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How Does Students' Attitude towards Biology Affect Their Academic Achievement at Secondary Level

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Abstract: *Despite the widespread importance of Science, students' interest in it has deteriorated over time. Achievement is mainly related to the students' attitude. The major goal of the present research is how students' attitudes about Biology affected their academic performance in Biology at the secondary level. A 24-item questionnaire (Biology Attitude Questionnaire, BAQ) was adopted. All the 10th graders Biology students from public schools constituted the population of the study, belonging to Punjab province. The sample of 10th-grade students was taken from the public secondary schools under the control of the Punjab province using a multistage sampling technique. Utilizing previous class Biology exam scores, achievement data was gathered. SPSS was used to examine the data. The analysis led to the conclusion that girls had a more favourable attitude toward Biology than boys. In addition, attitudes had a substantial impact on achievement for males, females, and urban students, but not for rural respondents.*

Key Words: Attitude, Biology, Achievement

Introduction

Science is developing at an incredibly fast rate right now. In contrast, students' interests have shifted away from science and altered. Such a mindset toward science courses is quite concerning. Calculating the impact of restructuring challenges on students' attitudes is crucial and will require measuring instruments with high psychometric features since science students' attitudes toward science have an impact on advancement and career choices (Owen, Toepperwein, & Marshall, 2008). Attitude is a challenging and dissimilar idea that refers to someone's predisposition regarding his belief, feelings, or favours

anything depending to judge an object, which might be true or false (Muazzam, Muhammad, & Naseer, 2021). Attitude is made up of three parts: cognitive, affective, and behavioural (Ahmed, Muhammad, & Anis, 2020). It is also about someone's perspective on an object, as stated by Coll-Dalgety and Salt (2002), and Kind (2007). Depending on the person's viewpoint, an object may be great or dreadful, damaging or beneficial, enjoyable or uncomfortable, significant or trivial. Nowadays, attitudes toward science and scientific education are given a lot of thought, especially in terms of teaching and learning. On the other hand, some students have

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complained that science is a challenging and boring subject. Students' performance typically declines as they advance through the grades. Prior to the age of 18, students' attitudes toward science are at their highest, and as they progress through middle and high school, the proportion of children under the age of eleven drops significantly as indicated by Barmby, Kind, and Jones, (2008); George, (2006); and Simon (2000). In secondary classes, science is seen as being unneeded in daily life. People think that because science is complicated, it has led to societal and environmental problems.

The fall in student interest in science developments as a result of growing worldwide scientific and technology achievement has spurred international attempts to restructure science education. To address this predicament, it is important to assess the performance of modification activities on the attitude of pupils. Since student attitudes toward science have a substantial impact on the choices of subjects and careers. Moreover, an important focus of studies related to attitude in the field of scientific education is on college students, high school students, and students in middle and elementary schools (Turkmen, 2007). Considering how quickly science and its related fields are developing in the present day. Subjects that are related to real life and its various phenomena tend to pique students' interests more. Only Biology is the most inventive science field in this regard. The study of life is the fundamental definition of Biology. Biology teaches us about living things, their bodies, how they interact with the environment, and the things that impact how long they survive. The study of organisms including plants, animals, and even people is a part of Biology. According to Hussaini (2015), Biology, as a science subject, helps students develop practical abilities in experimental work like observation, accurate recording, logical thinking, and effective equipment use.

According to Lazarowitz and Penso (1992), students can have trouble understanding biological ideas for a variety of reasons. Learning Biology is challenging due to the biological level of efficiency and the

speculative nature of the conceptions, but learning science is challenging due to the nature of science and its teaching methods, claim Lazarowitz and Penso (1992). Overcrowded Biology classes, the complexity and interdisciplinary of biological areas, and faulty texts are further learning barriers. At this point, a person's level of achievement of specific goals continues to be the focus of discussion concerning events in various educational contexts. It is known as academic success. Numerous education systems include cognitive objectives that are either like critical thinking related to learning concepts in specified domains like literacy, numeracy, art, design and history. Because academic achievement is such a broad topic that covers a variety of educational experiences, it should be understood as a multidimensional concept encompassing various knowledge domains (Amjad, Shah, & Muhammad, 2019).

It is clear that attitude has an obvious impact on how well science students do in the future. The way a student approaches the study of science affects their academic performance in that subject. It's critical to both recognize and change participants' attitudes in educational research projects (Prokop et al., 2007). It is possible to have a positive, negative, or neutral attitude. The phrase "attitude toward" is used to describe any concept that expresses how someone thinks about something, whether they like it or hate it. According to Khan and Ali (2012), an attitude is a manner of thinking, being, feeling, or acting toward someone or something. Similar to academic performance, a student's attitude has a significant impact on their success. Scientists must make sure that their students are enthusiastic about science classes, but research suggests that how students are taught may have an effect. They find science class material to be dull. Students' attitudes have an effect on how well they do in science subjects relates their attitudes which can help them succeed in a specific field. The attitudes of students affect their performance in science. In order to help people succeed in a certain sector and boost their success, it is critical to

understand the different attitudes that people hold (Prokop et al. [2007](#)).

Biology is perceived as a difficult subject by students for various reasons, including a lack of interest according to Limer (2012). Students' motivation to learn Biology also impacts their achievement as Aluçdibi & Ekici (2012a) found. Prokop, Tuncer, and Chudá ([2007](#)) claim students' attitudes toward science significantly influence their science achievement. Numerous studies on attitudes toward science are reviewed, with Rutjens ([2018](#)) finding attitudes shifted due to scientific advances. He found links between political/religious views and science attitudes.

Osborne et al.'s ([2003](#)) review summarizes attitudes toward science, emphasizing understanding factors like gender, teachers, culture, and curriculum that contribute to poor attitudes and potential solutions. Xiao and Sandoval ([2017](#)) examined links between attitudes toward science and assessments of socio-scientific issue comprehension. Anwer and Iqbal ([2012](#)) used the gender- and location-specific TOSRA instrument.

Mengstie (2018) studied junior and secondary students' attitudes toward learning science foundations. Eyu ([1995](#)) researched science attitudes and performance of third graders. SERIN and Mohamazade ([2008](#)) also found connections between primary students' science attitudes and achievement. Ali et al. ([2013](#)) found positive correlations between attitudes toward science and intermediate achievement. Neathery ([1997](#)) further explored elementary students' attitudes toward science regarding gender, culture, ability, grade, and aptitude. Hacieminoglu & Esme (2016) studied primary students' science attitudes and related factors. Bennet (2003) found differences between students' opinions of and attitudes toward science. Schibeci and Riley ([1986](#)) assert students' perspectives and backgrounds impact science attitudes and performance. Akpinar et al. ([2009](#)) examined students' attitudes toward science and technology based on gender, grade, and grades. Similarly, Wan and Lee ([2017](#)) provided gender difference analysis and

structural models of Hong Kong secondary students' science attitudes. George, [2007](#), showed how daily use of science impacted students' attitudes. Moustafa Ali et al. ([2013](#)) claim inexperienced science teachers alter students' science perspectives.

McBride et al. ([2013](#)) define Biology literacy as applying scientific inquiry to understand biological issues, incorporate concepts into decision-making, and communicate conclusions. Suwono et al. ([2017](#)) examined socio-biological case-based learning for improving biological literacy and critical thinking. Hussaini et al. ([2015](#)) revealed students' perspectives on Biology. Ekli et al. in [2009](#) investigated student attitudes toward biological sciences.

Almasri et al. (2021) showed how gender, group, and learning environment influence biological perceptions. Sandika and Fitrihidajati ([2018](#)) used inquiry-based learning to improve Biology education students' critical thinking and scientific attitudes. Kisoglu ([2018](#)) examined high schoolers' Biology learning motivation and subject/lecture attitudes. Incantalupo et al. ([2013](#)) described technology-rich Biology class attitudes and knowledge. Manganye ([1994](#)) identified factors impacting youth Biology attitudes in Ghazan Kulo. Ebuoh ([2011](#)) studied gender effects on Biology attitudes in Enugu East. Shaheen and Kiyani ([2017](#)) examined student perceptions of Biology as a classroom subject. Solpuk (2017) meta-analyzed attitude effects on achievement.

Mehmood and Anwer ([2020](#)) investigated associations between Biology attitudes and performance across grades and genders. Ndirika et al. ([2018](#)) studied senior secondary attitudes and Biology performance. Uitto ([2014](#)) emphasized how attitudes, self-efficacy, and interests contribute to upper-secondary students' Biology career desires. Suzuki and Akane ([2007](#)) investigated Japanese students' biology classroom attitudes. Kortam et al. ([2018](#)) found that project-based learning improved 7th graders' biology attitudes and engagement. Rabgay ([2017](#)) discussed

cooperative learning effects on 10th-grade biology achievement and attitudes.

Rogayan Jr. examined the Biology Learning Station Strategy (BLISS) on junior high attitudes and achievement. Malto (2017) studied academic performance and attitudes in a flipped biology classroom. Nair and Bindu (2016) examined secondary students' achievement and environmental attitudes with blended biology learning. Ali et al. (2014) described Nigerian secondary biology achievement and potential improvements. Gurbuz et al. (2010) investigated how teacher PowerPoint presentations impact student biology attitudes and performance.

Oghenevwe (2019) found self-regulated learning improved senior secondary biology performance and attitudes. Agbhoghorama and Oyouwi (2015) reported on students' progress in addressing difficult senior biology topics. Gbore and Daramola (2013) examined teaching characteristics and attitudes effects on Nigerian secondary biology performance. Fareo (2019) examined secondary biology achievement in Adamawa State. Kumar Das (2020) studied higher secondary student perceptions of biology teaching and achievement.

Statement of the Problem

Students in Pakistan have a strong interest in biology and other science courses. For entry into the medical field and those that are related to it, biology is regarded as an elective subject. The attitudes of science students are crucial to their future success. The hardest part of understanding science is helping students develop a positive attitude toward it. According to Georg (2006), it might pique students' interest in jobs in science education and related subjects. The purpose of this study was to investigate how students' attitude toward biology relates to their performance in biology. Biology attitudes among secondary school students must be understood since at this level, students should be required to select courses that will have an impact on their careers.

Objectives

This research explored the following objectives:

- To find out the effect of attitudes towards biology on students' achievement.

Questions for Research

1. What is the effect of students' attitudes towards biology on their achievement?
2. What is the effect of Male and Female students' attitudes towards biology on their achievement?
3. What is the effect of Rural and Urban students' attitudes towards biology on their achievement?

Method

This research was descriptive in nature and was based on quantitative mode. All the 10th graders biology students from public schools constituted the population of the study, belonging to Punjab province. Pupils in the 10th grade were selected as the study's population because research indicates that secondary school pupils have a more advanced attitude toward science and are capable of performing better. Achievement in biology was a determinant for the future profession at this age and grade level in Pakistan. Moreover, this representation of the population and sample from that group are also necessary for an exhaustive and trustworthy investigation. The total quantity of secondary school students is less overwhelming than those at lower levels.

The sample for the study consisted of 36 districts. Such a dispersed group made it impossible for the researcher to gather data from them. As a result, a sample of 10th graders was chosen using multistage sampling techniques from each public secondary school run by the Punjab province. Based on the percentage of literate residents in each district, Punjab was classified into two groups. Two districts from each category were first selected using a convenient sampling approach. In the following stage, samples were collected based on gender and location from strata and substrata levels.

Research Instrument

BAQ (Biology Attitude Questionnaire) was employed. Salta and Tzougraki (2004) developed it. Mehmood (2020) first applied it in a Pakistani context to examine the relationship between learners' attitudes about and accomplishments in biology at grade and

gender levels. The document was translated into Urdu. There were 24 items altogether. Six subscales are included in this study instrument: interest in biology, potential careers in biology, the value of biology, biology teachers, and challenges and equipment, 3-5 items. Achievement scores were collected from the BISE gazette.

Analysis and Findings

Table 1

Attitude towards Biology of Respondents on the basis of Gender and Locale

Respondents	N	Mean	Std. deviation
Total	1043	87.62	11.879
Male	485	85.04	12.852
Female	558	89.86	10.471
Urban	637	87.81	12.248
Rural	406	87.31	11.283

The values from the above table depicted that the total mean scores of attitudes towards biology for all students were positive and were also positive on the gender and locale basis. The table also shows that there exists a

difference on a gender basis, i.e., Females showed higher values for attitude towards biology than their male counterparts and locale basis as well.

Table 2

Effect of Attitude towards Biology on Achievement on the basis of Gender and Locale

Respondents	N	Mean	F	p
Total	1043	87.62	8.315*	0.000
Male	485	85.04	6.746*	0.000
Female	558	89.86	4.323	.014
Urban	637	87.81	11.446*	0.000
Rural	406	87.31	0.166*	0.847

The values from the above table depicted a difference in mean scores of attitudes towards biology for all students and on gender and locale basis i.e., females and urban students have higher attitudes towards biology showing significant differences. Similarly, it was the same in the case of the effect of attitude towards biology on students' achievement i.e. all females and all urban students have a higher effect of attitude towards biology on students' achievement thus showing significant difference. It was low in the case of males and rural respondents.

Conclusion

It was shown that students from rural and urban areas had similar attitudes toward biology, with female respondents having a more favourable opinion than male respondents. Additionally, a strong effect of attitude toward biology on academic achievement was discovered in female respondents as opposed to male respondents. In comparison to urban respondents, the views of rural respondents did not significantly affect their academic achievement in biology in accordance with locality.

Discussion

The results of the study were in contrast to the findings of other researchers (Nasir & Soltani, 2011), Green Field (1997), and Hussaini et al. (2015), where findings claim non-significant differences in attitudes toward biology scale for both genders. Additionally, this study demonstrates that girls have a more favourable view about biology than boys do which is also contrary to the findings of studies by Osborne et al. (2003). However, this study backs up the findings of many other researchers (Nasir & Soltani, 2011; Dhindsa & Chung, 2003). This conclusion is supported by the fact that women are more devoted to their work. They take greater responsibility for their work. They can finish their assignments and complete their responsibilities more quickly if they spend enough time at home. Women are more interested in science, particularly biology. These factors aid them in improving their attitude relative to men. Males typically show little interest in biology; instead, they show great interest in physics and chemistry. They have a high level of comprehension of these areas and do so because they have excellent observational abilities. They leave the house to investigate novel phenomena relating to daily life.

The study's findings indicate that there are significant differences in the attitudes of rural and urban pupils toward biology when locale is taken into account. These findings confirm those of Zacharia and Barton (2004) while rejecting those of Serin and Mohammazade (2008), Anwer and Iqbal (2012), and George (2000). They contend that there is no appreciable variation in the opinions of rural and urban students. When compared to urban students, where there are no issues like those in rural areas, rural students' attitudes might sometimes shift due to a lack of amenities and a low literacy rate. While urban areas lack such resources, there are numerous educational institutions in rural areas that offer evening tuition to those in need. Additionally, there are many places where students can find additional instructional materials related to their courses, like public libraries, internet cafés, bookstores,

etc. Urban teachers have higher levels of education and a greater grasp of cutting-edge technology. They have the power to improve students' attitudes about science classes. Additionally, museums can encourage students' natural curiosity and help them choose science as an engaging topic to study. However, the culture of rural communities discourages girls from continuing their education, which makes them fall behind. Schools in rural areas lack laboratories with suitable equipment, which prevents secondary students from developing a deeper grasp of various phenomena. Due to the distance between rural and urban locations, it is challenging for students to routinely visit public libraries.

The fundamental idea taught to pupils in our society is that biology is a crucial subject to take in secondary school if they want to become doctors. Without question, science has become remarkably popular in terms of its advantages. Science majors often land more respectable jobs. The facts in science encourage critical thinking. It raises a person's degree of intellect. Different scientific fields each have a purpose. One of the disciplines you must choose if you want to work in the medical profession or one of its allied fields, such as biotechnology, microbiology, parasitology, environmental biology, etc. Students are required to be informed about biology-related subjects and subfields at the secondary level. Consequently, students should have a good attitude toward biology (Azizoglu & Cetin, 2009).

Recommendations

This study recommended that:

Teachers ought to treat male and female students on an equal basis when it comes to academics. It will assist in addressing gender inequality. Teachers ought to promote male pupils' interest in biology as a field of study. They will get an interest in biology and a good outlook as a result. The government needs to give teachers the tools they need to implement cutting-edge teaching methods. The students' attitudes toward science courses like biology will be improved. In order for students to choose occupations in the future that align with

their interests, they should be provided with sufficient knowledge and information about the fields and subfields linked to their academic

subjects. The head of the school should make sure that there is enough equipment in the labs for each student to do experiments.

References

- Ahmed, F., Muhammad, Y., & Anis, F. (2020). Developing Secondary School Teachers' Positive Attitude towards Reflective Teaching: A Collaborative Action Research Study. *Sir Syed Journal of Education & Social Research*, 3(4), 43–53. [https://doi.org/10.36902/sjesr-vol3-iss4-2020\(43-53\)](https://doi.org/10.36902/sjesr-vol3-iss4-2020(43-53))
- Akpınar, E., Yıldız, E., Tatar, N., & Ergin, Ö. (2009). Students' attitudes toward science and technology: an investigation of gender, grade level, and academic achievement. *Procedia - Social and Behavioral Sciences*, 1(1), 2804–2808. <https://doi.org/10.1016/j.sbspro.2009.01.498>
- Ali, A. R., Toriman, M. E., & Gasim, M. B. (2014). Academic achievement in biology with suggested solutions in selected secondary schools in Kano State, Nigeria. *International Journal of Education and Research*, 2(11), 215–224. <https://in.ijern.com/journal/2014/November-2014/18.pdf>
- Ali, M. S., Iqbal, A., & Akhtar, M. M. S. (2013). Students' attitude towards science and its relationship with achievement score at intermediate level. *Journal of Elementary Education*, 25(2), 61–72. [http://pu.edu.pk/images/journal/JEE/PDF-Files/4_Shabbir%20&%20Asif%2025\(II\).pdf](http://pu.edu.pk/images/journal/JEE/PDF-Files/4_Shabbir%20&%20Asif%2025(II).pdf)
- Amjad, H., Shah, A. H., & Muhammad, Y. (2019). Parental involvement and students' academic achievements: A case study comparing public and private elementary schools. Paper presented at the 7 International Conference on Research in Education, Lahore.
- Anwer, M., Iqbal, H. M., & Harrison, C. (2012). Students' attitude towards science: A case of Pakistan. *Pakistan Journal of Social and Clinical Psychology*, 9(2), 3–9. <https://gcu.edu.pk/pages/gcupress/pjscp/volumes/pjscp2012april-1.pdf>
- Barmby, P., Kind, P. M., & Jones, K. (2008). Examining Changing Attitudes in Secondary School Science. *International Journal of Science Education*, 30(8), 1075–1093. <https://doi.org/10.1080/09500690701344966>
- Bennett, J. (2003). *Teaching and learning science*. New York: Continuum.
- Chung, Y. L., & Son, D. H. (2000). Effects of cooperative learning strategy on achievement and science learning attitudes in middle school biology. *Journal of the Korean Association for Science Education*, 20(4), 611–623.
- COLL, R. K., DALGETY, J., & SALTER, D. (2002). THE DEVELOPMENT OF THE CHEMISTRY ATTITUDES AND EXPERIENCES QUESTIONNAIRE (CAEQ). *Chem. Educ. Res. Pract.*, 3(1), 19–32. <https://doi.org/10.1039/b1rp90038b>
- Das, S. K. (2020). Attitude towards biology education and academic achievement in biology of higher secondary students. *Editorial Board*, 9(4), 204.
- EBUOH, C. N. (2011). INFLUENCE OF GENDER ON STUDENTS' ATTITUDE TOWARDS BIOLOGY IN ENUGU EAST LOCAL GOVERNMENT AREA OF ENUGU STATE. *The Nigerian Journal of Research and Production*, 18(1), 1–9. <http://eprints.gouni.edu.ng/id/eprint/2047>
- Ekli, E., Karadon, H. D., & Sahin, N. (2009). High school student's attitudes and opinions regarding biology course and biological sciences. *Procedia - Social and Behavioral Sciences*, 1(1), 1137–1140. <https://doi.org/10.1016/j.sbspro.2009.01.204>
- Eyu, F. O. (1995). *Science-related Attitudes and Science Achievement of Form Three Students in Fully Residential Science Schools in Kelantan*. (Doctoral dissertation, Universiti Utara Malaysia).
- FAREO, D. O. (2019). Study Attitude and Academic Achievement in Biology at Secondary School Level in Mubi Metropolis of Adamawa

- State. *International Journal of Scientific and Research Publications (IJSRP)*, 9(8), p9253.
<https://doi.org/10.29322/ijsrp.9.08.2019.p9253>
- Gbore, L. O., & Daramola, C. A. (2013). Relative Contributions of Selected Teachers' Variables and Students' Attitudes toward Academic Achievement in Biology among Senior Secondary Schools Students in Ondo State, Nigeria. *Current issues in Education*, 16(1).
- George, R. (2000). Measuring Change in Students' Attitudes toward Science over Time: An Application of Latent Variable Growth Modeling. *Journal of Science Education and Technology*, 9(3), 213–225.
<http://www.jstor.org/stable/40186571>
- George, R. (2006). A Cross-domain Analysis of Change in Students' Attitudes toward Science and Attitudes about the Utility of Science. *International Journal of Science Education*, 28(6), 571–589.
<https://doi.org/10.1080/09500690500338755>
- Hussain, H., & Anwar, N. (2017). Effects of Problem-Based Learning on Students' Critical Thinking Skills, Attitudes towards Learning and Achievement. *Journal of Educational Research*, 20(2), 28–41.
https://jer.iub.edu.pk/journals/JER-Vol-20-No-2/3_Effects_of_Problem_Based_Learning_on_Students%E2%80%99Critical_Thinking_Skills,_Attitudes_towards_Learning_and_Achievement.pdf
- Incantalupo, L., Treagust, D. F., & Koul, R. (2013). Measuring Student Attitude and Knowledge in Technology-Rich Biology Classrooms. *Journal of Science Education and Technology*, 23(1), 98–107.
<https://doi.org/10.1007/s10956-013-9453-9>
- Kind, P., Jones, K., & Barmby, P. (2007). Developing Attitudes towards Science Measures. *International Journal of Science Education*, 29(7), 871–893.
<https://doi.org/10.1080/09500690600909091>
- Kisoglu, M. (2018). An Examination of Science High School Students' Motivation towards Learning Biology and Their Attitude towards Biology Lesson. *International Journal of Higher Education*, 7(1), 151–164.
<https://doi.org/10.5430/ijhe.v7n1p151>
- Kortam, N., Basheer, A., Hofstein, A., & Hugerat, M. (2018). How Project-Based Learning promotes 7th grade students' motivation and attitudes towards studying biology. *Action Research and Innovation in Science Education*, 1(2), 9–17.
<https://doi.org/10.51724/arise.10>
- MALTO, G. A. (2017). Biology students' academic achievement and attitude in the flipped classroom. *Theses and Dissertations (All)*.
<https://archium.ateneo.edu/theses-dissertations/32>
- Manganye, H. T. (1994). *Factors influencing adolescents' attitude towards biology in Gazankulu* (Doctoral dissertation).
- Marsh, H. W., & Yeung, A. S. (1998). Longitudinal Structural Equation Models of Academic Self-Concept and Achievement: Gender Differences in the Development of Math and English Constructs. *American Educational Research Journal*, 35(4), 705–738.
<https://doi.org/10.3102/00028312035004705>
- McBride, B. B., Brewer, C. A., Berkowitz, A. R., & Borrie, W. T. (2013). Environmental literacy, ecological literacy, ecoliteracy: What do we mean and how did we get here? *Ecosphere*, 4(5), 1–20.
<https://doi.org/10.1890/es13-00075.1>
- Mehmood, N. (2020). Relationship of Students' Attitude towards and Achievement in Biology across Gender and Grade. *Pakistan Social Sciences Review*, 4(II), 422–435.
[https://doi.org/10.35484/pssr.2020\(4-ii\)34](https://doi.org/10.35484/pssr.2020(4-ii)34)
- Moustafa, A., Ben-Zvi-Assaraf, O., & Eshach, H. (2012). Do Junior High School Students Perceive Their Learning Environment as Constructivist? *Journal of Science Education and Technology*, 22(4),

- 418–431.
<https://doi.org/10.1007/s10956-012-9403-y>
- Muazzam, H. A., Muhammad, Y., & Naseer, H. (2021). English Language Teachers' Attitudes towards Instructional Policy in Public Secondary Schools: An Interview Study. *Global Educational Studies Review*, VI(I), 24–35.
[https://doi.org/10.31703/gesr.2021\(vi-i\).03](https://doi.org/10.31703/gesr.2021(vi-i).03)
- Nair, T. S., & Bindu, R. L. (2016). Effect of Blended Learning Strategy on Achievement in Biology and Social and Environmental Attitude of Students at Secondary Level. *I-Manager's Journal on School Educational Technology*, 11(4), 39–52.
<https://doi.org/10.26634/jsch.11.4.6011>
- Nasr, A. R., & Soltani, A. K. (2011). Attitude towards Biology and Its Effects on Student's Achievement. *International Journal of Biology*, 3(4).
<https://doi.org/10.5539/ijb.v3n4p100>
- Ndirika, M. C., & Obumnaeke, E. Students Attitude and Gender as Correlates of Senior Secondary School in Biology in Abia State, Nigeria. *AJSTME*, 4(1), 107–117.
https://www.researchgate.net/profile/Maryann-Ndirika/publication/359512951_Student_s_Attitude_and_Gender_as_Correlates_of_Senior_Secondary_School_in_Biology_in_Abia_State_Nigeria/links/6241fc4221077329f2dd2c27/Students-Attitude-and-Gender-as-Correlates-of-Senior-Secondary-School-in-Biology-in-Abia-State-Nigeria.pdf
- Neathery, M. F. (1997). Elementary and Secondary Students' Perceptions Toward Science: Correlations with Gender, Ethnicity, Ability, Grade, and Science Achievement. *The Electronic Journal of Science Education*, 2(1), 1–6.
- Njoku, M. I. A., & Nwagbo, C. R. (2020). ENHANCING STUDENTS' ATTITUDE AND ACHIEVEMENT IN BIOLOGY THROUGH INNOVATIVE STRATEGIES. *PEOPLE: International Journal of Social Sciences*, 6(2), 134–152.
<https://doi.org/10.20319/pijss.2020.62.134152>
- Oghenevwe, O. E. (2019). Enhancing Biology Students' Academic Achievement and Attitude through Self-Regulated Learning Strategy in Senior Secondary Schools in Delta Central Senatorial District. *Journal of Educational and Social Research*, 9(4), 149–156.
<https://doi.org/10.2478/jesr-2019-0064>
- Osborne, J., Simon, S., & Collins, S. (2003). Attitudes towards science: A review of the literature and its implications. *International Journal of Science Education*, 25(9), 1049–1079.
<https://doi.org/10.1080/095006903200032199>
- Prokop, P., Tuncer, G., & Chudá, J. (2007). Slovakian Students' Attitudes toward Biology. *EURASIA Journal of Mathematics, Science and Technology Education*, 3(4), 287–295.
<https://doi.org/10.12973/ejmste/75409>
- Rabgay, T. (2018). The Effect of Using Cooperative Learning Method on Tenth Grade Students' Learning Achievement and Attitude towards Biology. *International Journal of Instruction*, 11(2), 265–280.
<https://doi.org/10.12973/iji.2018.11218a>
- Rogayan, D. V. (2019). Biology Learning Station Strategy (BLISS): Its Effects on Science Achievement and Attitude towards Biology. *International Journal on Social and Education Sciences*, 1(2), 78–89.
<https://doi.org/10.46328/ijoneses.10>
- Rutjens, B. T., Heine, S. J., Sutton, R. M., & van Harreveld, F. (2018). Attitudes towards science. In *Advances in experimental social psychology* (Vol. 57, pp. 125–165). Academic Press.
- Salta, K., & Tzougraki, C. (2004). Attitudes toward chemistry among 11th grade students in high schools in Greece. *Science Education*, 88(4), 535–547.
<https://doi.org/10.1002/sce.10134>
- Sandika, B., & Fitrihidajati, H. (2018). Improving creative thinking skills and

- scientific attitude through inquiry-based learning in basic biology lecture toward student of biology education. *Jurnal Pendidikan Biologi Indonesia*, 4(1), 23–28. <https://doi.org/10.22219/jpbi.v4i1.5326>
- Schibeci, R. A., & Riley, J. P. (1986). Influence of students' background and perceptions on science attitudes and achievement. *Journal of Research in Science Teaching*, 23(3), 177–187. <https://doi.org/10.1002/tea.3660230302>
- Serin, O., & Mohammadzadeh, B. (2008). The relationship between primary school students' attitudes towards science and their science achievement (sampling: Izmir). *Journal of Educational Sciences*, 2(6), 68–75.
- Shaheen, M. N. K., & Kayani, M. M. (2017). Improving students' attitude towards biology as a school subject: Do the instructional models really work? *Journal of Applied Environmental and Biological Sciences*, 7(1), 170–179. [https://www.textroad.com/pdf/JAEBS/J.%20Appl.%20Environ.%20Biol.%20Sci.,%207\(1\)170-179,%202017.pdf](https://www.textroad.com/pdf/JAEBS/J.%20Appl.%20Environ.%20Biol.%20Sci.,%207(1)170-179,%202017.pdf)
- Suwono, H., Pratiwi, H. E., Susanto, H., & Susilo, H. (2017). Enhancement of Students' Biological Literacy and Critical Thinking of Biology through Socio-Biological Case-Based Learning. *Jurnal Pendidikan IPA Indonesia*, 6(2), 213–220. <https://doi.org/10.15294/jpii.v6i2.9622>
- Suzuki, A. (2007). *Attitudes of Japanese students in relation to school biology* (Doctoral dissertation, University of Glasgow).
- Turkmen, L., & Darcin, E. S. (2007). A Comparative Study of Turkish Elementary and Science Education Major Students' Knowledge Levels at the Popular Biotechnological Issues. *International Journal of Environmental and Science Education*, 2(4), 125–131.
- Uitto, A. (2014). Interest, Attitudes and Self-Efficacy Beliefs Explaining Upper-Secondary School Students' Orientation towards Biology-Related Careers. *International Journal of Science and Mathematics Education*, 12(6), 1425–1444. <https://doi.org/10.1007/s10763-014-9516-2>
- Wan, Z. H., & Lee, J. C. K. (2017). Hong Kong secondary school students' attitudes towards science: a study of structural models and gender differences. *International Journal of Science Education*, 39(5), 507–527. <https://doi.org/10.1080/09500693.2017.1292015>
- Xiao, S., & Sandoval, W. A. (2017). Associations between Attitudes towards Science and Children's Evaluation of Information About Socioscientific Issues. *Science & Education*, 26(3-4), 247–269. <https://doi.org/10.1007/s11191-017-9888-0>