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Original Article

The Application of Context-Based Teaching in the Realization of the Program Content "The Decline of Pollinators"

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Abstract

This paper analyzes the efficiency of context-based teaching in the realization of the program content: "The Decline of Pollinators." The aim of context-based biology teaching is to connect biology contents with everyday life. The application of knowledge in everyday situations is encouraged so as to develop the skills that deepen one's knowledge and make it less abstract.

The task of the experimental study was to evaluate the effectiveness of the application of context-based teaching vs. conventional expository teaching in the implementation of the teaching content. In order to accomplish the tasks of this paper, a model of a pedagogical experiment with parallel groups [experimental (E) and control (C)] was applied. The teaching content „The Decline of Pollinators" was presented to Group E by using a text based on newspaper articles and the real-life context provided by those articles. In Group C, the same content was presented through conventional expository instruction, which is the traditional lecturing model. The results showed a statistically significant difference between the experimental and control groups in the number of points scored in the post-test evaluation of knowledge. The difference was observed based on individual ranks and a test as a whole, in favour of the experimental group. In terms of the quantity and quality of knowledge acquired by the students in the tested teaching field, the experimental didactic model of context-based teaching proved to be more effective.

Keywords: *context-based teaching; decline of pollination; innovations in teaching biology; learning in context; newspaper articles.*

Introduction

Science education research has shown that the learning of science is a hard task for most students. The abstract nature of science makes learning scientific concepts difficult for most students. Furthermore, the emphasis on theory and the lack of context, i.e. failure to connect science with everyday life and society, makes teaching science unpopular and difficult to understand (Tsaparlis et al., 2013).

The major goals of science education are to develop students' scientific literacy and their higher order thinking skills (Avargil et al., 2011), skills for lifelong education and communication (Seddon, 2008). According to Bennet (2005), scientific literacy includes knowledge, understanding and skills that young people need to develop, in order to think and act appropriately on scientific matters, which may affect their lives and the lives of other members of the local, national and global communities. However, at present, the most common teaching practice is the classic lecture-based teaching. This model is characterized by the transmission of ready knowledge, where students are a passive factor of their own development (Stanisavljević, 2011) Studies have shown that teaching and learning styles have been teacher-dominated and have not allowed students to develop their own ideas; as a result, there are no satisfactory results in education (Parchman & Luecken, 2010).

Context-based teaching

Today the biology curriculum is quite isolated from everyday life. That is the reason why the teaching of biology is uninteresting and difficult for students. It is necessary to connect teaching and daily life to a larger degree (Chamany et al, 2008). Learning scientific facts, concepts and natural phenomena in school should not be separated from the context in which they appear (Holbrook, 2014). Teaching should be based on the students' previous knowledge, and the connection between the experience of students and biological concepts can help students better understand biological concepts (Lu et al., 2010). The key to successful learning is to link the knowledge gained to something that is meaningful to students (Kukliansky & Eshach, 2013). According to De Jong (2006), one of the efforts to overcome the isolation of the current curriculum is the use of a meaningful context for teaching and learning chemistry. Contexts were adopted to encourage a more positive attitude and a better understanding of chemistry (De Jong, 2006).

Context-based teaching should enable the achievement of the major goals of science education, connecting science to everyday life (Avargil et al., 2011) and learning scientific concepts and processes through dealing with real-world problems (Avargil et al., 2011; Wieringa et al., 2011). This didactic model makes teaching science meaningful for students (Pilot & Bulte, 2006) and contributes to overcoming deficiencies in education (Ültay & Calik, 2012). Furthermore, this model shows students how to use the skills acquired in the course of their education in practice (Seddon, 2008), and encourages student engagement in the classroom (Ültay & Calik, 2012). Context-based teaching changes the roles of students and teachers, placing student activity at the centre of the teaching process (Vos et al., 2010b).

Context can be defined in several ways. Very often, context is described as stories, topics, practice, problem and situation (Bennet et al., 2005; Pilot & Bulte, 2006; Wieringa, et al., 2011). According to one definition, contexts are described as situations that help students give meaning to concepts, rules and laws. This definition can be expanded by the notion that context can also be described as practices that help students to give meaning to activities in the school laboratory (De Jong, 2006).

According to De Jong (2006), context should be more precisely defined. De Jong makes a distinction between the following four domains of the origin of context, namely the personal domain, the social and society domain, the professional practice domain, and the scientific and technological domain. Every domain is important because schools should contribute to the personal development of students by connecting science with their personal lives; prepare students for their roles of responsible citizens, by clarifying science and its role in social issues; contribute to preparing students for their role as professional workers in public or private areas; contribute to developing the scientific literacy of students (De Jong, 2006).

According to Bennet, context-based teaching is an approach adopted in science teaching, where contexts and the application of science are used as the starting point for the development of scientific ideas. This is in contrast to more traditional approaches, in which scientific ideas are covered first, before looking at their application (Bennet, 2005; Bennet et al. 2006; Taber, 2011).

Context-based approaches to the teaching of science have their origins in the early 1980s (Bennett & Lubben, 2007). A number of studies have been conducted so far, examining the effect of this model in chemistry (Vos et al., 2010b; Pilot & Bulte, 2006), physics (Kukliansky & Eshach, 2013; Kuhn & Muller, 2014; Lye et al, 2001), medicine (Guo et al., 2013) and biology (Weber, 2010; Chamany et al, 2008). When students learn about a topic, they usually wonder “Why do I need to learn this?” (Ültay et Çalik, 2012), "Will I ever use this?". Answers are becoming apparent with a contextual approach to teaching; students understand how and why to use their knowledge and skills (Taasoobshirazi & Carr, 2008). This approach, on the one hand, shows students the importance of science and on the other- demonstrate the application of scientific concepts and methods (Perchmann & Lueck, 2010; Blute & Pilot, 2006). Learning scientific terms in the context of real life enables students to connect with the concept in question and to apply it (Taasoobshirazi & Carr, 2008, Perchman & Lueck, 2010) and enables a deep approach to learning. On the other hand, the emphasis on scientific facts without connecting them to everyday problems encourages a superficial approach to learning and learning by heart (Seddon, 2008). Students become aware of the connection between science and everyday life (Ültay & Calik, 2012), achieving motivation for work.

The tasks of context-based teaching are to provide a better understanding of the teaching (programme) content, which is the starting point for meaningful learning (Wieringa, et al., 2011). This is expected to improve students’ motivation, develop a sense of curiosity about nature (Ultay & Calik, 2012), develop students’ positive attitudes towards science and the scientific view of the world (Bennett et al., 2006; Wieringa, et al., 2011), and provide easier learning (Bennet et al., 2006; Pilot & Bult, 2007).

The teacher's role is to encourage students to connect concepts with everyday activities (Lye et al., 2010). The application of this model in teaching is a major challenge for teachers (Avargil et al., 2011) and the training of teachers is necessary (Parchmann & Lueck, 2010; Pilot & Bult, 2007). In context-based teaching it is possible to use a wider range of teaching strategies, unlike in the traditional methods of teaching; for example, working with small groups, discussions, drama, student presentations (Bennet et al., 2007).

Benet thinks that making science issues relevant to students, their families and their peers, as opposed to the wide-spread perception of science as being dry and irrelevant, will increase the motivation for learning. Using context as the starting point in designing plans, programs and lesson units is a good way to avoid overload and makes a representative curriculum (Bennett et al., 2007).

The use of context-based teaching might mean, for example, that students study medical diagnostic techniques in order to develop their understanding of electromagnetic radiation and atomic structure in chemistry lessons (Bennet, 2005). Students can play the role of pilots to learn topics of mechanics, such as gravity and air circulation (Taasoob-Shirazi & Carr, 2008).

According to De Jong, context-based teaching should be viewed from different perspectives. From students’ perspective it is important to select an adequate context. The context must be known and relevant for students (Vos et al., 2010a), should not distract attention from the concept or be complicated and confusing for students. From the perspective of the curriculum, it is important to ensure the dominating position of context in education, while still paying attention to concepts (De Jong, 2006).

In a broad sense of the word, context-based teaching is defined as using concepts and process skills that are relevant to students in a real-life context. Beginning, embedding and connecting teaching contents with an interesting story are good ways of relating it to the context of real-life. A particular form of this is a story from newspaper articles (Taber, 2011; Kuhn & Müller, 2014). Newspaper articles should be used in teaching because, on the one hand, they create real-life contexts, and on the other, journalists are experts for writing interesting and good stories (Kuhn & Müller, 2014). Grant et al. state that in the selection of articles, it is important to consider some characteristics of successful teaching. Attention must be paid to the value of the perspectives that the author wants to show. The article should contain the optimum amount of information, both positive and negative arguments, in order to develop quality student attitudes. In addition, it is important to look for stories that are appropriate for the age of the students and easy to connect with science (Grant et al., 2009).

Decline of pollinators

There is a large number of biology topics discussed in the media (Grant et al., 2009). It is possible to find a wide variety of articles if we want to use them in biology teaching. Today many discussions can be found about the decline of pollinators. There is clear evidence that the number of cultivated and wild pollinators decreases, thus reducing the number of plants that depend on them. The decline was caused by the intensification of agriculture, which reduces the wealth of plant habitats. This is associated with the fragmentation of habitats, causing the loss of places for nesting, pathogens and the lethal consequences of insecticides and pesticides (Holland et al., 2015), as well as invasive species and climate changes (Potts et al., 2010; Willmer, 2012).

The decline of pollinators can lead to a loss of pollination services which would have major negative environmental and economic consequences, potentially significantly affecting the maintenance of the diversity of wild plants, the stability of ecosystems, crop production, food security, human existence (Potts et al., 2010). Pollinators, especially bees, are needed to pollinate 75% of crops used in human nutrition (Klein, 2007). Although some of the most cultivated crops (wheat and rice) are wind pollinated, a large number of fruits (apple, melon, cherry...) are threatened due to the decline of pollinators. 80% of wild plants are directly dependent on pollinators (Potts et al. 2010).

These biological problems are complicated for students and require extensive knowledge; furthermore, it is important to point out the alarming situation in the world to students. Based on the analysis of studies that show the benefits of context-based teaching, there emerged the idea of applying this method of teaching in the realization of the mentioned content. The aim is to develop logical thinking and reasoning; therefore, the teaching content should be presented in such a way so as to serve as an incentive to students, and to create a strong emotional experience that will help students remember not only the content itself, but also the attitude towards it, and, finally, to develop environmental awareness. In this study, the context of everyday life is provided by newspaper articles, i.e. stories about the disappearance of pollinators, which indicate the alarming situation in the world.

Methods

The main task of this research is to experimentally verify the effectiveness of context-based teaching in accomplishing the content "The Decline of Pollinators", as well as the effects on students' motivation and interest.

The basic null hypothesis is that there is no statistically significant difference in accomplishing the teaching goals (resulting in students acquiring knowledge) between the experimental and control groups, after introducing the experimental factor (context-based teaching) to the experimental group.

The alternative hypothesis is that there is a statistically significant difference in acquired knowledge between the experimental and control groups, after introducing the experimental factor to the experimental group. It is expected that the difference in the quality and quantity of the knowledge acquired between the experimental and control groups will favour the experimental group.

The study included the total of 65 eighth grade students from “Dvadeseti oktobar” elementary school, Belgrade. To achieve the aims of this research, a model of a pedagogical experiment with parallel groups [experimental (E) and control (C)] was applied (Appendix 1).

Students were grouped into Group E and Group C (Killermann, 1998). Before the introduction of the experimental factor, the groups were made uniform concerning the number of students, gender and the pre-test of knowledge.

The pre-test of knowledge measured the general knowledge of pollination and pollinators.

It was composed of nine tasks in total, which were classified into three broad categories of the cognitive domain, according to Bloom's taxonomy. Bloom's cognitive domain categories include six levels of knowledge: knowledge, comprehension, application, analysis, evaluation and creation (Anderson & Krathwohl, 2001). The levels of cognitive domains were grouped into three ranks: knowledge and understanding of concepts (Rank I), application and analysis (Rank II), evaluation and creation of knowledge (Rank III). The tasks included all contents about pollination and pollinators. The maximum points that a student could score in the pre-test was one hundred. After equalizing Groups E and C, Group E began covering the prepared contents by applying context-based teaching, while Group C did the same on the basis of the traditional model of instruction.

The students in Group C were exposed to the traditional teaching approach in presenting the teaching contents “The Decline of Pollinators”. The teacher presented the content through the following teaching methods: oral presentation, illustrations and demonstrations (during the entire instructional period). The teacher did not ask any questions about the content. There was no discussion. The only activities for this group of students were listening to what the teacher was saying and watching what the teacher was showing.

The realization of context-based teaching in Group E was divided into three phases. The teacher introduced the students to the topic, along with illustrations and a PowerPoint presentation (the topic: “The Decline of Pollinators”). Then, the teacher shared newspaper articles that the students were required to read, as well as the questions that they were expected to answer (some examples are included in Appendix 2 and Appendix 3). Newspaper articles were supposed to present scientific facts to the students. The students were to recognize the importance of the issue, the alarming problems related to it, and to propose solutions. Finally, they presented their answers, analyzed the problem and came to conclusions.

To evaluate the knowledge acquired by students in Groups E and C, a post-test was applied. It measured the quantity and quality of the knowledge that the students acquired in the teaching field (The Decline of Pollinators). The post-test consisted of nine tasks in total (divided into three categories, as was the case with the pre-test).

Data and result analyses were performed using the standard statistical methods/tables of descriptive statistics (sum, percentage frequency, mean, standard deviation, the coefficient of variation and a Student’s t-test (Student, 1908) for testing differences between the statistics of the same kind). All these analyses were conducted using the statistical software package Statistica 6 (StatSoft, 2001).

Table 1. The success of students for the pre-test (number of points, percentage of ranks and total).

Group	Number of stud.	Rank I		Rank II		Rank III		Total	
		No. points	%	No. points	%	No. points	%	No. points	%
E	34	876	73,61%	696	68,24%	734	61,68%	2306	67,82%
K	31	792	73,00%	579	64,19%	644	59,35%	2033	65,58%
Total	65	1668	73,32%	1293	66,31%	1378	60,57%	4339	66,75%

Table 2. Basic statistical data for the pre-test ($\bar{x}$ - mean of the number of achieved points, S- standard deviation, V - coefficient of variation).

	Rank I			Rank II			Rank III			Total		
Group		S	V		S	V		S	V		S	V
E	25.76	4.76	18.47%	20.47	5.42	26.47%	21.59	5.65	26.16%	22.61	5.76	25.47%
C	25.55	5.92	23.16%	19.26	5.64	29.28%	20.77	4.94	23.80%	21.86	6.13	28.05%

Table 3. Testing group uniformity in terms of the pre-test, using a t-test (for a significance level of $p \leq 0.05$ and acritical value of $t \geq 1.96$).

Relation	Rank I	Rank II	Rank III	Total
E:C (t-value)	0,14	0,90	0,62	0,50

Results

The results of the pre-test are presented in Tables 1, 2 and 3.

Based on the results presented for the pre-test for Groups E and C, we can conclude, using a Student's t-test for a significant level of $p=0.05$ and a critical value of $t=1.96$, that there is no statistically significant difference in the achieved number of points between Groups E and C in the three levels of tasks and in the test as a whole.

(Rank I: $t= 0,14<1,96$; Rank II: $t=0,9<1,96$; Rank III: $t=0,62<1,96$, Total: $t=0,5<1,96$). These two groups were balanced in terms of their general knowledge of pollinators and pollination before the introduction of the experimental factor.

The results of the post-test are presented in Tables 4, 5 and 6.

On the basis of the results presented for the post-test of knowledge for Groups E and C (Table 4, 5, 6), we can conclude that there are statistically significant differences in the number of points achieved in all three levels of tasks and in the test as a whole, in favour of Group E (Rank I: $t=2,71 \geq 2,58$; Rank II: $t=2,8 \geq 2,58$; Rank III: $t=3,22 \geq 2,58$; Total: $t=2,81 \geq 2,58$). The obtained t-coefficient values are significantly higher than the critical value (by all three ranks and as a whole).

Context-based teaching proved to be more efficient in terms of the quantity and quality

Table 4. The success of students for the post-test (number of points, percentage of ranks and total).

Group	Number of students	Rank I		Rank II		Rank III		Total	
		No. points	%	No. points	%	No. points	%	No. points	%
E	34	942	79,16%	848	83,14%	1078	90,59%	2868	84,35%
C	31	754	69,49%	579	62,26%	805	74,19%	2150	69,35%
Total	65	1696	74,55%	1427	73,18%	1883	82,77%	5018	77,20%

Table 5. Basic statistical indicators for the post-test ($\bar{x}$ - mean of the number of achieved points, standard deviation, V - coefficient of variation).

	Rank I			Rank II			Rank II			Total		
Group		**S**	V		S	V		S	V		S	V
E	27,71	4,44	16,01%	24,94	6,53	24,84%	31,71	3,52	11,11%	28,12	4,93	17,54%
C	24,32	5,42	22,29%	18,68	9,63	51,56%	25,97	10,09	38,85%	22,99	9,19	39,96%

Table 6. Testing group uniformity in the post-test, using a t-test (for a significance level of $p \leq 0.01$ and a critical value of $t \geq 2.58$).

Relation	Rank I	Rank II	Rank III	Total
E:C (t-value)	2,71	2,83	3,22	2,81

of the knowledge acquired by the students in the tested teaching field. Particularly significant are differences in Rank III test tasks (related to the evaluation and creation of knowledge).

Discussion

The above-listed results obtained through experimental assessment can relate and be compared to numerous studies which have shown the positive effects of context-based teaching applied in natural sciences.

Kuhn and Müller considered the effect which the teaching of science based on the context provided by newspaper articles, had on motivation. They showed that connecting teaching contents to a lay story contributed to understanding scientific terms. The motivation of students from Group E after the introduction of the experimental factor (contents from newspaper articles) was significantly higher in comparison to the control group, which processed the same contents from a textbook; furthermore, there was a significant difference in accomplishments in the final tests in favour of the favour group (Kuhn &

Muller, 2014). Jarman and McClune (2010) came up with similar results; they carried out a comparative review of applying and using newspaper articles in teaching. By providing students with a context in which they can test and apply their theoretical knowledge, we influence their understanding and association of facts (Holbrook, 2014).

Ramsden (1997) considered the effects of context-based teaching and traditional teaching by comparing students' answers. The study showed that there was a slight difference in understanding the content in question, however; the approach based on context encouraged the students' interests. The studies that have tested the application of this model of teaching have confirmed the conclusion that teaching in context engages students more (Avargil et al., 2011) and encourages them to engage in certain activities, such as argumentation and discussion (Wieringa, et al., 2011). This type of teaching offers students' the possibility to present their ideas more freely (Avargil et al., 2011; Pilot & Bult, 2007). In her review paper, Bennet stated that activities in context-based teaching encouraged students to work independently, thus helping them increase their confidence (Bennet, 2005). These conclusions were confirmed by the analysis of 17 experimental studies (Bennet et al. 2007), whose results showed that this approach in teaching, in contrast to the traditional one, developed a positive attitude towards science and comprehension. The influence of teaching chemistry based on context on the development of motivation and interest, was also demonstrated in the studies of Pilot and Bult (2006, 2007); the evidence of this model`s application and influence gathered by 2012 was summed up by Ültay & Çalik (2012).

Similar results were presented by Seddon (2008). His study involved 72 subjects-second year students of a veterinary school. The students attending a genetics class examined the influence of genes on the determination of coat colour of dogs. Their task was to find the genes responsible for the colour of fur and offer their customers an ingenious possibility to obtain certain colour combinations. A survey was conducted to examine how the students' understood the task and what their general attitude was. The results of the survey showed that the students were motivated to learn, and that role play had helped them to apply theoretical knowledge in practice.

Studies examining the effectiveness of this model, carried out in the context of teaching physics, showed similar results. Luy et al. (2010) pointed out that if particular information was linked to a context, the students remembered it easier and retained it longer, as compared to the information without meaning they had to remember. This was confirmed by a comparative review of the strengths and limitations of this approach in teaching (Taasoobshirazi & Carr, 2008). In addition, in a study with parallel transmission groups of 107 students, Kuklianski and Esah (2013) confirmed the significant learning achievements of students who were exposed to this model of teaching.

Various studies in the domain of biology show that it is the lessons that are associated with everyday life that students find interesting. Haman et al. (2010) examined the impact of context-based learning on the interest of students who were learning lessons about evolution. Weber proved that learning the contents of botany was more effective if they were connected to the previous experience that students had acquired in everyday situations (Weber, 2010). Studies also point to the possibility of teaching based on context outside the classroom, e.g. in the zoo (Camp & Sminia, 2010).

Chamany et al. (2008) presented examples of how complex issues, such as sickle-cell anaemia, lac operon and energy, can be displayed in the context of everyday life, in order to facilitate students' understanding of these biological contents.

As with any innovation, this innovative approach too depends on the efficacy of the teacher (Fullan, 2005); the teacher needs to conceive and carry out a lesson (Wieringa, et al., 2011). Studies indicate that in order to implement a lesson successfully, it is necessary to invest much time and effort, and to carry out well-thought preparation. (Taasoobshirazi & Carr, 2008; Williams, 2008; Wieringa, et al., 2011). In their study Wieringa et al. (2011) present some examples of preparation for context-based teaching. However, teachers are not sufficiently trained for this approach. A large number of studies indicate that the training of teachers in this area is necessary (Ültay and Çalik, 2012). Pershmann and Luecken (2008) gave the proposed structure of training programs for teachers to approach the teaching of biology, chemistry and physics based on context. Comparing their findings with other studies, they came to the conclusion that the cooperation of teachers was an important factor in the successful introduction of the innovation.

The results of our study that we have presented above can be compared with the results of other studies conducted in our region, examining the efficiency of application of other didactic models in various biological disciplines.

Stanisavljević and Djurić have conducted several experimental studies in which they assessed the efficiency of applying the problem, exemplary and programme-based biology teaching: the application of problem-based teaching in an environmental programme content (topic: Marine Life Community) (Stanisavljević & Djurić, 2010); the application of exemplary teaching in the realization of a botanical programme content (Stanisavljević & Đurić, 2011); and the implementation of programmed instruction in the realization of a physiological programme content (Stanisavljević, 2011). Each of the studies shows that there is a statistically significant difference in the number of points scored between the experimental and the control group in favour of the experimental group, after introducing experimental factors in each study. The difference is evident in the test as a whole and in the individual ranks. Rank III contains an especially visible difference (problem teaching t= 3.00; exemplary teaching t= 3.407; t= programmed instruction 9, 29). Studies have shown that these didactic models contribute to the quantity and quality of knowledge gained, and have a particular effect on the application of such knowledge.

Comparing the results of our experimental testing (Rank III, t= 3.22> 2.58), it has been noted that context-based teaching is equally efficient in the implementation of biological programme contents as the mentioned didactic models

Conclusion

After the introduction of the experimental factor (context-based teaching in the experimental group), the experimental group achieved better results in the post-test compared to the control group. The statistically significant difference between the experimental and control groups (in favour of the experimental group) is particularly evident in the Rank III tasks (evaluation and creation of knowledge in a given teaching field).

Thus, the null hypothesis that there is no statistically significant difference in the mastery of the teaching material between the students in the experimental and control groups can be discarded. The alternative hypothesis- that there is a statistically significant difference in the level of the attained knowledge in favour of the experimental group after the introduction of the experimental factor (context-based teaching) - can be accepted.

Therefore, it can be concluded that the application of context-based teaching directly contributed to the better quantity and quality of knowledge. In other words, the high quality of the knowledge which the students acquired in the tested teaching field was especially significant in the Rank II and III tasks (application and evaluation of knowledge).

Through context-based teaching, students connect the given content with everyday life. They can understand this content better and apply the knowledge acquired. Furthermore, they are able to assess the value of learning, and connect it with the previously acquired knowledge, in order to build their own system of knowledge. In this way, they become aware of the bigger picture, and of the value and application of the concepts learned.

After the analysis of the studies examining the efficacy of the application of context-based teaching, it was concluded that the application of this model with students encourages the internal need and desire to work. Context-based teaching demonstrated that the disappearance of pollinators was something which we faced in today's world; it stressed to what extent modern man depended on pollination. Applying lessons learned through connecting with everyday situations encourages the development of skills that deepen knowledge and make it more thorough and less abstract. The application of context-based teaching has the same effect as programme, problem and exemplary-based teaching in terms of the quantity and quality of the knowledge acquired. This didactic model contributes to the development of thinking and the high quality and quantity of the knowledge gained.

Future research is necessary to confirm the durability of the knowledge gained by a re-test and to examine the resilience of this model in teaching different age groups. Finally, teachers coming from different fields should be educated to apply this didactic model in teaching a particular content.

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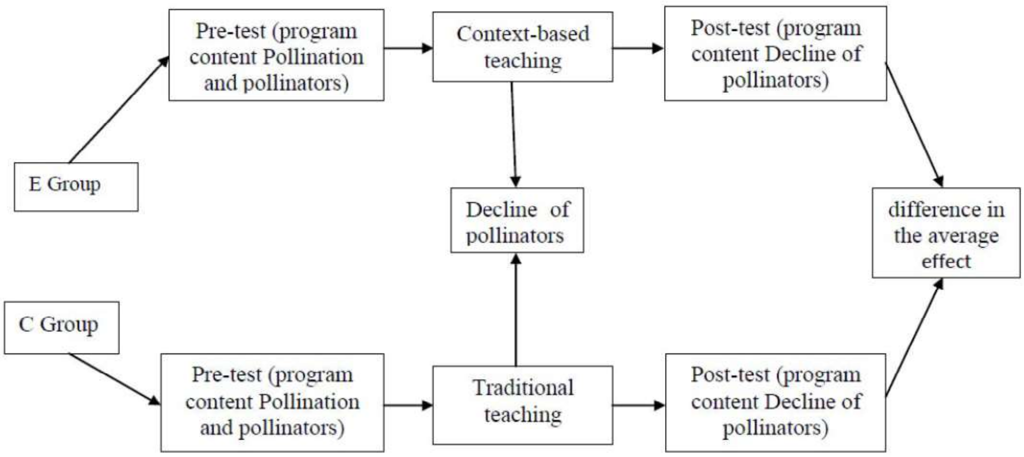
Appendices

Appendix 1: The model of pedagogical experiment with parallel group



Appendix 2: Newspaper article used in context-based teaching

Decline of pollinators forces apple farmers to pollinate by hand

Evidence from around the world points to falling of insect-pollinated crops, particularly in the areas with the most intensive farming. Where crops are grown in vast fields, there are not enough insects to go around. If insecticides are sprayed too frequently, then pollinators cannot survive. The most dramatic example comes from the apple and pear orchards of south west China, where wild bees have been eradicated by excessive pesticide use and a lack of natural habitat.

In recent years, farmers have been forced to hand-pollinate their trees, carrying pots of pollen and paintbrushes with which to individually pollinate every flower, and using their children to climb up to the highest blossoms. This is clearly just possible for this high-value crop, but there are not enough humans in the world to pollinate all of our crops by hand. Without bees, our diets would be depressingly poor. We would be forced to survive on wind-pollinated crops; wheat, barley and corn. Imagine shops without raspberries, apples, strawberries, peas, beans, courgettes, melons, tomatoes, blueberries, pumpkins and much more. We need to recognise that the health and wellbeing of our children depends upon us preserving a healthy environment, and that to do so requires that we show some respect for the myriad of wild animals and plants with which we share the world

Appendix 3: The questions about newspaper article used in context-based teaching

1. What happens to the insect pollinators in the last few years?
2. In which areas this problem is most pronounced?
3. What are the causes of decline of pollinators?
4. How is pollination in china and what led up to it?
5. The consequences of the fall in the bee?
6. What are your suggestions for the solution of problems in the number of pollinators?
7. Write your personal position on the issue of disappearance of pollinators?

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