reflects teachers' perception of their personal ability to bring about desired results. The second dimension which is *Teaching Efficacy* is revealed in the following sentence: "I am sure if students attend my class and participate actively as recommended by the NSP, they will be able to understand and discuss effectively environmental issues." This sentence indicates teachers' perceptions of the consequences of their own teaching.

***Research Question # 3: What are SPCT and BES teachers' practices and methods in their classroom related to the teaching of the EE topics infused in the science curricula?***

Teachers indicated use of a diverse set of instructional strategies. Between 54% and 91% of participating teachers reported having used each of the listed strategies (Table 4). Of most interest is the high reported use of computer-assisted lessons (91.7% of the respondents), indoctrination (87.7%), audiovisuals/simulations (87.3%), role-playing (81.6%), value judgment (73.5%), and guided discovery (70.3%). Excepted for the indoctrination method, these practices and methods are consistent with Benin national document and policies (MEPS, 2000). SPCT teachers indicated that they use audiovisuals/simulations, computer-assisted lessons, indoctrination, guided discovery, field trips, and role-playing; whereas BES teachers mentioned they prefer computer-assisted lessons, indoctrination, audiovisuals/simulations, role-playing, value judgment and independent and Group Projects.

Table 4 shows the self-reported use of teaching methods by the Taiwanese teachers in Ko and Lee's (2003) study as well as those of this study. Of most interest is not the range, which varied from 86% to 9.8%, but that the lowest self-reported use, for computer-assisted lessons, was the highest reported usage among Beninese teachers.

Table 4  
*Teaching Practices and Methods in EE by Percentage of Use, by Subgroups*

Teaching Strategy Used	All teachers (%)	SPCT (%)	BES (%)	Ko & Lee (%)
D35 Field trips/Outdoors	54.1	82.9	29.5	27.4
D36 Guided Discovery	70.3	84.6	57.1	58.6
D37 Lecture	65.1	67.1	63.0	86.0
D38 Experiments	59.7	65.3	54.4	80.5
D39 Role-Playing	81.6	80.7	82.4	18.6
D40 Independent and Group Projects	68.6	74.3	63.4	60.5
D41 Critical Thinking Activities	59.2	67.6	51.6	53.0
D42 Audiovisuals/Simulations	87.3	89.5	85.3	63.3
D43 Computer -Assisted	91.7	88.7	94.4	9.8
D44 Value Judgment	73.4	73.6	73.1	23.7
D45 Behavior Modification	60.9	65.7	56.5	22.3
D46 Indoctrination	87.7	86.6	88.8	22.8

Teachers participating in the interview indicated that in order to teach the EE topics, they usually follow the instructions provided in their teaching guides and use the pedagogical processes related to Benin's NSP (MEPS, 2000). The NSP is a student-centered program allowing the child to mobilize all the necessary competencies to solve academically and socially constructed problems. NSP has a direct relationship between the subject matters and the relevance of knowledge, systemic and continuous learning, and endowing students the necessary way of thinking geared toward solving problems. NSP endorsed teaching methods include: problem-solving/critical thinking activities; projects development; guided discovery; experiments; value judgment activities; field trips; and role-playing. These methods are the coherent ways utilized by the teacher to help the student learn and to better master the subject matter content. The pedagogical process also includes developing relationships between teacher-student and student-student. One BES teacher recalled his role in the classroom while teaching the competency-based curriculum.

While interacting with my students in the classroom, my actions are very simple and consist of: (1) becoming aware of the students' prior knowledge regarding the learning topic; (2) taking into account their prior conceptions and misconceptions of the subject; (3) facilitating the learning environment (material, group, human resource); (4) proposing learning activities; (5) providing clear and precise guidance for proposed activities; (6) facilitating student's knowledge building; (7) encouraging students to connect prior and new knowledge; (8) supporting exchanges between different small groups, and managing group work; assisting with the review and projection phase; and (9) constantly performing formative assessments. (BES teacher's interview, 30 June 2012)

One of the SPCT teachers indicated that he is no longer using lecture and indoctrination strategies. He identified the teaching strategies that he frequently used in the classroom. He stated:

Sometimes, I help my students to perform role-playing activities. I learn this strategy during a workshop funded by the American Peace Corps. I use also lessons plans provided in the teaching EE guide that I received during that professional development. I believe that students learn better when their classmates play an educational drama. Every now and then, I design critical thinking activities where students must demonstrate their abilities to define an environmental problem, collect data related to the problem, analyze the data, draw a conclusion and communicate the findings. I also use value judgment activities during which after reading a text or an article students must make a judgment of rightness or wrongness or the usefulness of facts containing in the article. (SPCT teacher's interview, 30 June, 2012)

The statements of these two science teachers are aligned with Bregman and Fisher's (1999) findings related to the ways of delivering EE. They also stressed two teaching strategies recommended in the NSP science curricula.

***Research Question # 4: What are SPCT and BES teachers' perceived barriers to teaching EE topics infused in the science curricula?***

Overall, the surveyed secondary science teachers had a mean response in the moderate range to perceived barriers ( $M = 4.0677$ ,  $SD = 1.11$ ). The BES teachers had a statistically significant lower mean ( $M = 3.9424$ ,  $SD = 1.13$ ) for perceived barriers than did SPCT teachers ( $M = 4.2140$ ,  $SD = 1.08$ ). The most important barriers to teaching EE mentioned by both groups of teachers are lack of: (1) instructional materials ( $M = 5.15$ ,  $SD = 1.90$ ), (2) funding ( $M = 4.97$ ;  $SD = 1.94$ ), (3) principal support ( $M = 4.57$ ,  $SD = 1.85$ ), and (4) and knowledge of EE ( $M = 5.57$ ,  $SD = 2.03$ ). Teachers did not perceive the following factors as barriers: (1) access to available natural environmental ( $M = 3.26$ ,  $SD = 1.92$ ); (2) safety problems ( $M = 3.95$ ,  $SD = 1.95$ ); (3) EE not relevant to teaching ( $M = 2.62$ ,  $SD = 1.68$ ) and (4) no interest in teaching EE ( $M = 2.68$ ,  $SD = 1.74$ ) (See Table 5).

Table 5  
*Perceived Barriers by Subscale Items and Subgroups*

Item	$M$ (All teachers)	$SD$	$M$ (SPCT)	$SD$	$M$ (BES)	$SD$
C22 Class Time	4.14	2.08	4.27	2.06	4.01	2.10
C23 Prep Time	4.16	2.02	4.34	1.98	3.99	2.03
C24 Materials	5.15	1.90	5.07	1.89	5.21	1.90
C25 Funding	4.97	1.94	4.98	1.92	4.97	1.94
C26 Support	4.57	1.85	4.52	1.86	4.62	1.83
C27 Knowledge of issues	4.23	2.09	4.58	2.07	3.93	2.06

C28 Knowledge of EE	4.57	2.03	4.99	1.95	4.19	2.02
C29 Class size	4.46	2.13	4.69	2.04	4.27	2.18
C30 Access	3.26	1.92	3.36	1.95	3.17	1.88
C31 Safety	3.95	1.95	3.97	1.85	3.92	2.04
C32 Not relevant	2.62	1.68	2.68	1.68	2.58	1.68
C33 No interest	2.68	1.74	2.97	1.88	2.43	1.57

Interviewee's responses supported the quantitative results. Participating teachers viewed lack of instructional materials and funding as the two major barriers. In response to the question related to barriers to teaching EE topics infused in the science curricula, one teacher stated:

I would say that many things are holding us back in our job as science teachers. First, we lack instructional materials in our schools. Most of the schools have laboratories, but these are empty. Sometimes, when a school has the materials, teachers lack the necessary trainings to use the materials. So, we need materials and professional development programs. We do not have financial supports to buy simple materials. Other barriers are school principal support and large class sizes. Sincerely, I don't know how we can teach effectively in overcrowded classrooms. Related to teaching EE topics, really we need to be trained in order to be effective before our students. (BES teacher's interview, 30 June, 2012).

The BES teacher's response seen above listed obstacles in teaching both science and EE topics. Most of the respondents indicated that the obstacles hindering teaching EE topics are identical to those in teaching science.

Table 6  
*Correlations for Study Subscales*

Variable		1	2	3
1. Teachers' Attitudes	Pearson Correlation	--		
	Sig. (2-Tailed)			
2. Personal Efficacy	Pearson Correlation	.224**	--	
	Sig. (2-Tailed)	.000		
3. Teaching Efficacy	Pearson Correlation	.076	.390**	--
	Sig. (2-Tailed)	.083	.000	
4. Perceived Barriers	Pearson Correlation	.067	.006	.057
	Sig. (2-Tailed)	.125	.895	.198

$p < .00$  (two-tailed test);  $N = 532$

In a holistic analysis of factors affecting teachers' likelihood of teaching EE, a correlation was run on four subscales contained in the EE survey. For the entire sample of SPCT and BES teachers, there are two pairs of significantly related factors. First, there was a significant correlation between *Teachers' Attitudes* and *Personal Efficacy*. The  $r$  value ( $r = 0.224$ ) showed a low correlation between Teachers' Attitudes and Personal Efficacy; however,  $r^2 = .005$  which is a coefficient of determination indicated that 5 % of Teachers' Attitudes can be accounted for by Personal Efficacy.

Second, there was a significant correlation between Teaching Efficacy and Personal Efficacy ( $r = .390$ ,  $p < .001$ ) accounting for 15.2 % of the total variance. These statistical relationships suggest the importance of the interplay between attitudes, knowledge, and beliefs in the effective teaching of EE (Table 6).

### Discussion of Results

This study was designed as a descriptive study to (1) provide information regarding implementation of the compulsory science curricula in secondary school settings in Benin in which were infused elements of EE and (2) investigate the possible relationships between science teachers' perceptions toward teaching environmental topics, specifically regarding self-efficacy, teaching practices, and perceived barriers in teaching EE. The following four sections discuss new knowledge to be added to the existing literature regarding EE.

#### *Discussion of findings # 1*

Participating teachers indicated strong support for the importance of EE for secondary students. This finding supports results for Asian studies which demonstrated that teachers have positive attitudes toward teaching environmental issues (Chapman & Sharma, 2001; Ko & Lee, 2003). Support for the importance of EE is founded in contemporary environmental issues. Awareness of global warming, land degradation, acid rain, depletion of natural resources, water pollution, and many other environmental problems, teachers understand that there is an urgent need to preserve the environment and improve it qualitatively not only for the present, but also for future generations. Many EE supporters recognize that the environment is the crucible in which identities, relations with others and "being-in-the-world" are formed. In some developing countries, teachers are not supportive of the infusion of EE in science curricula (e.g., Jekayinfa & Yusuf, 2004). The current study revealed that Benin secondary school science teachers understand the significance of environmental issues and support the teaching of EE topics.

#### *Discussion of findings # 2*

The surveyed teachers assumed that they possess the competencies to teach the EE topics infused in the science curricula; and moreover, after attending their class, their students could have more knowledge on the impacts of their behavior on the environment or they could better understand the values underlying environmental issues. This finding can be explained in two ways.

First, we could advance that teachers are aware of the various environmental problems like pollution, green house effect, global warning, ozone layer depletion, waste accumulation,

health effects, population explosion, wild life, forests, and limited natural resources including energy. Therefore, they have decided to teach environmental issues despite lack of formal professional development. During their interviews, teachers mentioned that they utilized the teaching guides and lesson plans provided by diverse national environmental organizations such as the Benin environmental association and international organizations such as the American Peace Corps.

Second, their determination to teach the EE issues without taking any prior classes in the subject matter is surprising. This finding enriches the knowledge in the domain of teaching EE; and we could state like Yusof et al. (2011) that teachers' self-efficacy in teaching EE is related to their attitudes and awareness towards environment. This study uncovered a cultural change in Benin teachers' behavior inherited since the colonial period. Indeed, Kelani and Khourey-Bowers (2012) indicated that teachers will not try out the topics they did not learn during their teacher preparation; and that this behavior could be traced to the colonial type of education received by some African scholars or teachers, which does not typically empower teachers to learn by themselves, take ownership and be creative.

### *Discussion of findings # 3*

This study indicates that all participating teachers showed greater diversity of instructional strategies than teachers surveyed with comparable instrument by Ko and Lee (2003) in Hong Kong. See Table 4. Teaching methods such as computer-assisted lessons, indoctrination, audiovisuals/simulations, role-playing, value judgment, and guided discovery have the higher mean score.

First, the present study highlights the use of technology by Benin science teachers. Indeed, in recent years, most science teachers are using technology such as audiovisuals/simulations and computer-assisted lessons. This change in Beninese science teachers' behavior is aligned with Clifford' (1983) assertion stating that technology will not replace teachers, but teachers who do not use technology will be replaced. More importantly, however, the findings of this study reveal the use of diverse instructional strategies by Benin science teachers, mostly the use of new technologies to help students learn. This result enlightens us because of the preconceived idea that science teachers in developing countries are not ready to use new technologies in their classroom.

Second, the role-playing strategy followed by classroom discussions is commonly used in Benin secondary school to develop students' consciousness, and is thus a means to creating awareness and pro-environmental values. This strategy has the same goals as African tales and community theatre in some areas in Africa. Community theatre uses drama as an educational springboard and a means of creating awareness, developing skills, and inculcating values; it's also includes movement, song, role-play, interventions, and discussions (Okhakhu & Evawoma-Enuku, 2011).

Third, the NSP promotes student-centered approach to teaching, thus value-judgment and guided discovery are other strategies used by teachers in order to be in line with the goals of this compulsory curriculum in Benin schools. Students are taught to develop their critical thinking

and make value-judgment on different environmental issues. They are guided to awareness of local environmental issues as well as global issues.

Finally, the teaching strategy called indoctrination should not be so highly chosen because of the reasons related to the demands of NSP curriculum in use. Less use of indoctrination is consistent with the requirements of the learned-centered strategy supported by the new curriculum.

BES teachers had significantly greater teaching self-efficacy and lower perceived barriers than SPCT teachers. These findings could be explained in two ways. First, data analysis indicated that 37 % of BES teachers took some EE classes in their pre-service years and 22.3% in their in-service years; whereas only 13% of SPCT teachers attended some EE classes during their pre-service years and 19% in their in-service years. Therefore, the findings of this study showed that BES teachers have the pedagogical content knowledge and have had more opportunities to learn to teach the EE topics. Second, through the subject matters learned during their teacher preparation, BES teachers are much more aware of the environment and its related issues than their colleagues of SPCT. BES teachers interviewed indicated that because of some of their formal coursework, they are inclined to convey awareness of various environmental problems like pollution, green house effect, global warming, ozone layer depletion, waste accumulation, health effects, population explosion, wild life, forests, and limited natural resources including energy. This study highlights the difference between Beninese BES and SPCT teachers with regard to knowledge of EE issues and the related pedagogical knowledge.

#### *Discussion of findings # 4*

Almost all the perceived barriers to teaching EE have been considered by the surveyed teachers. The greatest barriers include lack of materials, funding, principal support, knowledge about environmental issues, knowledge about EE, class time, preparation time and class size. This study highlights, once more, the challenges teachers face in developing countries in general and particularly in Benin. The perceived barriers mentioned by teachers are typical for both EE and science teaching in Benin.

Physical sciences and biology/earth sciences are experimental sciences; however, they are not taught that way. Science teachers experience lack of materials, lack of funding and lack of principal support. When asking for instructional materials to use for the experiments in their classroom, science teachers are told that there are no financial resources, or funding for those materials. Sometimes, teachers are compelled to use their own money to buy small lab materials such as lighters, alcohol and distilled water. To solve this problem, school principals should be able to include teaching materials and science experiments funds in the school expenses at the beginning of the school year.

Preparation time and large class size are other challenges facing teachers in developing countries. In Benin, teachers are overwhelmed with their workload and their difficult teaching conditions (Kelani & Khourey-Bowers, 2012). Indeed, secondary school teachers face heavy teaching hours because of the shortage of teachers, overloaded curriculum, overcrowded classroom (it is common to find 80 or more students in a class), and are generally “the most

poorly paid of all professional workers” (Fafunwa, 1967, p. 57). After more than 40 years, this assertion is still typical.

Lack of knowledge about EE and lack of knowledge about environmental issues are two other challenges that Benin science teachers are experiencing in their job. There is no surprise that teachers mention these challenges, as they are related to teachers’ initial preparation. The study revealed that curriculum planners in Benin, when designing new program of study, did not take into account teachers’ prior preparation.

### **Implications of the Study**

Two implications emerged from this study. The first implication is regarding teachers’ empowerment to teach EE issues in their class. Short, Greer and Melvin (1994) defined empowerment as “a process whereby school participants develop the competence to take charge of their growth and resolve their own problems” (p. 38). Empowerment of teachers is a desirable ingredient of school improvement (Seed, 2008). Teachers in this study felt empowered to teach the EE topics even though they didn’t get formal pedagogical content knowledge themselves during their teacher preparation program. Nevertheless in this study, when faced with the urgency to develop students’ awareness about environmental problems, teachers decided to be self-taught, take ownership, be creative and teach the EE topics infused in their curriculum. Through this behavior, we can conclude like Blatt (2013), that the participating teachers have entered the empowerment stage of environmental identity development. Further research could investigate the impact of the implementation of this curriculum on student achievement.

The interviewees not only indicated that strongly supported of EE for secondary science students, but also raised the importance of introducing EE courses in teacher preparation programs. Therefore, the second implication of this study is for teacher education and professional development programs. On the one hand, aware that teachers are the cornerstones in educating students for the protection and the preservation of the environment, in-service programs should encompass courses related to environmental issues and the relevant pedagogical content knowledge; and these courses should be requirements for science teachers. Secondary school inspectors and professional development programs developers should design curricula incorporating the environmental issues and diverse teaching strategies that would enable teachers to teach well. McDonald and Dominquez (2010) argue that the science methods course is a logical home for EE methods, and that the impact of EE would be greatly increased if teachers were trained to teach EE. Teachers should learn how to help their students become pro-environmental adults. Further research could explore the relationship between students’ attitudes regarding environmental issues and the learned EE topics.

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## APPENDIX

### *Chapters or Learning Situations infused with EE topics in secondary schools*

Grade	Science Physics, Chemistry and Biology and Earth Sciences Technology (SPCT) (BES)		
	Ch.	Title of Learning Situation	
Grade 6	3	The rapid combustions	Title of Learning Situation Utilization of fertilizers and pesticides in the development of farming Feeding and man nutritional needs
	4	Water in its different states	
	5	Oh! Pollution, you are killing us	
Grade 7	3	The chemical compounds	I am learning to grow and maintain plants Living beings and us
	5	Physical properties of the gases	
Grade 8	5	How atoms are linked in molecules	Soil: Future of the man
Grade 9	5	Combustion of hydrocarbons and polymerization reactions	Man and the natural resources

<b>Grade 10</b>	3	Matter and its transformations around us	The cell founds the unit and the diversity of living beings Cycles of matter and fluxes of energy in the communities of living beings
	7	Soil and plants needs	
	8	Superficial water pollution and the water table (nappe phréatique)	
<b>Grade 11</b>	2	The study of some organic components and their properties	Conversion of the metabolites energy in usable energies by cells Knowledge of microorganisms and their utilization in agro alimentary and medical biology
	5	Temperature and heat	
<b>Grade 12</b>	4	Organic chemistry	
	6	Atomic and nuclear physic	

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