

# ***Teachers Candidates' Knowledge, Attitudes and Behaviors Within the Context of Environmental Education***

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**Abstract** — The purposes of this study were to determine participants' views on environmental problems ; assess their level of environmental knowledge, attitude and behavior; and investigate the relationships between environmental knowledge, attitude and behavior. Quantitative data were collected through a questionnaire administered to 133 teacher candidates enrolled in physical sciences and technology and biology and earth sciences teaching program in a public university in Africa. Results of the study showed that : (1) participants are aware of environmental problems and indicated the Ministry of environment, municipalities and daily news papers and magazines as the three most important sources of information which raise awareness; (2) they had a relatively high level of environmental knowledge, demonstrated positive attitude and high level of environmental behavior towards conservation, recovery and recycling ; (3) there was a significant correlation between students' environmental behavior and their environmental knowledge and a significant correlation between students' behavior and their attitudes as well ; and finally (4) participants environmental knowledge is a significant positive predictor of behavior and their environmental attitude is a significant positive predictor of their environmental behavior. Important educational implications were derived from the study.

**Keywords** — *Teacher Candidate; Environmental Attitudes; Environmental Behavior; Environmental Education; Environmental Knowledge; Environmental Problems.*

## **I. INTRODUCTION**

Various environmental problems pose a threat to environmental sustainability, among which global warming, loss of the earth's protective ozone layer, toxic pollution of air, water shortages, environmental noise, global climate change and loss of biodiversity. Other problems associated with environmental issues include population growth and consumption. 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 environmental education (EE) and training [1]. The 1977 Tbilisi Conference [2], which followed soon after the launch of the United Nations Environmental Program (UNEP), resulted in a declaration which listed seven directive principles for EE programs. After that conference, recommendations have been made that "the Tbilisi goals and objectives be further

clarified for use by teachers and youth leaders" (p.112) [3]. Moreover, Agenda 21 [4] has exerted strong pressure on many governments to develop EE policies and curricula. In that sense, many nations in the developed world and in the developing countries as well have implemented various types of EE programs within schools.

## **II. ENVIRONMENTAL EDUCATION IN SECONDARY SCHOOLS IN BENIN**

The Republic of Benin, located in West Africa, has adopted many documents such as the Benin National environmental plan and the Agenda 21 dealing with and encouraging the protection and the preservation of the environment. In addition, the Benin constitution of December 11, 1990, article 27 [5] in particular, stipulates: "Every person has the right to a healthy, satisfying and lasting environment and has the duty to defend it. The State watches over the protection of the environment" (p. 6). Taking into account the significance and the contents of these different documents, Benin educational leaders

infused EE elements in the secondary school sciences (physics, chemistry and Technology or SPCT and Biology and Earth Sciences or BES) curricula [6]. The moral values included in the general orientations of the competency-based programs, in use in Benin since the 2001-2002 academic year, stress the significance of EE in schools. On the one hand, 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. On the other hand, 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; (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.

### III. KNOWLEDGE, ATTITUDES AND BEHAVIORS WITHIN THE CONTEXT OF ENVIRONMENTAL EDUCATION

The reference [7] defined environmental literacy as the “knowledge necessary to comprehend relatedness, and an attitude of care or stewardship... [An environmentally literate] person would also have the practical competence required to act on the basis of knowledge and feeling” (p. 92). The reference [8] suggests that ‘environmental literacy’ is the ultimate goal of EE. In that sense, environmental literacy encompasses an understanding of “how people and societies relate to each other and to natural systems, and how they might do so sustainability” (p. 92) [7]. On the other hand, knowledge of environmental issues includes an understanding of environmental problems/issues caused as a result of human interaction with the environment [9].

Environmental attitudes are defined as an enduring combination of motivational, emotional, perceptual and cognitive processes with respect to some aspects of our environment [10]; or a learned predisposition to respond in a consistently favorable manner with respect to a given object [11]. The term behavior is understood as an active responsiveness to current environmental issues, believed to be pro-environmental by the person performing the response

[12]. Responsible environmental behavior is a learned action that does not develop in a vacuum, but in response to interacting components [13]. Also, pro-environmental behavior is defined as an individual's actions that consciously seek to reduce the negative impact of human activities on the environment [14]

The assumption believes on “if people become more knowledgeable about the environment and its associated issues, they will, in turn, become aware of the environment and its problems and, be more motivated to act toward the environment in more responsible ways ” [15]. Beginning in the 1970s, early models of EE assumed some type of linear relationship between attitudes and behavior, where positive attitudes lead to positive behavior ([16], [14]), and positive behavior is perceived as an ultimate goal of EE ([17], [18]). Indeed, researchers found that EE would raise the awareness, knowledge and contribute to shift of attitudinal and behavioral aspect towards the environment and its sustainability in the society ([19], [20]).

### IV. RATIONALE FOR THE STUDY

As mentioned above, EE topics have been infused in the secondary school science (SPCT and BES) curricula in the Republic of Benin [6] since the 2001-2002 academic year. Now that these curricula have been taught in the secondary school settings for almost 15 years, we are in a position to investigate its outcomes on these beginning teacher candidates. The rationale for conducting this study is manifold. First, this study is needed because currently, there is little information in the Republic of Benin with regard to the effects of EE topics taught in students' everyday life. Second, the results of the current study may help educational decision makers in Benin and other nations to take necessary actions in order to review the EE topics infused in the science curricula and its teaching strategies.

Third, it is expected that the findings would enlighten teachers, educators at students teachers' colleges or trainings institutions to incorporate EE courses in their programs; for many researchers indicated that preservice teachers lacked the content knowledge needed to teach EE and that they experienced “ecophobia,” a fear of the outdoors and nature [21]. Finally fourth, the author thinks that the outcomes of this research study would most likely inform policy makers in developing nations about how to raise public awareness concerning environmental problems.

## V. ENVIRONMENTAL KNOWLEDGE, ATTITUDES AND BEHAVIORS OF TEACHER CANDIDATES

Educators, governments, and NGOs have taken and are taking action to educate youth with a stronger awareness of our dependence on the environment, a concern for future generations [22]. Thus, in order to achieve a higher level of environmental literacy amongst the students, it is necessary to implement effective environmental lessons and teachers play a crucial important role to attain this aim ([23], [24]). Among the recommendations included in the competency-based programs in use in Benin, it was mentioned that implementing the EE topics infused in the science curricula depends on well trained and motivated teachers and most importantly those who have the competencies and dedication to change positively students [25]. Indeed, if teachers lack proficiency in their environmental knowledge, skills and commitment, it is unlikely they will be able to effectively lead environmental change in schools ([26], [27]). Researchers indicated that insufficient teacher preparation has been identified as one factor in the weakness of EE efforts and EE curriculum ([28], [6]).

It is worth noting that concerning teacher candidates' environmental knowledge, researchers focus on different environmental issues. For example, the reference [29] among others investigators revealed that pre-service teachers do not possess the desired knowledge and understanding, and have misconceptions regarding complex issues such as the greenhouse effect, ozone layer depletion and acid rain. Whereas, the reference [30] reported that pre-service teachers demonstrated a moderate level of knowledge about marine pollution issues. Investigating teacher candidates' basic knowledge about environmental pollutants such as chemicals, electromagnetic pollution (mobile phones, computers, microwave ovens, etc.), fertilizer, medical sewages, plastic products and solid waste pollutant. The reference [31] found that they possess less pro environmental knowledge. According to these researchers, participating teacher candidates do not fully comprehend the underlying ecological and environmental concepts related to environmental issues.

Even though many scholars investigated college students' and/or secondary school teachers' attitudes towards environmental problems, there is little literature dealing with especially teacher candidates' attitudes concerning environmental issues. However, many authors related prospective teachers' attitudes towards environmental problems to environmental knowledge and/or environmental behavior. Generally, they found that pre-

service teachers have positive attitudes, limited environmental knowledge and low levels of environmental behaviour ([30], [32], [33], [34], [35]). In their research with Israeli pre-service teachers, the reference [33] revealed that the participants have limited knowledge and positive attitudes towards the environment. The reference [34] indicated that even though Turkish prospective teachers in the study demonstrated low levels of knowledge on current environmental issues, they expressed positive attitudes towards the environment along with a high degree of concern about the related issues. These researchers viewed pre-service teachers' positive attitudes as a reflection of their awareness and desire to identify with what they intuitively accept as correct values, regardless of their limited knowledge.

## VI. PURPOSES OF THE STUDY AND RESEARCH QUESTIONS

The major research purposes of this study were as follows :

- To explore teacher candidates' views on environmental problems.
- To assess the level of environmental knowledge, attitude and behavior among freshmen teacher candidates enrolled in physical sciences and technology (SPCT) and biology and earth sciences (BES) course teaching departments, and
- To investigate the relationships between environmental knowledge, attitude and behavior towards conservation, recovery and recycling.

The following research questions were raised to guide this study :

- What are the views on environmental issues of teacher candidates?
- What is the level of environmental knowledge, attitude and behavior possessed by the teacher candidates?
- What type of relationships exists between environmental knowledge, attitude and behavior towards conservation, recovery and recycling of teacher candidates?
- Does teacher candidates' environmental knowledge, predict environmental attitudes and/or environmental behavior ; and does teacher candidates' environmental attitude predict their environmental behavior towards conservation and recycling ?

## VII. RESEARCH METHODS

### A. Research Design

This research was conducted using quantitative method approach. Data were collected through a survey

questionnaire. This type of instrument is preferred because “surveys are used in educational research to describe attitudes, beliefs, opinions and other information” (p.38) [36]. In addition, the researcher considered that when the questionnaire is well designed, used in an appropriate way, it 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 [37].

### B. Population and sample

The population of this study was freshmen teachers candidates registered for the academic year 2015-2016 at the high normal school of education – where the researcher is an instructor teaching the subject of general pedagogy – after passing the baccalaureate examination, the most important benchmark and the diploma needed to enter higher education. This convenience sample was preferred because students were supposed to have been taught, during their high school years, the EE topics infused in their science curricula; also, they did not have any EE coursework at the university level. In total 133 student teachers (82.0 % males and 18.0 % females) comprising SPCT (28.2 %) and BES (71.8 %) students answered to the questionnaire. Table 1 provides descriptive statistics related to teacher candidates in the two departments.

**TABLE 1: DESCRIPTIVE STATISTICS OF TEACHER CANDIDATES IN THE SPCT AND BES DEPARTEMENTS**

| Department | Male | Female | Total |
|------------|------|--------|-------|
| SPCT       | 29   | 09     | 38    |
| BES        | 80   | 15     | 95    |
| Total      | 109  | 24     | 133   |

### C. Instrument

The Republic of Benin is a developing country. Therefore, because of the lack of suitable research tools in the literature, the items containing in the questionnaires, were selected from questionnaires used or adapted by authors from other developing countries (see [12], [31], [38]). The questionnaire had three parts: (1) general information; (2) environmental problems and factors affecting awareness and (3) statement. The general information part dealt with the participant's age, gender, field of study and whether or not the teacher candidate had heard about EE during his high school years. The second part of the instrument constitutes of two lists: the first is related to 12 environmental problems facing Benin people

and the second concerns with seven potential sources of information which may affect students' awareness. The participant was required to prioritize the environmental problems and the information sources affecting students' awareness. The third part of the questionnaire is composed of three subscales: environmental knowledge (17 items), attitudes towards the environment (22 items) and ecological behavior (20 items). Teacher candidates were asked to express their opinions using a 5-point Likert-type scale ranging from Strongly agree (1) to Strongly disagree (5). The modified instruments have kept their original constructs intact and the robustness of the surveys have not been compromised. Cronbach's alpha ( $\alpha = 0.892$ ) was calculated for the adapted instrument.

The questionnaire was administered to the participating teacher candidates at the same time during a class session. Thirty minutes before the end of its session, the researcher handed out the questionnaire to his BES students, while another teacher, in his class, administered it to his SPCT students.

### D. Data Analysis

Data gathered from the questionnaires were tabulated, analyzed and interpreted. In order to analyze the data, appropriate descriptive statistical tools such as percentage, frequency table, standard deviation, mean, and inferential statistics of linear regression and Pearson's correlation coefficient were used. On the one hand, mean and standard deviation as well as percentage and frequency table are used to investigate average scores with respect to science teacher candidates' views on environmental problems and their level of environmental knowledge, attitude and behavior. On the other hand, correlation coefficients were used to examine the type of relationships that exist among respondents environmental knowledge, attitude and behavior towards conservation, recovery and recycling.

## VIII. RESULTS

### A. Research question # 1: What are the views on environmental issues of teacher candidates?

To explore science teachers candidates' views on environmental issues, they were required to prioritize the environmental problems and the sources of information affecting their awareness.

TABLE 2: DESCRIPTIVE STATISTICS OF TEACHER CANDIDATES' VIEWS ABOUT ENVIRONMENTAL PROBLEMS AND INFORMATION SOURCES

| Environmental problems             | M    | SD   | Factors affecting awareness   | M    | SD   |
|------------------------------------|------|------|-------------------------------|------|------|
| Acid rains                         | 8.35 | 3.80 | Ministry of Environment       | 4.60 | 1.95 |
| Urbanization                       | 7.60 | 3.64 | Municipalities                | 4.49 | 1.67 |
| Population growth                  | 7.23 | 4.01 | Daily newspaper and magazines | 4.22 | 1.57 |
| Sound pollution                    | 7.06 | 3.43 | Family                        | 3.95 | 2.45 |
| Erosion                            | 6.85 | 2.93 | Internet                      | 3.74 | 2.47 |
| Shortening of natural resources    | 6.38 | 3.75 | Educational system            | 3.47 | 1.72 |
| Water pollution (river, lake, sea) | 5.92 | 3.00 | Radio-Television              | 3.28 | 1.74 |
| Decrease of biodiversity           | 5.90 | 3.21 |                               |      |      |
| Air pollution                      | 5.82 | 3.03 |                               |      |      |
| Soil pollution                     | 5.62 | 2.83 |                               |      |      |
| Solid waste/garbage                | 5.28 | 3.04 |                               |      |      |
| Deforestation                      | 4.90 | 3.30 |                               |      |      |

Regarding environmental problems, participating teacher candidates indicated that the first of these problems in the Republic of Benin is acid rains ( $M = 8.35$ ,  $SD = 3.80$ ) in the fields. The second, third and fourth most important problems are respectively urbanization ( $M = 7.60$ ,  $SD = 3.64$ ), population growth ( $M = 7.23$ ,  $SD = 4.01$ ) and sound pollution ( $M = 7.06$ ,  $SD = 3.43$ ). According to the participants, the least important of these environmental problems are Solid waste/garbage ( $M = 5.28$ ,  $SD = 3.04$ ) and deforestation ( $M = 4.90$ ,  $SD = 3.30$ ) in the Republic of Benin context (Table 2).

Results in Table 2 showed that Ministry of environment ( $M = 4.60$ ,  $SD = 1.95$ ), municipalities ( $M = 4.49$ ,  $SD = 1.67$ ) and daily newspapers and magazines ( $M = 4.22$ ,  $SD = 1.57$ ) were the three first sources of information with regard to raising their environmental. Participants indicated that the Internet, educational system and radio and television were less effective to raise their awareness regarding environmental issues in Benin.

B. *Research question # 2: What is the level of environmental knowledge, attitude and behavior possessed by student teachers ?*

To assess teacher candidates' environmental knowledge, 17 statements were proposed to participants related to the concepts or the nations they were supposed to have been taught in secondary school. Table 3 indicates that respondents had a relatively high level of environmental knowledge ( $M = 2.74$ ,  $SD = 0.43$ ). Most of the participants (70.65 %) answered correctly 12 over 17 (70.58 %) items containing in the knowledge subscale (table 4).

TABLE 3: MEAN SCORE OF RESPONDENTS RELATED TO THE SUBSCALES

| Instrument/Subscale     | M    | SD   |
|-------------------------|------|------|
| Environmental knowledge | 2.74 | 0.43 |
| Attitudes               | 2.50 | 0.40 |
| Behavior                | 2.14 | 0.37 |

TABLE 4: ENVIRONMENTAL KNOWLEDGE

| Declaration |                                                                                                                      | A (%) | NA (%) | UN (%) |
|-------------|----------------------------------------------------------------------------------------------------------------------|-------|--------|--------|
| B1          | Melting of the polar ice caps may result in a flooding of shores and islands                                         | 76.8  | 11.2   | 12.0   |
| B2          | Fossil fuels (e.g. gas, oil) produce CO <sub>2</sub> in the atmosphere when burned.                                  | 80.8  | 6.9    | 12.3   |
| B3          | All living beings (micro-organisms, plants, animals, and humans) are interdependent with one another.                | 75.6  | 3.0    | 21.4   |
| B4          | Poisonous metals are introduced into the food chain, for instance, via ground water.                                 | 41.7  | 36.2   | 22.1   |
| B5          | Ozone near the ground may cause respiration problems.                                                                | 71.7  | 18.9   | 9.4    |
| B6          | A change in climate caused by increased levels of CO <sub>2</sub> in the atmosphere is called the greenhouse effect. | 79.1  | 14.0   | 7.0    |
| B7          | Poisonous metals remain in the human body.                                                                           | 36.8  | 26.4   | 36.8   |

|     |                                                                                                                                                 |      |      |      |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|
| B8  | The world climate will probably massively change if CO <sub>2</sub> continues to be emitted into the atmosphere in as huge amounts as it is now | 84.3 | 6.3  | 9.4  |
| B9  | A reduced number of species may interrupt the food chain, affecting some subsequent species in the chain.                                       | 86.9 | 6.9  | 6.1  |
| B10 | The greenhouse effect does not result in the melting of glaciers in central Europe                                                              | 38.3 | 39.1 | 21.9 |
| B11 | The primary purpose of tree planting is to beautify the environment in terms of aesthetics                                                      | 14.5 | 4.5  | 81.0 |
| B12 | Since the environment can clean itself, human waste does not cause a problem.                                                                   | 4.6  | 3.8  | 91.6 |
| B13 | Instead of spending money on historical places, it is more advantageous for us to build luxurious roads.                                        | 48.5 | 13.1 | 38.5 |
| B14 | The government should give permission for building, on touristic purpose, in national parks and forests.                                        | 56.2 | 10.8 | 32.3 |
| B15 | The media news about polluted seas, rivers and lakes are exaggerated.                                                                           | 22.1 | 16.0 | 61.8 |
| B16 | The best way to build houses is to dry up the wetlands and build there.                                                                         | 20.9 | 20.9 | 58.2 |
| B17 | I do not think that recycling works as much as it is said.                                                                                      | 55.8 | 17.1 | 27.1 |

In Table 4, (like in Table 5 and Table 6) the Likert scale has been simplified; the researcher combined "Strongly agree and Agree" to Acceptance (A), "Strongly Disagree and Disagree" to Non Acceptance (NA) and maintained Uncertain (UN). NA doesn't necessarily mean wrong answer as for declarations B11, B12, B15 and B16, respondents should not accept.

It is important to mention that participating teacher candidates' answered were split for items B4 "Poisonous metals are introduced into the food chain, for instance, via ground water." B7 "Poisonous metals remain in the human body."; B10 "The greenhouse effect does not result in the melting of glaciers in central Europe." And B13 "Instead of

spending money on historical places, it is more advantageous for us to build luxurious roads."

To evaluate teacher candidates' environmental attitude towards conservation, recovery, and recycling, they were asked to express their opinions on 22 declarations containing in the attitude subscale. As indicated in Table 3, respondents demonstrated positive attitude ( $M = 2.50$ ,  $SD = 0.40$ ) towards the environment, as they were favorable to all the items proposed in the subscale. Adding the percentage of favorable answers and dividing by the number of items, we find that 76.74 % of participants answered favorably to all the 22 items (Table 5).

TABLE 5: ATTITUDES TOWARDS ENVIRONMENTAL ISSUES

| Declaration |                                                                                                                                                               | A (%) | NA (%) | UN (%) |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------|--------|
| B18         | Using rechargeable batteries instead of disposable batteries supports recycling.                                                                              | 81.7  | 7.6    | 10.7   |
| B19         | Giving old clothes to the people in need supports recycling.                                                                                                  | 72.5  | 6.1    | 21.4   |
| B20         | We should throw the used batteries and bottles into the appropriate trash bins.                                                                               | 87.0  | 0.8    | 12.2   |
| B21         | Using old newspapers for packing supports recycling.                                                                                                          | 57.1  | 15.1   | 27.8   |
| B22         | We should use both sides of white papers to support recycling                                                                                                 | 50.8  | 21.1   | 28.1   |
| B23         | For saving energy, I turn off the lights in my house when they are not used.                                                                                  | 91.6  | 2.3    | 6.1    |
| B24         | I can go from door to door to teach people recycling.                                                                                                         | 73.3  | 8.4    | 18.3   |
| B25         | I separate waste materials in my house for recycling                                                                                                          | 74.8  | 12.6   | 12.6   |
| B26         | I feel sad when I see people throwing away objects that can be recycled.                                                                                      | 86.0  | 6.2    | 7.7    |
| B27         | When I buy a product I pay attention ,whether its case is recyclable.                                                                                         | 81.9  | 11.8   | 6.3    |
| B28         | It makes me happy when people recycle used bottles, cans and paper.                                                                                           | 74.8  | 6.3    | 18.9   |
| B29         | Energy and water conservation in homes and workplaces should be done.                                                                                         | 87.4  | 3.9    | 8.7    |
| B30         | Exhaust emission inspection is unnecessary in vehicles.                                                                                                       | 22.9  | 14.5   | 61.8   |
| B31         | Global warming causes major tragedy for humanity.                                                                                                             | 86.2  | 3.8    | 10.0   |
| B32         | Rapid population growth and unplanned urbanization accelerate environmental pollution.                                                                        | 81.5  | 4.6    | 13.8   |
| B33         | Take measures for the protection of endangered species is an empty effort. There are a large number of species in the world, what if some may become extinct. | 28.2  | 6.9    | 64.8   |
| B34         | The environmental harm of Pesticides and synthetic hormones used in agriculture                                                                               | 20.6  | 9.5    | 69.9   |

|     |                                                                                                               |      |      |      |
|-----|---------------------------------------------------------------------------------------------------------------|------|------|------|
|     | is negligible.                                                                                                |      |      |      |
| B35 | Rapid destruction of natural resources creates a major problem for the future.                                | 92.9 | 0.8  | 6.4  |
| B36 | As the ozone layer is thinner in certain areas, only those regions are under threat.                          | 20.8 | 10.4 | 68.8 |
| B37 | In schools, radio and television, awareness-raising activities should be carried out in environmental issues. | 89.7 | 0.8  | 9.5  |
| B38 | Because much of the world is water, water resources will not deplete                                          | 23.0 | 15.1 | 61.9 |
| B39 | I don't worry about environmental problems.                                                                   | 6.5  | 1.6  | 91.9 |

Finally, as it can be seen from Table 2, participating science teacher candidates' demonstrated high level of environmental behavior ( $M = 2.14$ ,  $SD = 0.37$ ) towards conservation, recovery and recycling. Table 6 shows that almost all the respondents (78.66 %) were willing to engage and participate in activities related to conservation, recovery and recycling.

TABLE 6: BEHAVIOR TOWARDS ENVIRONMENT

|     | Declaration                                                                          | A (%) | NA (%) | UN (%) |
|-----|--------------------------------------------------------------------------------------|-------|--------|--------|
| B40 | For a livable environment, I can work voluntarily for a long time if needed.         | 88.2  | 3.9    | 7.9    |
| B41 | I do not waste water while I am brushing my teeth.                                   | 80.3  | 3.9    | 15.8   |
| B42 | I prefer environmentally harmless products, even if they are more expensive.         | 80.3  | 7.9    | 11.8   |
| B43 | I participate in environmental projects.                                             | 92.1  | 4.0    | 3.9    |
| B44 | My friends know me as a sensible person towards the environment.                     | 75.0  | 14.5   | 10.5   |
| B45 | I talk with people around me on environmental matters.                               | 90.6  | 3.9    | 5.5    |
| B46 | I can reutilize the back sides of used papers if possible.                           | 71.7  | 7.0    | 21.3   |
| B47 | I put dead batteries in the garbage.                                                 | 73.6  | 4.8    | 21.6   |
| B48 | I collect and recycle used paper.                                                    | 61.3  | 12.0   | 26.7   |
| B49 | If there are insects in my apartment, I kill them with a chemical insecticide.       | 40.2  | 6.3    | 53.5   |
| B50 | If I am offered a plastic bag in a store I will always take it                       | 41.7  | 12.6   | 45.6   |
| B51 | For shopping, I prefer paper bags to plastic ones.                                   | 59.5  | 8.0    | 32.5   |
| B52 | I am a member of an environmental organization.                                      | 49.6  | 17.1   | 33.4   |
| B53 | In the past, I have pointed out to someone his or her unecological behavior.         | 76.2  | 12.7   | 11.1   |
| B54 | I disperse my used clothes to other people can use                                   | 68.3  | 5.6    | 26.2   |
| B55 | I change my habits in order to contribute to the solution of environmental problems. | 85.8  | 5.5    | 8.7    |
| B56 | I support the activities carried out for the use of renewable energy sources.        | 86.6  | 7.1    | 6.3    |
| B57 | I turn off the light when leaving a room.                                            | 97.6  | 1.6    | 0.8    |
| B58 | I read in publications what I find about the environment.                            | 91.2  | 4.8    | 4.0    |
| B59 | I use detergents that do not harm the environment.                                   | 88.0  | 5.6    | 6.4    |

Table 6 shows that participating teacher candidates' answered were split for items: B49 "If there are insects in my apartment I kill them with a chemical insecticide." And B50 "If I am offered a plastic bag in a store I will always take it."

*C. Research question # 3: What type of relationships exist between environmental knowledge, attitude and behavior of teacher candidates?*

To examine the type of relationships that exist between science teacher candidates' environmental knowledge, attitude and behavior towards conservation, recovery and recycling, a correlation was computed on these subscales

contained in the survey. As Table 7 shows, a significant correlation between students' behavior and their attitudes; additionally, a significant correlation between students' behavior and their environmental knowledge. The  $r$  value ( $r = 0.260$ ) showed a low correlation between both factors; however, the coefficient of determination ( $r^2 = 0.0676$ ) indicated that 6.76 % of students' behavior towards environmental issues can be accounted for by their knowledge of these issues. Finally, the findings indicated that there was a significant correlation between students' behavior and their attitudes towards conservation, recovery and recycling. The  $r$  value ( $r = 0.507$ ;  $p < 0.01$ ) showed a moderate positive correlation between both variables.

TABLE 7 : CORRELATIONS BETWEEN PARTICIPANTS' ENVIRONMENTAL KNOWLEDGE, ATTITUDES AND BEHAVIOR

| Variable                   |                     | 1      | 2      | 3   |
|----------------------------|---------------------|--------|--------|-----|
| 1. Environmental knowledge | Pearson Correlation | ---    |        |     |
|                            | Sig. (2-tailed)     |        |        |     |
| 2. Attitudes               | Pearson Correlation | .099   | ---    |     |
|                            | Sig. (2-tailed)     | .260   |        |     |
| 3. Behavior                | Pearson Correlation | .232** | .507** | --- |
|                            | Sig. (2-tailed)     | .009   | .000   |     |

$p < .01$  (2-tailed test) ;  $N = 133$

D. Research question # 4: Does environmental knowledge predict environmental attitudes and/or environmental behavior; and does environmental attitude predict their environmental behavior?

Results showed that, participating teacher candidates environmental knowledge is a positive predictor of behavior towards conservation, recovery and recycling ( $\beta = 0.184$ ,  $p < 0.05$ ). Thus, environmental knowledge accounted for 38.5 % of the change in study participants' behavior. However,

the study indicated that environmental knowledge did not predict significantly teacher candidates' environmental attitude. Then again, when participants' environmental attitude is regressed on their behavior, the result showed that attitude is a significant positive predictor of their environmental behavior towards conservation, recovery and recycling ( $\beta = 0.489$ ,  $p < 0.000$ ). Thus, the study participant's attitude accounted for 29.1 % of the change in their environmental behavior (Table 8).

TABLE 8 : SUMMARY OF LINEAR REGRESSION ON THE STUDY VARIABLES

| Variables | Knowledge        |                |       |       | Attitude         |                |       |       |
|-----------|------------------|----------------|-------|-------|------------------|----------------|-------|-------|
|           | Beta ( $\beta$ ) | R <sup>2</sup> | t     | Sig.  | Beta ( $\beta$ ) | R <sup>2</sup> | t     | Sig.  |
| Attitude  | .099             | .010           | 1.132 | .260  |                  |                |       |       |
| Behavior  | .184             | .385           | 2.424 | 0.017 | .489             | .291           | 6.431 | 0.000 |

## IX. DISCUSSION OF THE RESULTS

When selecting beginning college students as participants of this study, one of the main goals of this research was to investigate the outcomes of the implementation, after almost 15 years, of secondary school science curricula in the republic of Benin in which were infused EE topics. The following four sections discuss new knowledge to be added to the existing literature regarding the outcomes on students of the implementation of EE programs.

### A. Discussion of findings from Research Question # 1

According to the participating teacher candidates, the most important environmental problems in the republic of Benin are acid rains, urbanisation, population growth, sound pollution and erosion. Even though this classification of environmental problems differs from others ([31], [38]), it is important to mention that these problems are effectively in Benin context. SPCT and BES teachers usually use different

teaching strategies such as discussions in small groups, lectures, exposés etc. to teach students about these environmental issues. Also, results showed that teacher candidates are aware of environmental problems through diverse sources of information such as Ministry of environment, daily newspapers and magazines as well as Internet. However, it is worth mentioning that educational system, through schools and media such as radio and television are the greatest channels of information with regard to environmental issues and pro-environmental behavior.

### B. Discussion of findings from Research Question # 2

Results from the study showed that student teachers had relatively high levels of environmental knowledge. This finding of the study is consistent with other researchers ([39], [31]). Even though participants did not select educational system as a primary factor of information, we can advance that the study respondents demonstrated that level of environmental knowledge because of the courses

received and the lessons learned from secondary school years. For example, secondary school students will demonstrate their understanding of ecological and environmental concepts related to environmental issues through sketches or shows during science fairs organized by schools to raise peoples' awareness. Then again, the findings of this study showed that teacher candidates exhibited positive behavior and a high level of environmental behavior towards conservation, recovery and recycling. These results strengthened the findings of other studies worldwide ([40], [41], [42], [33], [34]).

The overall results from the first two research questions indicated the impact of EE programs on secondary school students; as the underlying goal of EE is to help achieve awareness, knowledge, attitude and responsible behavior about the environment.

### *C. Discussion of findings from Research Question # 3*

The study results showed a significantly lower correlation between participants' behavior and their environmental knowledge and a significant positive, moderate correlation between students' behavior and their attitudes towards recycling, recovery and conservation. These findings are similar to other researchers' results ([43], [17], [34]). This study's findings provide insights into the goal of learning outcomes. When developing educational programs in Benin, the focus is on the role and efficacy of environmental knowledge and attitude development when the ultimate goal is the promotion of environmental behavior. For EE has long been as a critical step in the process of creating and environmentally literate population, leading to changing attitudes and behaviors of the population and a more environmentally sustainable way of life [43].

### *D. Discussion of findings from Research Question # 4*

It was found in this study that environmental knowledge is a positive predictor of teacher candidates' behavior and also attitude is a significant positive predictor of their environmental behavior towards conservation, recovery and recycling. These results corroborated the linear relationship between attitudes and behavior where positive attitudes lead to positive behavior ([16], [14]); and positive behavior is perceived as an ultimate goal of EE ([17], [18]). Also, these findings coincide with those of researchers ([42], [44]) which show that environmental knowledge is a powerful predictor of responsible environmental concern and behavior. Educational leaders in the Republic of Benin,

when integrating EE in the science curricula believe strongly in that relationship among environmental knowledge or literacy, attitudes and behavior. In that sense, teachers have been well prepared to implement the compulsory science curricula to change positively our students. Also, many NGO and international institutions such as Peace Cops working with the ministry of secondary education were associated in the process of teachers' training and the provision of teaching materials.

The limitations of this study were that a small sample of beginning pre-service science teachers enrolled in a three-year program at the high normal school of education of Natitingou was used and this does not represent all high school students that pass their baccalaureate examination. There is a need for further studies to investigate the impact on science students of the implementation of EE topics infused in the science curricula in the republic of Benin, in terms of awareness related to environmental issues, the environmental knowledge acquired, their attitudes and behavior towards the environment.

## **X. IMPLICATIONS OF THE STUDY**

Interpretations of the results led to two educational implications that could enhance EE topics teaching in secondary school settings in Benin, as well as in other developing countries with similar cultural contexts. Findings from the first two research questions showed that the EE topics integrated in the secondary school science curricula impact these students with regard to their environmental knowledge, attitude and responsible behavior towards the environment. This implies that secondary school teachers should be encouraged in their effort to teach environmental topics to their students. Teachers should be incited to pursue their remarkable job raising students' awareness and positively influencing their attitudes and behaviors towards the environment. Moreover, teachers should be empowered to infuse new topics or concepts taking into account students' real-life context and other existing and new environmental issues people are facing nowadays in the world.

Findings from this study indicated that environmental knowledge is a positive predictor of teacher candidates' behavior and also attitude is a significant positive predictor of their environmental behavior towards conservation, recovery and recycling. EE is a lifelong interdisciplinary approach with the aim of developing a world population, which is conscious of the environment. Therefore, the second implication of this study is to train the participants

who are prospective teachers to learn to teach the EE topics. Indeed, to perpetuate the impact of the EE topics for students and indirectly on population, High Normal School of Education professors should design programs encompassing courses related to environmental issues and the relevant pedagogical content knowledge; and these courses should be requirements mainly for all science students [6].

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