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AN INVESTIGATION OF BIOLOGY TEACHERS' AND STUDENTS' VIEWS ON TEACHING ABOUT VIRUSES IN SECONDARY EDUCATION IN TURKEY[1]

Research article

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Abstract

The purpose of the study was to investigate the views of Biology teachers and secondary education students on virus-related subjects taught in secondary education in Turkey. The study adopted the case study deign, one of the qualitative research methods. The participants, who were selected randomly, consisted of 26 Biology teachers and 51 secondary education students on voluntary basis. The data were collected via a semi-structured interview form on viruses that was developed by the researchers. The data were analysed using content analysis method. The results revealed that both student and teacher participants' responses to the question concerning "linking the subject with daily life" showed parallelism; student participants were well-aware that their life would be affected if the viruses were active in their environment, teachers' competencies were considered important for teaching virus-related subjects; and both student and teacher participants were of the opinion that virus-related subjects could be taught more effectively through visual materials.

Keywords: Virus, Biology, effective education, teacher competence, secondary education

1. Introduction

When the necessities of the era, technological developments and the dangers of viral diseases are taken into consideration, it is crucial to provide effective education to individuals and to do social researches on the issues related to viruses in Biology. Viruses, which stands out in the field of Biology, are the most remarkable parasites. The effects of viruses in disease formation, potentials in biotechnological studies, genetic activities and biochemistry in cellular events can be among the reasons for scientists and society to be informed on virus-related subjects (Madigan & Martinko, 2012). These initiatives suggest that young people, who are adults of the future, should be better informed on virus-related subjects.

Viruses are known to produce their copies using the internal arrangements of the cell they infect. These are organisms that create microscopic pathogens with their abilities and are known as the pathogenesis. In this regard, virus-borne diseases (as chickenpox, rabies, and jaundice) are diverse and well-known with its ever-changing forms of influenza (Lodish, Berk, Kaiser, Krieger, Scott, Bretscher & Ploegh, 2006). Especially in recent years, fighting against influenza-like diseases (SARS, MERS, COVID19 etc.) that may cause epidemics has become significant worldwide. To have young people in adolescence become healthy adults, it is necessary to raise awareness of high infectious viral diseases. It is also important since high-risk viral diseases such as HIV/AIDS is observed in young age distribution that behaves naively and recklessly. Considering the age distributions, it is seen that one-fifth of AIDS patients in society are in their twenties and AIDS caused deaths in the 15-24 age group is at a considerable amount (AAWH, 1994).

Biotechnological studies conducted with viruses have high potential to create new remedies in terms of vaccine and drug production for many diseases in the world. In scientific studies, especially with the use of the baculovirus expression vector system, various proteins used as a treatment of many diseases that negatively affect humanity, are produced. According to the studies conducted, in recent years, baculoviruses have become scientific study and vaccine material that has attracted the world's attention in the fields of pesticide, molecular Biology, gene expression and gene treatment (Demir, Nalçacıoğlu & Demirbağ, 2008). In light of this information, it can be said that viruses have great importance for living creatures not only they cause disease but also their use in the treatment process. Also, the use of viruses as biological weapons and its use in biotechnological genetic engineering is remarkable (Topal, 2006).

Schools have great importance on the education of viral disease and HIV/AIDS, as well as many others (Main, Iverson, Mcgloin, Banspach, Collins, Rugg & Kolbe, 1994; Duyan & Duyan, 2004). Even though the students at secondary education in Turkey have a good level of HIV/AIDS knowledge, it is observed that they do not adequately reflect it in their behaviour and attitudes. Also, researcher reported that the majority of students obtained relevant information most frequently through television programs and conferences (Ekin Uzer, 2014). These results suggest that qualified curriculum and effective education activities should be increased to increase the level of knowledge on both AIDS, similar virus-borne diseases and potentials of viruses.

To provide effective education in learning virus-related subjects at schools, to transform the knowledge into a behaviour, and to achieve the goals, relationship between teachers, students and current curriculum should support each other. This becomes very valuable in such conditions, where the importance of learning about viral diseases and the ways of protection is understood. In this regard, firstly, students' and Biology teachers' view of learning Biology-related subjects in the programme should be determined. Therefore, teachers can support potential revision study that may increase the daily life practices by contributing to Biology and health information programmes. Considering that students and teachers, who are the implementers of the programme, are active members of education, their knowledge and feedbacks are important. As stated, teachers- the implementers of the curriculum - can identify the pros and cons of the curriculum by experiencing it (Gwimbi & Monk, 2003). Moreover, students, with whom the program is implemented- also get ideas about the curriculum through their learning experiences. Thus, when the implementation and post-implementation process of the curriculum are analysed, the need of identification of missing or problematic and positive aspects of the curriculum and collecting feedbacks have made the task of the teachers and students even greater. Hence, throughout the current curriculum, teachers are expected to guide the active learning process and establish mutual interactions with the students (Rotgans & Schmidt, 2011).

In this study, it is aimed to identify teachers' and students' view on virus-related subjects taught in secondary education in Turkey. Based on the views of Biology teachers and students studying Biology and health information curricula in different grades, efforts are also given to emphasise the importance of the subject and to contribute to the curriculum accordingly. This study underlines how to inform young people on viruses, one of the most important issues in our era, and its importance for human life.

2. Method

. In the study, secondary education students' and Biology teachers' opinion about the virus-related subjects was investigated via a case study pattern– one of the qualitative research

methods. Case studies are used to be interpreted by identifying and analysing the cases individually or comparatively (Yıldırım & Şimşek, 2011). To reveal the themes considering the virus-related subjects, teacher and student views were examined in terms of various parameters such as, grade levels, content, learning outcome, to meet the needs (expectations), and to learn about viruses.

1.1. Participants

The participants were selected randomly and voluntary basis. They consisted of 26 Biology teachers at various secondary education institutions in the central districts of Ankara and 51 students in the same school. Demographic characteristics of the participant teachers and students are given in Table 1 and 2 below.

Table 1. *General Characteristics of Students*

The demographic characteristics of 26 Biology teachers are as follows (Table 2).

Characteristics	Sub-group	N (51)	%
Gender	Female	29	56,9
	Male	22	43,1
Grade	9th Grade	13	25,5
	10th Grade	11	21,6
	11th Grade	12	23,5
	12th Grade	15	29,4
Science/Biology Grade	1	0	0
(5point grading system)	2	0	0
	3	7	13,7
	4	15	29,4
	5	29	56,9
Health Information Grade	1	0	0
(5point grading system)	2	0	0
	3	0	0
	4	9	17,6
	5	42	82,4
Education Level of Mother	Primary School	8	15,7
	Secondary School	24	47,1
	University	17	33,3
	Post-Graduate/PhD	2	3,9
Education Level of Father	Primary School	4	7,8
	Secondary School	25	49,0
	University	16	31,4
	Post-Graduate/PhD	6	11,8
Income Level	1000-2000	7	13,7
(TL)	2000-3000	12	23,5
	3000-4000	10	19,7
	4000-5000	4	7,8
	5000 and +	18	35,3

As is seen in Table 1, 56.6% of the participants are female and 43.1% are male; 25.5% of the students are in 9th grade, 21.6% are in 10th grade, 23.5% are in 11th grade and 29.4% are in 12th grade. In the 5-point grading system, students' Science/Biology grades from the previous term are determined to be 1 for 0%, 2 for 0%, 3 for 13.7%, 4 for 29.4% and 5 for 56.9%; and

their health information grades from previous term are 1 for 0%, 2 for 0%, 3 for 0%, 4 for 17.6% and 5 for 82.4%. The education level of participants' mothers is primary school for 15.7%, secondary school for 47.1%, university for 33.3% and postgraduate/PhD for 3.9%. The education level of participants' fathers is primary school for 7.8%, secondary school for 49.0%, university for 32.4% and postgraduate/PhD for 11.8%. The income level of the participants is 1000-2000 TL for 13,7% 2000-3000 TL for 23,5%, 3000-4000 TL for 19,7%, 4000-5000 TL for 7,8%, and 5000 TL and plus for 35,3%.

Table 2. *General Characteristics of Teachers*

Characteristics	Sub-Group	N (26)	%
Gender	Female	15	57,7
	Male	11	42,3
Service Year	1-5 year	3	11,5
	6-10 year	3	11,5
	11-15 year	4	15,4
	16-20 year	8	30,8
	21 and +	8	30,8
Type of School You Graduated	Faculty of Education	14	53,8
	Faculty of Science	12	46,2
Postgraduate	Yes	8	30,8
	No	18	69,2
PhD	Yes	2	7,7
	No	24	92,3

Table 2 illustrates that 57.7% of the teachers are female and 42.3% are male; years of service is 1-5 years for 11.5%, 6-10 years for 11.5%, 11-15 years for 15.4%, 16-20 years for 30.8%, 21 and + for 30.8%. 53.8% of the teachers are graduated from the faculty of education and 46.2% of the teachers are graduated from the faculty of Science. 30.8% of the teachers attended postgraduate degree and 69.2% of them did not; 7.7% of them have PhD degree and 92.3% have not.

1.2. Data collection process

Considering the easy transportation options from central districts of Ankara and student density, 7 central districts were identified for data collection purposes. These 7 districts were Çankaya, Yenimahalle, Keçiören, Mamak, Etimesgut, Sincan and Altındağ. Official Anatolian High Schools in central districts in 2016-2017 education year were communicated, students from 9^{th}, 10^{th}, 11^{th}, and 12^{th} grade were randomly selected to get their feedback on "Semi-Structured Student Interview Form on Viruses". 10 minutes long semi-structured interviews developed by the researchers were administered to volunteer students. "Semi-Structured Teacher Interview Form on Viruses" was administered to teachers of Biology and health information classes. All the interviews were transferred to the digital environment through Microsoft Office Word 2010 programme.

1.3. Data collection tools

In the study a semi-structured interview form on viruses developed by the researchers was utilized. A literature review was conducted through theoretical knowledge research on viruses, question pool to be included in the semi-structured interview form was developed, and its design and content were presented to expert's opinion. The first section of student interview

form was on the personal information part, showing the student profile, in variables such as “Gender”, “Grade”, “Science/Biology course grade for the previous term”, Health Information course grade for the previous term”, “Level of Education of Mother”, “Level of Education of Father”, “Income Level”. The second part of the interview form comprised two open-ended questions: “Why do you care about having information on viruses?” and “How to learn virus-related subjects effectively in school?”. The first section of teachers’ interview form included the personal information part, that shows the teachers profile, in variables such as “Gender”, “Service Year”, “Type of School You Graduated”, “Post-Graduate”, “PhD”. The second part was composed of three open-ended questions: “Why is it important for your students to have information on viruses”, “If any, what are your opinions on how virus-related subjects are taught in Biology and health information courses”, and “How to learn virus-related subjects effectively in school?”.

1.4. Data analysis

After the data transferred to digital environment was edited, IBM Statistical Package for the Social Sciences Statistics (SPSS) 20 package program was used for the analysis. In the statistics program, the frequency and percentage distributions of the participants' demographic characteristics and the items in the questionnaire were analysed via descriptive statistics.

Descriptive content analysis was used for the qualitative analysis. In this regard, students’ and teacher’s’ statements that were similar to each other were gathered under specific themes. Firstly, collected data were analysed in detail by the researchers and codes were created. Themes were created to cover identified codes. Therefore, frequencies were determined from the answers given in line with the codes. In order to interpret the content analysis made for the opinions expressed by the teachers and students on learning virus-related subjects in students and teachers semi-structured interview form, direct citation from stated opinions were included. Hence, readers were provided with concrete data directly. In the citations provided to readers, initials were used for students’ and teachers’ name information. The letter “S” stands for the student, and the number next to the letter indicates the survey number for that student (S15, S16 etc.). In this stage, a total of 51 students were interviewed and data collected. “T” stands for the teacher, and the number next to it indicates the survey number of that s-teacher (T1, T2, etc.). In this stage, a total of 26 teachers were interviewed and data collected.

1.5. Validity and reliability

In order to minimize bias in data analysis, the data set was analysed by two researchers. When the statements of the participants were analysed by two researchers independently of each other, similar codes were accepted as "Consensus" and different codes were accepted as "Disagreement". Researchers was agreed on the codes of contradiction. As a result of the coding; reliability was calculated by using the formula "Consensus / (Consensus + Disagreement) x 100" (Miles & Hubermale, 1994) and it was determined that the coherence between the coders was 85%.

For the reliability of the study, the research methods, the research stages and the whole process are clearly explained. The implementation phase of the data collection tools was carried out in accordance with the permissions received from the Ankara Provincial Directorate of National Education. "Voluntary Participation Form" and "Parent Consent Form" were distributed to the participants.

Researchers mentioned minimized the effect of other external factors such as fatigue and carelessness at the time of application. The researchers mentioned the purpose of the research before the application and introduced the researcher himself. The researchers stated to the participants that their identity would be kept strictly confidential. In applications, attention was

paid to keep the environment quiet and calm and to have sufficient time. During the interviews, the participants were never directed.

Data collection tools were examined by 6 field experts from different fields (language, measurement and evaluation, Biology, Biology education) in order to ensure scope validity. In order to ensure validity at the data collection stage, the research approach and the data obtained have been reported in detail, as the impartiality of the researchers is an important factor in ensuring the validity of the research (Büyüköztürk, Çakmak Kılıç, Akgün, Karadeniz & Demirel, 2014).

3. Results

The results of the study are given under separate sub-headings as follows:

1.1. Students' view on learning virus-related subjects

Content analysis done for students' views on questions in semi-structured interview form on viruses is shown in Table below (Table 3-4). An example statements highlighting the views on this theme is as follows.

Table 3. *Distribution of students' view on the question "Why do you care about having information on virus-related subjects?"*

Theme	Code	F	F_{total}	%
Exam anxiety	To have better grades	2		
	The necessity of the education system	3	9	5,14
	To be informed on related questions	4		
Choice of Profession	Genetic engineering	3	10	5,72
	Any department related to Biology	7		
Daily Life	Impact on human lives	33		
	Desire to be conscious	29		
	Ways of protection	15	90	51,43
	Mode of transmission	6		
	Treatment methods	7		
Advantage	Vaccine production	4	23	13,14
	Other improvements in the field of health	19		
Disadvantage	Cause of death	3		
	Cause of diseases	29	35	20
	Its use as a biological weapon	3		
Structure of Viruses	Living/Non-living	5	8	4,57
	Invisible	3		
	Total		175	%100

In the content analysis for students' views on learning virus-related subjects, it is observed that there were 6 themes under the question "Why do you care about having information on virus-related subjects" including exam anxiety; choice of profession; daily life; advantages, disadvantages and structure of viruses. When the distribution of the codes is looked at, 3 codes were created: ''To have better grades'', ''The necessity of education system'', ''To be informed on related questions''. The distribution of the theme 'Exam Anxiety' was found to be 5.14%.

S1: *"Every information taught at school is provided for us to get better grades, it is boring, rote and dull. It is important for me because, in the future, I want to be a doctor and I only want to deal with Biology."*

Under the theme 'Choice of Profession', 2 codes were created: ''Genetic Engineering'' and ''Any department related to Biology''. The distribution of the theme 'Choice of Profession' was found to be 5.72%.

S2: *"I am interested in virus-related subjects because they are invisible, and we know that they are powerful. We can fight against them by producing weapons. I may consider choosing a job in the field of Biology in the future."*

Under the theme 'Daily Life', 5 codes were created: ''Impact on Human Life'' ''Desire to be Conscious'', ''Ways of Protection'', ''Mode of Transmission'', and ''Treatment Methods''. Engineering'' and '' Any department related to Biology''. The distribution of the theme 'Daily Life' was found to be 51.43%.

S8: *''In our lives, especially in the field of health, viruses have great importance. I am interested in Biology, and a person who gives importance to Biology for its contribution to the field of health. I believe that knowing the characteristics of viruses that can make our lives easier or more difficult is important in human life. So, I would like to gather any information possible on the viruses and to be familiar with them."*

Under the theme 'Advantage', 2 codes were created: "Vaccine Production" and "Other Improvements in the Field of Health". The distribution of the theme 'Advantage' was found to be 13.14%.

S4: *''Viruses can be good or bad for humans. Some viruses may cause the deaths but on the other hand, it is possible to produce the vaccine and save lives.''*

Under the theme 'Disadvantage', 3 codes were created: "Cause of deaths'', ''Couse of Diseases'' and ''Its use as a Biological Weapon''. The distribution of the theme 'Disadvantage' was found to be 20%.

S32: *''Viruses lead sickness. When sicknesses increase, it damages the social structure. I give importance to any matter that is important for society.''*

Under the theme ''Structure of Viruses'', 2 codes were created: ''Living/Non-living'', and ''Invisible''. The distribution of the theme 'Structure of Viruses' was found to be 4.57%.

S37: *''In normal life, viruses are the cells we can often encounter. Viruses divide into different structures and settle in different organs, cells, tissues. I care about having information on virus-related subjects to protect myself.''*

Table 4. *Distribution of students' view on the question 'How to learn virus-related subjects effectively in school?'*

Theme	Code	F	$F/_{total}$	%
Visual Material	Film/Video	10		
	Animation	3	22	18,49
	Slide	4		
	Cast/Model	5		
Laboratory Work	Application	16		
	Observation	3	19	15,97
Life-Based	Embodiment	4		
	Intriguing Elements	4	23	19,33

	Linking with Daily Life	15		
Verbal Lecture	Listening	6		
	Note-taking	3	28	23,53
	Teachers' competencies in the field	19		
Research	Journal	2		
	Article	4	18	15,12
	Book	8		
	Homework/Project	4		
Self-Study	Revising	2	4	3,36
	Reading	2		
Expert Support	Question-answer with experts in their field	3	5	4,20
	Informative Presentation done by Experts	2		
	Total		119	%100

In the content analysis for students' views on learning viruses, it is observed that there were 7 themes under the question "How to learn virus-related subjects effectively in school?" including visual material, laboratory works, life-base, verbal lecture, research, self-study and expert support. When the distribution of the codes is examined, 4 codes were created: ''Film/Video'', ''Animation'', ''Presentation (slide)'', and ''Cast/Model''. The distribution of the theme 'Visual Material' was found to be 18.49%.

S41: *''More importance should be given to visualization. It is easier to memorize things in slides or video.''*

Under the theme 'Laboratory Work', 2 codes were created: ''Implementation'', ''Observation''. The distribution of the theme 'Laboratory Work' was found to be 15.97%.

S21: *''I believe that viruses can be taught more effectively in a laboratory environment in school. Students can be provided with more permaleent information by benefitting from technology, visuals and experiments.''*

Under the theme 'Life-Based', 3 codes were created: ''Concrete Examples'', ''Intriguing Elements'', and ''Linking with Daily Life''. The distribution of the theme 'Life-Based' was found to be 19.33%.

S28: *''To teach something, students' interest should be first increased. It is necessary to make students think, wonder and show interest on the subject though good and interesting films, and then the subject should be explained.''*

Under the theme 'Verbal Lecture', 3 codes were created: ''Listening'', ''Note-taking'' and ''Teachers' knowledge in the field''. The distribution of the theme 'Verbal Lecture' was found to be 23.53%.

S39: *''It is easier to learn effectively when a teacher who has sufficient competencies in the filed explain the subject linking it with concrete examples without depending on slides.''*

Under the theme 'Research', 4 codes were created: ''Journal'', ''Article'', ''Book'', and ''Homework/Project''. The distribution of the theme 'Research' was found to be 15.12%.

S26: *''It can be included in the subjects of Biology or health information lessons. Movies can be watched in common rooms. It can be given as a performance or project assignment.''*

Under the theme ‘Self-Study’, 2 codes were created: ‘’Repetition’’ and ‘’Reading’’. The distribution of the theme ‘Self-Study was found to be 3.36%.

S35: *‘’We are familiar with such topics in Biology courses but not well enough. I prefer to research on my own. If it is going to be done in class, research topics can be given.’’*

Under the theme ‘Expert Support’, 2 codes were created: ‘’Question-answer with experts in their field’’ and ‘’ Informative presentation done by experts’’. The distribution of the theme ‘Expert Support’ was found to be 4.20%.

S10: *‘’The results of the research can be explained with slides and graphics at school, and experts in the field can be brought to school to provide information. Therefore, people’s awareness and desire to learn can be increased.’’*

1.2. Teachers’ view on learning virus-related subjects

Content analysis done for teachers’ views on questions in semi-structured interview form on viruses is shown in Table below (Table 5-6-7). An example statements highlighting the views on this theme is as follows.

Table 5. *Distribution of teachers’ view on the question “Why is it important for your students to have information on virus-related subjects?”*

Theme	Code	F	$F/_{total}$	%
Exam Anxiety	The necessity of the education system	1	1	1,11
Choice of Profession	Offer an employment opportunity	2	2	2,22
Daily Life	Ways of protection	9		
	Treatment methods	6		
	Awareness	8	42	46,67
	Desire to be conscious	11		
	Impacts on human life	8		
Advantage	Economic advantages (drug, vaccine production)	4	16	17,78
	Improvements in the field of health	12		
Disadvantage	Cause of Diseases	21		
	Misconception	2	23	25,55
Structure of Viruses	Living/Non-living	4	6	6,67
	Mutation	2		
	Total		90	%100

In the content analysis for teachers’ views on learning virus-related subjects, it is observed that there were 6 themes under the question “Why is it important for your students to have information on virus-related subjects?” including exam anxiety, choice of profession, daily life, advantage, disadvantage and structure of viruses. The distribution of the theme ‘Exam Anxiety’ was found to be 1.11%.

T7*: ‘’It is important for me to guide my students in the university entrance exam (obliged), and to shed light on very unknown details, such as viruses, to contribute to Biology literacy for their post-secondary life.’’*

Under the theme ‘Choice of Profession, 1 code was created: ‘’Offer an employment opportunity’’. The distribution of the theme ‘Choice of Profession’ was found to be 2.22%.

T21: *''Students should be informed on viruses to ensure that they have enough knowledge about the disease, to protect themselves and people around them, and to have an idea for the choice of profession.''*

Under the theme 'Daily Life', 5 codes were created: ''Ways of Protection'', ''Treatment Methods'', ''Awareness'', ''Desire to be conscious'', ''Impacts on Human Life''. The distribution of the theme 'Daily Life' was found to be 46.67%.

T15: *''They will have information on the diseases that they may encounter and take precautions accordingly.''*

Under the theme 'Advantage', 2 codes were created: ''Economic Advantages (drug, vaccine production)'', and ''Improvements in the field of health''. The distribution of the theme 'Advantage' was found to be 17.78%.

T20: *''Having information on virus-related subjects is important for students to keep healthy. Also, it is important to learn how to use viruses in biotechnology.''*

Under the theme 'Disadvantage', 2 codes were created: "Cause of Diseases'', and ''Misconception''. The distribution of the theme 'Disadvantage' was found to be 22.55%.

T26: *''Student experience viruses in their daily lives. Having information on diseases increases their quality of life. There are many misconceptions regarding virus-related subjects, and they need to avoid misconceptions.''*

Under the theme 'Structure of Viruses', 2 codes were created: ''Living/Non-living'' and ''Mutation''. The distribution of the theme 'Structure of Viruses' was found to be 6.67%.

T12: *''Although the curriculum information is insufficient in linking with daily life, we try to fill the missing pieces. Virus-borne diseases and Living/Non-living virus treatment process should be emphasized.''*

Table 6. *Distribution of teachers' view on the question "If any, what are your thoughts about the ways of teaching virus-related subjects in Biology and health information lessons?"*

Theme	Code	F	$F/_{total}$	%
Duration	Very limited	7		
	Insufficient	11	24	19,2
	Sufficient	6		
Number of	Very Few	6		
Gain	Insufficient	11	25	20
	Sufficient	8		
Grade	9^{th} Grade	24		
	10^{th} Grade	2	29	23,2
	11^{th} Grade	2		
	12^{th} Grade	1		
Timing	Beginning of Term	3		
	Mid-Term	6	23	18,4
	End of Term	14		
Content	Insufficient	18		
Strands	Sufficient	6	24	19,2
	Total		125	%100

In the content analysis for teachers' views on learning virus-related subjects, it is observed that there were 6 themes under the question "Why is it important for your students to have information on virus-related subjects?" including exam anxiety, choice of profession, daily life,

advantage, disadvantage and structure of viruses. 5 themes, including duration, number of learning outcomes, grade level, timing and content strands were focused on in the determination of teachers' place in Biology/health information and traffic culture curriculum. When the distribution of the codes under the themes is looked at, 3 codes were created: ''Very limited'', ''Insufficient'' and ''Sufficient''. The distribution of the theme 'Duration' was found to be 19.2%.

T1: *''Students cannot be well-informed due to limited time.''*

Under the theme 'Number of Learning Outcomes'', 3 codes were created: ''Very Few'', ''Insufficient'' and ''Sufficient''. The distribution of the theme 'Number of Learning Outcomes'' was found to be 20%.

T7: *''Considering its importance, the number of learning outcomes is insufficient.''*

Under the theme 'Grade Level', 4 codes were created: ''9th Grade'', ''10th Grade'', ''11th Grade'' and ''12th Grade''. The distribution of the theme 'Grade Level' was found to be 23.2%.

T17: *''It is mostly taught at 9th Grade.''*

Under the theme 'Timing', 3 codes were created: ''Beginning of term'', '' Mid-Term'' and ''End of Term''. The distribution of the theme 'Timing' was found to be 18.4%.

T6: *''It is mostly taught by the end of 2nd term of the 9th Grade.''*

Under the theme 'Content Strand', 2 codes were created: ''Insufficient'' and ''Sufficient''. The distribution of the theme 'Content strand' was found to be 19.2%.

T4: *''The topic of viruses is explained under general titles in the textbook. I think the content is superficial.''*

Table 7. *The distribution of teachers' view on the question "How to learn virus-related subjects effectively in school".*

Theme	Code	F	F/$_{total}$	%
Visual Material	Film/Video/Documentary,	9		
	Animation	4	32	52,46
	Slide	4		
	Cast/Model/Figure	11		
	Banner	4		
Laboratory Work	Implementation (practice)	2	2	3,28
Life-Based	Concrete examples	2		
	Intriguing Elements	2	10	16,39
	Linking with daily life	6		
Verbal Lecture	Discussion	1		
	Question-answerer	2	5	8,20
	Briefing	2		
Research	Book	1	4	6,56
	Project/ Homework	3		
Expert Support	Content Detailing	3	8	13,11
	Informative Presentation done by Experts	5		
	Total		61	%100

In the content analysis for teachers' views on learning virus-related subjects, it is observed that 6 themes were focused on under the question "How to learn virus-related subjects effectively in school?" including visual material, life-based, verbal lecture, research and expert support. The distribution of the theme 'Visual Materials' was found to be 52.46%.

T2: *''It can be taught by hanging posters on the boards in the school corridors, organizing conferences, and providing audio-visual materials.''*

Under the theme 'Laboratory Work', 1 code was created: ''Implementation (practice)'', The distribution of the theme 'Laboratory Work' was found to be 3.28%.

T1: *''Videos should be watched, and students should be provided with opportunities to analyse in laboratories.''*

Under the theme 'Life-Based', 3 codes were created: ''Concrete Examples'', ''Intriguing Elements'', and ''Linking with Daily Life''. The distribution of the theme 'Life-Based' was found to be 16.39%.

T26: *''Linking with other courses and daily life is a must.''*

Under the theme 'Verbal Lecture', 3 codes were created: ''Discussion'', ''Question-Answer'', and ''Briefing''. The distribution of the theme 'Verbal Lecture' was found to be 8.20%.

T7: *''The subject 'viruses' can be combined with the subject 'common characteristics of living creatures. It can be explained by dividing it into classification such as genetic engineering and biotechnology.''*

Under the theme 'Research', 2 codes were created: ''Book'', and ''Homework/Project''. The distribution of the theme 'Research' was found to be 6.56%.

T1: *''Research projects or homework can be assigned.''*

Under the theme 'Expert support', 2 codes were created: ''Content Detailing'' and ''Informative Presentation done by Experts''. The distribution of the theme 'Expert Support' was found to be 13.11%.

T19: *''Experts in the field, working in hospitals or universities can provide information. Documentaries, films can be watched.''*

4. Discussion and Conclusion

In the study, students view on the question "Why do you care about having information on virus-related subjects?" were gathered under 6 theme (Table 3). The theme "daily life" has the highest distribution percentage with 51.43%. In parallel with this results have been noted, that lectures conducted by giving concrete examples from daily life help students to understand/interpret the subject better and to increase the interest (Doğan, Kırvak & Baran, 2004).

In the study, student views under the theme "daily life" were focused on impacts of viruses on humale life, the desire to become more cautious about viruses, the ways of protection from viruses, mode of transmission of viruses and treatment methods. Accordingly, under the theme "daily life", students believe that viruses have better importance in terms of "its effects on humale life".

The theme "disadvantages" of the viruses have the second-highest distribution percentage with 20%. Accordingly, students tend to learn about viruses because they are aware of their negative aspects.

According to students' views, the theme "the Structure of Viruses" has the lowest distribution percentage with 4.6%. In the literature, it is known that success and interest decrease in cases where abstract topics such as viruses involve in Biology lesson (Staeck, 1995).

The students' views on the second question of our study "How to learn virus-related subjects effectively in school?", can be gathered under 7 themes (Table 4). The theme "Verbal Lecture" has the highest distribution percentage with 23.53%. This shows that students believe that virus-related subjects cannot be easily understood by self-study, and students give importance to teachers' influence on the subject. Also, because the code of "Teachers' competencies in the field" is the highest frequency within this theme, students think that having teachers who have sufficient knowledge in the field is the best way to learn the subject. Some Researchers reported that field knowledge, general culture and professional knowledge are the most important qualification that a teacher must-have (Çetin, 2001). According to a study conducted, subjects conveyed by different teachers have different results (Ün Açıkgöz, 1996).

Secondly, the theme "Life-based implementations" was emphasized by the students in the study. These results show that students need concrete examples and link them with daily life; prefer an educational process where teachers are active and have sufficient knowledge in the field, and they can be more successful with the help of visual material and through the methods suitable for context-based learning approach.

Teachers' view of learning virus-related subjects contains interesting results. Based on the opinions expressed by the teachers upon the question "Why is it important for your students to have information on virus-related subjects?", 6 themes were created by the researches. Similar to students' views, the theme "Daily Life" has the highest distribution percentage among the themes (Table 5). This may make the teacher think that students have different opinions on virus-related subjects so that they may have difficulties in motivating them. However, since supporting and promoting motivated learning, being able to attract students' interest on the subject, in other words, is considered the fundamental responsibility of the teaching profession, teachers must be supported in this regard (Jerusalem & Röder, 2007).

In the study, codes concerning duration, number of learning outcomes, grade level, timing and content strand, are identified upon the question "If any, what are your thoughts about the ways of teaching virus-related subjects in Biology and health information lessons?" (Table 6). The theme ''Grade Level'' has the highest distribution percentage (23.2). It is stated by the teachers that the virus-related subjects are taught mostly in the 9^{th} grade in the curriculum, generally at the end of the term. It is also stated by the teachers that limited time makes it difficult to teach the subject and decrease students' motivation. Similar to the results of our study, in literature, the programme is not suitable for students in terms of content, insufficient lesson hours and inadequate lab, teaching materials and teacher participation are among the reasons that make the curriculum difficult for teachers (Kaya, 2001; İrez & Yavuz, 2009; Westbroek, Vries, Walraven, Handelzalts & McKenney, 2019).

Based on the opinion expressed by the teachers in the interview form on the question "How to teach virus-related subjects effectively?", the most frequently expressed themes are 6 (Table 7). As seen, similar to students' thoughts, teachers also think that the most effective way of teaching is teaching through 'Visual Materials' (52.46%). According to teachers, students can best understand virus-related subjects by concretising it with three-dimensional materials. In many studies, it is reported that students' interest is increased by using more visual materials such as animation and videos instead of using direct instructions (Mayer & Moreno, 2002; Rotbain, Marbach-Ad & Stavy, 2005).

According to another result of our study, while students believe that it is easier to learn virus-related subjects with lab works, teachers believe that lab works are less effective in learning. The opposite ideas of students and teachers in this malener remind the importance of competencies of teachers and school in using labs and facilities. Some researcher state the importance of lab uses but also indicate that inadequate physical conditions are effective reasons preventing the use of labs (Nakiboğlu & Sarıkaya, 1999).

In summary of our study are significant, as it underlines the ways of informing young people regarding virus-related subjects in Turkey, which is one of the issues affecting humale life, and shows awareness towards viruses that cause pandemics.

5. Implications

According to our results obtained the following recommendations can be developed in light of stated views:

- Context-based teaching practices may be recommended to be used more frequently when conveying the virus-related subjects. Considering the viral effects of viruses, it may be important for teachers to include more current events to increase their interest in the lesson.

- Materials (cast, model, video etc.) that help to embody the structure and features of viruses can be chosen.

- Updated information on virus-related subjects must continue to be transferred to teachers through effective in-service training activities and seminars.

- Curriculums can be rearranged, and the information can be transmitted at every grade level to strengthen students' behaviour against viral diseases.

- During distance education, where teachers and students stay at home and continue online education, simple experiments or models can be performed. This helps students to have quality time at home and to have fun while learning about viruses causing pandemics.

- In order to increase more conscious behaviour in the society, it may be suggested to conduct new studies considering the views and behaviours of samples from different age group who have already experienced epidemic viral diseases. Thus, the impact of viruses on our health and life – one of the most crucial topics of our era- can be analysed in detail.

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