



ASSESSMENT OF THE KNOWLEDGE LEVELS OF HITIT UNIVERSITY FACULTY OF MEDICINE AND DEPARTMENT OF NURSING STUDENTS REGARDING FORENSIC BIOLOGICAL ANALYSIS

HİTİT ÜNİVERSİTESİ TIP FAKÜLTESİ VE HEMŞİRELİK BÖLÜMÜ ÖĞRENCİLERİNİN ADLI BİYOLOJİK ANALİZLER KONUSUNDAKİ BİLGİ DÜZEYLERİNİN DEĞERLENDİRİLMESİ

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Abstract

Forensic biological analyses have an important place in the elucidation of crimes. In this context, evaluating the knowledge and awareness levels of forensic biological analyzes can contribute to the development of medical and nursing students' education curricula. This study aims to determine the knowledge levels of Hitit University Faculty of Medicine and Faculty of Health Sciences, Department of Nursing students about forensic biological analysis, DNA analysis, toxicology, microscopic examination and other forensic medicine applications.

The data were collected by questionnaire method and the knowledge and interest levels of the students towards forensic biological analysis were statistically analyzed. The findings showed that medical school students had a higher level of knowledge about forensic biological analysis, while nursing students had a relatively lower level of knowledge.

This result is due to the fact that the medical school curriculum includes more biological sciences and forensic medicine courses. On the other hand, it was observed that the educational content on forensic biological analysis was limited in the nursing program. The findings of the study reveal that education on forensic biological analysis should be strengthened in both programs.

As a result, it was concluded that more comprehensive training on forensic biological analysis should be provided in health professions education and curricula should be reorganized to increase awareness in this field.

Keywords: DNA analysis, Forensic biological analyses, Health professions, Medical faculty, Nursing department

Öz

Adli biyolojik analizler, suçların aydınlatılmasında önemli bir yer tutmaktadır. Bu bağlamda, adli biyolojik analizlere ilişkin bilgi ve farkındalık düzeylerinin değerlendirilmesi, tıp ve hemşirelik öğrencilerinin eğitim müfredatlarının geliştirilmesine katkı sağlayabilir. Bu çalışma, Hitit Üniversitesi Tıp Fakültesi ve Sağlık Bilimleri Fakültesi Hemşirelik Bölümü öğrencilerinin adli biyolojik analizler, DNA analizi, toksikoloji, mikroskopik inceleme ve diğer adli tıp uygulamaları konusundaki bilgi düzeylerini belirlemeyi amaçlamaktadır.

Araştırmada veriler, anket yöntemiyle toplanmış ve öğrencilerin adli biyolojik analizlere yönelik bilgi ve ilgi düzeyleri istatistiksel olarak analiz edilmiştir. Bulgular, tıp fakültesi öğrencilerinin adli biyolojik analizler konusunda daha yüksek bilgi düzeyine sahip olduğunu, hemşirelik bölümü öğrencilerinin ise nispeten daha düşük bilgi seviyesine sahip olduğunu göstermiştir.

Bu sonuç, tıp fakültesi müfredatının biyolojik bilimler ve adli tıp derslerine daha fazla yer vermesinden kaynaklanmaktadır. Buna karşılık, hemşirelik programında adli biyolojik analizlere dair eğitim içeriğinin sınırlı olduğu gözlemlenmiştir. Çalışmanın bulguları, her iki programda da adli biyolojik analizlere yönelik eğitimin güçlendirilmesi gerektiğini ortaya koymaktadır.

Sonuç olarak, sağlık meslekleri eğitiminde adli biyolojik analizler konusunda daha kapsamlı bir eğitim verilmesi gerektiği ve bu alandaki farkındalıkların artırılmasına yönelik müfredatların yeniden düzenlenmesi gerektiği sonucuna ulaşılmıştır.

Anahtar Kelimeler: DNA analizi, Adli biyolojik analizler, Sağlık meslekleri, Tıp fakültesi, Hemşirelik bölümü.

1. Introduction

Forensic biology is the scientific study of biological materials in criminal cases with the aim of establishing a relationship between the offender and the victim, determining the type of crime and identifying the offenders. This field covers a wide range of processes from the collection of biological samples (such as blood, saliva, hair, sperm) to their analysis. In particular, genetic analysis and DNA testing are one of the most important components of forensic biological analysis, and these technologies provide reliable and effective tools for solving crimes (Butler, 2005). Forensic biology plays a critical role in the investigation of criminal cases. Therefore, health professionals, especially medical and nursing students, need to have a high level of knowledge in this area. Two brutal murders in Leicestershire, England in the early 1980s revolutionized the use of DNA analysis to catch criminals. Colin Pitchfork was the first criminal in history to be convicted using DNA testing (Jobling & Gill, 2004). 15-year-old Lynda Mann disappeared on the night of November 21, 1983, and her body was found the next day on the side of a footpath. The autopsy revealed that the young girl had been raped and strangled to death. Biological samples found at the scene were preserved to identify the culprit, but the technology of the time was not sufficient to analyze this evidence. On July 31, 1986, 15-year-old Dawn Ashworth disappeared in the same area. Two days later her body was found in a bush and the method of murder was very similar to the Lynda Mann case. The police considered the murders to be linked and concluded from semen samples found at the crime scene that the perpetrator might be the same person (Jeffreys et al., 1985; Wambaugh, 1989). Following the

murders, the police arrested a young man, Richard Buckland, in connection with the Dawn Ashworth case. Buckland confessed to the murder of Ashworth but gave no information about the murder of Lynda Mann. At this point, the investigating authorities decided to use the DNA fingerprinting method recently developed by Alec Jeffreys at the University of Leicester (Gill et al., 1985). Jeffreys and his team compared semen samples from the crime scene with Buckland's DNA profile and proved that Buckland was innocent (Jeffreys et al., 1985). This is the first case of a suspect exonerated by DNA analysis in history. The Colin Pitchfork case was one of the first cases where forensic DNA analysis revolutionized crime solving. This case pioneered the revolutionization of DNA testing in criminal law and became a worldwide has contributed to solving many crimes. Today, DNA analysis is recognized as critical evidence in many forensic cases ranging from homicides to sexual assaults (Gill et al., 1985).

The knowledge level of nursing and medical faculty students on forensic biological analysis will enable them to make correct professional decisions and contribute effectively when faced with forensic cases in the future. Therefore, it is of great importance to measure the current knowledge levels in this field of education and to determine the necessary deficiencies. Medical faculties and nursing departments form the basis of health sciences education, and the quality of teaching in these programs directly affects the professional competence of students. However, training in forensic biology is still very limited, often restricted to specialized disciplines such as forensic medicine or forensic sciences. For example, many nursing students are not formally trained in forensic nursing and their level of knowledge is very low (Abou Hashish, 2024).

It is critical for nursing and medical students to have in-depth knowledge of forensic biological analysis in order to develop their skills in this field. This knowledge is necessary not only for the correct resolution of forensic cases, but also for health professionals to fulfill their responsibilities in forensic processes. Studies conducted in the 2020s emphasize the need for a more robust integration of forensic biology and forensic nursing knowledge into medical and nursing curricula, as serious knowledge gaps have been observed among students in forensic case and evidence handling (Abou Hashish, 2024). Research shows that evidence handling and forensic case management skills are significantly increased in students who receive forensic nursing education, and their post-participation knowledge levels increase statistically significantly (Özden et al.,

2019). In addition, the majority of nursing academics support the revision of the curriculum to include forensic nursing concepts, but cite obstacles such as time constraints, saturation of the curriculum and lack of forensic knowledge of the teaching staff (McFadden, 2021; Freedberg, 2008). Therefore, forensic biology knowledge should be strengthened in both medical and nursing education through modules combining theory and practice, simulation applications and case studies. For all these reasons, measuring the knowledge levels of medical and nursing students on forensic biological analyses is of great importance both in terms of evaluating educational programs and in order to eliminate deficiencies in this area. This study aims to examine the knowledge levels of medical and nursing students on forensic biological analyses. In addition, evaluating the effectiveness of the education these students have received and making suggestions to improve their current knowledge levels on this subject are among the objectives of the study. The research aims to determine the areas where medical and nursing students have deficiencies in forensic biological analyses and to contribute to educational programs that will eliminate these deficiencies.

2. Materials and Methods

This study covers students from the Faculty of Medicine and the Department of Nursing of the Faculty of Health Sciences of Hitit University. A total of 241 students participated in the study, 156 from the Faculty of Medicine and 85 from the Department of Nursing. The students were randomly selected and volunteered. The survey method was used for this study. The survey was

designed to measure the knowledge level of students on forensic biological analysis. The survey, consisting of 22 questions, covers topics such as basic concepts of forensic biological analysis, forensic medicine applications, DNA tests and the importance of forensic biological analysis in health professions education (Table 1). Survey questions were adapted from the thesis of (Mut, 2018). Before the application of the questionnaire, the students were informed about the purpose of the research and the research was started by taking into account the principle of willingness and voluntariness to participate in the research and by obtaining their verbal consent.

In this study, chi-square test was performed to determine the differences in the level of knowledge of students about Forensic Biological analyzes between faculties with frequency and percentage distributions. In addition, a pilot study was not conducted prior to this survey. In order to conduct the research, institutional permission was obtained from the Hitit University Faculty of Medicine and Faculty of Health Sciences, and approval was obtained from the Hitit University Non-Interventional Research Ethics Committee (dated 28/02/2024 and numbered 2024-41).

3. Results and Discussion

The survey study was conducted with 241 volunteer participants consisting of senior students from the Faculty of Medicine and the Department of Nursing of the Faculty of Health Sciences of Hitit University. 85 of the participants were students from the Department of Nursing and 156 were students from the Faculty of Medicine and participated in the study voluntarily.

Table 1. Survey questions used in the study

Survey Questions		
1) Faculty		
a) Faculty of Health Sciences		
b) Faculty of Medicine		
2)Class		
a)4th Grade	b)5th Grade	c) Intern
3) In your opinion, which subject or subjects does "Forensic Sciences" deal with?		
a) Murder cases b) Paternity cases		
c) Autopsy d) DNA tests		
4) Which of the following work in the field of forensics?		
a) Forensic Physician b) Chemist		
c) Biologist d) Judge		
5) Is there a legal dimension to the evidence to be obtained regarding the solution of events in Turkish Law?		
a) Yes, there is, it is included in the Criminal Procedure Code No. 5271.		

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b) No, evidence does not have a legal dimension.
c) I have no idea about this subject.
6) Have you heard the term “Forensic Biology” before?
a) Yes b) No
7) What concept or concepts come to mind when Forensic Biological Analyses are mentioned?
a) Serological Analyses
b) DNA Analyses
c) Mitochondrial DNA Analyses
d) X-STR – Y-STR Studies
8)In your opinion, which incidents are Forensic Biological Analyses more effective in elucidating?
a) Murder cases
b) Paternity determinations
c) Identification studies
d) Rape cases
9)Are “Forensic Biological Analyses” and “Forensic DNA Analyses” the same concepts?
a) Yes b) No c) I have no idea.
10)Which biological material is obtained more in order to perform forensic biological analyses in forensic cases?
a) Blood b) Hair
c) Urine d) Semen (Sperm Fluid) - Vaginal Fluid
11) In your opinion, which information or information is correct about the DNA molecule?
a) It stores and transfers genetic information.
b) It is only found in the human organism.
c) It is used in solving forensic cases.
d) It creates the genetic code of living things.
12) Do you have any information about DNA Analysis?
a) Yes b) No
13) Are the definitions of “DNA Analysis” and “DNA Isolation” the same?
a) Yes b) No
14) Which one(s) do you think DNA samples can be taken from in solving a criminal case?
a) Chewed gum b) Toothpick
c) Cigarette butt d) Bite marks
15)Which(s) of the following are authorized institutions to perform DNA analysis?
a) Forensic Medicine Institution
b) Gendarmerie General Command
c) General Directorate of Security
d)Security and Gendarmerie Criminal Department Presidency
16)If the samples obtained from the crime scene are insufficient, are there other available methods for solving criminal cases?
a) Yes b) No
c) There are alternative methods other than DNA analysis.
17) Do you have any information about mitochondrial DNA analysis?
a) Yes b) No
18) Do you think Forensic Biological Analysis is sufficient in solving forensic cases?
a) Yes b) No
19) Are DNA analysis effective in crime cases where biological samples are considered as evidence?
a) Yes b) No

20) Have you ever taken a course on Forensic Biology in your department?
a) Yes b) No
21) Do you find the training in Forensic Biology in your department sufficient?
(Those who answered yes to question 20 and question 21 will evaluate.)
a) Yes b) No
22) Do you think it is necessary to create a DNA database in our country?
a) Yes b) No

The survey was prepared to measure the knowledge levels of the students in the field of forensic sciences and forensic biological analysis.

Survey content:

- Contains 20 questions.
- There are multiple choice questions with more than one correct answer.
- Closed-ended (Yes/No) type questions were designed to be answered according to the participant's preference.

This study aims to evaluate the knowledge levels of the students in the field of forensic sciences. Frequency analysis was used in the evaluation of the data obtained in the study. Also, chi-square test was performed to determine the differences in the level of knowledge of students about Forensic Biological analyzes. IBM SPSS Statistics 20 (IBM Corp. 2011) and Microsoft Office Excel 2016 programs were used during the relevant analyses. The distributions of the answers given by the students of the Faculty of Health Sciences and the Faculty of Medicine regarding forensic sciences were examined in the study.

Table 2 shows the distribution of students participating in the study by faculty and class. A total of 241 students participated in the study. When the distribution of participants by faculty is

examined, it is seen that 35.26% are students of the Faculty of Health Sciences (Department of Nursing) and 64.74% are students of the Faculty of Medicine. When evaluated on a class basis, it is understood that all students of the Faculty of Health Sciences are in their 4th year, 50% of the students of the Faculty of Medicine are in their 5th year, and 50% are in intern positions.

Table 3 shows the distribution of responses to the question "What do you think forensic sciences are interested in?" by faculty. Faculty of Health Sciences (Department of Nursing) students think that forensic sciences are mostly interested in murder cases (75.29%). In addition, 50.59% of the students think that it is interested in autopsy, 42.35% in DNA tests and 27.06% in paternity cases.

Faculty of Medicine students think that forensic sciences are mostly interested in autopsy (83.33%). This is followed by murder cases (74.36%), paternity cases (58.97%) and DNA tests (35.26%). When considered as a whole, 75.69% of the students think that forensic sciences are mostly interested in murder cases, 71.78% in autopsy, 47.72% in paternity cases and 37.76% in DNA tests.

Table 2. Distribution of Participants by Faculty and Class

Class	4th Class		5th Class		Intern		Total	
	n	%	n	%	n	%	n	%
Faculty of Health Sciences	85	100.0	-	-	-	-	85	35.26
Faculty of Medicine	-	-	78	50.00	78	50.00	156	64.74
Total	85	35.26	78	32.34	78	32.34	241	100.00

Table 3. Distribution of Responses to the Question "Forensic Sciences" deal with?"

Faculty	In your opinion, which subject or subjects does "Forensic Sciences" deal with?									
	Murder cases		Paternity Cases		Autopsy		DNA Tests		Total	
	n	%	n	%	n	%	n	%	n	%
Faculty of Health Sciences	64	75.29	23	27.06	43	50.59	36	42.35	85	100
Faculty of Medicine	116	74.36	92	58.97	130	83.33	55	35.26	156	100
Total	180	74.69	115	47.72	173	71.78	91	37.76	241	100

*Since there were students who marked more than one option in the answers given, the sum of the results exceeds 100%.

Table 4 shows the distribution of responses to the question "Which of the following work in the forensic field?" Among the officers working in the forensic field, the students of the Faculty of Health Sciences stated that they know forensic physicians at the highest rate (91.76%). This occupational group is followed by biologist (31.76%), judge (29.41%) and chemist (23.53%). Among the students of the Faculty of Medicine, the order of awareness of officers working in the forensic field is similarly forensic physician (97.44%), judge (36.54%), biologist (27.56%) and chemist (17.95%).

When considered holistically, the majority of the participants think that forensic physician (95.44%) is the leading profession in the forensic field. In addition, the professions of judge (34.02%) and biologist (29.05%) are also perceived as groups working in the forensic field.

However, the presence of chemists (19.92%) in the field of forensic sciences has low awareness among participants.

In order to measure the participants' knowledge about the legal dimension of the evidence to be obtained, the question "Does the evidence to be obtained regarding the solution of the incidents have a legal dimension in Turkish law?" was asked.

Table 4. Distribution of Responses to the Question "Which of the following work in the field of forensics?"

Faculty	Which of the following work in the field of forensics?									
	Forensic Physician		Chemist		Biologist		Judge		Total	
	n	%	n	%	n	%	n	%	n	%
Faculty of Health Sciences	78	91.76	20	23.53	27	31.76	25	29.41	85	100
Faculty of Medicine	152	97.44	28	17.95	43	27.56	57	36.54	156	100
Total	230	95.44	48	19.92	70	29.05	82	34.02	241	100

*Since there were students who marked more than one option in the answers given, the sum of the results exceeds 100%.

When Table 5 is examined, it is seen that 76.83% of the students of the Faculty of Health Sciences think that the evidence has a legal dimension, while 2.44% think that the evidence does not have a legal dimension. 20.73% of these students stated that they have no opinion on this issue.

A similar tendency is observed among the students of the Faculty of Medicine. While 93.59% of the students of the Faculty of Medicine stated that they think that this evidence has a legal dimension, only 2.56% think that this dimension does not exist.

Table 5. Distribution of Responses to the Question "Is there a legal dimension to the evidence to be obtained regarding the solution of events in Turkish Law?"

Faculty	Is there a legal dimension to the evidence to be obtained regarding the solution of events in Turkish Law?							
	Yes, there is. It is included in the Criminal Procedure Code No. 5271		No, the evidence has no legal dimension		I have no idea about this subject		Total	
	n	%	n	%	n	%	n	%
Faculty of Health Sciences	63	76.83	2	2.44	17	20.73	82	100
Faculty of Medicine	146	93.59	4	2.56	6	3.85	156	100
Total	209	87.82	6	2.52	23	9.66	238	100

In addition, 3.85% stated that they have no opinion on the issue. When the knowledge status of the participants regarding the legal dimension is examined in terms of all participants, it is seen that 87.82% of the participants think that the evidence has a legal dimension, while only 2.52% think that this dimension does not exist, and 9.66% stated that they have no opinion on this issue.

The data show that the majority of students in both the Health Sciences and Medical Schools think that evidence has a legal dimension. It can be said that students have a general awareness of the law's understanding of evidence, but still a group of students are uncertain about this issue.

Table 6 shows the familiarity of the participants with the term forensic biology. In this context, the students were asked the question "Have you heard

the term forensic biology before?" While 77.50% of the students of the Faculty of Health Sciences stated that they had heard the term forensic biology before, 22.50% of the students stated that they had not heard this term. Among the students of the Faculty of Medicine, 86.54% of the students stated that they had heard the term forensic biology before, while 13.46% of the students stated that they had not heard the term before. This rate shows that the awareness of the term forensic biology is higher among the students of the Faculty of Medicine. In total, 83.47% of the participants had heard the term forensic biology, while 16.53% were not familiar with this term.

This situation shows that the participants generally have a certain awareness of the term forensic biology. As a result, it can be said that the students have a general level of knowledge about forensic biology, but there is more uncertainty, especially among the students of the Faculty of Health Sciences.

Table 7 presents the concepts that come to mind of the participants regarding the term forensic biological analyses. In this context, the students were asked, "When forensic biological analyses are mentioned, which concept or concepts come to

mind?" 84.71% of the students of the Faculty of Health Sciences stated that DNA analyses come to mind, 25.88% mitochondrial DNA analyses, 23.53% serological analyses and 7.06% X-STR - Y-STR analyses come to mind. 96.15% of the students of the Faculty of Medicine stated that DNA analyses come to mind, 61.54% mitochondrial DNA analyses, 51.92% serological analyses and 45.51% X-STR - Y-STR analyses come to mind. These findings suggest that students of the Faculty of Health Sciences are particularly familiar with the subject of DNA analysis, while there is a lower awareness of other concepts, while students of the Faculty of Medicine have a broader conceptual understanding of forensic biological analysis. When examined on a per-participant basis, the concepts that participants associate with forensic biological analysis are distributed as follows: 92.12% DNA analysis, 48.96% mitochondrial DNA analysis, 41.91% serological analysis, and 31.95% X-STR - Y-STR analysis. In particular, DNA analysis was the most well-known concept among participants. As a result, it can be stated that the participants' general knowledge level on forensic biological analysis is high, but awareness of some concepts is more limited.

Table 6. Distribution of Responses to the Question "Have you heard the term "forensic biology" before?"

Faculty	Have you heard the term "forensic biology" before?					
	Yes		No		Total	
	n	%	n	%	n	%
Faculty of Health Sciences	62	77.50	18	22.50	80	100
Faculty of Medicine	135	86.54	21	13.46	156	100
Total	197	83.47	39	16.53	236	100

Table 7. Distribution of Responses to the Question "What concept or concepts come to mind when Forensic Biological Analyses are mentioned?"

Faculty	What concept or concepts come to mind when Forensic Biological Analyses are mentioned?									
	Serological Analyses		DNA Analyses		Mitochondrial DNA Analyses		X-STR - Y-STR Analyses		Total	
	n	%	n	%	n	%	n	%	n	%
Faculty of Health Sciences	20	23.53	72	84.71	22	25.88	6	7.06	85	100
Faculty of Medicine	81	51.92	150	96.15	96	61.54	71	45.51	156	100
Total	101	41.91	222	92.12	118	48.96	77	31.95	241	100

*Since there were students who marked more than one option in the answers given, the sum of the results exceeds 100%.

Table 8 includes the participants' opinions on which incidents forensic biological analyses are more effective in elucidating. In this context, the students were asked the question "In your opinion, which incidents forensic biological analyses are more effective in elucidating?" While 58.82% of the students of the Faculty of Health Sciences thought that forensic biological analyses were effective in

elucidating murder cases, 40.00% stated that these analyses were effective in identification studies, 35.29% in determining paternity, and 30.59% in rape cases. On the other hand, 75.00% of the students of the Faculty of Medicine stated that forensic biological analyses were effective in identification studies, 68.59% in determining murder cases, 55.13% in determining paternity,

and 53.85% in rape cases. These findings may indicate that the students of the Faculty of Medicine have a more comprehensive view on the usability of forensic biological analyses in different types of incidents. It is observed that their awareness, especially regarding identification studies, is high. In total, 65.15% of the participants think that forensic biological analyses are more effective in solving murder cases, 62.66% in identification studies, 48.13% in paternity determinations, and 45.64% in rape cases. In general, murder cases and identification studies stand out as the areas where forensic biological analyses are most effective according to the participants. While the awareness of how forensic biological analyses are effective in different types of cases is higher among the students of the Faculty of Medicine, it can be said that the awareness of the students of the Faculty of Health Sciences on this issue should be increased. Table 9 shows the distribution of participants' responses to the question "Are forensic biological analyses and forensic DNA analyses the same concept?" While 55.29% of the students of the Faculty of Health Sciences stated that these two concepts were not the same, 32.94% had no idea about this issue, and 11.76% stated that the two concepts were the same. This may indicate that there is confusion or uncertainty between the concepts of forensic biological analyses and forensic DNA analyses among the students of the Faculty of Health Sciences. While 90.38% of the students of the Faculty of Medicine stated that these two concepts were not the same, 5.13% stated that these concepts were the same, and 4.49% did not have an idea about this issue. This result suggests that the majority of the students of the Faculty of Medicine clearly know the difference between forensic biological analyses and forensic DNA analyses. In total, 78.01% of the participants stated that forensic biological analyses are different from forensic DNA analyses, 14.52% did not have an opinion on this issue, and 7.47% stated that the two concepts were the same. In conclusion, although there is a general awareness that there is a difference between forensic biological analyses and forensic DNA analyses, it can be said that this difference needs to be clarified, especially among the students of the Faculty of Health Sciences. Table 10 shows the distribution of participants' responses to the question "Which biological

material is most commonly obtained for forensic biological analyses in forensic cases?" 58.82% of the students of the Faculty of Health Sciences stated that they thought hair was the most commonly obtained biological material, while 49.41% stated blood, 18.82% stated semen or vaginal fluid, and 9.41% stated urine.

This shows that the students of the Faculty of Health Sciences focused most on hair and blood samples. 72.44% of the students of the Faculty of Medicine stated that blood was the most commonly obtained biological material, while 28.21% stated hair, 5.77% stated semen or vaginal fluid, and 3.21% stated urine. It can be said that the students of the Faculty of Medicine agreed that blood samples were most commonly collected in forensic cases.

In total, 64.32% of the participants stated that they thought the most commonly collected biological material was blood, 39.00% indicated hair, 10.37% indicated semen or vaginal fluid, and 5.39% indicated urine. In conclusion, while there is a general consensus that blood samples are collected the most in forensic cases, it is noteworthy that hair is also seen as an important biological material among the students of the Faculty of Health Sciences.

Table 11 shows the distribution of responses given by participants to the question "Which information or information is true about the DNA molecule?" While 70.59% of the students of the Faculty of Health Sciences agreed with the statement that DNA "stores and transfers genetic information", 58.82% stated that it is used in solving forensic cases, and 56.47% stated that it constitutes the genetic code of living things. Only 4.71% agreed with the statement that DNA "is only found in the human organism". While 84.62% of the students of the Faculty of Medicine agreed with the statement that DNA "stores and transfers genetic information", 80.13% agreed with the statement that DNA "is the genetic code of living things". In addition, 60.90% agreed with the statement that DNA "is used in solving forensic cases", and only 3.21% agreed with the statement that DNA "is only found in the human organism". In total, 79.67% of the participants agreed with the statement that DNA "stores and transfers genetic information", while 71.78% stated that DNA constitutes the genetic code of living things.

Table 8. Distribution of Responses to the Question “In your opinion, which incidents are Forensic Biological Analyses more effective in elucidating?”

Faculty	In your opinion, which incidents are Forensic Biological Analyses more effective in elucidating?									
	Murder Cases		Paternity Determinations		Identification Studies		Rape Cases		Total	
	n	%	n	%	n	%	n	%	n	%
Faculty of Health Sciences	50	58.82	30	35.29	34	40.00	26	30.59	85	100
Faculty of Medicine	107	68.59	86	55.13	117	75.00	84	53.85	156	100
Total	157	65.15	116	48.13	151	62.66	110	45.64	241	100

*Since there were students who marked more than one option in the answers given, the sum of the results exceeds 100%.

Table 9. Distribution of Responses to the Question “Are “Forensic Biological Analyses” and “Forensic DNA Analyses” the same concepts?”

Faculty	Are “Forensic Biological Analyses” and “Forensic DNA Analyses” the same concepts?									
	Yes		No		I Have No Idea		Total			
	n	%	n	%	n	%	n	%		
Faculty of Health Sciences	10	11.76	47	55.29	28	32.94	85	100		
Faculty of Medicine	8	5.13	141	90.38	7	4.49	156	100		
Total	18	7.47	188	78.01	35	14.52	241	100		

Table 10. Distribution of Responses to the Question “Which biological material is obtained more in order to perform forensic biological analyses in forensic cases?”

Faculty	Which biological material is obtained more in order to perform forensic biological analyses in forensic cases?									
	Blood		Hair		Urine		Semen-Vaginal fluid		Total	
	n	%	n	%	n	%	n	%	n	%
Faculty of Health Sciences	42	49.41	50	58.82	8	9.41	16	18.82	85	100
Faculty of Medicine	113	72.44	44	28.21	5	3.21	9	5.77	156	100
Total	155	64.32	94	39.00	13	5.39	25	10.37	241	100

*Since there were students who marked more than one option in the answers given, the sum of the results exceeds 100%.

While 60.17% stated that DNA is used in solving forensic cases, only 3.73% found the information that DNA is only found in the human organism to be correct.

Table 12 shows the distribution of participants' responses to the question “Do you have knowledge about DNA analysis?” 62.96% of the students of the Faculty of Health Sciences stated that they had knowledge about DNA analysis, while 37.04% stated that they were not informed about this issue. While 91.67% of the students of the Faculty of Medicine stated that they had knowledge about DNA analysis, only 8.33% stated that they were not informed about this issue.

This rate shows that there is a wide awareness about DNA analysis among the students of the Faculty of Medicine. In total, 81.86% of the participants stated that they had knowledge about

DNA analysis, while 18.14% stated that they were not informed. As a result, there is a significant awareness about DNA analysis among the participants in general, and this awareness is especially high among the students of the Faculty of Medicine.

Table 13 shows the distribution of participants' responses to the question "Are the definitions of DNA analysis and DNA isolation the same?" 90.36% of the students of the Faculty of Health Sciences stated that these two definitions were not the same, only 9.64% thought they were the same. Similarly, 91.03% of the students of the Faculty of Medicine stated that these definitions were different, while 8.97% thought they were the same. In general, 90.79% of the participants stated that the definitions of DNA analysis and DNA isolation were different, while 9.21% thought they were the

same. This shows that the majority of the students are aware of the difference between these two definitions.

Table 14 shows the participants' opinions on which substances DNA samples can be taken from in forensic cases. In this context, the students were asked, "Which substance(s) do you think DNA samples can be taken from in solving a forensic case?" 70.59% of the students of the Faculty of Health Sciences stated that DNA samples can be taken from chewed gum, followed by bite marks (63.53%), cigarette butts (48.24%), and toothpicks (42.35%). A similar trend is seen among the students of the Faculty of Medicine. 80.77% of the students stated that DNA can be taken from chewed gum, followed by bite marks (65.38%), cigarette butts (64.10%), and toothpicks (57.69%). In total, 77.18% of the participants think that DNA samples can be obtained from chewed gum, 64.73% from bite marks, 58.51% from cigarette butts, and 52.28% from toothpicks. These results show that the majority of the participants are aware that DNA can be obtained from various biological materials in forensic cases.

Table 15 shows the participants' level of knowledge about the institutions authorized to perform DNA analysis. In this context, the students

were asked the question "Which of the following institutions is/are authorized to perform DNA analysis?" 97.65% of the students at the Faculty of Health Sciences think that the Forensic Medicine Institution is authorized, followed by the Security and Gendarmerie Criminal Department with 16.47%. While 2.35% of the students see the Gendarmerie General Command as authorized, 1.18% stated that the General Directorate of Security is authorized. Among the students at the Faculty of Medicine, 96.15% think that the Forensic Medicine Institution is authorized, followed by the Security General Directorate with 45.51% and the Security and Gendarmerie Criminal Department with 41.67%. 20.51% think that the Gendarmerie General Command is authorized.

In general, 96.68% of the participants think that the Forensic Medicine Institution is authorized to perform DNA analysis. While the Police and Gendarmerie Criminal Department is stated as having authority at a rate of 32.78%, the General Directorate of Security is seen as having authority at a rate of 29.88% and the General Command of Gendarmerie is seen as having authority at a rate of 14.11%.

Table 11. Distribution of Responses to the "Question In your opinion, which information or information is correct about the DNA molecule?"

Faculty	In your opinion, which information or information is correct about the DNA molecule?									
	It stores and transfers genetic information		It is only found in the human organism		It is used in solving forensic cases		It creates the genetic code of living things		Total	
	n	%	n	%	n	%	n	%	n	%
Faculty of Health Sciences	60	70.59	4	4.71	50	58.82	48	56.47	85	100
Faculty of Medicine	132	84.62	5	3.21	95	60.90	125	80.13	156	100
Total	192	79.67	9	3.73	145	60.17	173	71.78	241	100

*Since there were students who marked more than one option in the answers given, the sum of the results exceeds 100%.

Table 12. Distribution of Responses to the Question "Do you have any information about DNA analysis?"

Faculty	Do you have any information about DNA analysis?					
	Yes		No		Total	
	n	%	n	%	n	%
Faculty of Health Sciences	51	62.96	30	37.04	81	100
Faculty of Medicine	143	91.67	13	8.33	156	100
Total	194	81.86	43	18.14	237	100

Table 13. Distribution of Responses to the Question “Are the definitions of “DNA analysis” and “DNA isolation” the same?”

Faculty	Are the definitions of “DNA analysis” and “DNA isolation” the same?					
	Yes		No		Total	
	n	%	n	%	n	%
Faculty of Health Sciences	8	9.64	75	90.36	83	100
Faculty of Medicine	14	8.97	142	91.03	156	100
Total	22	9.21	217	90.79	239	100

Table 14. Distribution of Responses to the Question “Which one(s) do you think DNA samples can be taken from in solving a criminal case?”

Faculty	Which one(s) do you think DNA samples can be taken from in solving a criminal case?									
	Chewed gum		Toothpick		Cigarette butt		Bite marks		Total	
	n	%	n	%	n	%	n	%	n	%
Faculty of Health Sciences	60	70.59	36	42.35	41	48.24	54	63.53	85	100
Faculty of Medicine	126	80.77	90	57.69	100	64.10	102	65.38	156	100
Total	186	77.18	126	52.28	141	58.51	156	64.73	241	100

*Since there were students who marked more than one option in the answers given, the sum of the results exceeds 100%.

Table 15. Distribution of Responses to the Question “Which(s) of the following are authorized institutions to perform DNA analysis?”

Faculty	Which(s) of the following are authorized institutions to perform DNA analysis?									
	Forensic Medicine Institution		Gendarmerie General Command		General Directorate of Security		Security and Gendarmerie Criminal Department Presidency		Total	
	n	%	n	%	n	%	n	%	n	%
Faculty of Health Sciences	83	97.65	2	2.35	1	1.18	14	16.47	85	100
Faculty of Medicine	150	96.15	32	20.51	71	45.51	65	41.67	156	100
Total	233	96.68	34	14.11	72	29.88	79	32.78	241	100

*Since there were students who marked more than one option in the answers given, the sum of the results exceeds 100%.

Table 16 shows the participants' opinions on "whether there are other ways to solve forensic cases when the samples obtained from the crime scene are insufficient". While 54.12% of the students of the Faculty of Health Sciences think that there are other ways, 50.59% stated that there are alternative ways other than DNA analysis. Only 4.71% think that there is no other way in this regard. Among the students of the Faculty of Medicine, 50.00% of the participants stated that there are other ways and the other 50.00% stated that alternative methods other than DNA analysis can be used. There was no "No" answer among the students of the Faculty of Medicine. In total, 51.45% of the participants think that there are other ways when the samples obtained from the crime scene

are insufficient, while 50.21% stated that alternative methods other than DNA analysis can be used. This situation shows that the majority of the students are aware of alternative methods in solving forensic cases. Table 17 shows the distribution of participants' responses to the question “Do you have information about mitochondrial DNA analysis?” Only 27.06% of the students of the Faculty of Health Sciences stated that they had information about mitochondrial DNA analysis, while 72.94% stated that they did not have information on this subject. This situation shows that there is a significant lack of information about mitochondrial DNA analysis among the students of the Faculty of Health Sciences.

Table 16. Distribution of Responses to the Question “If the samples obtained from the crime scene are insufficient, are there other available methods for solving criminal cases?”

Faculty	If the samples obtained from the crime scene are insufficient, are there other available methods for solving criminal cases?							
	Yes		No		There are alternative methods other than DNA analysis		Total	
	n	%	n	%	n	%	n	%
Faculty of Health Sciences	46	54.12	4	4.71	43	50.59	85	100
Faculty of Medicine	78	50.00	-	0.00	78	50.00	156	100
Total	124	51.45	4	1.66	121	50.21	241	100

Among the students of the Faculty of Medicine, 79.35% stated that they had information about mitochondrial DNA analysis, while only 20.65% stated that they did not have information on this subject.

This result shows that there is a higher level of awareness about mitochondrial DNA analysis among the students of the Faculty of Medicine. In total, 60.83% of the participants stated that they had information about mitochondrial DNA analysis, while 39.17% stated that they did not have information on this subject.

This situation shows that there is a level of knowledge about mitochondrial DNA analysis in general, but there is a significant lack of knowledge, especially among the students of the Faculty of Health Sciences.

Table 18 shows the distribution of participants’ responses to the question “Do you think forensic biological analyses are sufficient in solving forensic

cases?” Only 21.43% of the students of the Faculty of Health Sciences stated that forensic biological analyses are sufficient in solving forensic cases, while 78.57% stated that these analyses are not sufficient. This situation shows that the students of the Faculty of Health Sciences have a strong perception that the scope of forensic biological analyses is insufficient. Among the students of the Faculty of Medicine, 29.68% stated that forensic biological analyses are sufficient, while 70.32% stated that these analyses are insufficient.

These rates reveal that there is a similar opinion among the students of the Faculty of Medicine regarding the adequacy of forensic biological analyses.

In total, only 26.78% of the participants thought that forensic biological analyses were sufficient in solving forensic cases, while 73.22% did not share this opinion.

Table 17. Distribution of Responses to the Question “Do you have any information about mitochondrial DNA analysis?”

Faculty	Do you have any information about mitochondrial DNA analysis?					
	Yes		No		Total	
	n	%	n	%	n	%
Faculty of Health Sciences	23	27.06	62	72.94	85	100
Faculty of Medicine	123	79.35	32	20.65	155	100
Total	146	60.83	94	39.17	240	100

Table 18. Distribution of Responses to the Question “Do you think forensic biological analysis is sufficient in solving forensic cases?”

Faculty	Do you think forensic biological analysis is sufficient in solving forensic cases?					
	Yes		No		Total	
	n	%	n	%	n	%
Faculty of Health Sciences	18	21.43	66	78.57	84	100
Faculty of Medicine	46	29.68	109	70.32	155	100
Total	64	26.78	175	73.22	239	100

Table 19 shows the distribution of participants’ responses to the question “Are DNA analyses effective in crimes where biological samples are considered evidence?” While 91.46% of the students of the Faculty of Health Sciences stated

that DNA analyses are effective, only 8.54% expressed a negative opinion on this issue. Among the students of the Faculty of Medicine, 98.08% thought that DNA analyses were effective. Only 1.92% stated that DNA analyses were not effective. In total, 95.80% of the participants stated that DNA

analyses were effective in crimes where biological samples were considered evidence, while only 4.20% stated that these analyses were insufficient. The vast majority of the participants believed that DNA analyses played a critical role in solving crimes. Table 20 shows whether the participants have taken a course on forensic biology in their departments. Only 26.58% of the students of the Faculty of Health Sciences stated that they have taken a course on forensic biology, while 73.42% stated that they have not received any training on

this subject. On the other hand, 66.45% of the students of the Faculty of Medicine stated that they have taken a course on forensic biology, while 33.55% stated that they have not taken these courses. It is seen that the students of the Faculty of Medicine receive more forensic biology training, which can be interpreted as the students having a better opportunity to increase their knowledge in this field. In total, 52.99% of the participants have taken a course on forensic biology, while 47.01% stated that they have not taken these courses.

Table 19. Distribution of Responses to the Question “Are DNA analysis effective in crime cases where biological samples are considered as evidence?”

Faculty	Are DNA analysis effective in crime cases where biological samples are considered as evidence?					
	Yes		No		Total	
	n	%	n	%	n	%
Faculty of Health Sciences	75	91.46	7	8.54	82	100
Faculty of Medicine	153	98.08	3	1.92	156	100
Total	228	95.80	10	4.20	238	100

Table 20. Distribution of Responses to the “Question Have you ever taken a course on Forensic Biology in your department?”

Faculty	Have you ever taken a course on Forensic Biology in your department?					
	Yes		No		Total	
	n	%	n	%	n	%
Faculty of Health Secince	21	26.58	58	73.42	79	100
Faculty of Medicine	103	66.45	52	33.55	155	100
Total	124	52.99	110	47.01	234	100

Table 21 shows whether the participants found the forensic biology training provided in their departments sufficient. While only 15.38% of the students of the Faculty of Health Sciences found the forensic biology training sufficient, 84.62% stated that this training was insufficient. This result reveals that the training of the students of the Faculty of Health Sciences in forensic biology was seen as seriously insufficient. Among the students of the Faculty of Medicine, there was an equal distribution of views on the adequacy of the training; 50.00% found the training sufficient, while 50.00% stated that it was insufficient. This situation shows that the students of the Faculty of Medicine have more diverse views on forensic biology training. In total, 36.08% of the participants found the forensic biology training sufficient, while 63.92% stated that this training was insufficient. According to Table 22, the majority of the Faculty of Health Sciences students think that it is necessary to create a DNA database. This situation suggests that these students have a high awareness of the importance of DNA analysis in judicial processes. Only 18.99% question the necessity of such a database. While 76.62% of the Faculty of

Medicine students state that a DNA database is necessary, 23.38% do not share this opinion. It is seen that the Faculty of Medicine students generally have a positive perspective on the DNA database. In total, 78.11% of the participants find it necessary to create a DNA database in our country. This result reveals that the students generally understand the importance of applications in the field of forensic biology and DNA analysis and think that such a system will make a positive contribution to the judicial processes in our country. The necessity of creating a DNA database is emphasized. In a similar study, a survey consisting of 20 questions was applied to 290 senior students of the Faculty of Medicine, Faculty of Law and Faculty of Health Sciences, Department of Nursing, studying at Samsun Ondokuz Mayıs University in the Fall semester of the 2017-2018 Academic Year. The students' field knowledge about forensic sciences and their knowledge levels about forensic DNA analysis were tried to be measured. The results of the study showed that there was a significant difference between the knowledge levels of the students of the Faculty of Medicine,

Faculty of Law and Department of Nursing about forensic sciences. It is recommended that comprehensive courses including forensic sciences

be added to the curriculum of all faculties as it will increase the knowledge level of students who will work in the field of forensics. (Mut, 2018).

Table 21. Distribution of Responses to the Question “Do you find the training in Forensic Biology in your department sufficient?”

Faculty	Do you find the training in Forensic Biology in your department sufficient?					
	Yes		No		Total	
	n	%	n	%	n	%
Faculty of Health Scince	12	15.38	66	84.62	78	100
Faculty of Medicine	58	50.00	58	50.00	116	100
Total	70	36.08	124	63.92	194	100

Table 22. Distribution of Responses to the Question “Do you think it is necessary to create a DNA database in our country?”

Faculty	Do you think it is necessary to create a DNA database in our country?					
	Yes		No		Total	
	n	%	n	%	n	%
Faculty of Health Scince	64	81.01%	15	18.99%	79	100%
Faculty of Medicine	118	76.62%	36	23.38%	154	100%
Total	182	78.11%	51	21.89%	233	100%

In another survey conducted to measure the knowledge levels of 103 lawyers living in different cities about forensic DNA analysis, 87% of the lawyers who participated in the survey accepted that DNA analysis is an effective method in solving forensic cases. Seven lawyers (7%) thought that the importance of these analyses was exaggerated. Six (6%) lawyers stated that they did not have an opinion on this subject. (Tug et al., 2007). In a study conducted in 2020, 310 nursing students studying at Akdeniz University were surveyed to determine their level of knowledge about forensic nursing. According to the results of the study, it was determined that students had moderate knowledge about forensic nursing (Düzgün et al., 2020).

Chi-square analysis revealed that there were significant differences between faculties in students' knowledge and attitudes towards forensic biological analysis. A statistically significant difference was found in the level of knowledge about DNA analysis; students of the Faculty of Medicine reported having a higher level of knowledge on this subject compared to students of the Faculty of Health Sciences ($\chi^2=29.578$; $p<0.001$). Similarly, the level of knowledge about mitochondrial DNA analysis also differed significantly according to faculties, with the students of the Faculty of Medicine having a higher level of knowledge in this field ($\chi^2=63,011$; $p<0,001$). Perceptions on whether DNA analysis is effective in the evaluation of biological evidence also showed a significant difference between the faculties and the students of the Faculty of Medicine accepted the effectiveness of these analyzes more ($\chi^2=5,840$; $p=0,016$). The status of

receiving forensic biology education also showed a significant difference between the groups; the students of the Faculty of Medicine stated that they received this course more frequently ($\chi^2=33,392$; $p<0,001$). In addition, there was a significant difference between the opinions on the adequacy of forensic biology education, and it was observed that the students of the Faculty of Health Sciences found this education more inadequate ($\chi^2=24,231$; $p<0,001$). On the other hand, no significant difference was found between the faculties in the opinions on whether the concepts of DNA analysis and DNA isolation are equivalent ($\chi^2=0,029$; $p=0,866$), perceptions on the adequacy of forensic biological analysis in solving forensic cases ($\chi^2=1,891$; $p=0,169$) and attitudes towards the necessity of establishing a DNA database in Turkey ($\chi^2=0,588$; $p=0,443$). These results reveal that the level of awareness of some technical concepts is similar between faculties, but the students of the Faculty of Medicine are in a more advantageous position in terms of knowledge level and access to education.

4. Conclusion

The results of the study showed that there were some differences between the knowledge levels of the students of the Faculty of Medicine and the Department of Nursing regarding forensic biological analyses. As a result of the chi-square tests, it was observed that the level of knowledge and access to training on forensic biological analysis was significantly higher among the students of the Faculty of Medicine compared to the students of the Faculty of Health Sciences. On

the other hand, there was no significant difference between faculties in some conceptual attitudes (e.g. the need for a DNA database). It is recommended that comprehensive courses including forensic biological analyses be added to the curriculum of both faculties, as this will increase the knowledge level of students who will work in the forensic field. A wide variety of methods such as theoretical exams, practical studies, case studies, written reports, simulations, in-class discussions and portfolio assessments can be used to measure the knowledge level of the students of the Faculty of Medicine and the Department of Nursing regarding forensic biological analyses. These methods provide a comprehensive approach to assess both the theoretical knowledge and practical skills of the students. Forensic biological analyses are an area where the participation of nurses in criminal investigations in health services is increasing, and therefore it is important for students to have a solid knowledge base on this subject. As a result, biological evidence found at the scene of the crime is of great importance in solving forensic events. As a result of the analysis of DNA genetic material, the identification of criminals becomes easier. Therefore, it is important for the personnel who will work in Forensic Sciences and Forensic Medicine to have knowledge about forensic biological analyses.

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Conflicts of interest

None

Author Contributions

Z.D. contributed to the concept, study design, data collection and/or processing, literature search, writing, critical review, submission and revision, project management, and funding acquisition; D.T. contributed to the concept, study design, supervision, data collection and/or processing, data analysis and/or interpretation, literature search, writing, critical review, submission and revision, project management, and funding acquisition; A.V. contributed to the concept, study design, supervision, data collection and/or processing, data analysis and/or interpretation,

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