REVIJA ZA ELEMENTARNO IZOBRAŽEVANJE
JOURNAL OF ELEMENTARY EDUCATION
Vol. 17, No. 3, pp. 291–307, September 2024

APPROACHES TO EDUCATIONAL ACTIVITIES AND CONSTRUCTION OF AN INFORMATICS CURRICULUM

DARKO ETINGER[1], MARINA DIKOVIĆ[2] & HRVOJE ALILOVIĆ[1]

[1]Juraj Dobrila University of Pula, Faculty of Informatics
[2]Juraj Dobrila University of Pula, Faculty of Educational Sciences

Potrjeno/Accepted
8. 5. 2024

Objavljeno/Published
30. 9. 2024

CORRESPONDING AUTHOR/KORESPONDENČNI AVTOR
marina.dikovic@unipu.hr

Abstract/Izvleček

The research section of the paper explores elementary school students' satisfaction with informatics. This research was carried out using the *American Customer Satisfaction Index* (ACSI). Four subscales were used: Expectation, Satisfaction, Quality, and Values. The number of Croatian elementary school pupils investigated (from Brod-Posavina County) is 135 (N). Research results show that pupils have high expectations of informatics, including that it will progressively meet their expectations and help them to receive a quality education. It can also be concluded that the problems once faced by students, such as classroom and equipment quality, are becoming much smaller compared to previous years.

Keywords:
American Customer Satisfaction Index (ACSI), computer science curriculum, ICT, informatics, student satisfaction.

Pristopi k izobraževalnim dejavnostim in konstrukciji kurikuluma Informatike

Raziskovalni del prispevka analizira zadovoljstvo osnovnošolcev s predmetom informatika. Raziskava je bila izmerjena in predstavljena z uporabo ameriškega indeksa zadovoljstva strank (angl. *American Customer Satisfaction Index* – ACSI). Uporabljene so bile štiri podlestvice, in sicer *pričakovanje, zadovoljstvo, kakovost* in *vrednote*. Anketiranih je bilo 135 (N) hrvaških osnovnošolcev (iz Brodsko-posavske županije). Rezultati raziskav kažejo, da učenci od predmeta informatika veliko pričakujejo in da se njihova pričakovanja postopoma izpolnjujejo ter da so deležni kakovostne izobrazbe. Ugotoviti je mogoče tudi, da so težave, s katerimi so se učenci srečevali prej, kot sta kakovost učilnic in opreme, v primerjavi s prejšnjimi leti precej manjše.

Ključne besede:
American Customer Satisfaction Index (ACSI), učni načrt predmeta informatika, IKT, informatika, zadovoljstvo učencev.

UDK/UDC:
37.091.2:004

DOI https://doi.org/10.18690/rei.3207

University of Maribor Press

Introduction

Because information and communication technology (ICT) has changed the world and become a large part of everyday life, digital literacy is a necessity for every individual who wants to use all the benefits of these technologies (Bischof and Sabitzer, 2011; Bahromova, 2021). Even after knowing the basic terms, concepts, and practices, an individual not only has to be a user of technology but also a creator (Spirin, 2005). Furthermore, most 21st-century jobs require at least some knowledge of computers or computer systems. Therefore, Informatics as a school subject has become essential in elementary and secondary education (Dagienė, Hromkovič and Lacher, 2021).

In the Decision on Adoption of Informatics Curriculum for Elementary and High Schools in the Republic of Croatia (NN 22/2018), the section titled Informatics in the Educational System encompasses the following:

1. Acquisition and use of ICT (information and communication technologies) skills.
2. Problem-solving using a programming language to develop a computational way of thinking that involves understanding, analysing, and solving problems using strategy, algorithms, and programming solutions.
3. The use of abstractions, logical connections, analysis, algorithmic thinking and other problem-solving techniques and tools that are applicable not only in informatics, but also in many areas of everyday life.
4. Competences such as creativity and innovation, critical thinking, problem-solving, and decision-making are acquired through ICT, information and digital literacy, responsible and effective communication, and respect and appreciation in a digital environment.

In the same document, it is recommended to adopt the content from informatics teaching using the spiral model, where the knowledge acquired at lower levels of education is extended to higher ones, and the role of the subject is highlighted as very important in supporting other subjects and cross-curricular topics.

Furthermore, in the said Decision, four domains are indicated through which the goals of informatics teaching are realized:

1. e-Society
2. Digital Literacy and Communication
3. Computer Thinking and Programming
4. Information and Digital Technology.

In the Information and Digital Technology domain, content related to computer science and data management are studied, forming the basis of the information society, i.e., basic knowledge and concepts of computer science and understanding of digital display, storage, and transmission of data using computers or networks. In the Computer Thinking and Programming domain, students learn to develop logical and algorithmic thinking suitable for troubleshooting and other areas, including everyday life. The Digital Literacy and Communication domain, closely related to other domains, provides essential digital competencies necessary for high-quality technology application in everyday tasks and for acquiring competences from other domains. The last domain, e-Society, includes topics such as online security, data protection, electronic violence, caring for one's digital reputation, and responsibility and ethics in the digital environment. Understandably, these domains intertwine and complement each other and jointly form informatics classes intended to train students to become responsible, conscientious, creative individuals able to use information and communication technologies and, as such, be constructive members of the digital society. Considering that it is possible to adapt such activities and content to the needs and interests of diverse students, classes, and schools, e-learning is present in our everyday lives, and students must be able to use the tools that facilitate learning (Diković, Etinger and Golja, 2020). Some authors (Babić, Bjelanović, and Čičin-Šain, 2021) provide examples of how to use various methods to achieve learning outcomes according to the first-grade curriculum for elementary school. In addition to games, group and partner work is often used where creative, organizational, and communication skills are acquired in addition to digital skills. Greater student motivation can also be achieved by including children in the choice of content, the digital tools they will use, and topics covered, as well as by putting everything in a realistic context and allowing them to present their work. Nowadays, children use digital technologies and devices earlier and earlier, so they come to informatics classes with various levels of prior knowledge and experience. Teachers then have the task of assessing students' prior knowledge and upgrading it from a theoretical perspective, as well as devising sufficiently exciting and creative tasks that will enable students to reach their full potential and develop their skills. Some of the challenges are indeed creating an atmosphere of freedom and creativity by experimenting with different technologies and devices, creating equal foundations for students' initial knowledge so that they can all develop equally, and finally, of

course, teachers themselves must keep pace with new technologies to be able to transfer their knowledge.

The teacher is a collaborator, leader, and mentor of students in the process of achieving educational goals; s/he is responsible for motivating students, creating a positive and creative atmosphere; s/he is accountable for student safety, and for designing activities that will encourage attention, interest, respect, and empathy in students. Furthermore, partnership with students and mutual appreciation of ideas, concepts, and content are also essential. In addition, teachers must be self-critical and continuously re-evaluate their methods, the quality of work and communication, and, finally, their entire work (Fleer, 2017). The importance of teachers' role in teaching informatics is recognized by several authors (Kabátová, Kalaš and Tomcsányiová, 2016; Caspersen et al., 2019; Orehovački, Diković and Dautović, 2022), some of whom describe post-2020 new informatics education (Kanemune, Shirai and Tani, 2017).

Some studies indicate that the primary attention in Polish schools is paid to pedagogical approaches to teaching and learning informatics and its needs, focusing on preparing for living and lifelong learning in the information (knowledge-based) society (Syslo and Kwiatkowska, 2005). Informatics education is recognized (Kabátová, Kalaš and Tomcsányiová, 2016, pg. 125) in Slovakia, where it is "believed that it offers an important opportunity for developing informatics knowledge, computational thinking and problem-solving skills".

Research shows that one problem in elementary schools is organizing quality learning spaces for informatics. However, this problem has been intensively addressed in Croatia recently. Providing students with a networked computer classroom with sufficient high-quality computers and Internet access is essential.

In teaching informatics at schools, it is necessary to use modern/contemporary teaching resources, first, computers and various other digital devices and media. It is also essential for teachers to use modern teaching methods to present the content to the students as efficiently as possible. Teachers should apply a range of methods through which students acquire knowledge, skills, and values and shape their attitudes. However, for the process of upbringing and education to be more effective in advancing the educational achievements of students, educational systems should encourage and develop ways and methods of teaching and learning that would not only improve knowledge and skills but also innovate the monitoring and evaluation of their application in practice (Orehovački, Diković and Dautović, 2022).

Traditional teaching methods mainly focus on the teacher, while the student has a more passive role, the listener. Modern methods recognize this practice as flawed and shift the focus to the student. Cooperation between students and teachers and stimulating creativity and research are among the main characteristics of modern teaching methods. Some of these methods that can be used in informatics are project creation and presentation, debates, experimentation, games, problem-solving using digital and other tools, competitions, and the like. It is crucial to provide the student with an active position in which s/he solves a problem, i.e., seeks possible solutions, uses available tools, and, consequently, grows in responsibility, independence, creativity, intelligence, resourcefulness, and communication skills.

While not diminishing the value of traditional and working methods mainly well-known to teachers, we will introduce some new ones that can modernize the teaching process. These are exploratory learning, flipped classroom, collaborative learning, project teaching, and gamification (Mišurac, 2017).

Student research includes the students' search for interesting problems in informatics, for example, setting up a hypothesis, using multiple creative research methods, analysing results, and reaching a conclusion. The focus is on the student (Syslo and Kwiatkowska, 2005), who then develops their creativity, independent reasoning, and curiosity. The knowledge gained in this way is more long-lasting. The processed content is more understandable to the student, and the acquired knowledge is more straightforward to transfer to the everyday context and use in appropriate contexts. Including a "child-friendly approach to modern ICT", the teacher can achieve learning outcomes in the acquisition of informatics content (Sabitzer, Antonitsch and Pasterk, 2014).

As the name reveals, collaborative learning is learning in pairs, i.e., in a group, to study a topic or solve a problem. It is a process in which communication skills, creativity, empathy, and reasoning are developed. In learning a certain teaching content, students discover its meaning through joint work while the teacher guides them (Mišurac, 2017). Collaborative learning in informatics, and not only in informatics, is based on the theory of constructivism, whose basic thesis is that learning occurs only with the active engagement of students, which is realized through interaction with their environment (Blaho and Salanci, 2011). Problem-based collaborative learning groupware can improve pupils' computer programming skills (Chorfi et al., 2022).

In project classes, students independently investigate a problem in all its phases, from research and implementation to presenting conclusions. Multiple students usually participate in the projects, which is also a form of collaborative learning (Kong, Chiu, and Lai, 2018).

The use of games or elements of games in teaching, called gamification, is a great motivator that adds a fun and relaxed character to teaching. Digital games provide numerous opportunities for learning and practicing learning content in modern teaching. They are very close to the students, who get emotionally involved and experience higher levels of interest and concentration. In these games, students immediately receive feedback on their work, influencing them to voluntarily change, supplement their knowledge, and develop competences (Mišurac, 2017).

In the last few years, and especially in the era of the coronavirus pandemic, schools have started using a hybrid learning method in which, in addition to classroom teaching, technology is also used for communication and learning.

Whatever method and technique teachers decide to use, it is of utmost importance that they develop their distinctive teaching style. This will allow them to use their greatest strengths, resulting in better teaching quality and greater student satisfaction and success.

American Customer Satisfaction Index

The American Customer Satisfaction Index (ACSI), which started in 1994, was developed by the National Center for Quality Research at the University of Michigan in collaboration with the American Society for Quality and the CFI Group, Inc. The model was originally designed in 1989 for the Swedish economy (Swedish Customer Satisfaction Barometer – SCSB). The Swedish version and the ACSI were developed by Claes Fornell, Distinguished Professor Emeritus of Business Administration at the University of Michigan and President of the CFI Group (Fornell, 1996).

The ACSI measures customer satisfaction with the quality of products and services offered by different companies with a significant share in a given market. Such an indicator is helpful for business entities, researchers, and consumers. It is precisely for this reason that this index has been used in this research, as it enables the measurement of quality of satisfaction, although on a much smaller scale. The American Customer Satisfaction Index is a causal model with left-hand satisfaction indices such as customer expectations, perceived quality, and value. Satisfaction is in

the middle of the model, while customer complaints and loyalty are on the right, which includes customer retention and price tolerance.

This research uses four subscales: Expectation, Satisfaction, Quality, and Values. Each subscale is examined using five statements/questions answered on a 5-point Likert scale, where 1 represents disagreement, 2 partial disagreement, 3 neither agreement nor disagreement, 4 partial agreement, and 5 agreement.

In addition to the subscales, three identification questions were asked: school attended, class, and gender.

The Expectations subscale was examined with the following statements:

- Considering what you expected from Informatics, to what extent did you acquire the knowledge you hoped for?
- Considering your expectations before attending Informatics, to what extent are modern computer skills taught?
- What is the probability that you will enrol in the Informatics elective next year as well?
- Would you recommend Informatics to friends who have not yet chosen this elective subject?
- Considering what you learned in Informatics in the 5th and 6th grades, are you satisfied with the knowledge upgrade in your current grade? (Do you feel you are learning the same things? Are you improving your existing knowledge or learning something new?)

The Satisfaction subscale was examined with the following statements:

- How satisfied are you overall with the teaching of Informatics?
- How satisfied are you with the range of areas of Informatics covered in the Informatics class?
- How satisfied are you with the method of teaching Informatics? (group work, research work, creativity etc.)
- How satisfied are you with the Informatics textbook? (clarity, comprehensibility, etc.)
- How satisfied are you with the amount of time spent on particular areas of Informatics teaching? (Excel, Word, programming, Windows, etc.)

The Quality subscale was examined with the following statements:

- Are you satisfied with the quality of computers and IT equipment in your IT classroom?
- Are you satisfied with your IT classroom's program support (software)?

- Are you satisfied with the quality and speed of Internet access in your IT classroom?
- Are you satisfied with the space where Informatics takes place?
- Are you satisfied with the number of computers and seats in the IT classroom?

The Values subscale was tested with the following statements:

- Are you satisfied with the informatics knowledge you have acquired so far?
- Did the teaching of Informatics satisfy all your needs and desires for information technology knowledge?
- Are you satisfied with the quality of informatics knowledge you have learned so far?
- Are you satisfied with using your time by choosing Informatics as an elective?
- Do you think you could learn the material taught in Informatics classes so far on your own?

The Customer Satisfaction Index is calculated as average values of the survey questions that measure different aspects of satisfaction with a product or service, in this case, Informatics.

The next index is Customer Expectations. It measures clients' expectations of the quality of a specific product or service, in this case, student expectations about the quality of Informatics based on previous experience.

The next index is Perceived Quality, where client assessments are derived from recent experience using the services or products of a company, i.e., in this case, the quality of teaching aids and the space where Informatics takes place.

After that, the Perceived Value Index is measured, where the current quality is measured in relation to the price paid. In this study, the expected value is based on the effort and time invested in relation to the quality of what was learned.

Method

Aim

This study aims to identify and understand the factors influencing elementary school students' satisfaction with Informatics.

Research problems

The research problems are as follows:

1. to examine the relation between satisfaction with Informatics teaching and measured variables of expectations, quality, and value from the American National Satisfaction Index model;
2. to check whether there is a gender difference in their satisfaction with Informatics teaching;
3. to investigate the connection between some variables and satisfaction with the teaching of Informatics.

Sample

The research involved 135 elementary school students (N=135), 65 of whom were female (48%). Of the total number of participants, 55 were 7th-grade students, and 80 were 8th-grade students. The pupils came from three elementary schools in Brod-Posavina County.

Instrument

The American National Customer Satisfaction Index was used to measure satisfaction with Informatics teaching. The questionnaire consists of twenty-two items comprising four subscales: Expectations, Satisfaction, Quality, and Values.
In this study, four subscales were used; Expectation, Satisfaction, Quality, and Values. Each subscale was examined with the help of five statements/questions that were answered on a 5-point Likert scale, where 1 represented disagreement, 2 partially disagree, 3 neither agree nor disagree, 4 partially agree and 5 agree.
In addition to the subscales, three identification questions were asked: school attended, class, and gender.

Procedure

School principals approved the conduct of the research, and written parental consent forms were collected. The research was conducted in March 2022 using the paper-pencil method. The students were given concise instructions on how to fill out the questionnaire. It was explained that the research was completely anonymous and voluntary and that the results would be analysed on the group rather than the individual level. Filling out the questionnaire took an average of 10 minutes. At the end of the research, the participants were told to contact the research manager if they were interested in the research results.

Results and Discussion

The Relationship Between Satisfaction with Informatics Teaching and Measured Variables of Expectations, Quality, and Value

Since ACSI (all four construct dimensions) is based on a Likert-type scale, which produces ordinal data, it was necessary to verify the normality of the distributions of the constructs to ascertain which kind of procedures, parametric or nonparametric, would be used. A Kolmogorov-Smirnov (K-S) test was conducted to assess if the distribution of the pupils' answers on the four constructs was normally distributed. The null hypothesis was that the distribution of the answers was normal. For all four constructs, the null hypothesis of normality was rejected (the complete ACSI is normally distributed): Expectation, $D(135) = .159$, $p = .002$; Satisfaction, $D(135) = .126$, $p = .028$; Quality, $D(135) = .136$, $p = .013$; Value, $D(135) = .151$, $p = .004$; Complete ACSI (normally distributed), $D(135) = .111$, $p = .074$. For this reason, nonparametric tests were used to compare the scores on the construct scales by gender and by school grade. Descriptive statistics are shown in Table 1.

Table 1: Descriptive statistics and reliability coefficients for the variables on the American National Satisfaction Index its subscales Expectations, Satisfaction, Quality and Value (N=135)

	Mean	Median	SD	Variance	Cronbach's α
Expectation	4.02	4.20	0.870	0.757	0.82
Satisfaction	3.97	4.20	0.757	0.573	0.71
Quality	3.89	4.00	0.809	0.655	0.81
Values	3.69	4.00	0.854	0.729	0.77
ACSI	3.89	4.00	0.687	0.471	0.91

Concerning the first research question, examining the connection between satisfaction with informatics teaching and the measured construct variables of expectations, quality, and value, we can conclude that the correlations (Pearsons' are high between the measured construct variables with the satisfaction index (see Table 2). This may mean that students expect, but also receive, quality Informatics education and are satisfied with the high quality of Informatics teaching. It can also be concluded that the quality of classrooms and equipment is increasing.

Table 2: Correlation matrix (N=135) (the variables Grade and Gender were used in the linear regression analysis)

	Grade	Gender	Expectation	Satisfaction	Quality	Values	ACSI
Grade	—						
Gender	-0.135	—					
Expectation	0.064	0.141	—				
Satisfaction	0.015	0.098	0.720***	—			
Quality	-0.008	0.053	0.432***	0.430***	—		
Values	0.053	0.247**	0.773***	0.779***	0.426***	—	
ACSI	0.038	0.164	0.883***	0.872***	0.683***	0.896***	—

Note. * p < .05, ** p < .01, *** p < .001

This result corresponds to research showing that ICT, robotics, and programming activities are the most attractive for elementary school pupils (Purković, Delač, and Kovačević, 2022).

Satisfaction with Informatics Teaching

Differences in the results of the Satisfaction Index and the ACSI subscales Expectations, Satisfaction, Quality and Value were tested with regard to gender and class grade with the Brunner-Munzel nonparametric test (Karch, 2023).

Table 3: Brunner-Munzel test of the results of the Satisfaction Index and its subscales by gender

Brunner-Munzel Test

		Statistic	df	p
Expectation	Asymptotic	2.370	132	0.019
Satisfaction	Asymptotic	1.406	132	0.162
Quality	Asymptotic	0.738	133	0.462
Values	Asymptotic	2.701	125	0.008
ACSI	Asymptotic	2.119	133	0.036

Note. H_a P(Female < Male) + ½P(Female = Male) ≠ ½

There are significant differences in the Expectations, Values, and the complete ACSI between males and females (see also Table 4).

Table 4. Descriptives

						Skewness		Kurtosis	
	Gender	Mean	Median	Mode	SD	Skewness	SE	Kurtosis	SE
Expectation	Female	3.89	4.00	3.80	0.819	-0.890	0.297	0.548	0.586
	Male	4.14	4.40	5.00	0.904	-1.562	0.287	2.214	0.566
Satisfaction	Female	3.89	4.00	4.20	0.730	-0.799	0.297	0.790	0.586
	Male	4.04	4.20	4.60	0.780	-1.002	0.287	0.985	0.566
Quality	Female	3.85	4.00	4.60	0.799	-0.702	0.297	-0.119	0.586
	Male	3.93	4.00	4.40	0.822	-0.859	0.287	0.417	0.566
Values	Female	3.48	3.60	4.40	0.964	-0.796	0.297	0.182	0.586
	Male	3.90	4.10	4.20[a]	0.685	-0.938	0.287	0.247	0.566
ACSI	Female	3.78	4.00	4.00	0.694	-0.632	0.297	-0.193	0.586
	Male	4.00	4.15	4.55	0.666	-1.121	0.287	1.196	0.566

[a] More than one mode exists only the first is reported

The Brunner-Munzel test of differences by school grade revealed no differences between the 7th and 8th grade pupils (see Table 5).

Table 5: Brunner-Munzel Test of differences in Constructs by School Grade.

Brunner-Munzel Test				
		Statistic	df	p
Expectation	Asymptotic	0.559	97.3	0.577
Satisfaction	Asymptotic	0.630	114.8	0.530
Quality	Asymptotic	-0.113	127.3	0.910
Values	Asymptotic	0.676	111.8	0.501
ACSI	Asymptotic	0.300	103.1	0.765

Note. H_a $P(7 < 8) + \frac{1}{2}P(7 = 8) \neq \frac{1}{2}$

BECTA's study (2008) confirms the results of this study, stating that boys attending elementary school see somewhat more value and motivation in Informatics than girls do. One reason is that girls feel less confident using technology and see IT as a tool to explore their interests further and gain knowledge more efficiently, while boys are interested in IT for its own sake. Also, there is evidence that girls in higher grades are becoming less interested in Informatics. There is also the problem of stereotypes because the media and society in general have created an image that information technologies are the domain of boys, i.e., men.

A more recent study (Qazi et al., 2022) that analysed 42 studies on gender differences in the use of information technology in education found that many factors influence satisfaction with and use of technology in teaching girls, including geographical influences, social differences, prejudices, and teaching quality.

The Relationship Between Some Variables and Satisfaction with Informatics

We wanted to examine the third research problem: Investigate the assumption that the questionnaire variables of gender, class, expectations, quality, and values increase satisfaction with informatics teaching. To verify whether gender and class and the construct variables mentioned above predict overall satisfaction with teaching (Satisfaction subscale), a hierarchical regression analysis was conducted, with the Satisfaction subscale included as a criterion. Before carrying out the hierarchical regression analysis, correlations between criteria and predictors were checked. Hierarchical regression analysis was performed in four steps. In the first step, the gender and class variables were introduced. The expectation variable was included in the second step of the regression analysis. The third step of the hierarchical regression analysis included the construct Quality, and the fourth step was the construct Values.

The gender and class variables included in the first step of the regression analysis explain a nonsignificant 1.04% of the variance in satisfaction with informatics teaching (R^2=0.0104, p=.0502). In the second step, the item "Considering what you expected from the Informatics class, to what extent did you acquire the knowledge you hoped for?" was included, and an additional 32.1% of the variance in satisfaction with the Informatics class was explained ($\Delta R2$=.312, p< 0.01). At the same time, it was shown that this item was a significant positive predictor of satisfaction with the teaching of Informatics; that is, the higher the self-assessment of the acquired knowledge, the greater the satisfaction with the learning.

Table 6: Results of hierarchical regression analysis with subscale Satisfaction as a criterion

Predictor	β	t	R	R^2	ΔR^2	F change
I Block						
Gender	.088	1.018				
Class	.035	.404	.90	.008	.008	.557
II Block						
Gender	.047	.649				
Class	.065	.900				
Extent of acquired knowledge	.562	7.850**	.566	.321	.312	61.625**
III Block						
Gender	.041	.585				
Class	.064	.916				
Extent of acquired knowledge	.527	7.414**				
Satisfaction with speed and Internet in the IT classroom	.193	2.727**	.597	.357	.036	7.437**

** p < 0.01

In the third step, satisfaction with the quality and speed of Internet access was included, and an additional 3.6% of the variance in satisfaction with teaching was explained ($\Delta R2=.036$, $p<0.01$). The change in the explained variance was statistically significant, even though the relative contribution of satisfaction with the quality and speed of Internet access was low. The overall model explained 35.7% of the total variance in satisfaction with computer science teaching. At the same time, the items "Considering what you expected from the Informatics class, to what extent did you acquire the knowledge you hoped for?" and "Are you satisfied with the quality and speed of Internet access in your Informatics classroom?" proved to be significant positive predictors of satisfaction with Informatics teaching.

To check the model's multicollinearity, the coefficients of the variance increase factor (VIF), whose values range from 1.009 to 1.043, and tolerance, whose values range from .959 to .991, were calculated. According to the results, no multicollinearity was found among the measured variables. It is recommended that VIF values be less than 10. The value of the Durbin-Watson test in this model is 1.427, indicating that the residuals are independent.

Conclusion

The quality of informatics teaching results from the competence of teachers, particular technical prerequisites, student motivation, and the implementation of curriculum co-construction in educational institutions. Quality cooperation between teachers, students, and institutions requires a free and creative atmosphere where all suggestions and problems are heard, and solutions are found through joint work. The goal is the quality of education and teaching, which can be achieved through a better understanding of children and their needs, monitoring technological achievements, and teaching the necessary knowledge in this subject.

Thus, informatics is a necessary area of education that continues to develop in the right direction in Croatia. With effective teamwork among students, teachers, professional associates, and institutions, it has the potential to develop into the modern, advanced subject it could be.

The above research concludes that students expect a great deal from informatics, that their expectations are increasingly being met, and that they receive quality education. It can also be concluded that past difficulties, such as the quality of classrooms and equipment, are now less of a problem.

Emphasizing that students become the creators of educational work is necessary because they are at the center of the educational system. This approach builds understanding, develops competences, and helps students see themselves as creative and active participants.

Limitations of this research concern the geographical area from which the originate; moreover, only elementary school pupils were included, and their number was low, so future studies could be more extensive, making the conclusions more authoritative in the context of the ACSI.

References

Babić, S., Bjelanović, D., and Čičin-Šain, M. (2021). Programming and Mathematics through Game. In K. Skala (ed.), *2021 44th International Convention on Information, Communication and Electronic Technology (MIPRO)* (pp. 870–874). Rijeka: Croatian Society for Information, Communication and Electronic Technology – MIPRO. DOI: 10.23919/MIPRO52101.2021.9597117

Bahromova, M. M. (2021). The importance and necessity of teaching computer science and programming for primary school students. *Asian Journal of Multidimensional Research*, *10*(9), 162–166. https://doi.org/10.37547/pedagogics-crjp-02-09-40

BECTA (2008). *How do boys and girls differ in their use of ICT?* Available on: https://dera.ioe.ac.uk/8318/1/gender_ict_briefing.pdf (Retriewed: November 22, 2022).

Bischof, E., and Sabitzer, B. (2011). Computer science in primary schools – not possible, but necessary?!. In I. Kalaš, and R. T. Mittermeir (eds.), *International Conference on Informatics in Schools: Situation, Evolution, and Perspectives* (pp. 94–105). Berlin, Heidelberg: Springer-Verlag. https://doi.org/10.1007/978-3-642-24722-4_9

Blaho, A., Salanci, L. (2011). Informatics in primary school: principles and experience. In I. Kalaš, and R. T. Mittermeir (eds.), *International Conference on Informatics in Schools: Situation, Evolution, and Perspectives* (pp. 129–142). Berlin, Heidelberg: Springer-Verlag. https://doi.org/10.1007/978-3-642-24722-4_12

Dagienė, V., Hromkovič, J., and Lacher, R. (2021). Designing informatics curriculum for K-12 education: From Concepts to Implementations. *Informatics in Education*, *20*(3), 333–360.

Diković, M., Etinger, D., and Golja, D. (2020). E-learning as a tool for competencies development: University students' point of view. In L. Gómez Chova, A. López Martínez, and I. Candel Torres (eds.) *INTED2020 Proceedings, 14th International Technology, Education and Development Conference* (pp. 1389–1398). Valencia: INTED. DOI:10.21125/inted.2020.0462

Caspersen, M. E., Gal-Ezer, J., McGettrick, A., and Nardelli, E. (2019). Informatics as a fundamental discipline for the 21st century. *Communications of the ACM*, *62*(4), 58–63. https://doi.org/10.1145/3310330

Chorfi, A., Hedjazi, D., Aouag, S., and Boubiche, D. (2022). Problem-based collaborative learning groupware to improve computer programming skills. *Behaviour & Information Technology*, *41*(1), 139–158.

Fleer, M. (2017). Digital pedagogy: How teachers support digital play in the early years. In L. Arnott (ed.), *Digital technologies and learning in the early years* (pp. 114–126). Newbury Park, California: SAGE Publications. DOI:10.4135/9781526414502.n10

Fornell, C., Johnson, M. D., Anderson, E. W., Cha, J., and Bryant, B. E. (1996). The American customer satisfaction index: nature, purpose, and findings. *Journal of Marketing*, *60*(4), 7–18.

Kabátová, M., Kalaš, I., and Tomcsányiová, M. (2016). Programming in Slovak primary schools. *Olympiads in Informatics*, *10*(1), 125–159.

Kanemune, S., Shirai, S., and Tani, S. (2017). Informatics and programming education at primary and secondary schools in Japan. *Olympiads in Informatics*, *11*(1), 143–150.

Karch, J. D. (2023). Bmtest: A Jamovi Module for Brunner–Munzel's Test—A Robust Alternative to Wilcoxon–Mann–Whitney's Test. *Psych*, *5*(2), 386–395.

Kong, S. C., Chiu, M. M., and Lai, M. (2018). A study of primary school students' interest, collaboration attitude, and programming empowerment in computational thinking education. *Computers & Education*, *127*, 178–189.

Mišurac, I. (2017). *Primjena scenarija poučavanja, digitalnih alata i obrazovnih trendova* [Application of teaching scenarios, digital tools and educational trends]. Zagreb: Hrvatska akademska i istraživačka mreža – CARNet. Available on: https://www. eskole. hr/wp-content/uploads/2016/12/Prir–ucnik_Scenarij-poucavanja.pdf (Retriewed: May 03, 2023).

Odluka o donošenju kurikuluma za nastavni predmet informatika za osnovne škole i gimnazije u Republici Hrvatskoj. [Decision on Adoption of Informatics Curriculum for Elementary and High Schools in the Republic of Croatia] (NN 22/2018). Zagreb: Narodne novine. Available on: https://narodne-novine.nn.hr/clanci/sluzbeni/2018_03_22_436.html. (Retriewed: May 05, 2023).

Orehovački, T., Diković, M., and Dautović, I. (2022). Perceived digital competence of primary and secondary school teachers – a pilot study. In S. Karolj (ed.) *Proceedings of the 45th International Convention on Information and Communication Technology, Electronics and Microelectronics*. Rijeka: Croatian Society for Information, Communication and Electronic Technology – MIPRO (pp. 621–626).

Purković, D., Delač, D., and Kovačević, S. (2022). Interests of Croatian primary school pupils about elective Technology Teaching and school activities. *Metodički ogledi: časopis za filozofiju odgoja*, *29*(1), 167–189.

Qazi, A., Hasan, N., Abayomi-Alli, O., Hardaker, G., Scherer, R., Sarker, Y., Kumar Paul, S., and Zubairu Maitama, J. (2022). Gender differences in information and communication technology use & skills: a systematic review and meta-analysis. *Education and Information Technologies*, *27*, 4225–4258.

Sabitzer, B., Antonitsch, P. K., and Pasterk, S. (2014). Informatics concepts for primary education: preparing children for computational thinking. In C. Schulte, M. E. Caspersen, J. Gal-Ezer (eds.), *Proceedings of the 9th Workshop in Primary and Secondary Computing Education* (pp. 108–111). New York: Association for Computing Machinery. https://doi.org/10.1145/2670–757.2670778

Spirin, O. (2005). The present-day tendencies of teaching informatics in Ukraine. In R. T. Mittermeir (ed.), *International Conference on Informatics in Secondary Schools – Evolution and Perspectives* (pp. 75–83). Berlin, Heidelberg: Springer-Verlag.

Syslo, M. M., and Kwiatkowska, A. B. (2005). Informatics versus information technology – how much informatics is needed to use information technology – a school perspective. In R. T. Mittermeir (ed.), *International Conference on Informatics in Secondary Schools – Evolution and Perspectives* (pp. 178–188). Berlin, Heidelberg: Springer-Verlag.

Authors:

Darko Etinger, PhD
Associate Professor, Juraj Dobrila University of Pula, Faculty of Informatics, Petra Preradovića 1, 52100 Pula, Croatia, e-mail: darko.etinger@unipu.hr
Izredni profesor, Univerza Juraj Dobrila Pula, Fakulteta za informatiko, Petra Preradovića 1, 52100 Pula, Hrvaška, e-pošta: darko.etinger@unipu.hr

Marina Diković, PhD
Associate Professor, Juraj Dobrila University of Pula, Faculty of Educational Sciences, I. M. Ronjgova 1, 52100 Pula, Croatia, e-mail: marina.dikovic@unipu.hr
Izredna profesorica, Univerza Juraj Dobrila Pula, Fakulteta za pedagoške vede, I. M. Ronjgova 1, 52100 Pula, Hrvaška, e-pošta: marina.dikovic@unipu.hr

Hrvoje Alilović
Master's degree in informatics education, Juraj Dobrila University of Pula, Faculty of Informatics, Petra Preradovića 1, 52100 Pula, Croatia, e-mail: hrvoje.alilovic@unipu.hr
Magistar informatike, Univerza Juraj Dobrila Pula, Fakulteta za informatiko, Petra Preradovića 1, 52100 Pula, Hrvaška, e-pošta: hrvoje.alilovic@unipu.hr