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Investigating the Relationship between Non-Formal Education, Flora Recognition Ability and Students' Attitudes toward Plants

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ABSTRACT

The present study had as its primary purpose to present and compare the learning outcomes of non-formal education versus formal education in terms of the ability of secondary school students to recognize the local flora and attitudes that they develop against plants. The educational activities took place both within the school environment (control group) and in the Information Centre of the Olympus National Park (experimental group). Through non-formal learning and direct contact with plants, the research sought to determine the extent to which the students' knowledge of flora improved, as well as whether their attitudes changed to a level beyond the cognitive level. The results showed that both groups of students presented However, although both groups had an initially positive attitude, the improvement in attitudes was more evident in the control group (formal education). The assessment process proved to be crucial for assessing the conversion of students' initial knowledge, enriching the relevant literature, especially for secondary school students' education, and providing inspiration for future relevant research.

INTRODUCTION

The main research issue examined in this study concerns the way and extent to which non-formal education can support formal education in the essential acquisition of knowledge, in particular in the ability of students to recognize the local flora and their consequent attitudes towards plants. At the same time, the specific factors that contribute to this interaction are sought.

The need for a shift away from the outdated teacher-centered model of teaching is strongly supported by modern pedagogy, which promotes new approaches that facilitate the student's transition from empirical to school-based knowledge (Driver, Guesne, & Tiberghien, 1985; Carey, 1985). Traditional teaching, which often relies on memorization and book reading, can lead to negative attitudes among students towards the natural sciences (Mavrikaki *et al.,* 2012). Therefore, emphasis is placed on the importance of visits to non-formal learning environments and direct contact with the objects of study for the active structuring of knowledge (Dillon *et al.,* 2006; Anderson, Lucas, & Ginns, 2003).

Non-formal education, when combined with traditional methods, is considered to contribute positively to both the cognitive level and the level of students' attitudes (Czerkawski, 2016). In the context of environmental education, the integration of non-formal learning allows students to develop a stronger connection with the subjects taught through real-world applications (Griffin & Symington, 1997). Direct and experiential interaction with an object, such as plants, increases the interest and motivation of students (Krapp, 2002), introducing a realism into the educational process that is potentially beneficial (Harriman, 2006).

Extracurricular activities promote environmental behavior, improve knowledge and cultivate positive attitudes towards the environment through the active participation of students (Hungerford & Volk, 1990; Zelezny, 1999). Environments such as the Olympus National Park Information Center offer alternative learning methods, encouraging students to interact with exhibits, collaborate, and engage in a variety of activities (Dierking, 1991). This approach shifts instruction to a student-centered model (Jacobs, Lee, & Ng, 1997· Cohen, 1992), offering freedom for students to structure knowledge in various ways (Driver *et al.,* 1994).

The present study investigated the above concepts through an educational intervention in two groups of first grade high school students, who participated in a lesson on the flora of Mount Olympus. The control group was taught the topic in the classroom in a formal way, while the experimental group visited the Information Center of Olympus National Park.

Theoretical Background

Theories of Learning and Forms of Knowledge

Science teaching incorporates three fundamental forms of knowledge: scientific knowledge, empirical knowledge, and school knowledge (Duschl, Schweingruber, & Shouse, 2007). Scientific Knowledge is generated within university and research centers. Research often explores its connection with students' attitudes toward science, noting that positive attitudes are capable of positively affecting learning and cognitive progress (Koballa & Crawley, 1985). Experiential Knowledge refers to the accumulated experiences a person has gained from interaction with the natural environment or through

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social relationships (Metz, 1995). This constitutes the pre-existing knowledge of students, which is essential to consider during teaching in order to identify possible learning obstacles. In contrast, School Knowledge is found within the texts of science curricula and textbooks. Modern learning processes place emphasis on the active participation of students. For example, constructivism regards learning as an active process in which students transform information into meaningful knowledge by integrating new knowledge into their existing framework (Philips, 1995). School knowledge is ultimately accomplished through the simplification and transformation of scientific knowledge so that it relates to the everyday world and the experiences of the students (Duschl, Schweingruber, & Shouse, 2007).

Formal and Non-Formal Education

Formal education is structured and planned learning that takes place within the school system, facilitated by an educator, and often leads to a degree or certification (Maynard, 2004). In contrast, non-formal education takes place in environments outside the classroom, such as museums or related institutions, and may not have formal assessment or certification (Dierking, 1991). The most effective approach is combination of formal and non-formal learning experiences, as this significantly enhances the acquisition of scientific knowledge (Dillon *et al.,* 2006). Non-formal environments encourage a student-centered approach and allow knowledge to be structured with more varied and less restrictive methods (Griffin & Symington, 1997). However, some research has questioned the effectiveness of non-formal methods, as traditional teaching approaches have been reported to be yield better results in knowledge and positive attitudes (Moustafa, Ben-Zvi-Assaraf, & Eshach, 2013).

The Relationship with Flora and Attitudes

Non-formal education, especially when integrated into environmental issues, enhances students' connection to the subject of study through real-world applications (DiEnno & Hilton, 2005). Direct and experiential interaction with subjects such as plants increases interest (Krapp, 2002). Although students often have a positive attitude towards the environment, their knowledge on specific environmental issues is often incomplete (Mavrikaki *et al.,* 2012). The relationship between environmental knowledge and attitudes has not been fully elucidated, as knowledge alone is not enough to change behavior (Shrigley, 1990; Hungerford & Volk, 1990). In addition, many people find animals more interesting than plants, a phenomenon known as "plant blindness", which is due to plants being considered inferior or less visually dynamic (Lindemann-Matthies, 2005). This indifference can be exacerbated in developed countries, where information about the natural world is acquired indirectly, through the media, instead of direct experience (Patrick & Tunnicliffe, 2011). The role of the teacher is crucial in all settings, as an enthusiastic and knowledgeable educator can significantly stimulate students' interest (Fraser, 1998).

MATERIALS AND METHODS

Participants and Design

The study utilized a quantitative approach, employing a pre-experimental design that included a pre-test, an intermediate test, and a final test, specifically to investigate the effect of non-formal education. The sample comprised 28 students from the A High School of the General High School of Kolindros, Pieria, all of whom were attending the elective course "Geology and Management of Natural Resources". This sample was divided into two equal groups of 14 students each through convenient sampling, ensuring a gender-balanced total (14 boys and 14 girls). The Control Group received traditional, formal training, while the Experimental Team engaged in non-formal education through a visit to the Information Center of Olympus National Park. The students came from an area rich in natural environment, where a significant part of the local population is involved in agricultural activities, suggesting they had a direct connection with the local flora.

Data Collection Tools

Data collection was carried out using a specially designed questionnaire. The content of the questionnaire included both closed-ended questions, mainly multiple-choice and Likert scale items, and open-ended questions, such as those requiring the naming of tree or shrub species, in order to gather specific information. The questions related to knowledge were adapted from the Geology and Natural Resource Management textbook. For the measurement of attitudes, a five-point Likert scale was used, which had been adapted from the study by Fancovicova and Prokop (2010). This scale ranged from 1, representing Strongly Disagree or the Most Negative Attitude, to 5, representing Strongly Agree or the Most Positive Attitude. The reliability of this attitude scale was tested using the Cronbach's alpha index (), with an acceptable value sought (Ouzouni & Nakakis, 2011).

Research Procedure

The research procedure began with the Pre-Test (Baseline), where the questionnaire was administered to both groups one day before the intervention took place, serving to record their initial knowledge of the flora and their initial attitudes. The Intervention followed, differing between the groups: the Control Group (Formal Education) participated in a two-hour lecture delivered in the school's laboratory, focusing on the flora of Mount Olympus, utilizing audiovisual material and laboratory equipment, characterized as an upgraded, but teacher-centered approach. In contrast, the Experimental Group (Non-Formal Education) visited the Information Center of Olympus National Park for a two-hour organized tour, which involved the exploration of exhibits, data collection (notes, photos), and video projection, thus facilitating

direct contact with the object of study. Immediately after the intervention, the Intermediate Test was conducted, requiring both groups to complete the same questionnaire for the immediate assessment of cognitive progress and change in attitudes. Finally, the Final Evaluation was administered ten days after the intervention, utilizing the same questionnaire for a third time, aiming to measure the medium-term retention of knowledge and attitudes.

Analyses and Statistical Processing

The analysis of the collected data incorporated both descriptive and deductive statistics. Knowledge scoring utilized a range from 0 to 19. The reliability of the attitude scale, measured by Cronbach's alpha index (), was found to be satisfactory across all three measurements: (Initial), (Intermediate), and (Final), confirming consistency and reliability (Ouzouni & Nakakis, 2011). For comparative tests designed to assess the differences in averages between the two independent groups (Control Group versus Experimental Group), the t-test for independent samples or the Mann-Whitney U test was employed. Conversely, to compare the averages within the same group at different time points (such as Pre-test versus Final Test), the t-test for pairs of dependent samples was utilized. Lastly, the Pearson correlation coefficient was used to estimate the linear relationship between the knowledge scores and the attitude scores.

RESULTS AND DISCUSSION

Initial State of Knowledge and Attitudes

In the initial measurement, no statistically significant difference in general knowledge scores or attitudes towards plants was observed between the control group and the experimental group (), confirming that the groups were comparable at the start of the study.

In the open-ended identification questions, both groups mentioned similar, recognizable trees and shrubs, such as Pine and Fir, which is attributed to their direct contact with the everyday environment. The students identified human activity and exhaust gases as the most important factors affecting the local flora.

Initially, both groups demonstrated an overall positive attitude towards plants and nature, recognizing their necessity for life.

Impact of Interventions on Knowledge

In the intermediate measurement conducted immediately following the intervention, the experimental group demonstrated a statistically significant increase in knowledge scores after participating in the non-formal activity. Conversely, the control group did not show a statistically significant change in knowledge during this same direct measurement period. Ten days later, in the final measurement, both groups—the Control Group and the Experimental Group—showed a statistically significant improvement in cognition when compared to their initial measurement (pre-test) (Control Group: Experimental Group:). This overall outcome suggests that while the non-standard approach led to faster cognitive gains, the standard formal approach also eventually resulted in a statistically significant improvement. Importantly, the cognitive gains achieved were successfully maintained in both groups over the ten-day assessment period.

Impact of Interventions on Attitudes

Regarding attitudes toward plants, the intermediate measurement immediately after the intervention revealed that the control group showed a small but statistically significant improvement. The experimental group, however, did not demonstrate a statistically significant change in attitudes at this intermediate stage. Ten days later, in the final measurement, the control group successfully maintained the statistically significant improvement in attitudes compared to the original measurement. In contrast, the experimental group remained without any statistically significant change in attitudes. Thus, formal education was shown to be more effective in promoting positive changes in attitudes, which contrasts with non-formal education, which, although enhancing knowledge faster, did not lead to a statistically significant shift in attitudes.

Correlation of Knowledge and Attitudes

The Pearson correlation analysis demonstrated that there was no statistically significant correlation between students' degrees of cognition and degrees of attitudes toward plants, either at the beginning or end of the intervention. This suggests that improving cognition does not automatically translate into improved postures, a finding that agrees with previous research (Shrigley, 1990; Fancovicova & Prokop, 2011).

Discussion

Cognitive Outcomes and Non-Formal Education

The most important cognitive finding of the study is the faster and more immediate acquisition of knowledge by the experimental group after the non-formal training at the Information Center. This result is supported by relevant research that emphasizes the positive impact of experiential programs on the acquisition of knowledge (Dillon *et al.,* 2006). The immediate, visual and interactive nature of the experience in the non-formal environment, where learning becomes student-centered and knowledge is structured in a variety of ways (Griffin & Symington, 1997), explains faster cognitive gains.

However, the knowledge gained was ultimately comparable, as well as the control group showed a statistically significant improvement in the final evaluation. This indicates that both methods were effective. The fact that there was no further increase in knowledge between the intermediate and final evaluation (after 10 days) highlights the challenge of maintaining interest (Strgar, 2007) and long-term learning.

Emotional Effects and Formal Education

In contrast to the cognitive outcomes, the control group (formal training) showed a statistically significant positive

change in attitudes towards plants, an improvement that was maintained. This finding is consistent with some studies that found that control groups with traditional teaching may show more positive attitudes compared to experimental groups using constructive approaches (Moustafa, Ben-Zvi-Assaraf, & Eshach, 2013).

The positive change in the control group is probably due to the fact that the structured, guided by the educational environment of formal education, effectively took advantage of the students' already positive initial attitudes. The finding that the initial level of attitude is a strong predictor of the final attitude suggests that the initially more sensitive students were the ones who further improved their attitudes.

The Disconnect between Knowledge and Attitude

The absence of a significant correlation between knowledge and attitudes reinforces the common finding in environmental education that the improvement of the cognitive dimension does not imply an automatic and proportional change in the emotional dimension (Shrigley, 1990; Fancovicova & Prokop, 2011). This suggests that, while students were better informed, their underlying attitudes did not change to the same extent.

Constraints and Future Directions

The study has significant limitations, mainly due to the relatively small sample size, which makes it difficult to generalize the findings to a wider student population (Cohen & Manion, 1997). Practical constraints, such as school schedules and financial difficulties, limit the possibility for more frequent non-formal educational interventions and wider collaborations.

For the future, it is proposed to conduct research with larger and more representative samples. It is recommended to combine the advantages of both approaches: the experiential nature of non-formal education for cognitive gains and the structured framework of formal education for the cultivation of attitudes. Also, investigating the long-term effects of successive interventions and the investigation of whether teaching makes students feel happier could offer new perspectives for the development of positive attitudes towards the natural sciences.

CONCLUSIONS

The study aimed to compare non-formal and formal education for secondary school students concerning flora recognition ability and their attitudes toward plants, yielding nuanced conclusions. Both educational approaches proved successful in leading to improved knowledge of flora. However, the non-formal education approach, which centered on the visit to the Olympus National Park Information Center, resulted in a faster and more immediate cognitive improvement for the experimental group, which is attributed to the direct, hands-on, and interactive learning experience. Conversely, the formal education approach, involving traditional classroom instruction, was shown to be more effective in fostering positive attitudes, resulting in a statistically significant improvement in attitudes for the control group. The non-formal approach, despite its cognitive benefits, did not yield a statistically significant change in attitudes. Furthermore, the study found no significant correlation between knowledge and attitudes, thus confirming the established finding that improving factual knowledge does not automatically translate into a corresponding improvement in attitudes toward plants. This result is consistent with previous research. Key challenges identified include the difficulty in maintaining student interest and long-term learning gains, evidenced by the lack of further significant improvement noted after the intermediate assessment. Consequently, recommendations suggest that future educational interventions should combine the advantages of both methods: leveraging the experiential nature of non-formal education for cognitive gains and utilizing the structured framework of formal education for the cultivation of attitudes. It is also recommended to explore the use of multiple, successive interventions to achieve more enduring changes in attitude and behavior. The generalization of the study's findings to a wider student population is complicated by its relatively small sample size. Practical constraints, such as school schedules and economic difficulties, also limited the possibility of implementing more frequent non-formal interventions and broader school collaboration. Future research should focus on obtaining larger, more diverse samples and investigating the long-term impact of successive, varied educational interventions on both knowledge and attitudes. Additionally, exploring whether a particular form of teaching makes students feel happier might offer valuable insights for developing a more enjoyable learning experience, potentially leading to a positive impact on science education and attitude development.

REFERENCES

Anderson, D., Lucas, K. B., & Ginns, I. S. (2003). Theoretical perspectives on learning in an informal setting. *Journal of Research in Science Teaching, 40*(2), 177–199.

Carey, S. (1985). *Conceptual change in childhood.* Cambridge, MA: M.I.T. Press.

Cohen, E. G. (1992). Restructuring the classroom: Conditions for productive small groups. *Issues in Restructuring Schools, 2,* 4–7.

Cohen, L., & Manion, L. (1997). *Methodology of educational research* (S. Kyranakis, K. Betsis, & M. Vamvouka, Trans.). Athens: Metaichmio.

Czerkawski, B. (2016). Blending formal and informal learning networks for online learning. *International Review of Research in Open and Distributed Learning, 17*(3).

Dierking, L. (1991). Learning theory and learning styles: An overview. *Journal of Museum Education, 16*(1), 4–6.

DiEnno, C., & Hilton, S. (2005). High school students' knowledge, attitudes, and levels of enjoyment of an environmental education unit on non-native plants. *Journal of Environmental Education, 37*(1), 13–25.

Dillon, J., Rickinson, M., Teamey, K., Morris, M., O'Donnell, L., Saunders, M., & Spackman, S. (2006). The value of outdoor learning: Evidence from research in the UK and elsewhere. *School Science Review, 87*(320), 105–111.

Driver, R., Guesne, E., & Tiberghien, A. (1985). *Children's ideas in science*. Milton Keynes: Open University Press.

Driver, R., Asoko, H., Leach, J., Mortimer, E., & Scott, P. (1994). Constructing scientific knowledge in the classroom. *Educational Researcher, 23*(7), 5–12.

Duschl, R. A., Schweingruber, H. A., & Shouse, A. W. (2007). *Taking science to school: Learning and teaching science in grades K-8*. Washington, D.C.: The National Academies Press.

Fancovicova, J., & Prokop, P. (2010). Development and initial psychometric assessment of the Plant Attitude Questionnaire. *International Journal of Science Education, 19,* 415–421.

Fancovicova, J., & Prokop, P. (2011). Plants have a chance: Outdoor educational programmes alter students' knowledge and attitudes towards plants. *Environmental Education Research, 17,* 537–551.

Fraser, B. J. (1998). Classroom environment instruments: Development, validity and applications. *Learning Environments Research, 1,* 7–33.

Georghiou, K., & Delipetrou, P. (2010). Patterns and traits of the endemic plants of Greece. *Botanical Journal of the Linnean Society, 162,* 130–422.

Griffin, J., & Symington, D. (1997). Moving from task-oriented to learning-oriented strategies on school excursions to museums. *Science Education, 81*(6), 763–779.

Harriman, H. (2006). *The outdoor classroom: A place to learn.* England: Corner to Learn Limited.

Hungerford, H. R., & Volk, T. L. (1990). Changing learner behavior through environmental education. *Journal of Environmental Education, 21,* 8–22.

Jacobs, G. M., Lee, C., & Ng, M. (1997). Co-operative learning in the thinking classroom. Paper presented at the *International Conference on Thinking,* Singapore.

Koballa, T., & Crawley, F. (1985). The influence of attitude on science teaching and learning. *School Science and Mathematics, 85*(3), 222–232.

Köse, S. (2008). Diagnosing student misconceptions: Using drawings as a research method. *World Applied Sciences Journal, 3*(2), 283–292.

Krapp, A. (2002). An educational-psychological theory of interest and its relation to self-determination theory. In E. Deci & R. Ryan (Eds.), *The handbook of self-determination research* (pp. 405–427). Rochester, NY: University of Rochester Press.

Lindemann-Matthies, P. (2005). "Loveable" mammals and "lifeless" plants: How children's interest in common local organisms can be enhanced through observation of nature. *International Journal of Science Education, 27*(6), 655–677.

Mavrikaki, E., Kokolakis, S., Koumparou, D., & Koliopoulos, D. (2012). Greek secondary school students' views about biology. *International Journal of Environmental & Science Education, 7*(2), 217–232.

Metz, K. E. (1995). On the complex relation between cognitive developmental research and children's science curricula. *Review of Educational Research, 67*(1), 151–163.

Moustafa, A., Ben-Zvi-Assaraf, O., & Eshach, H. (2013). Do junior high school students perceive their learning environment as constructivist? *International Journal of Science Education, 22,* 418–431.

Ouzouni, C., & Nakakis, K. (2011). Validity and reliability of measurement instruments in quantitative studies. Department of Nursing, TEI of Lamia.

Patrick, P., & Tunnicliffe, S. D. (2011). What plants and animals do early childhood and primary students name? Where do they see them? *International Journal of Science Education, 20,* 630–642.

Philips, D. C. (1995). The good, the bad and the ugly: The many faces of constructivism. *Educational Research, 24*(7), 5–12.

Shrigley, R. L. (1990). Attitude and behavior are correlates. *Journal of Research in Science Teaching, 27,* 97–113.

Strgar, J. (2007). Increasing the interest of students in plants. *Journal of Biological Education, 42,* 19–23.

Strid, A. (1995). The Greek mountain flora, with special reference to the Central European element. *Boconea, 5,* 99–112.

Zelezny, L. (1999). Educational interventions that improve environmental behaviors: A meta-analysis. *Journal of Environmental Education, 31,* 5–14.