Revista Românească pentru Educație Multidimensională
ISSN: 2066-7329 | e-ISSN: 2067-9270
Covered in: Web of Science (WOS); EBSCO; ERIH+; Google Scholar; Index Copernicus; Ideas RePeC; Econpapers; Socionet; CEEOL; Ulrich ProQuest; Cabell, Journalseek; Scipio; Philpapers; SHERPA/RoMEO repositories; KVK; WorldCat; CrossRef; CrossCheck

2024, Volume 16, Issue 3, pages: 15-31 | https://doi.org/10.18662/rrem/16.3/880
Submitted: April 9th, 2024 | *Accepted for publication:* June 5th, 2024

Student Teachers' Perception of Science Teaching in Croatia

Alma ŠKUGOR [1]
Alena LETINA [2]
Suzana TOMAŠ [3]

[1] Faculty of Education, University of Osijek, Croatia, askugor@foozos.hr
[2] Faculty of Teacher Education, University of Zagreb, Croatia, alena.letina@ufzg.hr
[3] Faculty of Humanities and Social Sciences in Split, Croatia, suzana@ffst.hr

Abstract: *In the Republic of Croatia, all education-related documents, reforms, and changes at all levels of education rest on a constructivist approach to learning and teaching. The initial teacher education system should take responsibility for introducing new methodological scenarios, didactic design of spaces, and equipment that are compatible with contemporary learning theories and support multiple learning styles. This paper aimed to identify and compare the perceptions of teacher education students in the Republic of Croatia regarding the teaching of Science. Students' perceptions in the academic year 2022/23 were compared to the academic year 2011/12 when the research was first conducted. This paper included teacher education students in their 2nd (N=366) and 5th year (N=386) of study from three Croatian universities. Students' perception of teaching was assessed through drawings, the analysis of which indicates the students' self-perception as teachers during the teaching of Science and reveals their preconceptions about teaching and learning. The results show that 2nd-year students are more likely to perceive themselves in teacher-centered environment. Furthermore, 2022/23 generation students are more likely to perceive themselves in teacher-centered environment when compared to students 11 years ago. For 5th-year students, there is no statistically significant difference in the perception of teaching between the 2011/12 generation and the 2022/23 generation. However, when the results are categorized on the continuum of teaching theory, it is evident that 24% more of them perceive themselves to be in teacher-centered classes in 2022/23 and 20% less in student-centered environment as opposed to 11 years ago. Therefore, it is recommended to modernize higher education teaching with new didactic solutions, strategies, and technologies that will help students change their perceptions of teaching and learning, and subsequently implement it once they start working.*

Keywords: *student-centered teaching; teacher-centered teaching; teacher education students; DASTT-C.*

How to cite: Škugor, A., Letina, A., & Tomaš, S. (2024). Student teachers' perception of science teaching in Croatia. *Revista Românească pentru Educație Multidimensională, 16*(3), 15-31. https://doi.org/10.18662/rrem/16.3/880

©2024 Published by LUMEN Publishing. This is an open access article under the CC BY-NC-ND license http://creativecommons.org/licenses/by-nc-nd/4.0/

Introduction

Over the last twenty years, Croatia has tried to achieve European educational standards at all levels – from early childhood and preschool to higher education. This is reflected in reform attempts and the adoption of several education-related documents, such as state pedagogical standards for all levels of education, national curricula for all levels of education, subject curricula, the introduction of the state graduation exam for high school students, the Bologna Process for students, the designing of the Croatian Qualifications Framework, the implementation of comprehensive curriculum reform and currently a new experimental project (2023–2027) "Primary School as a Whole-day School – A Balanced, Fair, Efficient, and Sustainable Education System". All of these changes have redefined the role of the modern teacher. The teachers are expected to be skilled in native and foreign languages, computer science, mathematics, and science as well as civic competence and entrepreneurship. In addition, there should be a shift in the teaching paradigm from teacher-centered teaching to student-centered teaching, where the teacher is the organizer of activities, collaborator, and mentor, while the student is an active participant in the teaching process (Felder and Brent, 1996; Barr and Tag, 1995; Landrum, 1999); Paris and Combs, 2000 according to Mundhenk, 2004; Matijević, 2010). Barber & Mourshed (2007) emphasize that there are no reforms or educational strategies that bypass the role of teachers in education because the quality of the teaching staff is one of the main factors that influence the outcomes of the education process and students' learning outcomes. Changes can be achieved through the initial system of teacher education. Therefore, teacher education programs should be responsible for innovating and implementing programs with balance of professional and academic content. Given that all teacher education programs in the Republic of Croatia last five years, during which students acquire 300 ECTS, there is time and space to improve the quality of education by involving students in scientific research and by introducing new technologies in teacher education. Emphasis is also placed on introducing methodological scenarios and the didactic design of space and equipment that correspond to learning theories and support multiple learning styles. Fosnot (2005) and Markic & Eilks (2008) consider reflection to be extremely important for the education of future teachers and novice teachers because, from a meta-position, they can reflect on different learning strategies and learning process and correct what they have learned if necessary. It requires knowledge and development not only for the students but also for those who educate students and future teachers. Valenčič Zuljan

(2008) states it is necessary to introduce reflection as the driving force of teachers' professional development instead of lectures and seminars, which merely provide information, while Šagud (2006) sees the modern teacher as a reflective practitioner who questions and explores solutions and possible actions as answers to practical problems and is characterized by "reflective openness". Nespor (1987) finds that experiences, mental models, and beliefs acquired during teacher education strongly predict teacher behavior in the classroom. It is confirmed by the research findings of Thomas et al. (2001), Kleickmann et al. (2010), and Jones & Leagon (2014). Kalyon (2020) finds a correlation between teachers' teaching style and students' perceptions of teaching, and Imaduddin et al. (2019) find a correlation between the teaching paradigm in which students were taught and their current perception of teaching. Hulings (2022) also finds this in his research, where novice teachers use experience gained during education as a stepping stone for teaching science. Bakir (2016) also mentions the influence of faculty members' teaching on the formation of their teaching style in addition to experiences from their school days. Older studies (Pajares, 1992; Kagan, 1992) infer that future teachers' beliefs are difficult to change, while more recent studies find the opposite. For example, studies by Yilmaz et al. (2007), Bursal (2010), Bautista (2011), Markic & Eilks (2012), and Azam & Menon (2021) find that students' belief system about teaching is changeable and that students change their perception and beliefs about teaching, especially while attending methodological courses. Methodology courses provide students with different experiences that change their beliefs about teaching, such as hands-on work, inquiry-based teaching, designing methodological scenarios, using technology, watching and analyzing videos of exemplary lessons, different discussions, and types of documenting (Bautista, 2011; Buldur, 2017). Liaw (2009) and Tatar et al. (2012) state that students' perception of the experiences they have during internships in schools change, i.e., their beliefs about learning and teaching change from an explicit, lecturing style of teaching to a constructivist one. Minogue (2010) and Go & Kang (2015) found changes in future teachers' perceptions of teaching after taking a course based on a constructivist approach to learning and teaching. The authors conclude that future teachers should be allowed to reconstruct their mental models and beliefs about teaching. Ucar (2012) finds that initial and continuing teacher education and professional development based on constructivism leads to changes in beliefs and views about teaching in the sense that teachers are perceived in student-centered teaching. Research by Tatar et al. (2012), Lay & Khoo (2013), and Imaduddin et al. (2019) find that

there is no difference in the perception of teaching regarding the gender of students, interns, and teachers.

Students' perceptions of teaching can be examined using different methods. This research examined students' drawings, the analysis of which indicates students' perception of teaching, their view of themselves as teachers teaching Science, and reveals their preconceptions about teaching and learning.

Methodology

This research aimed to identify and compare the perceptions of teacher education students in the Republic of Croatia regarding the teaching of Science in the academic year 2022/23 compared to the academic year 2011/12, when the research was conducted for the first time. The study involved 2nd-year (N=366) and 5th-year (N=386) teacher education students from three Croatian universities – Zagreb, Osijek and Split (Table 1). The research problems aim to identify and investigate the difference in the perception of teaching of 2nd-year teacher education students in 2011/12 and 2022/23 and 5th-year teacher education students in 2011/12 and 2022/23. The following hypotheses arise from the research question:

H1 There is no statistically significant difference in the perception of teaching of 2nd-year students in 2011/12 compared to students in 2022/23.

H2 There is no statistically significant difference in the perception of teaching of 5th-year students in 2011/12 compared to students in 2022/23.

Regarding the aim and hypotheses of the research, the study included a deliberate sample of 2nd- and 5th-year teacher education students (N=752) at teacher training colleges in the Republic of Croatia. Second-year students who participated in the study had acquired basic pedagogical-psychological-didactic methodological knowledge in their first two years of studying but had not developed any methodological competencies yet. According to the study programs of all teacher training colleges, courses in methodology are not offered before the third year of study, including the course Methodology of Science. The research participants were also 5th-year students. They are in their final year of studies and will be competitive in the job market next school year. The research was conducted in the academic year 2011/12 and in 2022/23. The students gave their consent to participate in the research and they could withdraw at any time. Table 1 shows the structure of the sample of students according to the independent variables of year of study and academic year. Regarding the academic year, 2nd-year students (N=366, accounting for 48.7%) and 5th-year students (N=386, accounting for 51.3%) are equally represented, i.e., the sample is

homogenous. Considering the majority of female students in the teacher training programs, the sample is not gender-balanced, so the results were not statistically analyzed in terms of gender. This type of research can undoubtedly contribute to a more efficient approach to the organization, implementation, and reflection of higher education teaching in teacher education and other education programs in the Republic of Croatia.

Table 1. Structure of the sample in terms of academic year and year of study

Year of study	Academic year		Total (N)
	2011/12	2022/23	
2nd year	240	126	366
5th year	224	162	386
Total (N)	**464**	**288**	**752**

The Draw-A-Science-Teacher-Test-Checklist (DASTT-C) questionnaire by Thomas, Pedersen & Finson (2001) was used for this study. The purpose of the DASTT-C questionnaire is to provide future teachers with the opportunity for self-reflection by a) drawing a picture of themselves as teachers teaching Science, b) placing themselves on the continuum of teaching theory which examines students' perception of teaching Science. The instrument consists of two parts: in the first part, there is a blank squared space in which students draw themselves as teachers of Science and Society and fill in the basic sociodemographic data. Below the square provided for the drawing are several blank lines in which students briefly describe what the teacher is doing in the drawing and what the students are doing. This short description has been added to facilitate the interpretation of the individual components and aspects of the drawing, as it makes the drawing even clearer for the assessor. The instructions for participants to complete the questionnaire were simple and stated, "Draw yourself as a teacher of Science and write a brief description of the drawing". Participants were given 15 minutes and it was emphasized that their drawing skills were not assessed. In analyzing the DASTT-C questionnaire, a quantitative frequency analysis of the content of the drawings of 2nd- and 5th-year students (N=752) was used as the source of analysis. The units of the drawing analysis are the indicators marked on the DASTT-C Checklist for Assessors. The checklist consists of three parts: Teacher, Students, and Environment. The first part, Teacher, has five indicators (*Demonstrating Experiment/Activity, Lecturing/Giving Directions* (*teacher talking*); *Using Visual Aids* (*chalkboard*, *overhead*, *and charts*); *Centrally located* (*head of class*). The second part, Students, has three indicators (*Watching and Listening* (*or so suggested by*

teacher behavior; *Responding to Teacher/Text Questions*; *Seated* (*or so suggested by classroom furniture*). The third part, Environment, has five indicators (*Desks are arranged in rows* (*more than one row*); *Teacher desk/table is located at the front of the room*; *Laboratory organization* (*equipment on teacher desk or table*); *Symbols of Teaching* (*ABC's*, *chalkboard*, *bulletin bord,* etc.); *Symbols of Science Knowledge* (*science equipment, lab instruments, wall charts, etc.*).

In this study, three independent reviewers scored the drawings by assessing the presence (1) or absence (0) of the indicator in the drawing for each of the 13 indicators. The Cohen-Kappa coefficient was a measure of inter-rater agreement. Since there were only two possible answers, the third reviewer resolved any of the existing disagreements between the two reviewers. Thomas et al. determined the reliability of the DASTT-C questionnaire in 2001, with a Cronbach's alpha coefficient of 0.82; Finson et al. (2006) determined a reliability of 0.94 to 0.98 in 2006, while in Škugor's study (2013), the reliability was 0.76. Empirical research data were collected quantitatively using the statistical program SPSS 20.0 for Windows. Univariate analysis methods were used in data processing to determine the descriptive characteristics. The following descriptive parameters were determined: arithmetic mean, standard deviation, minimum and maximum values, curvature, flatness, and data distribution, expressed as frequencies and percentages. The normality of the distribution was tested using the Kolmogorov-Smirnov test, and the t-test was used to compare the participants according to their educational characteristics.

Results and discussion

Before data processing, Kappa coefficients were calculated for all 13 indicators, which ranged from .91 to 1.00, indicating almost perfect agreement between reviewers. In the end, the indicators present in each drawing were added up for each part (Teacher, Students, and Environment) and in total for the entire drawing. The scores ranged from 0 to 13 points. The results are grouped into three levels on a continuum. Scores in the 0 – 4 range represent a teacher whose teaching style is constructivist, inquiry-based, and student-oriented; scores in the 5 – 6 range represent a teacher whose teaching style is conceptual but not sufficiently constructivist; while scores in the 7 – 13 range represent a teacher whose teaching style is explicit, traditional, lecture-like, and teacher-centered. Although some authors divide the categories on the continuum differently, this study retains the range by category as provided by the authors of the instrument (Thomas et al., 2001). The same range was used in research by Louca et al. (2002), Markic et al. (2008), Škugor (2013), Schumacher & Wilde (2021), Azam & Menon (2021).

The first step in conducting the statistical analysis of the results of the DASTT-C questionnaire was the frequency analysis of the perception of the teaching of Science among 2nd-year students in 2011/12 (N=240) and 2022/23 (N=162). The frequencies of the individual score categories (from 0 to 13), expressed as percentages by academic year, are shown in Table 2. The analysis showed that the total score on the DASTT-C checklist ranged from 2 to 13 points. The most frequent score of students in the 2nd year 2011/12 was 9 points (Mo=9, f_{max} =38) for 15.9%, while the arithmetic mean was 8.31 (SD=2.76), which belongs to the category of teacher-centered teaching. In the academic year 2022/23, the range of frequency of scores was from 3 to 13, and the most frequent score was 11 (Mo=11, f_{max} =32) for 25.6% of students, while the arithmetic mean was 10.15 (SD=1.69). In Figure 1, the curve for the students of the 2022/23 generation is shifted more to the right, which means that the students of the 2nd year of the 2022/23 generation still perceive themselves slightly more in teacher-oriented classes compared to the students of the 2011/12 academic year.

Table 2. Percentage of frequency of scores on the DASTT-C checklist for 2nd-year students

Score on DASTT-C checklist	**2nd-year students**	
	2011/12 f (%)	**2022/23 f (%)**
0	0	0
1	0	0
2	0.5	0
3	5.1	0.7
4	3.6	2.1
5	8.2	1.7
6	7.9	3.1
7	12	2.8
8	8.3	6.7
9	**15.9**	11.8
10	13.2	17.3
11	13.5	**25.6**
12	4.8	22.1
13	7	6.1
TOTAL	**100**	**100**

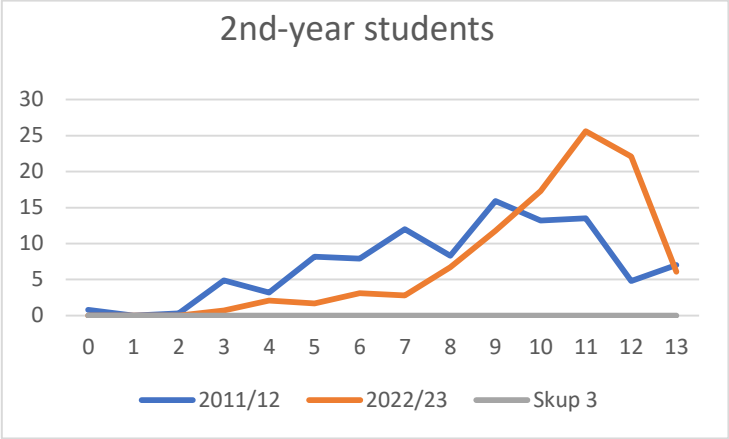


Figure 1. Graphic representation of f (%) for 2nd-year students

To test the first hypothesis of this study, which assumed that there is no statistically significant difference in the perception of teaching by 2nd-year students in 2011/12 compared to 2nd-year students in 2022/23, an independent samples t-test was conducted. The result of the t-test ($t(311) = -7.88$; $p>0.05$) showed that there is no statistically significant difference in self-perception as a teacher in Science between the 2nd-year students of the 2011/12 generation and the 2022/23 generation. Therefore, H1 is confirmed and accepted.

Since the DASTT-C checklist scores fall into three categories on a continuum that depends on the total number of points on the checklist, Table 3 shows the results by category. Table 3 shows that 9.2% of 2nd-year students of the 2011/12 generation felt they were in a student-centered classroom, while in 2022/23 generation, only 2.8% of students felt that. Teacher-centered teaching was presented by 74.7% of 2nd-year students of the 2011/12 generation, while 92.4% of students in the 2022/23 generation perceive teacher-centered teaching. This result is consistent with the findings of other studies (Louca et al., 2002; Talsma, 2007; Tatar et al., 2012) in the sense that students are more likely to perceive teacher-centered teaching before taking methodological courses because their beliefs about teaching stem from previous school experiences, i.e., the teacher-centered teaching paradigm. As this study was repeated after 11 years, a shift in the teaching paradigm from teacher-centered teaching to student-centered teaching was expected, as it was assumed that previous experiences during schooling were, nevertheless, based on conceptual, inquiry-based, and constructivist teaching. The results showed the opposite, a shift to the other side of the continuum where more 2022/23 generation students are emerging in

teacher-centered classes. Since 2nd-year students take methodological courses starting from the third academic year, a great responsibility lies with their professors, who can change students' beliefs and perceptions about teaching, which currently does not align with the needs of students and the times we live in.

Table 3. 2nd-year students' (%) perception of teaching by category on the continuum

Academic year	Student-centered teaching (%) 0 – 4 points	Non-specified orientation of teaching (%) 5 – 6 points	Teacher-centered teaching (%) 7 – 13 points
2011/12	9.2	16.1	74.7
2022/23	2.8	4.8	92.4

Analysis of the drawings yielded results (Table 4) showing the total score achieved on the DASTT-C checklist for 5th-year students in the 2011/12 academic year (N=224) and in the 2022/23 academic year (N=162). The frequencies of each outcome category (from 0 to 13), expressed as a percentage by academic year, are shown in Table 4. The 2011/12 5th-year students' drawings achieved a total score of 2 to 13 on the checklist. The most common total score on the DASTT-C checklist for 5th-year students was 4 points (Mo=4, f_{max}=44), accounting for 19.6% of students, while the arithmetic mean was 6.36 (SD=2.76), which belongs to the non-specific orientation of teaching that is neither student-centered nor teacher-centered. The scores of the 5th-year students of the 2022/23 generation ranged from 3 to 13 points, while the most frequent result was 9 points (Mo=9, f_{max}=29), which was achieved by 17.8% of the students. The arithmetic mean score was 7.8 (SD=2.46), which falls into the category of teacher-oriented teaching. To test the second hypothesis, which assumes that there is no statistically significant difference in the perception of teaching by 5th-year students in 2011/12 compared to students in 2022/23, an independent samples t-test was conducted. The result of the t-test ($t(358)=-5.39$ $p>0.05$) showed that there is no statistically significant difference in the perception of 5th-year students of the 2022/23 generation compared to 11 years ago, and H2 is confirmed and accepted. A clearer distribution of scores on the DASTT-C checklist is shown in Figure 2. The curve showing the scores of 5th-year students in 2011/12 is shifted to the left, indicating student-centered teaching, while the scores of 2022/23 generation students are more concentrated in the middle and to the right, corresponding to non-specific perceptions of teaching and teacher-centered teaching.

Table 4. Percentage of frequency of scores on the DASTT-C checklist for 5th-year students

Score on DASTT-C checklist	5th-year students	
	2011/12 f(%)	2022/23 f(%)
0	0	0
1	0	0
2	3.7	0
3	10.2	4
4	**19.6**	8.4
5	11.9	11.8
6	12.7	9
7	11.6	10.7
8	6.6	9.2
9	6.7	**17.8**
10	3.9	10.1
11	6.8	13.1
12	5.6	4.2
13	0.7	1.7
TOTAL	**100**	**100**

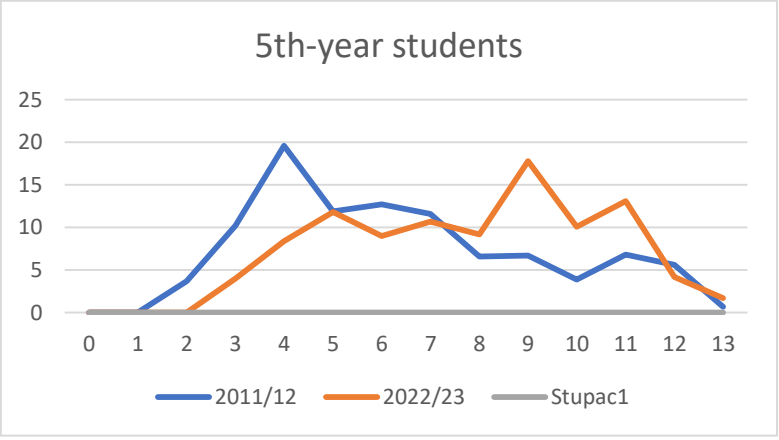


Figure 2. Graphic representation of f(%) for 5th-year students

Analyzing the results by category on the continuum (Table 5) shows that 5th-year students of the 2022/23 generation (66.7%) are more likely to see themselves in teacher-oriented classes than 11 years ago (42.1%). Only 12.5% of students in the 2022/23 generation compared to the generation of students 11 years ago (33.4%) perceive teaching as student-centered. It was

expected that the 2022/23 generation would perceive themselves more in student-centered teaching, or at least as much as they did 11 years ago, but the results showed the opposite. Many drawings lead to the conclusion that the students have a reasonably clear image of student-centered teaching of Science, but they still portray themselves at the center of the teaching process, where a teacher is the authority and keeps everything under control. The students show with their drawings that they understand the new role and position of the students in the classroom, but they still do not understand the new role and position of the teacher, i.e., they cannot detach themselves from the traditional role of the teacher. Although the educational policy of the Republic of Croatia in the last 20 years has been characterized by the adoption of several new education-related documents and several attempts at reform, in which a constructivist approach to learning and teaching and student-centered teaching is imperative, students and future teachers are still perceived in the traditional paradigm of teaching with the teacher at the center of the teaching process. It is assumed that one of the causes of the poorer outcome could be online teaching during the COVID-19 pandemic and the impossibility of carrying out professional-pedagogical practice and conducting exemplary lessons in the "practice schools". The results obtained by the 5th-year students are in contrast with the research results of Louca et al. (2002) and Talsma (2007), in which students perceive much more student-centered teaching after taking the methodological courses. El-Deghaidy (2006), Minogue (2010), Ambusaidi & Al-Balushi (2012), Lay & Khoo (2013), Tatar et al. (2012) and Buldur (2017) found a change in perception from teacher-centered teaching to student-centered teaching after attending methodology courses based on a constructivist approach to learning and teaching in the research conducted. El-Deghaidy (2006), Mensah (2011), and Tatar et al. (2012) state that teaching style is also influenced by the professional-pedagogical practice that students undertake in school. In doing so, the teaching style changes from an explicit to a constructivist one based on changing mental conceptions about teaching. The authors note that students and novice teachers receive support in school to apply what they have learned in theory during the initial education. This was confirmed by Turkmen and Unver (2018) in a comparative study of primary school students from Turkey, Denmark, Germany, and Scotland. The Scottish students' drawings showed student-centered teaching, the German and Dutch students showed teaching that was neither student-centered nor teacher-centered, and the Turkish students' drawings showed teacher-centered teaching. The research results showed a correlation between the results of the DASTT-C and the PISA tests. In the last three

PISA cycles, German, Dutch, and Danish students ranked between 10th and 20th in science literacy, while Turkish students ranked at the bottom. Aydogdu & Selanik-Ay (2016) state that the Turkish education system is in transition and that teachers need to be supported through professional development programs to train them for a constructivist approach to teaching. For Croatian teachers and future teachers, support through various forms of professional development and constant self-reflection is necessary because they are the ones who directly influence students' learning outcomes by changing their perceptions of teaching.

Table 5. 5th-year students' (%) perception of teaching by category on the continuum

Academic year	Student-centered teaching (%) 0 – 4 points	Non-specified orientation of teaching (%) 5 – 6 points	Teacher-centered teaching (%) 7 – 13 points
2011/12	33.4	24.5	42.1
2022/23	12.5	20.8	66.7

Conclusion

A constructivist approach to learning and teaching and student-centered teaching is an imperative of modern education systems. It is the cornerstone of the education-related documents, reforms, and changes adopted in the Republic of Croatia at all levels of education. The research results show that none of this has changed the traditional view of teaching and that future teachers still perceive teaching as teacher-centered, even more than 11 years ago when the research was first conducted. It means that the change in the pedagogical paradigm of teaching should be seen in a larger context and that changes and reforms in the education system should start from the needs of teachers and go from the bottom up and not be the result of a political competition that lacks focus on the students and the teaching process.

Second-year students in the 2011/12 and 2022/23 generations perceive themselves in student-centered teaching, which is expected and coincides with the findings of other studies, where lower-year students perceive themselves in student-centered teaching. Furthermore, 92.4% of 2nd-year students in the 2022/23 generation perceive themselves in student-centered teaching, which is 18% higher than 11 years ago. For 5th-year students, there is no statistically significant difference in perception between 2011/12 and the 2022/23 generations, but when the results are categorized on the continuum of teaching theory, they show that 24% more of students

perceive themselves in teacher-centered teaching in 2022/23 and 20% less in student-centered teaching in contrast to 11 years ago. The assumption is that this is a consequence of online classes and the impossibility of conducting professional-pedagogical practice and conducting exemplary lessons in the "practice schools". The 5th-year students showed that they are somewhat aware of the role of students at the center of the teaching process, but they cannot completely relinquish control over students and the belief that the teacher is most effective in frontal teaching when students are passive and listen to the teacher. The DASTT-C is a reliable and valid instrument for examining perceptions of teaching, and research such as this can inform future teachers about their previous experiences during their education and the beliefs and mental models they have when starting initial teacher education. Similarly, this research can extend to other teacher education programs and allow for a comparison of students' perceptions of teaching by future subject teachers. Changes in the beliefs and own theories of teaching among teachers who have worked in schools at all levels of education for many years will not occur without a focused and systematic examination of their beliefs about teaching and practice and self-reflection. Therefore, the recommendation is to modernize higher education teaching with new didactic solutions, strategies, and technologies that will help students change their beliefs about teaching and learning and that they will implement in their classrooms. The shortcoming of this study is that it is not a longitudinal study, so it is not possible to generalize the conclusions obtained. However, it can be continued in the future by assessing and re-assessing students, novice teachers, and experienced teachers.

Declaration of Conflicting Interest
The Authors declare that there is no conflict of interest.

References

Ambusaidi, A. K. & Al-Balushi, S. M. (2012). A Longitudinal Study to Identify Prospective Science Teachers' Beliefs about Science Teaching Using the Draw-a-science-teacher-test Checklist. *International Journal of Environmental & Science Education, 7*(2), 291-311.

Aydogdu, B., & Ay, T. S. (2016). Determination of teacher characteristics that support constructivist learning environments. *Eurasian Journal of Educational Research, 16*(63). 293-310, http://dx.doi.org/10.14689/ejer.2016.63.17

Azam, S. & Menon, D. (2021). Influence of Science Experiences on Preservice Elementary Teachers' Beliefs. *Electronic Journal for Research in Science & Mathematics Education, 25*(1), 20-45.

Bakır, S. (2016). What are their beliefs? What is their approach in practice? What is the profile of their science teachers and professors?. *International Journal of Environmental and Science Education, 11*(5), 587-602. doi: 10.12973/ijese.2016.402a

Barber, M. & Mourshed, M. (2007). *How the world's best performing schools come out on top.* McKinsey and Company.

Bautista, N. U. (2011). Investigating the use of vicarious and mastery experiences in influencing early childhood education majors' self-efficacy beliefs. *Journal of Science Teacher Education, 22*(4), 333-349. http://www.jstor.org/stable/43156605

Buldur, S. (2016). A longitudinal investigation of the preservice science teachers' beliefs about science teaching during a science teacher training programme. *International Journal of Science Education, 39*(1), 1–19. https://doi.org/10.1080/09500693.2016.1262084

Bursal, M. (2010). Turkish preservice elementary teachers' self-efficacy beliefs regarding mathematics and science teaching. I*nternational Journal of Science and Mathematics Education*, 8, 649-666. https://doi.org/10.1007/s10763-009-9179-6

El-Deghaidy, H. (2006). An investigation of pre-service teacher's self-efficacy and self-image as a science teacher in Egypt. *Asia-Pacific Forum on Science Learning and Teaching, 7* (2), Article 2 http://www.ied.edu.hk/apfslt/v7_issue2/heba/index.htm accessed 15/2/2011

Finson, K. D., Pedersen, J. E. & Thomas, J. (2006). *Comparing science teaching styles to students perception of scientist.* University of Nebraska, Department of Teaching, Learning and Teacher Education.

Fosnot, C. T. (2005). Constructivism Revisited: Implications and Reflections. *The Constructivist, 16*(1), 21-38.

Go, Y., Kang, J (2015). Early childhood pre-service teachers' self-images of science teaching in constructivism science education courses. *Asia-Pacific Forum on Science Learning and Teaching, 16*(2), 1-25.

Hulings (2022). What are they bringing with them? Understanding past science experiences of preservice elementary teachers and what they mean for the science methods course. *Journal of Research in Science Teaching, 59*(8), 1465-1488.

Imaduddin, M., Zuhaida, A., & Hidayah F. F. (2019). Pre-Service science teachers' images about their past and future classrooms: Scratches from Indonesian teacher training Program at Islamic University. *Journal for the Education of Gifted Young Scientists, 7*(3), 459-480. http://dx.doi.org/10.17478/jegys.549257

Jones, M. G. & Leagon, M. (2014). Science teacher attitudes and beliefs: Reforming practice. In N. G. Lederman & S. K. Abell (Eds.), *Handbook of research on science education* (Vol. II, 830-847). Routledge

Kagan, D. M. (1992). Implications of Research on Teacher Belief. *Educational Psychologist, 27*(1), 65-90. https://doi.org/10.1207/s15326985ep2701_6

Kalyon, D. S. (2020). Primary teachers' and students' images of teachers and learning environments. *International Electronic Journal of Elementary Education, 13*(1), 155-167. https://www.iejee.com/index.php/IEJEE/article/view/1249

Kleickmann, T., Vehmeyer, J. & Möller, K. (2010). Zusammenhänge zwischen Lehrervorstellungen und kognitivem Strukturieren im Unterricht am Beispiel von Scaffolding-Maßnahmen [Connections between teacher conceptions and cognitive structuring in the classroom using scaffolding as examples]. *Educational Science/ Unterrichtswissenschaft, 38*(3), 210-228.

Lay, Y. F. & Khoo, C. H. (2013). Pre-service science teachers' mental images of science teaching. *Social Sciences & Humanities, 21(*84), 1361-1377.

Liaw, E. (2009). Teacher efficacy of pre-service teachers in Taiwan: The influence of classroom teaching and group discussions. *Teaching and Teacher Education*, 25, 176-180. https://doi.org/10.1016/j.tate.2008.08.005

Louca, P., Rigas, P. & Valanides, N. (2002). Primary student teachers' conceptions of science teaching. In *Proceedings of the 2nd International Conference on Science Education. Nicosia, Cyprus*, 242-248.

Markic, S., Eilks, I. & Valanides, N. (2008). Developing a tool to evaluate differences in beliefs about science teaching and learning among freshman science student teachers from different science teaching domains: A case study. *Eurasia Journal of Mathematics and Technology Education, 4*(2), 109-120. https://doi.org/10.12973/ejmste/75311

Markic, S. & Eilks, I. (2012). A comparison of student teachers beliefs from four different science teaching domains using a mixed methods design. *International Journal of Science Education, 34(*4), 589-608. https://doi.org/10.1080/09500693.2011.608092

Matijević, M. (2010). Između didaktike nastave usmjerene na učenika i kurikulumske teorije. In *Zbornik radova četvrtog kongresa matematike. Hrvatsko matematičko društvo i Školska knjiga*, 391- 408.

Mensah, F. M. (2011). The DESTIN: Preservice teachers' drawings of the ideal elementary science teacher. *School Science and Mathematics, 111*(8), 379-388. https://doi.org/10.1111/j.1949-8594.2011.00103.x

Minogue, J. (2010). What is the teacher doing? what are the students doing? An application of the Draw-a-Science-Teacher-Test. *Journal of Science Teacher Education, 21*(7), 767–781. http://www.jstor.org/stable/43156577

Mundhenk, L. G. (2004). Toward an understanding of what it means to be student centered: a new teacher´s journey. *Journal of Management Education, 28*(4), 447-462. https://doi.org/10.1177/1052562903252660

Nespor, J. (1987). The role of beliefs in the practice of teaching. *Journal of Curriculum Studies, 19*(4), 317-328. https://doi.org/10.1080/0022027870190403

Pajares, M. F. (1992). Teachers` beliefs and educational research: cleaning up a messy construct. *Review of Educational Research, 62*(3), 307-332. http://www.jstor.org/stable/1170741

Schumacher, F. & Wilde, M. (2021). When prospective biology teachers visualize their beliefs about teaching and learning by drawing it, is it more than a reproduction of their experienced school lessons? *European Journal of Educational Research, 10*(2), 799-811. https://doi.org/10.12973/eu-jer.10.2.799

Šagud, M. (2006). *Odgojitelj kao refleksivni praktičar.* Visoka učiteljska škola.

Škugor, A. (2013). *The Paradigm of Pupil-Oriented Science and Society Teaching as a Guideline in Student Training at Faculties of Teacher Education* (Doctoral thesis). Zagreb: Faculty of Teacher Education

Talsma, V. L. (2007). Children learning science: Analysis of drawings from the science methods classroom. Paper presented at the *Annual Meeting of the North-Central Association for Science Teacher Educators (NASTE), October 11-13, 2007*, Madison, WI

Tatar, N., Yildiz Feyzioğlu, E. Buldur, S. & Akpinar, E. (2012). Pre-Service Science Teachers' Mental Models about Science Teaching. *Educational Sciences: Theory & Practice, 12*(4), 2934-2940. https://files.eric.ed.gov/fulltext/EJ1002893.pdf

Thomas, J. A., Pederson, J. E. & Finson, K. D. (2001). *Validating the Draw-A-Science-Teacher-Test Checklist (DASTT-C): Exploring Mental Models and Teacher Beliefs.* University of Nebraska, Department of Teaching, Learning and Teacher

Education. http://digitalcommons.unl.edu/teaclearfacpub/94 od 13.3.2010

Turkmen, H. & Unver, E. (2018). Comparison of elementary students' images of science teaching for Turkish, Dutch, Scottish, and German science classrooms. *Universal Journal of Educational Research, 6* (11), 2624-2633, DOI: 10.13189/ujer.2018.061127

Ucar, S. (2012). How Do pre-service science teachers' views on science, scientists, and science teaching change over time in a science teacher training program? *Journal of Science Education and Technology*, 21, 255–266

Valenčič Zuljan, M. (2008). *Subjektivne teorije - cjeloživotno učenje*. Hrvatsko futurološko društvo.

Yilmaz, H., Turkmen, H., Pedersen, J. E. & Cavasi, P. H. (2007). *Evaluation of Pre-service Teachers Images of Science Teaching in Turkey*. University of Nebraska, Department of Teaching, Learning and Teacher Education. http://digitalcommons.unl.edu/teaclearfacpub/80 accessed 13/2/2024