BirLE-Journal
Budapest International Research and Critics in Linguistics and Education
p.ISSN: 2655-2647
e.ISSN: 2655-1470
Budapest Institute

Common Science Misconceptions among Junior, Secondary School, and College Freshmen: A Case Study in Dire Dawa City, Ethiopia

Belay Sitotaw Goshu[1], Tewodros Misganu[2], Ermias Abas[3], Melaku Masresha Woldeamanue[4], Muhammad Ridwan[5]
[1,2,3,4]Department of Physics, Dire Dawa University, Ethiopia
[5]Universitas Islam Negeri Sumatera Utara, Indonesia
belaysitotaw@gmail.com, sofon2ms@gmail.com, bukharyahmedal@gmail.com

Abstract

This study aimed to clarify misconceptions about science subjects among middle school, high school, and first-year university students in Dire Dawa City. The sample size was 1,576 first-year middle school and university students in Dire Dawa, Ethiopia. The researchers asked each participant to write responses to open-ended questions about general concepts in biology, chemistry, and physics. The authors use descriptive analysis techniques. These results show that 31.6% of respondents and 49.9% of respondents incorrectly believe that breathing, breathing, and germs are always incorrect concepts. Furthermore, it was found that 33.0% of respondents had a misunderstanding that "seeds and eggs are not living things." 54.6% of respondents had a good understanding that carbon, oxygen, and hydrogen are essential elements for living things, but 26.1% said they needed a clearer understanding of this indicator. Moreover, it was found that 45.9% of respondents did not understand the concept of pressure and violence. 27.9% of respondents did not clearly understand this indicator, while the rest (20.6%) understood the importance of pressure. We concluded that the level of common misconceptions about science subjects among teachers, students' families, and students was very high. The government revised existing textbooks, and teachers need to review their teaching methods and work with school leaders to develop intervention mechanisms. Students should have a forum with their families to reflect on what students have learned and discuss science with their children. They are a source of dissemination of existing misconceptions.

Keywords

Misconception; science; school; students; teachers

I. Introduction

Science is based on laws, principles, and procedures. Students are introduced to teaching and learning practices. Understanding science subjects must be confirmed based on mutual understanding to avoid errors.

According to Modell et al. (2005), misconceptions are insights about phenomena that occur in the real world and are not scientific explanations. This misconception is an idea that differs from what experts agree upon and believe (Ibrahim, 2012). This misconception about science is supported by Research, especially among students and teachers (Belo et al., 2010; Brown et al., 2010; Markic & Eilks, 2010). It depends on the opinion and consensus of scientists, such as errors in presenting examples of concepts, errors in linking concepts, and incomplete understanding of concepts (Taufiq, 2012).

Brown et al. (2010) state that science teachers develop knowledge by mastering the program. The teacher has an enormous impact on the orientation of prospective science

DOI: https://doi.org/10.33258/birle.v7i3.7949

students by elaborating on the objectives and views of the teacher's role. Fitzgerald, Hacking, and Dawson (2010) show that students' beliefs and prior knowledge influence classroom teaching and learning processes. Lange et al. (2010) emphasize emotional aspects as part of teaching skills that may be the main factor in changing students' attitudes toward learning science.

According to Eggen and Kauchak (2004) and Martin et al. (2002), concepts, objects, or events help people understand the world around them. On the other hand, they are ideas that give a false understanding of images, objects, or events produced by a person's experience.

Students come to class with prior knowledge. Progress through training is gradual. Science education is a dynamic process. You have a solid plan to change any misconceptions that could put them at risk. Many strategies that can help teachers change misconceptions. This can be done by identifying the problems that students are having (Burgoon et al., 2010).

Misconceptions can be the source of most learning issues in school if they are not detected and processed like a shot. Science thought may be a vital downside at every level of education, particularly at the junior, secondary, and university levels. It is because junior and secondary school is where the most basic education taught would arouse the ensuing level.

According to Alter and Nelson (2002), parents taught misconceptions through tutoring by senior teachers and books. In teacher-centered instruction, teachers identify how to teach based primarily on the content of tradition and discipline. Teachers who have scientific misconceptions can communicate them to their students. According to Fisher 2004; Wood-Robinson 1994, teachers have great potential to teach students about misconceptions in science.

According to Murdoch (2018), preconceived ideas are common conceptions shared from life experience. According to Leaper et al. (2012, non-scientific beliefs are opinions or information learned by a student's colleagues.

Based on scientific evidence, misconceptions about language arise from the habit of using words with different meanings throughout life (Keeley, 2012). Misunderstandings occur in childhood and persist into adulthood. Therefore, this study aimed to determine the level of misconceptions among first-year elementary, secondary, and university students.

II. Research Method

2.1 Study Area

The study was conducted in Dire Dawa, located in eastern Ethiopia. It includes middle school, high school, and university students. Four middle and three high school students were randomly selected from public and private schools.

2.2 Data Collection

A literature review was used to analyze the current level of students' misconceptions of the sciences. In this study, we collected data, analyzed it, and made conclusions and recommendations based on the results.

Different methods were used to collect data to achieve the stated objectives. A questionnaire was employed to collect data from the selected schools from the Dire Dawa city administration. The item was developed to test the levels of students' and teachers' misconceptions about science subjects. It has seven levels of agreement with a total of forty-four questions.

2.3 Research Design

The study approach is qualitative in its research design. It was based on the respondents within randomly selected schools. The data was represented using tables and charts. Büyüköztürk et al. (2010); Özgür, (2013).

Teachers also identified students' language inadequacy as another problem preventing them from applying teaching aids. This, to a large degree, can be attributed to the design of English curriculum in Libya which has been criticised for being long and formal to teach, as well as neglecting the listening and speaking skills Gadour. A, Amaniana. S (2015)

2.4 Sample Size

The total sample size was 1,576 students, including 581 students from four different junior high schools, 888 secondary school students, and 107 first-year students of Dire Dawa University 2021. The number of students at each level is summarized in Table 1. Additionally, 100 teachers participated in the study from October to January 2021. Researchers are gathering insights on particle theory concepts across teachers across ages, genders, and different degrees.

III. Results and Discussion

3.1 Results

This section presents the study's main findings. Descriptive analysis obtained from answer sheets identified participants' misconceptions regarding scientific topics. The number of respondents who participated in this study was collected from middle and junior high school students and first-year students at the university (Batch, 2021).

Figure 1 shows the educational background of the respondents. The results showed that 36.9% of respondents attended elementary school, 56.3% attended junior high school, and 6.8% were new university students.

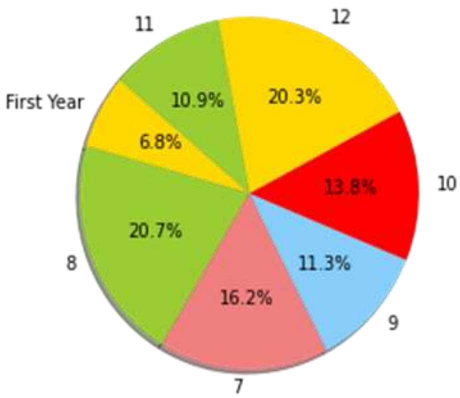
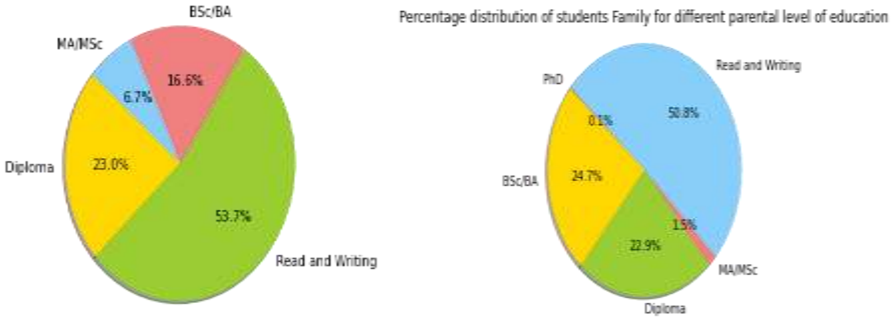


Figure 1. Educational background of students.

The gender participation and education level of the student's mothers and fathers in this study is shown in Table 1. The percentage of the respondents was 50.7% male and 49.7% female. Most of the respondents are between 15 and 20 years ol

Table 1. Respondents' demographic characteristics

Gender	Frequency	Percent
Male	799	50.7
Female	777	49.3
Ages		
14-15	344	21.8
15-20	953	60.5
Above 20	279	17.7



(a) (b)

Figure 2. Students' family education background (a = Mother, and b = Father education background)

The educational background of the student's father and mother is shown in Figure 2. Figure 2(b) revealed that 390 (24.7%) of respondents' fathers have BA/BSc degrees, 801 (50.8%) of respondents can read and write only, 361 (22.9%) of respondent's fathers have a diploma, 24 (1.6%) of student's fathers have an MA/MSc degree and 0.1% of respondents father have PhD. Moreover, Figure 2(a) shows the students' mothers educational backgrounds. The result depicts that most students' mothers can read and write; only 729 (46.3%) of the respondents have an MA/MSc, BSc/BA degree, or Diploma.

We attempted to evaluate students' preferred subjects in this work. The outcomes shown in Figure 3 reflect the top choice. Biology was the preferred subject of the majority of students, with 652 (41.4%), chemistry with 529 (33.6%), and physics with 395 (25.1%).

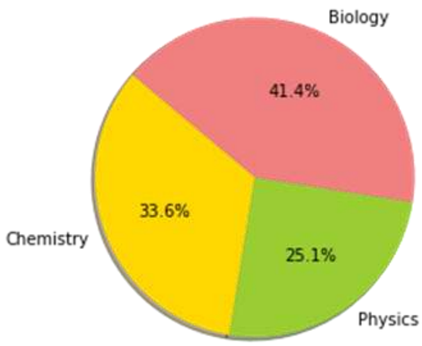


Figure 3. Student's first choices of science in science subjects

Table 2 shows that the inclusive questions from the life science subject are presented based on problem indicators, where the contribution of misconceptions has the highest value. It proves that students in junior high, high school, and university first-year programs have a high misconception.

Table 2. Life science misconceptions based on the problem indicator (UC understanding the concept), PUC, partly understanding, M (misconception), and NC (not clear)

Indicators	junior school				Secondary schools				First University students			
	UC (%)	PUC (%)	M (%)	NC (%)	UC (%)	PUC (%)	M (%)	NC (%)	UC (%)	PUC (%)	M (%)	NC (%)
Blood flows like oceans	17.1	0.0	10.2	10.8	14.3	0.0	28.7	14.0	2.5	0.0	2.0	2.3
A worm is an animal	17.1	3.7	10.7	6.0	24.3	3.9	11.7	11.0	2.4	1.0	2.3	1.1
Insects have blood	10.6	0.0	20.5	7.0	14.7	0.0	22.6	19.0	2.4	0.0	3.2	1.3
Seeds and eggs are not living things	9.5	2.0	10.8	11.6	11.6	5.1	17.3	19.7	2.2	1.0	2.9	0.8
A microscope is a device used to observe small objects that can be seen with the naked eye.	22.3	3.7	10.4	2.9	34.0	4.0	12.3	9.1	3.2	1.3	1.6	0.8
Plants need light to grow.	15.7	7.0	10.5	5.5	27.7	7.4	11.7	9.5	3.2	1.0	1.8	0.8
The growth of human beings is gradual and continuous	18.2	5.1	9.7	5.1	33.6	5.9	10.4	8.8	3.9	0.7	1.5	0.8
Insects are animals	12.2	3.5	13.7	13.3	22.9	8.1	10.4	12.7	3.1	0.8	1.6	1.3
Bacteria are always harmful to human beings	7.0	2.5	17.9	8.1	10.3	5.9	28.9	11.0	1.8	1.2	3.1	0.7
Plants get their food from the soil	8.2	4.0	10.8	6.5	17.1	9.3	18.8	11.3	3.9	2.5	5.6	1.9
If your dad is bald, you will be bald, too	8.0	3.4	11.7	13.8	10.3	8.6	17.7	16.4	1.7	1.1	3.1	1.0
Breathing is not the same as respiration	10.2	2.1	12.8	11.1	15.4	7.7	12.8	14.3	2.2	1.4	2.3	0.9
Plants do not have lungs, so they cannot breathe	10.4	2.8	14.7	9.1	17.1	5.7	20.6	14.7	1.8	1.2	2.7	1.0
Carbon, oxygen, and hydrogen are essential elements for living things	17.9	0.6	12.5	1.3	32.7	5.2	12.5	10.3	4.0	0.8	1.1	0.8
The average temperature of a human being is 37°C	12.6	4.1	12.5	8.2	29.6	5.2	11.3	12.3	4.4	0.4	1.4	0.6
Average	**13.1**	**3.0**	**12.63**	**8.0**	**21.0**	**5.5**	**16.51**	**12.9**	**2.85**	**1.0**	**2.41**	**1.1**

31.6% of the respondents in middle, high school, and first-year education have misconceptions about breathing and respiration. As shown in Table 2, 49.9% of the respondents believe bacteria are always harmful to humans. 33.9% of respondents have a misconception that plants get their nutrients from the soil, and 33.0% have a misconception that seeds and eggs are not living things.

According to the kingdom of animals, insects are animals. We have tried to assess the student's understanding of the concept. 15.9% of junior, high school, and first-year university students needed help understanding this concept. Moreover, 54.6% of respondents have a good understanding that carbon, oxygen, and hydrogen are essential elements for living things, but 26.1% of respondents do not.

The average misconception of students about the main concepts of the indicators shown in Table 2 was 33.4%, and 22.0% of students needed help understanding the indicators shown in Table 2. It shows that the extent of misconceptions in the life sciences is significant. It will be a challenge for students' future careers. In addition, you may not be able to express your thoughts in an organized manner or communicate with others. Mastering concepts helps students improve their ability to generate new ideas.

Therefore, by mastering the basic concepts, students can perform better in their field of study. Otherwise, they cannot exercise it. The results indicate that students typically develop interpretations inconsistent with Wandersee, Mintzes, and Novak (1994).

Table 3. Physical science misconceptions based on the problem indicator

Indicators	Junior school				Secondary schools				First University students			
	UC (%)	PUC (%)	M (%)	NC (%)	UC (%)	PUC (%)	M (%)	NC (%)	UC (%)	PUC (%)	M (%)	NC (%)
Particles expand when they are heated	16.8	3.8	6.7	4.5	29.6	5.2	11.0	10.2	3.2	1.4	1.6	0.6
Soil water only exists in regions where heavy rain areas	11.2	5.7	11.6	7.8	17.7	7.8	14.0	17.1	2.1	1.2	2.7	0.8
Water only evaporates from sea and oceans	15.2	0.0	12.4	9.1	20.5	0.0	23.0	12.9	3.8	0.0	2.4	0.6
Water exists in three states of matter	19.5	6.9	6.8	5.5	30.2	6.9	8.9	9.5	3.3	1.1	1.6	0.8
Water is a combination of hydrogen and oxygen	23.4	3.1	9.8	3.9	35.0	5.0	6.4	9.9	4.1	0.8	1.1	0.8
Planets revolve around the sun in an elliptical path	15.1	4.1	11.4	6.3	27.2	5.5	8.4	13.3	3.0	1.0	1.8	1.0
Temperature is a measure of the average kinetic energy of a molecule	18.0	4.7	9.5	4.5	29.0	6.8	5.8	11.6	4.1	0.6	1.1	1.0
Sounds need a material medium for transmission	18.0	4.3	7.1	7.4	33.4	5.1	8.2	9.7	3.8	1.1	1.2	0.7
Expansion and contraction of materials depend on temperature	17.9	3.6	9.3	6.1	27.7	8.3	8.6	10.3	3.4	1.5	1.1	0.8
Physical change needs energy	15.5	5.1	8.5	7.9	23.1	7.6	9.8	14.9	3.2	1.3	1.3	0.9
Force can only change the shape of objects.	7.6	0.0	19.1	8.4	10.6	0.0	25.6	18.3	2.5	0.0	3.7	0.7
A sound faints when moving objects closer to the source	14.7	0.0	15.1	6.9	13.7	0.0	23.6	17.8	2.3	0.0	3.1	1.4
pressure and forces are equal	7.6	0.0	19.1	8.4	10.6	0.0	25.6	18.3	2.4	0.0	3.2	1.2
The size of an object	4.8	3.9		12.9	16.4	6.7		15.0	1.6	1.3	2.8	1.1

depends on the temperature			15.2				17.3					
An object floats more in water than other fluids	9.8	0.0	19.8	7.2	15.0	0.0	29.2	11.4	2.4	0.0	3.5	0.9
An object sinks when its densities are equal	9.5	0.0	16.1	12.6	11.6	0.0	32.0	11.7	2.9	0.0	2.9	1.0
Adhesion is the same as cohesion	11.2	0.0	11.6	13.8	15.9	0.0	25.0	14.8	3.2	0.0	1.8	1.8
Faster-moving fluids have less pressure	11.5	5.1	11.2	9.6	24.0	5.7	15.0	11.9	1.6	0.3	3.4	1.5
Heat is a substance	12.6	0.0	17.6	6.8	25.6	0.0	20.6	9.7	2.4	0.0	3.7	0.8
Light always travels in a straight line	4.0	0.0	24.1	6.9	7.2	0.0	39.2	9.9	2.0	0.0	3.7	1.1
Our sins can cause solar eclipses, Earth a nd moon formations	4.8	0.0	25.3	7.0	8.8	0.0	34.8	12.0	2.0	0.0	3.7	1.7
Average	**12.8**	**2.4**	**13.7**	**8.7**	**20.6**	**3.4**	**18.7**	**12.9**	**2.8**	**0.6**	**2.4**	**1.0**

Table 3 presents the results of students' misconceptions about physical science. The average results show that 36.2% of the respondents clearly understand the problem indicator, and 6.4% of the respondents asking for partial understanding indicate the problem. The average misunderstanding rate was 36.2% on the indicator issue, which is significant, as shown in Table 3. Additionally, 22.6% of respondents did not understand the concept.

The main misconception about the indicator problem is presented in Table 3. The first is that force can only change the shape of an object. Concept of force: 47.4% of the respondents need to understand this concept; 27.4% need to clearly understand this concept, and the remaining 25.2% clearly understand the effects of force. Force can change the shape, size, and direction of motion by changing the speed of a moving object. The level of misunderstanding about the effects of force by grade level is shown in Figure 4. The results show that the level of misunderstanding among 7th-grade students is relatively high. In grade 11, the level of misunderstanding is lower than in other grades. Additionally, there is a degree of misconception about the effects of force at all grade levels. The percentage of students who do not know this concept is higher in grade 12.

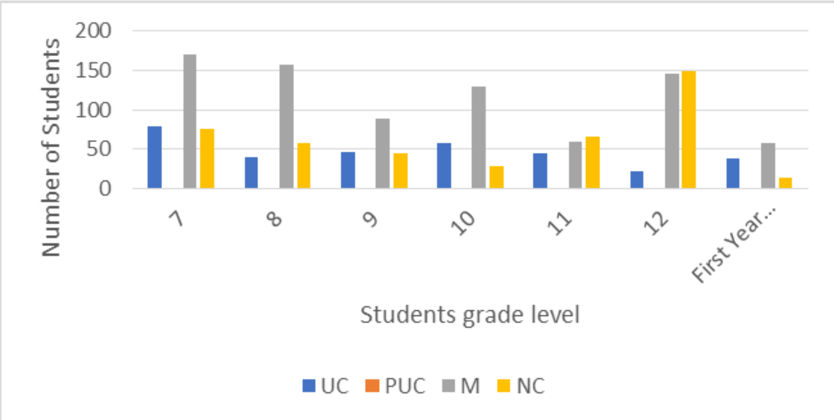


Figure 4. The level of the misconception of respondents on the effect of forces (UC understands the concept, PUC partly understands, M misconception, and NC, not clear)

The next misconception was pressure and force. The result revealed that 45.9% of respondents had not understood the concepts of pressure and force. Whereas 27.9% of the respondents do not have a clear idea of the indicator, the rest (20.6%) understand the pressure. The result shown in Figure 2 revealed that the level of misconception in grade twelve students was higher than in the other grade levels. The lowest level of understanding is in grade 7 compared to other students. This finding demonstrates the level of misinterpretation observed at all grade levels. Additionally, Figure 4 shows that grade levels needed help understanding this concept.

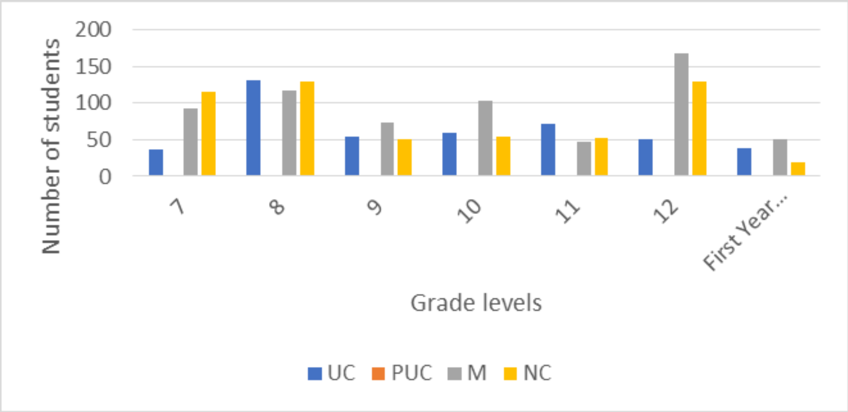


Figure 5. The level of the misconception of respondents about pressure and force relative to their grade levels

The size of an object depends on temperature changes. Table 3 shows that 35.3% of respondents did not understand the concept, 22.8% of respondents clearly understood the concept, 29.0% of respondents did not, and 12.9% still understood part of the concept. The level of misunderstanding of their grade level is shown in Figure 6. The results show that the level of misunderstanding in grade 7 is the highest. Furthermore, the results showed that the level of understanding of this concept was the lowest in 8th-grade students. This problem is observed from primary school to the university level.

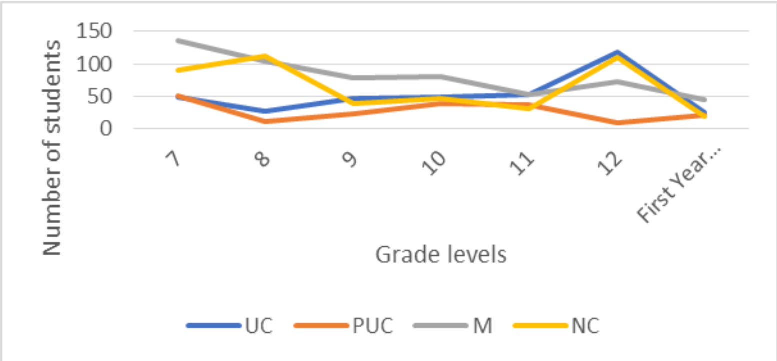


Figure 6. The extent of respondents' misconceptions about the size of objects depends on the temperature relative to the student's grade level.

Another concept that respondents need to understand is heat. Heat is not a substance; that is energy. The results in Table 3 show that 41.9% of respondents misunderstood the idea, and 17.3% did not understand. The remaining 40.6% understand the concept. The degree to which the basic idea that heat is a substance misconception is shown in Figure 7. The results showed that the level of misinterpretation was highest in the seventh and eighth grades. This concept is somewhat understood at other grade levels and is observed in twelfth grade.

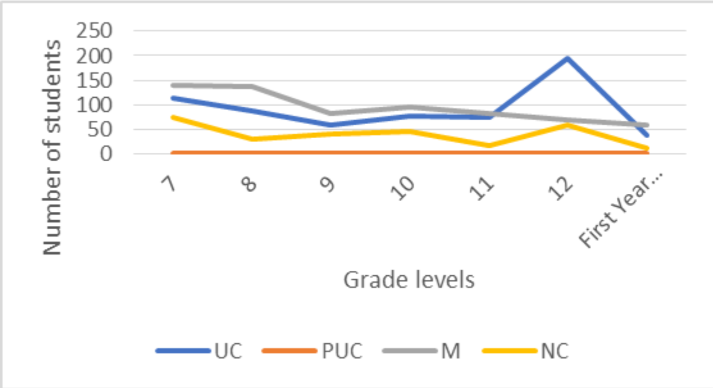


Figure 7. Level of misconception respondents on heat is a substance relative to students' grade levels

The misconception factors are shown in Figure 8. The results show that there are four main factors leading to misconceptions. These are teachers, families, books, and the students themselves. Students themselves are the most significant contributors to student deception. The results confirm those obtained by Agnes et al. (2015) that their colleagues may experience student misconceptions.

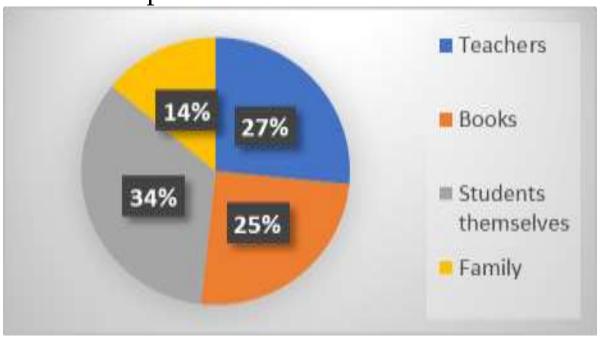


Figure 8. Factors of student misconceptions.

One symptom of the problem presented in Table 3 that needs to be better understood by students is that heat is a substance. As shown in Figure 7, family is one of the factors that causes students to have misconceptions. Therefore, we tried to evaluate the misconceptions of home-educated students, as shown in Figure 8. The results show that the error rate of 8th-grade students is higher than that of the rest of the classes relative to family education. The students only know how to read and write. Understanding of the concept of heat as a substance is highest in grade 12, and their families only know how to read and write. It suggests that a student's level of academic understanding may be a factor in their educational career.

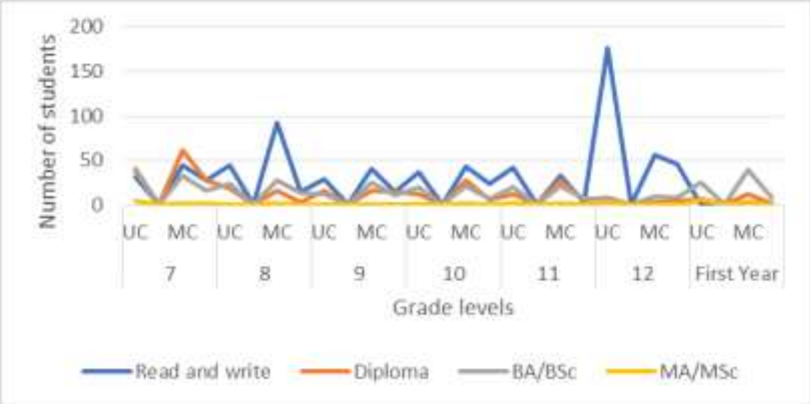


Figure 8. Education background of the student's family versus the rate of misconception that heat is a substance

Figure 9 shows the prevalence of misconceptions that seeds and eggs are not living organisms. The results showed that this index needed more basic knowledge at any grade level. Figure 9 shows relatively higher levels of conceptual ambiguity among 12th graders and their families' educational levels in reading and writing. It shows the extent to which family of origin is essential for understanding life science concepts.

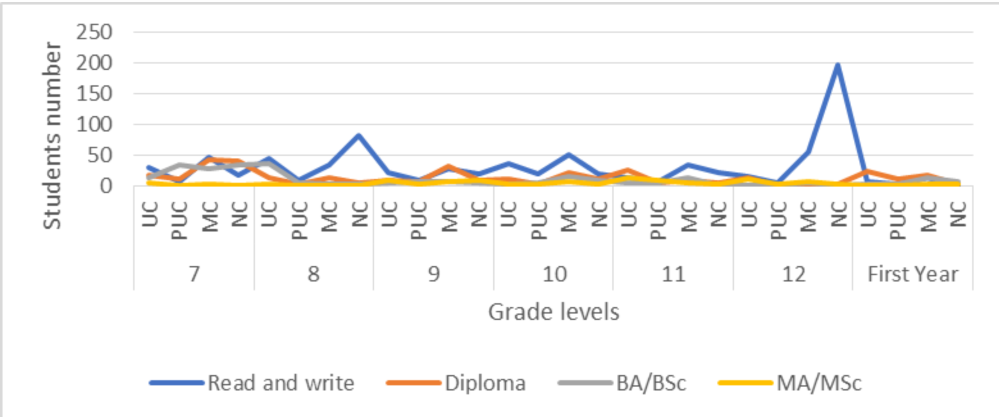


Figure 9. Education background of the student's family versus the rate of misconception that seeds and eggs are not living things

3.2 Discussion

Misconceptions are resilient to change, stubborn, deeply embedded in students' cognitive processes, and challenging to alleviate (Bayuni et al., 2018). They may arise in the process of absorbing previous information. He must absorb knowledge from the evidence that students get in class. But it's hard to integrate them. Misconceptions are armored by students' strong thinking, which is difficult to change and correct. From this data, it can be concluded that some students have misconceptions and are unfamiliar with this concept.

There are many reasons why students still need to understand and have mastered the theory. It is because they are abstract and cannot be seen directly with the eyes or sensed by the five existing senses. It is maintained by Hilarius and Adpriyadi's (2020) assertion that misconceptions can be caused by content that is too difficult and does not match students' thinking skills. The topic covered still needs to be discovered by the students. That notion is also due to misconceptions taught incorrectly by previous teachers. The cause of students' misconceptions is due to the lack of evidence and limited opportunities to test new theories and errors.

Furthermore, misconceptions are influenced by the theoretical understanding of the concept from school, college teachers, family, colleagues, or manuals. The ideas generated are sometimes inconsistent or contrary to facts accepted by experts. According to Berg (2004), the concept arose from their experiences and observations in society or daily life.

It can create misconceptions in students if they accept mistakes due to teacher misunderstandings. According to Cleminson (1990), science can be acquired through teaching concepts effectively and appropriately. Many scientific ideas are consistent and provide keys to understanding other concepts. Novick and Nussbaum (1978); Bayuni et al. (2018). The learning process is continuous, cognitive, influenced by ideas, and considered present and belonging to the learner Aydn and Uşak, (2003); Bayuni et al., (2018). Therefore, not only is the integration of the material lost, but the presentation of material in textbooks also affects students' ability to absorb it.

IV. Conclusion

Therefore, misconceptions are detrimental, limiting and hindering students' learning. This hinders learning scientific facts. Students cannot escape their mistakes over the years. These concepts will be imprinted in their minds and become part of their knowledge. These misconceptions hinder the absorption of new ideas or facts presented by teachers, and as a result, students feel confused and thus disagree with scientific concepts. This study highlights some issues related to misconceptions about science subjects among middle and high school students in Dire Dawa town. Many factors contribute to students' acquisition and retention of misconceptions about science, such as family, books, teachers, and students.

According to the results of this study, teachers, books, and students' families are the agents that cause misconceptions about science and propagate existing misconceptions about science. Educators must develop strategies to reduce or eliminate these misconceptions and implement these strategies.

This work helps overcome misunderstandings about scientific concepts contained in learning materials that teachers, families, and students encounter so that they can pass on their knowledge to the future. Learning process of future generations.

References

Agnes, D., Kaniawati, I., and Danawan, A. (2015). Analysis Descriptive Tes Tiga Tingkat Materi Optika Geometri dan Alat Optik [Descriptive Analysis Three-Tier Test Geometry Optics and Optical Instruments]. Prosiding Symposium Nasional Inovasi dan Pembelajaran Sains, 597-600

Alters, B. J., and Alters, S. M, (2001). Defending evolution: a guide to the creation/ evolution controversy. Sudbury, y. Sudbury, MA: Jones and Bartlett.

Aydın, H., M. Uşak, (2003). The Importance of the Investigation of Alternative Conceptions in Science Classes: A Theoretical Approach *Pamukkale University Journal of Education* 1(13), 121–135

Barrass, R., (1984). Some misconceptions and misunderstandings perpetuated by teachers and textbooks of biology. Journal of Biological Education, 18(3), 201–206.

Bayuni, T.C., W. Sopandi, A. Sujana, (2018). Identification misconception of primary school teacher education students in changes of matters using a five-tier diagnostic test, J. Phys.: Conf. Ser. 1013, 012086, 1-7

Belo, N. A.H., Driel, J. H. V, & Verloop N. (2010). Teachers' Beliefs about Making Physics Engaging and Comprehensible for Secondary Students in the Netherlands. In M.F. Taşar & G. Çakmakcı (Eds.), Contemporary science education research: teaching (pp. 29-39). Ankara, Turkey: PegemAkademi.

Berg EVD., (2004). Alternative conceptions in physics and remediation. Philippines: Science and Mathematics Education Institute University of San Carlos.

Brown, P., Friedrichsen, P., &Abell S. (2010). Do Beliefs Change? Investigating Prospective Teachers' Science Teaching Orientations during an Accelerated Post-baccalaureate Program. In M.F. Taşar & G. Çakmakcı (Eds.), Contemporary science education research: teaching (pp. 41-51). Ankara, Turkey: PegemAkademi.

Büyüköztürk, Ş., Çakmak, E. K., Akgün, Ö. E., Karadeniz, Ş., & Demirel, F. (2010). Bilimsel araştırma yöntemleri [Scientific research methods]. Ankara: PegemA, 6th Edition.

Cleminson, A. (1990). Establishing an epistemological base for science teaching in the light of contemporary notions of the nature of science and of how children learn science. Journal of Research in Science Teaching, 27(5), 429 - 445.

Cochran, W.G., (1977). Sampling Techniques (3rd edition). John Wiley &Sons.

Crawford, BA, Zembal-Saul, C, Munford, D, & Friedrichsen, P. (2005). Confronting prospective teachers' ideas of evolution and scientific inquiry using technology and inquiry-based tasks. Journal of Research in Science Teaching, 42(6), 613–637.

Driver, R, Squires, A, Rushworth, P, & Wood-Robinson, V. (1994). Making sense of secondary science. New York, NY: Routledge.

Fisher, KM. (2004). The importance of prior knowledge in college science instruction. In DW Dunal, EL Wright, & JB Day (Eds.), Reform in undergraduate science teaching for the 21st century (pp. 69–83). Greenwich, CT: Information Age Publishing.

Fitzgerald A., Hackling M, & Dawson V. (2010). Beliefs, Knowledge, and Practices of Two Effective Primary Science Teachers. In M.F. Taşar & G. Çakmakcı (Eds.), Contemporary science education research: teaching (pp. 53-58). Ankara, Turkey: Pegem Akademi.

Gadour. A, Amaniana. S (2015). An Evaluation of the Teaching Aids Used By English Teachers within Libyan Secondary Schools, *Britain International of Linguistics, Arts and Education (BIoLAE) Journal*

Haidar, A. (1997). Prospective chemistry teachers' conceptions of the conservation of matter and related concepts. Journal of Research in Science Teaching, pp. 34, 181–197.

Hilarious, J. D., and Adpriyadi, 2020, Students' Misconception in Concept of Biology Cel, Anatolian Journal of Education, 5(1), 47-52

Ibrahim, M. 2012. Konsep, Miskonsepsidan Cara Pembelajarannya. Surabaya: Unesa University Press.

Jarvis, T, Pell, A, & McKeon, F. (2003). Changes in primary teachers' science knowledge and understanding during a two-year in-service program. Research in Science and Technology Education, pp. 21, 17–42.

Keeley, P. (2012). Misunderstanding Misconceptions. Science Scope, 35(8), 12.

Kikas, E. (2004). Teachers' conceptions and misconceptions concerning three natural phenomena. Journal of Research in Science Teaching, 41(5), 432–448.

Lange K., Kleickmann T., & Moeller K. (2010). Measuring primary school teachers' pedagogical content knowledge in science education with open-ended and multiple-

choice items. In M.F. Taşar & G. Çakmakcı (Eds.), Contemporary science education research: teaching (pp. 67-69). Ankara, Turkey: Pegem Akademi.
Lawrenz, F. (1986). Misconceptions of physical science concepts among elementary school teachers. School Science and Mathematics, pp. 86, 654–660.
Leaper, C., Farkas, T., & Brown, C. S. (2012). Adolescent Girls' Experiences and Gender-Related Beliefs about Their Motivation in Math/Science and English. Journal of Youth and Adolescence, 41(3), 268–282.
Markic, S., & Eilks, I. (2010). A mixed methods approach to characterize the beliefs on science teaching and learning of freshman science student teachers from different science teaching domains. In M.F. Taşar& G. Çakmakcı (Eds.), Contemporary science education research: teaching (pp. 21-28). Ankara, Turkey: Pegem Akademi.
Modell, H, Michael, J, & Wenderoth, MP. (2005). Helping the learner to learn: the role of uncovering misconceptions. American Biology Teacher, 67, 20–26.
Mohapatra, JK, & Bhattacharyya, S. (1989). Pupils and teachers induced incorrect generalizations and the concept of force. International Journal of Science Education, pp. 11, 429–436.
Morais, M. D. F. (2013). Creativity: Challenges to a Key Concept for the XXI Century. Retrieved from https://repositorium.sdum.uminho.pt/handle/1822/26465
Murdoch, J. (2018). Our Preconceived Notions of Challenging. Early Years Educator, 19(9), 22-24
Novick, S., J. Nussbaum, (1978). Junior high school pupils' understanding of the particulate nature of matter: *An interview study Science Education* 62(3), 273–281.
Özgür, S., (2013). The Persistence of Misconceptions about the Human Blood Circulatory System among Students in Different Grade Levels, *International Journal of Environmental & Science Education*, **8**(2), 255-268
Sanders, WL, Horn, SP. (1994). The Tennessee value-added assessment system (TVAAS): Mixed-model methodology in educational assessment. Journal of Personnel Evaluation in Education, pp. 8, 299–311.
Smith III, J. P., Disessa, A. A., and Roschelle, J., 1994, Misconceptions reconceived: A constructivist analysis of knowledge in transition. The journal of the learning sciences, 3(2), 115-163. https://doi.org/10.1207/s15327809jls0302_1
Taufiq, M. (2012). RemidiasiMiskonsepsiMahasiswaCalon Guru FisikaPadaKonsep Gaya MelaluiPenerapan Model SiklusBelajar (Learning Cycle) 5E, JurnalPendidikan IPA Indonesia. 1(2) 198–203.
Wandersee, J. H., Mintzes, J. J., J.D. Novak, (1994). Research on alternative conceptions in science. In D. L. Gabel (Eds.), *Handbook of Research on science teaching and learning*, New York: Simon & Schuster and Prentice Hall International, 177-210
Wanderssee, J. H, Mintzes, J. J, & Novak, J. D, (1994). Research in alternative conceptions in science: part II learning. In DL Gabel (Ed.), Handbook of Research on science teaching and learning, 177–210, New York: Macmillan.
Wood-Robinson, C., (1994). Young people's ideas about inheritance and evolution. Studies in Science Education, pp. 24, 29–47.
Yates and Marek, (2014). Teachers teaching misconceptions: a study of factors contributing to high school biology students' acquisition of biological evolution, *Yates and Marek Evolution: Education and Outreach*, 2014, 7(7), 1-18