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## ANALYSIS OF FOOD SAFETY AND COLD CHAIN KNOWLEDGE OF LOGISTICS STUDENTS

Seydi YIKMIŞ<sup>1,2</sup>

Harun AKSU<sup>3</sup>

Fırat DEMİRKOL<sup>4</sup>

Mehmet ALPASLAN<sup>5</sup>

### Abstract

This study was planned and conducted in order to examine the knowledge, attitudes, and behaviors of university students in the logistics department reading about the food safety and cold chain. The study was conducted on 165 university students (59 girls, 106 boys) who are logistics associate degree students. In the collection of the data, 7 information questionnaire and 20 item attitude scale questionnaires were prepared to determine students' demographic characteristics, food safety, and cold chain knowledge, attitudes and behaviors. The obtained data were evaluated with SPSS 20.0 program using frequency (f), percent (%), t-test and one-way variance analysis (ANOVA) method. It has been determined that students have not received any prior training in the marking of "Have you been trained in Food Safety, Hygiene-Sanitation, Nutrition and Health before?" 146 students (88.5%) answered no to the question "Do you think your information about food safety is sufficient?" Statistically significant differences were found in the cold chain information group that the students had given the numbers 1 and 2 according to their gender ( $p < 0.05$ ). When the average scores of the infectious disease group were examined, it was determined that they participated in all statements in general. It was determined that there was a statistically significant difference between the responses of the students to the expression 14 in the cold chain of information group according to their gender ( $p < 0.05$ ). It has been concluded that students are not sufficient in food safety and cold chain knowledge. It has been found that most of the students want to be trained by specialists in the field of the field. Lessons in the curriculum have resulted in food safety and cold chain related compulsory courses, or elective courses that will benefit students to be equipped on a sectoral basis after graduation.

**Keywords:** Food safety, cold chain, logistics

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<sup>1</sup> Istanbul University, Veterinary Faculty, Department of Food Hygiene & Technology, [syikmis@hotmail.com](mailto:syikmis@hotmail.com)

<sup>2</sup> Namık Kemal University, School of Health Sciences, Department of Nutrition and Dietetics,

<sup>3</sup> Istanbul University, Veterinary Faculty, Department of Food Hygiene & Technology, [haksu@istanbul.edu.tr](mailto:haksu@istanbul.edu.tr)

<sup>4</sup> Istanbul Gelişim University, Istanbul Gelişim Vocational School, Logistics Program, Istanbul, Turkey, [fdemirkol@gelisim.edu.tr](mailto:fdemirkol@gelisim.edu.tr)

<sup>5</sup> Namık Kemal University, School of Health Sciences, Department of Nutrition and Dietetics, [malpaslan@nku.edu.tr](mailto:malpaslan@nku.edu.tr)

## 1. Introduction

Along with the development of technology and the changing of people's lifestyles, consumption and eating habits have also changed this trend. Nowadays people are moving away from the tendency to spend much time in the kitchen and they are focusing on the consumption of fast and ready food especially in big cities. These developments have increased the importance of food safety and cold chain today.

Food safety has become an increasingly global issue in the food trade, with from farm to fork principle (Bricher, 2010; Evelyn, Kim, & Silva, 2016). Safe food; Is defined as a clean, unspoiled, legal norm and rules-based foodstuff in terms of physical, chemical and microbiological preservation of the nutritional value (Bilici, Uyar, Beyhan, & Sağlam, 2006; Gülse Bal, Z.Gökalp, & Osman, 200AD).

Food safety, in general, includes a package of measures to be taken to ensure that food is delivered to the consumer in a healthy and reliable way while maintaining physical, chemical and sensory qualities, from production to consumption (Mikulsen & Diduck, 2016; Soares, Martins, & Vicente, n.d.; Wang & Yue, 2017).

**20** Hazard Analysis at Critical Control Points (HACCP), the most effective control method for ensuring food safety, is a food safety system that allows control of foodstuffs from the raw material stage to the processing and consumption of the product. As a preventive and preventive system, HACCP ensures that measures are taken and sustained at every stage of the product, from the field to table (Korkut, 2002; Motarjemi & Lelieveld, n.d.; Özbek & Fidan, 2010; Soman & Raman, 2016). In recent years, many studies on food safety management systems seem to increase the scope and implementation of ISO 22000: Food Safety Management Systems and HACCP (Arvanitoyannis & Varzakas, 2009; Başaran, 2016; Djordjevic, Cockalo, & Bogetic, 2011; Mercan & Bucak, 2013; Psomas & Kafetzopoulos, 2015; Sekheta, Sahtout, Sekheta, Sharabi, & Airoud, 2010). Logistics is a holistic management approach that enables the planning, implementation, and control of the flow and storage of raw materials, processed parts, end products, and their information in an efficient and economical way to the point where they will be consumed from the source in order to meet customer needs (Abbasi, 2011; Bowersox, Closs, Cooper, & Bowersox, 2013; Çakırlar, 2009; Hundy et al., 2016; Towill, 2001).

Cold chain, products that need to be stored and transported in cold environment; It is an integrated system of activities, records, procedures and equipment including cold rooms, transport containers, refrigerators, vehicles, including tracking and control of handling, storage, transportation, distribution and heat sensitive products (Ashok, Brison, & LeTallec, 2016; jie, 2010; Matuszak-Flejszman & Bramorski, 2008; Vesper, Kartoğlu, Bishara, & Reeves, 2010; Weng, An, & Chen, 2015; Zou, Xie, & Liu, 2013). The scope of the cold chain is usually listed as food, medicine, vaccine, blood, organ, fresh live flower/plant, and some chemical products (Matuszak-Flejszman & Bramorski, 2008).

Nowadays, in the modern consumption concept, customers consciously pay attention to the latest consumption dates of products, the freshness of product, appearance. In this context, retailers will be able to meet customer expectations by delivering the product to the customer in the desired quality and time. It is of the utmost importance that processes are best managed throughout the entire supply chain and food safety and cold chain are the most important steps. This is even more

55 pronounced in heat-sensitive products compared to other products. Such products are in every  
56 chain of many stages of food safety based on a principle from cutlery to table (Baines, 2010;  
57 Gökdemir, 2009; Hsiao, Chen, & Chin, 2017; Kele, Lengyel, & Deak, 2011; Matuszak-Flejszman &  
58 Bramorski, 2008; Piramuthu & Zhou, 2016). A breakage in the cold chain and food safety  
59 vulnerability; Negative impacts and effects on public health, financial damage due to product  
60 deterioration, rejection of the product at the point of delivery and cost increase in collection of the  
61 refunds, punitive sanctions to be applied to the operation as a result of failing to fulfill the  
62 obligations to be imposed on food safety, negative consequences due to customer dissatisfaction It  
63 will be the cause (Baines, 2010; Bowersox et al., 2013; Dölekoğlu, 2002; jie, 2010; Weng et al., 2015;  
64 Zhao, 2014; Zou et al., 2013). Therefore, in this study, it is aimed to measure the food safety and  
65 cold chain knowledge levels of the vocational college students in Istanbul and to evaluate the  
66 results.

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## 68 2. Method

### 69 2.1. Collecting and Analyzing Data

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71 In the study designed according to the descriptive scanning model, a scale form of three stages  
72 (personal information, knowledge level, and attitude) was used as data collection tool. The first part  
73 consists of the demographics of the students to determine the school, the school to which they  
74 graduated, the gender, the education level of the mother, the educational status of the father, the  
75 monthly income of the dynasty and the way of accessing information.

76 The second part consists of 7 general inquiries prepared to measure the level of knowledge of  
77 students about food safety and cold chain.

78 The last and third part of the questionnaire form consists of 20 Likert type attitude items to  
79 determine students' attitudes about food safety and cold chain. The reliability of the measurement  
80 tool was calculated (Cronbach-Alpha) and the reliability coefficient of the test was 0.754. The 11  
81 obtained were evaluated using frequency (f), percentage (%), independent groups t-test and one  
82 way analysis of variance (ANOVA) with SPSS (Statistical Package For Social Sciences) 20.0  
83 program.

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### 85 2.2. Sampling

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87 The sample of this study constitutes a total of 165 primary and secondary university students  
88 studying in the Vocational School Logistics Program of a Foundation University in the province of  
89 Istanbul during the 2015-2016 academic year spring semester. Demographic data on students  
90 participating in the study are presented in Table 2.1.

91

92 **Table 2.1.** Demographic data of the sampling group

Demografik Veriler	Kategori	Toplam
Gender	Female	59
	Male	106
Class	1	94
	2	71
Graduated School	Vocational High School	106
	Anatolian High School	38
	Anatolian Religious High School	3
	Technical High School	9
	Science High School	5

	Other	4
Mother Education	Uneducated	7
	Primary education	76
	Secondary education	71
	License	9
	Master Degree	1
Father Education	Uneducated	3
	Primary education	21
	Secondary education	127
	License	12
	Master Degree	2
Family Average Monthly Income	1500 TL and less	1
	1501-3000	21
	3001-4500	129
	4501-6000	10
	6001-7500	4
	7501 and over	0
Do you use the internet to access information?	Yes	165
	No	0

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### 95 3. Analysis of General Information Questions

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97 The findings of the frequency (f) and percent (%) values obtained as a result of the analysis  
98 performed by the test in which the general information questions prepared in the first part of the  
99 study are included are given in Table 3.1.

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101 **Table 3.1.** Analysis of general information questions

NO	Open-ended Question	Answer	f	%
1	Which logistics sector do you intend to work in when you graduate?	Food Logistics and Cold Chain	62	37,6
		Transportation companies (Air, Sea and Land)	51	30,9
		Logistics departments of manufacturing companies	17	10,3
		Supply Chain Management firms (3PL, 4PL)	31	18,8
		Other	4	2,4
2	Have you already been trained in Food Safety, Hygiene-Sanitation, Nutrition and Health?	Evet	0	0
		Hayır	165	100
3	If yes to the previous question, who did or did you get the training?	Business manager	-	-
		Dietitian	-	-
		A private firm official	-	-

		Lessons I have taken in my school years	
4	Do you find your information on food safety satisfactory?	Yes	19 11,5
		No	146 88,5
5	Do you think your occupation is an important step in ensuring food safety?	Yes	151 91,5
		No	14 8,5
6	Would you like to have Food Logistics and Cold Chain lessons in your curriculum?	Yes	147 89,1
		No	18 10,9
7	If your answer to the previous question is yes, which scientific field do you think education should be given by the teaching staff / member?	Food Engineer / Food Technology	98 59,4
		Nutrition and Dietetics	10 6,1
		Logistics Departments	39 23,6

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When examined in Table 3.1, it has been determined that students have never been trained in the markings they have made about "Have you ever been trained in Food Safety, Hygiene-Sanitation, Nutrition and Health"? 146 students (88.5%) answered no to the question "Do you think your information about food safety is sufficient?" There was a statistically significant difference ( $p = 0.03$ ) between the answers given by Vocational High School and Anatolian High School graduates to the questionnaire ( $p < 0.05$ ).

Students "Would you like to have food logistics and cold chain lessons in your course curriculum?" (89% of the respondents) answered that they think that they should be in the curriculum by 147 people. As shown in Table 3.2, there was no statistically significant difference in the answers given by the students to the general information questions ( $p > 0.05$ ).

No	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
1	,720	163	,472	,135	,188
2	-	-	-	-	-
3	-	-	-	-	-
4	1,391	163	,166	,070	,050
5	-,548	163	,585	-,024	,044
6	,877	163	,382	,043	,049
7	-,581	145	,562	-,085	,147

Table 3.2 T-test results according to class level of general information questions

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The logistics program students in Table 3.3 were found to have a statistically significant difference in gender differences between answers 1, 6 and 7 ( $p < 0.05$ ). However, the fourth question is, "Do you see enough information on food safety?" And question 5, "Do you think your occupation is an important stage in the provision of food safety?" There was no significant difference between boys and girls ( $p > 0.05$ ).

No	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
1	-2,975	163	,003	-,564	,189

2	-	-	-	-	-
3	-	-	-	-	-
4	1,422	163	,157	,074	,052
5	-,583	163	,560	-,027	,045
6	-3,453	163	,001	-,170	,049
7	4,861	145	,000	,670	,138

Table 3.3 T-test results of general information questions by gender

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### 19 Analysis of Food Safety and Cold Chain Attitudes Scale Items

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Factor analysis was performed primarily to determine the groupings (factors) between the items for the validity procedures. In the process of factor analysis, Kaiser-Meyer-Olkin (KMO) and Bartlett values were determined; The analysis of the basic components was carried out and finally, the varimax rotation process was carried out. The BMD test tests whether the partial correlations are small and whether the distribution is sufficient for factor analysis. In this research, the value of BMO was good. Barlett's test result was 1362,473 ( $p < .001$ ). The significance of Bartlett's values also supports the hypothesis that data come from a highly variable normal distribution.

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After the operations, Varimax Vertical Turning Technique was used to look at the factors' distribution of factors and it was seen that some materials gave high value ( $< .30$ ) in more than one factor. In the case of items with more than 0.30 times more than one factor, the amount of the load difference is looked at, and those items whose difference is less than 10% are eliminated (Büyüköztürk, 2002).

<b>Kaiser-Meyer-Olkin Measure Sampling Adequacy</b>	<b>0,786</b>
<b>Bartlett's Test of Sphericity</b>	<b>Chi-square Value</b> 1362,473
	<b>df</b> 190
	<b>Sig.</b> 000

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Table 4.1. KMO and Barlett's Test Values

At the end of the analysis, the measurement items were collected under 4 groups. The specified grouping is specified in Table 4.2.

Cold Chain Information	Food Preservation Information	Hygiene and Sanitation Information	Infection Information
1, 2, 4, 5, 7, 16, 19, 20	11, 15, 18	3, 6, 9, 13	8, 10, 14, 17

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Table 4.2. Groups Determined by Factor Analysis

Independent groups t test and Annova test were used to examine the effect of students' attitudes towards food safety and cold chain. The responses were based on an average of 1 and 5 points scored by the students on responses to food safety and cold chain attitude scale items. The average scores of students' attitudes towards Food Safety and Cold Chain scales are shown in the tables.

NO	The Food Safety and Cold Chain Attitudes Scale for Students	Average
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1	Freezing of food in deep freezing or -18 degree cold room is possible; But this is not the right method. Shocking in this way can damage food, deteriorate the quality of the product and reduce nutritional value. At the same time, because it is a slow shock method, it must also be in terms of food safety. For this reason, shocking with IQF is a contemporary, healthy and reliable method.	2,51
2	Knowing about food safety is important.	2,55
4	Products should not be stacked adjacent to the wall, leaving a distance of 40 - 50 cm between the wall and the products.	2,71
5	The vehicle carrying the products should be light-free, odorless, suitable humidity and temperature.	3,59
7	Food Chain: Consists of successive steps and processes, from production to consumption, from production to processing, distribution, storage and preparation of food and its ingredients.	3,38
16	The IQF Individual Fast Freezing process is a freezing process in which cell juice, together with the ingredients that make up food, does not crack the core membrane.	1,67
19	It is very important that products that are deteriorating, sensitive and require temperature control are handled thoroughly through the supply chain (the process is done in the shortest possible time with proper equipment) and that product quality and safety are not violated until the last customer arrives.	1,62
20	Dry ice, which is a very cold substance, instantly freezes the sensation in the cells when you take it to your hand, causing burning. It feels like burning with fire. To avoid this, it is recommended to wear thick gloves while working with dry ice. It is inedible because of the same reason.	4,28

Table 4.3. Students' Average Scores of Food Safety and Cold Chain Attitude Scale (Cold Chain Information)

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When the average score of the cold chain group is examined, a result which is close to the response of 10 and 20 questions strongly agree with me as a great majority has emerged. In the meanings of the answers to questions 16 and 19, it appears that the result is close to the response I do not strongly agree to as a majority.

Independent groups t-test was used to examine the effects of gender on students' food safety and cold chain attitudes. The number of female students in this study is 59 while the number of male students is 106. Test results are shown in Table 4.4.

No	1	2	3	4	5	6	7	8	9	10
Sig. (2-tailed)	0,036	0,124	0,107	0,540	0,649	0,241	0,445	0,187	0,018	0,606
No	11	12	13	14	15	16	17	18	19	20
Sig. (2-tailed)	0,482	0,396	0,172	0,019	0,067	0,474	0,923	0,778	0,748	0,043

Table 4.4. Effect of gender on statistical differences according to T test results

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There was a statistically significant difference between the scores given in cold chain of information group 1 and 2 according to the sex of the students ( $p < 0.05$ ). There were no statistically significant differences in the other tables of the group ( $p > 0.05$ ). It was found that there was a statistically significant difference in the graduation differences of the students ( $p < 0.05$ ). It was found that there was a statistically significant difference between the scores of 1, 7 and 20 according to the level of father education ( $p < 0.05$ ). There was no statistically significant difference in other expressions within the group ( $p > 0.05$ ). There was no statistically significant difference between father education, mother education level and family income level ( $p > 0.05$ ). There was no statistically difference between 7-20 questions of the students, 18-20 and 24 years old and over according to their age ( $p > 0.05$ ).



NO	The Food Safety and Cold Chain Attitudes Scale for Students	Average
11	The products are generally perishable products, PH changes during transportation and storage, maturation continues throughout the process, loss of moisture, oxidation, loss of nutritional value, effect of overdose, microbial deterioration, deterioration of temperature control in transport, cold chain breakdown, And the rapid onset of products are among the problems of food logistics.	3,25
15	Medium chill + 5 ° C bakery products and products such as butter, oil and cheese. Exotic temperature levels are products such as vegetables, fruits and eggs that can be exposed to temperatures from + 10 ° C to + 15 ° C.	3,08
18	Reefer containers can keep the internal temperature at -25 ° C even when the outside air temperature is + 35 ° C.	3,87

Table 4.5. Average Scores of Food Safety and Cold Chain Attitudes Scale (Food Conservation) of Students

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When the average score of the food-holding group was examined, it was found that the expressions 11 and 18 were generally undecided but only 18 expressions. No significant difference was found ( $p > 0.05$ ). There was no statistically significant difference between students' grades 15 and 18 ( $p > 0.05$ ) and statistically difference was found in item 11 ( $p < 0.05$ ). It was a statistically significant difference ( $p < 0.05$ ) between the scores of the pupils. There was no statistically significant difference in other expressions within the group ( $p > 0.05$ ). In addition, there was no statistically significant difference between the two groups ( $P > 0.05$ ). Significant differences were found between the primary and graduate students in interviews with parents of 11th grade students ( $p < 0.05$ ).

NO	The Food Safety and Cold Chain Attitudes Scale for Students	Average
3	Wearing gloves while touching clothes reduces the risk of infecting employees and individuals working.	3,1
6	ISO 22000: 2005 is a new standard designed to ensure safe food supply worldwide.	3,2
9	Good Hygiene Practice (GHP), which refers to Good Hygiene Practices, refers to hygienic requirements and includes practices such as hygienic design and construction of food production facilities, cleaning and disinfection methods, microbial quality of unprocessed foods in food processing, hygienic operation of each processing step, personnel hygiene system.	3,85
13	It is not healthy to freeze a melted frozen food. It is necessary to consume a moment of meltdown. This depends on the proper planning of the sales channels, as well as the special needs and equipment of the storage, storage, and riding. A minor omission or fault can cause all products to be discarded.	3,19

Table 4.6. Average Scores of Food Safety and Cold Chain Attitude Scale (Hygiene and Sanitation) of Students

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When the average scores of the hygiene and sanitation groups were examined, it was found that the 3, 6 and 13 expressions were generally unstable, but the 9 were the participants. According to the genders of the students, it was found that there was a statistically significant difference between the scores of 9 in the cold chain of the information group ( $p < 0.05$ ). There was no statistically significant difference in the scores of other expressions ( $p > 0.05$ ). It was determined that there was a statistical difference in all of the graduation differences of the students ( $p < 0.05$ ). There was no

195 statistically significant difference between the scores of the students in the group ( $p > 0.05$ ). There  
 196 was no statistically significant difference between the scores of the student in the group according  
 197 to father education, mother education level and family income levels ( $p > 0.05$ ). There was a  
 198 statistically significant difference between the scores according to the age differences of the  
 199 students who gave the 9th grade ( $p < 0.05$ ).  
 200

NO	The Food Safety and Cold Chain Attitudes Scale for Students	Average
8	Cross-contamination: harmful agents are transmitted indirectly through food.	3,55
10	There are chemical, biological and physical hazards in the form of risk in food. Biological hazards are the hazards that harmful bacteria, viruses, parasites and molds can create.	4,35
14	The difference of the cold chain from the traditional supply chain is first; The operational conditions in the cold chain are more detailed and secondly they are under the risk of degradation of the products subject to cold chain as far as production is consumed.	3,62
17	Temperature changes and non-hygienic conditions cause the generation of microorganisms.	3,7

Table 4.7. Students' Average Scores of Food Safety and Cold Chain Attitude Scale (Contagion Information)

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203 When the average score of the infectious disease group is examined, it has been generally agreed to  
 204 participate in all statements. It was determined that there was a statistically significant difference  
 205 between the scores given in the cold chain of the information group according to the genders of  
 206 the students ( $p < 0.05$ ). There was no statistically significant difference in scores of other  
 207 expressions ( $p > 0.05$ ). There was no statistically significant difference between the grades of the  
 208 10th grade students in graduation differences ( $p > 0.05$ ). There was a statistically significant  
 209 difference in other cases ( $p < 0.05$ ). There was no significant difference between parental education  
 210 level and parent education level and age differences ( $p > 0.05$ ). According to the monthly incomes  
 211 of the students, it was found that there was a statistically significant difference in the scores of the  
 212 8th grade students ( $p < 0.05$ ).  
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## 214 5. Discussion and Conclusion

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When studies in the literature are examined, no questionnaire study has been conducted to measure the attitudes of university students or another group to food safety and cold chain knowledge levels. Thus, the original study, the survey, led to the measurement of students studying in the field of logistics. Food safety is now of great importance. As has been known, in recent years it has become an increasingly important issue in terms of all countries, gaining in importance due to the public health and economic dimension. Nowadays, due to advances in the technology that is happening in the process of food processing, production, distribution and consumption, consumers are not sure about the safety of the food they consume in every part of the world; And more carefully examines the problems arising from food. Food logistics is no longer just for carrying or storing food products. Food safety "from field to table" or "farm-to-fork" principle, considering the understood the importance of food logistics. Therefore, the study of food logistics and cold chain students at the end of the level, it has been determined they do not have enough information about. To increase levels of the educational process and students' knowledge of curriculum or an elective course by experts in the field and placed in it is shown that increasing levels of information.

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