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Pre-Service Teachers' Conceptions about Materials of Fine Art Paintings

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KLJUČNE BESEDE: pouk likovne dejavnosti, likovni materiali, naravoslovje, znanje bodočih učiteljev

POVZETEK – Cilj raziskave je identificirati napačna razumevanja o materialih (na primerih izbranih umetniških slik), ki lahko vplivajo na prihodnje učitelje razrednega pouka in likovne pedagoge pri vključevanju omenjenih vsebin v lastno pedagoško dejavnost. Znanje o določenih slikarskih materialih lahko prihodnjim učiteljem osvetli možnosti in omejitve v okvirih prepoznavanja slikarskih tehnik, njihove uporabe, uvajanja interdisciplinarnega pedagoškega pristopa ter osveščanja učencev o skrbi za kulturno dediščino pri pouku likovne dejavnosti v osnovni šoli. V raziskavi je sodelovalo 93 študentov Pedagoške fakultete v Ljubljani. Podatki so pridobljeni s pomočjo štiristopenjskega testa prepoznavanja likovnih materialov. Rezultati so pokazali, da je raven razumevanja posebnosti likovnih materialov med študenti nizka, še posebej pri manj poznanih vrstah umetniških slik. Večji poudarek je potrebno nameniti razumevanju uporabe likovnih materialov z vidika njihovih možnosti, omejitev ter interdisciplinarnega pristopa v skladu s sodobnimi smernicami učnega načrta pouka likovne dejavnosti in naravoslovja.

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ABSTRACT – The aims of this study are to identify the misconceptions regarding fine art materials (from selected fine art paintings) that can influence the primary school and art student teachers' integration of this content into their teaching. The knowledge about fine art materials can help student teachers to become aware of the possibilities and limitations of a specific fine art material, and can be used to define the techniques, application and interdisciplinary context, and to raise awareness about the proper care of cultural heritage (heritage preservation education) in fine art classes. Altogether, 93 students from the Faculty of Education, University of Ljubljana, participated in the research. The data were collected using a four-tier multiple-choice fine art material achievement test. The results revealed that the level of understanding among student teachers was low, especially when lesser-known forms of fine art paintings were considered. It can be concluded that more emphasis should be placed on developing the understanding of fine art materials regarding their possibilities, limitations and interdisciplinary use according to contemporary art and science curriculum guidelines.

1 Introduction

Before students enter lower secondary school, they can be introduced to art and science topics during primary school education. Artworks could be a suitable tool for achieving a stimulating conversation among students when learning science topics, for example: finding the hidden chemistry in Egyptian artefacts (Giménez, 2015), exploring different material components of artefacts in museum collections (Brown, 2014), or frescos found in Pompeii that contain mercury in the vermilion pigments (Gaquere-Parker, 2012). For that reason, primary school student teachers (PSST) can integrate the characteristics of fine art materials in science lessons and vice versa, so that the interdisciplinary approach to education can be more efficiently achieved than at the higher

levels of schooling. The context-based teaching approach in general (Šindić, Pribišev Beleslin et al., 2019, p. 81) and in science can reduce the cognitive load and stimulate an interest in learning (Parchmann, Blonder and Mroman, 2017). Some research shows that students develop a deeper understanding of science concepts when using context in the teaching and learning of chemistry or science in general (Leite, Dourado, Afonso et al., 2017).

It must be emphasised that scientific knowledge about fine art materials can be beneficial for art student teachers (AST). That knowledge can help them to become aware of the possibilities and limitations of a specific fine art material, and can be used to define the techniques and application of these materials in fine art classes (Potočnik, 2017). Knowledge of the materials used in works of fine art can also be important for raising awareness about the need for material preservation in the context of the proper care of cultural heritage among primary school pupils (Potočnik, 2018). Primary school teachers and art teachers are favourably inclined towards contents related to heritage preservation education; however, they very rarely include these contents in their fine art classes (Potočnik, 2017). Other than presenting different kinds of cultural heritage, teachers often do not provide information on suitable and unsuitable interventions on cultural heritage (Gaskell and Owen, 2005) or on original materials and their uniqueness (Stanley-Price and King, 2009). To present the context of the research, the Slovenian educational system should first be introduced. The primary school teacher (graduates from the Faculty of Education) teaches the subject Fine Art between the 1st and 5th grades (6- to 10-year-old pupils); the art teacher usually teaches fine art from the 6th to 9th grades (11- to 14-year-old pupils). PSST can be indirectly informed about fine art materials through the course Visual Arts or Society and the Environment (Presentation Book, 2019). The analysis of both student teachers' study programmes reveals that student teachers are not provided with courses where they can develop their knowledge about preservation education directly, but do become familiar with the basic knowledge regarding fine art techniques (Presentation Book, 2019).

When assessing the students' level of understanding of fine art material concepts, different diagnostic instruments can be used. One possible way is the application of the multi-tier diagnostic instruments that come in various forms and can be used to identify students' misconceptions (MSC), as suggested by Treagust (1988). The two-tier test is quite popular and has been used in numerous studies in science education (Odom and Barrow, 1995). This form cannot distinguish correct responses on the basis of whether these are due to guesswork or content mastery. Such limitations can be addressed significantly with the use of three-tier or four-tier diagnostic questions. In these instruments, a confidence rating (typically on a scale from just guessing (1) to absolutely confident (6)) is added. If the confidence tier is appended to both tiers separately, the instrument is four-tiered, and where a mean rating is required for the answer and reason tiers, it becomes a three-tier instrument. Because the answer and reason tiers may have different difficulty levels, it is reasonable to assume that students would have different levels of confidence for both tiers (Caleon and Subramaniam, 2010, Gurel, Eryilmaz and Mcdermott, 2015) (see Table 1).

Table 1

Categorisation of student teachers' achievements and confidence rates

Answer	*Confidence*	*Reason*	*Confidence*	*Decision for four-tier test*
Correct	Sure	Correct	Sure	SC
	Sure		Not sure	LK
	Not sure		Sure	LK
	Not sure		Not sure	LK
Correct	Sure	Wrong	Sure	FP, Rarely MSC
	Sure		Not sure	LK
	Not sure		Sure	LK
	Not sure		Not sure	LK
Wrong	Sure	Correct	Sure	FN
	Sure		Not sure	LK
	Not sure		Sure	LK
	Not sure		Not sure	LK
Wrong	Sure	Wrong	Sure	MSC, Rarely MTK
	Sure		Not sure	LK
	Not sure		Sure	LK
	Not sure		Not sure	LK

Notes: SC: Scientific Conceptions; LK: Lack of Knowledge, FP: False Positive; FN: False Negative; MSC: Misconception; MTK: Mistake

Overall, according to the literature review, it can be summarised that the cross-curricular integration of this content could be a useful tool to develop an adequate understanding of the science and fine art concepts; therefore, the knowledge about fine art materials that different teachers (e.g. fine art, primary school) possess is one of the most critical factors for the inclusion of cross-cultural curriculum concepts.

Research problem and research questions

The primary focus of this research is to identify primary school student teachers' (PSST) and art student teachers' (AST) misconceptions (MSC) about materials used in the most common forms of paintings, and how they assess the difficulty of the presented tasks. According to the research problem, three research questions (RQ) were formed:

- *RQ1: What are the misconceptions of PSST and AST regarding the materials used in the most common forms of paintings?*
- *RQ2: How confident are PSST and AST in understanding the materials used in the most common forms of paintings with regard to misconceptions?*
- *RQ3: How do both groups of student teachers assess the difficulty of the presented tasks?*

2 Method

Participants

Altogether, 93 student teachers from the Faculty of Education, University of Ljubljana, participated in the research; 21 (22.6%) of them were AST, and 72 (77.4%) of the participants were PSST. There were only seven males (7.5%), and the average age was 22.8 (SD = 1.2 years). All student teachers were in their fourth year of undergraduate study. All participants signed the consent form, and the research plan was approved by the Faculty of Education Ethics Commission.

Instrument

The data were collected using the Fine Art Materials Achievement Test (FAMAT). FAMAT was developed as a diagnostic test using a methodological framework to identify student teachers' misconceptions (MSC), as suggested by Treagust (1988). It includes four-tier multiple-choice items comprising three parts each. Altogether, FAMAT comprised six tasks. Each task shows a different visual representation of a painting (for example, on stone, wood, wall, or other material); each task has two different parts. In the first part, participants had to define the type of painting support and in the second part the materials used in the paint layers. In the third part of each item, participants had to give their opinion about the level of difficulty of the item (see Figure 1 as an example of such a task).

Research design

The design of the research was non-experimental, cross-sectional, and descriptive. The FAMAT was applied anonymously in groups, and all the participants had the same conditions for completing the FAMAT. The responses of the students were entered into an Excel file for data analyses. The misconceptions (MSC) were further classified according to confidence (CF) when correct (CFC) and confidence when wrong (CFW) values (see Table 2), as proposed by Yan and Subramanian (2016).

Table 2

The misconceptions classification according to confidence values

MSC	*Misconception*
CF	Mean confidence; adding confidence ratings for a question and dividing the total by the number of student teachers
CFC	Confidence when correct; adding confidence rating for a correctly answered question and dividing the total by the number of student teachers who answered correctly
CFW	Confidence when wrong; adding confidence rating for an incorrectly answered question and dividing the total by the number of student teachers who answered incorrectly

Figure 1

An example of the task comprising FAMAT; answer tier (1.1; 1.5), confidence tier for answer (1.2; 1.6), reason tier (1.3; 1.7); confidence tier for reason (1.4; 1.8); rate of difficulty of the assignment (1.9). The correct answer and the correct reason are marked in bold and underlined.

A detail of an aquarelle painting is displayed (Pablo Picasso, A Simple Meal, 1904). (Image used from Wikipedia.)

Answer the following questions based on your experience in the context of fine art materials.

1.1. What is the support of the painting?			
A	B	C	D
Lime plaster.	Papyrus	Wood	Paper

1.2. How sure are you that the answer under 1.1. is correct?					
1	2	3	4	5	6
Just guessing	Very unconfident	Unconfident	Confident	Very confident	Absolutely confident

1.3. State the reason for the specific answer under 1.1.	
A	The surface formed by the staining of cellulose is noticeable on the aquarelle painting.
B	A smooth texture, which is typical for the wall surface, could be seen on the aquarelle painting.
C	The visible structure and colour of the wood, formed after treatment, could be seen on the aquarelle painting.
D	Patina could be seen on the aquarelle painting, which is formed on the surface of the metal when exposed to air.

1.4. How sure are you that the answer under 1.3. is correct?					
1	2	3	4	5	6
Just guessing	Very unconfident	Unconfident	Confident	Very confident	Absolutely confident

1.5. Which materials were used for the painting (paint layers)?	
A	Pigments like chromium and cobalt oxides, compounds of lead and antimony and calcium hydroxide (slaked lime) as a binder.
B	Pigments like iron oxides, lead carbonate and lead hydroxide, copper carbonate, iron hexacyanoferrate and liquid fat – oil as a binder.
C	Pigments such as chromium and cobalt oxides, lead and antimony compounds, iron oxides, lead carbonate and hydroxide, copper carbonate, iron hexacyanoferrate, and gum arabic (a complex mixture of glycoproteins and polysaccharides) as a binder.
D	Pigments like iron oxides, carbon from burning wood and bones, calcium carbonate – calcite and saliva or fat as a binder.

1.6. How sure are you that the answer under 1.5. is correct?					
1	2	3	4	5	6
Just guessing	Very unconfident	Unconfident	Confident	Very confident	Absolutely confident

1.7. State the reason for the specific answer under 1.5.	
A	Thin layers of paint are visible that may be overlap absorbed by paper.
B	We can find the typical texture of applied oil colours of different thicknesses, cracks (craquelure) and gentle transitions between shades of colour.
C	We can find the typical texture of the wall surface with materials that could be painted on fresh lime plaster.
D	We can find the typical texture of thin layers of various materials, without any preparation of the painting support.

1.8. How sure are you that the answer under 1.7. is correct?					
1	2	3	4	5	6
Just guessing	Very unconfident	Unconfident	Confident	Very confident	Absolutely confident

1.9. How do you rate the assignment?				
1	2	3	4	5
Very demanding	Demanding	Medium-demanding	Easy	Very easy

3 Results and Discussion

It can be summarised from Table that more than half of AST (56%) indicate a lack of knowledge about the materials of fine art paintings included in this study; 90% of PSST indicate a lack of knowledge. The highest percentage of misunderstanding can be identified in the context of the materials that compose paintings on a wooden support; 24% of AST could not identify the materials the painting support consisted of (i.e. wood with a preparation layer of chalk or gesso mixed with collagen). Furthermore, 14% of AST did not know that the egg tempera binder (coloured pigments mixed with a water-soluble binder) contains egg yolk. Misconceptions in the context of knowing the distinctive features of egg tempera on wood are also identified in PSST (7%). AST also expressed misconceptions about the materials that comprised oil on canvas (5%) and the materials of woven paintings (5%). PSST show similar misconceptions regarding the materials of woven paintings/tapestry (the woven texture of wool or cotton).

Table 3

Student teachers' relevant misconception measures

Materials – painting support and layer	*Student teachers / Question*	*Scientific Conception*	*False positive*	*False negative*	*Misconception (MSC)*	*Lack of knowledge*
Cave paintings	AST / 1.1	0.71	0.0	0.05	0.00	0.24
	PSST / 1.1	0.22	0.00	0.08	0.00	0.69
	AST / 1.2	0.24	0.10	0.00	0.00	0.52
	PSST / 1.2	0.06	0.03	0.00	0.01	0.86
Fresco paintings	AST / 2.1	0.62	0.05	0.00	0.00	0.29
	PSST / 2.1	0.15	0.01	0.01	0.00	0.82
	AST / 2.2	0.24	0.00	0.05	0.04	0.57
	PSST / 2.2	0.01	0.00	0.00	0.03	0.92
Paintings on wooden support	AST / 3.1	0.05	0.00	0.00	0.24	0.71
	PSST / 3.1	0.00	0.00	0.00	0.07	0.92
	AST / 3.2	0.00	0.00	0.05	0.14	0.76
	PSST / 3.2	0.01	0.01	0.00	0.00	0.96
Oil paintings on canvas	AST 4.1	0.05	0.10	0.10	0.00	0.71
	PSST 4.1	0.00	0.01	0.06	0.00	0.92
	AST 4.2	0.43	0.00	0.00	0.05	0.48
	PSST 4.2	0.00	0.00	0.01	0.00	0.97
Paintings on paper (aquarelle)	AST 5.1	0.33	0.10	0.00	0.00	0.57
	PSST 5.1	0.04	0.00	0.03	0.00	0.90
	AST 5.2	0.10	0.00	0.10	0.00	0.76
	PSST 5.2	0.01	0.00	0.00	0.00	0.97
Woven paintings (tapestry)	AST 6.1	0.38	0.00	0.10	0.05	0.43
	PSST 6.1	0.01	0.00	0.00	0.00	0.94
	AST 6.2	0.19	0.00	0.00	0.05	0.71
	PSST 6.2	0.00	0.00	0.00	0.00	0.99
Mean*	AST	0.28	0.03	0.04	0.05	0.56
Mean*	PSST	0.04	0.01	0.02	0.01	0.90

Note: * The difference of answers to 100 %, as it also contains unanswered replies from the questionnaire.

According to the identified misconceptions explained above, Table 4 shows more detailed analyses of students' success in solving the tasks and their confidence. Both groups showed lower levels of confidence when solving tasks in which misconceptions were identified. AST are not confident in understanding the fine art materials used in painting supports, such as panel paintings, woven paintings, and the fine art materials comprising

the paint layer of oil paintings on canvas. In contrast, however, PSST are not confident in solving tasks about the fine art materials used in the supports of panel paintings.

Higher confidence ratings when the answers are correct (CFC) for AST than for PSST (the difference is 1.33 points on a five-point scale for the answer tier and 1.37 for the reason tier) indicate that student art teachers are more confident in their knowledge and show higher levels of knowledge of fine art materials.

Table 4

Student teachers' performance in the FAMAT with the relevant confidence measures

Materials – painting support and paint layer	*Student teachers / Question*	*Proportion of correct answers*			*Confidence measures for answer tier (A tier)*			*Confidence measures for reason tier (R tier)*		
		A tier	*R tier*	*B tier*	*CF*	*CFC*	*CFW*	*CF*	*CFC*	*CFW*
Cave paintings	AST / 1.1	0.90	0.95	0.90	4.76	4.79	4.50	4.19	4.40	0
	PSST / 1.1	0.71	0.83	0.69	3.33	3.47	3.10	3.11	3.19	2.50
	AST / 1.2	0.95	0.71	0.71	3.38	3.60	1.00	2.71	3.00	2.00
	PSST / 1.2	0.56	0.36	0.32	1.92	2.36	1.30	1.71	2.16	1.47
Fresco paintings	AST / 2.1	0.95	0.81	0.81	4.43	4.45	4.00	4.10	4.59	2.00
	PSST / 2.1	0.72	0.71	0.69	2.76	2.94	2.26	2.83	2.98	2.90
	AST / 2.2	0.57	0.62	0.57	2.86	3.43	2.11	3.33	4.31	1.75
	PSST / 2.2	0.36	0.44	0.25	1.69	1.38	1.87	1.81	1.77	1.78
Paintings on wooden support	AST / 3.1	0.57	0.33	0.33	2.71	2.25	3.33	2.81	2.43	3.00
	PSST / 3.1	0.19	0.18	0.13	1.90	1.29	2.07	1.92	1.64	1.97
	AST / 3.2	0.29	0.48	0.19	2.24	2.83	2.00	2.29	1.70	2.82
	PSST / 3.2	0.33	0.33	0.18	1.46	1.50	1.44	1.44	1.42	1.44
Oil paintings on canvas	AST 4.1	0.52	0.67	0.33	2.67	2.55	2.80	2.71	2.57	3.00
	PSST 4.1	0.44	0.44	0.18	1.99	1.97	2.00	1.78	2.26	1.41
	AST 4.2	0.81	0.67	0.67	3.05	3.12	2.75	3.19	3.64	2.29
	PSST 4.2	0.58	0.61	0.47	1.72	2.10	1.19	1.82	2.07	1.36
Paintings on paper (aquarelle)	AST 5.1	0.90	0.81	0.71	3.48	3.47	3.50	3.67	3.71	3.50
	PSST 5.1	0.63	0.74	0.49	2.17	2.37	1.81	2.00	2.20	1.39
	AST 5.2	0.52	0.86	0.52	2.48	3.00	1.90	3.33	3.72	1.00
	PSST 5.2	0.46	0.61	0.35	1.60	1.61	1.59	1.76	1.87	1.52
Woven paintings (tapestry)	AST 6.1	0.62	0.76	0.52	3.33	3.92	2.38	3.43	3.75	2.40
	PSST 6.1	0.22	0.35	0.21	1.76	2.07	1.68	1.85	1.88	1.87
	AST 6.2	0.52	0.67	0.48	2.48	3.00	1.73	2.86	3.36	1.86
	PSST 6.2	0.24	0.51	0.17	1.43	1.47	1.42	1.42	1.47	1.35
Mean	AST	0.67	0.69	0.56	3.16	3.37	2.67	3.22	3.43	2.07
Mean	PSST	0.43	0.51	0.34	1.98	2.04	1.76	1.95	2.06	1.75

Table 4 reveals that only 11 % of AST and 3 % of PSST find it easy to identify the materials of the fine art paintings presented in FAMAT. PSST find it difficult to define the materials of all paintings; AST find it the most difficult to define the materials of paintings with wooden supports and woven painting, for which the most misconceptions were also identified.

Table 5

Student teachers' assessments of difficulty

Materials – painting support and paint layer	*Student teachers*	*Difficult*	*Somewhat difficult*	*Easy*
Cave paintings	AST	0.48	0.38	0.10
	PSST	0.88	0.10	0.03
Fresco paintings	AST	0.24	0.52	0.14
	PSST	0.75	0.10	0.04
Paintings on wooden support	AST	0.62	0.24	0.10
	PSST	0.97	0.01	0.01
Oil paintings on canvas	AST	0.48	0.38	0.10
	PSST	0.89	0.07	0.01
Paintings on paper (aquarelle)	AST	0.43	0.29	0.19
	PSST	0.89	0.06	0.03
Woven paintings (tapestry)	AST	0.71	0.19	0.05
	PSST	0.94	0.01	0.01
Mean	AST	0.50	0.33	0.11
Mean	PSST	0.90	0.07	0.03

The first research question deals with the misconceptions of PSST and AST regarding the materials of the most common forms of paintings. The analysis revealed that misconceptions among PSST are rarely detected because of their lack of knowledge regarding the materials of fine art paintings (Potočnik and Devetak, 2018). The answer to the second research question reveals that both groups of student teachers showed lower levels of confidence when solving tasks in which misconceptions were identified. Misconceptions regarding uncommon materials, such as paintings on wooden support or woven paintings, among AST and PSST could be understood as the result of a lack of experience with such artworks and, consequently, a lack of understanding. The results could be compared with the findings that experiences with works of fine art can aid in understanding the scientific characteristics of the materials (Hemraj-Benny and Beckford, 2012). AST have experience only with contemporary painting materials (industrial production, such as acrylic polymer emulsion), so misunderstandings of materials used in oil on canvas paintings are expected (Knut, 1999). The third research question is about student teachers' assessment of the difficulty of the presented tasks. Student teachers find the tasks difficult. Understanding the materials of fine art paintings is necessary for all the student teacher programmes that were selected for this study, especially since all tea-

chers should be generally educated (Batič, 2018, p. 47). Moreover, art teachers ought to understand the specific chemical characteristics of substances used for fine art products in their professional careers as teachers (Batič, 2003, p. 63). However, primary school teachers need to be competent in teaching science and art classes and, for that reason, should learn both aspects of the discussed issue (Potočnik and Devetak, 2018).

4 Conclusions

The research problem of this study was to determine the primary school student teachers (PSST) and the art student teachers (AST) misconceptions (MSC) about materials used in the most common forms of paintings, and how they assess the difficulty of the presented tasks.

We can conclude that more than half of the AST (56 %) and as much as 90 % of the PSST included in this study have insufficient knowledge about the materials of fine art paintings. The biggest misconception among AST can be emphasised in the context of the knowledge of the materials that compose paintings on wooden support. 24 % of AST misunderstand which materials make up a painting support – wood with a preparation layer of chalk or gesso mixed with collagen. Moreover, 14 % of AST misunderstood that the presented egg tempera binder consists of an egg. A misconception in the context of knowing the special features of egg tempera on wood is also seen among PSST (7 %). AST misunderstood materials that compose oil on canvas (5 %), and the materials of woven paintings (5 %). PSST show a similar misconception regarding the materials of woven paintings (tapestry). The study reveals that only 11 % of AST and 3 % of PSST find it easy to identify the materials of the fine art paintings presented in our research. According to the results, PSST find it difficult to define the materials in all the paintings, while AST find it very difficult to define the materials of the paintings on wooden support and woven paintings, where we detected the most misconceptions.

More emphasis should be placed on developing the understanding of fine art materials, regarding their possibilities, limitations and interdisciplinary use (in science and art education/heritage preservation education), according to the contemporary art and science curriculum guidelines. More emphasis should also be placed on the revival of old painting techniques which the student teachers would prepare by themselves (practical experience in the deep knowledge of the characteristics and needs of materials). Works of fine art could be a great tool for interdisciplinary approaches to teaching the contents of science and art (Greenberg and Patterson, 2008). Further research could focus in detail on the content of courses at the university level, on the in-class observation process (Batič, 2019, p. 61), where student teachers can learn about fine art materials from different fine art forms, such as sculptures, contemporary art forms (Zupančič and Čagran, p. 80) and the like. Similar research would also be important for other areas of fine art materials (e.g. sculpturing, graphics etc.). A course comprising interdisciplinary approaches should be developed for both groups of student teachers that participated in this research. This course should also be evaluated and optimised for effective competence development. It would also be important to determine the student teachers' competences relating to fine art materials and, in line with the results, develop appropriate

in-service educational programmes. The limitations of the study are the small samples of student teachers and that only student teachers in the last year of their university education were part of the research.

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Razumevanje pojmov o materialih umetniških slik pri prihodnjih učiteljih

Članek predstavlja raziskavo, katere cilj je bil identificirati razumevanje o materialih (na primerih izbranih umetniških slik), ki lahko vpliva na prihodnje učitelje razrednega pouka in likovne pedagoge pri vključevanju omenjenih vsebin v lastno pedagoško dejavnost.

Znanje o določenih slikarskih materialih lahko prihodnjim učiteljem osvetli možnosti in omejitve v okvirih prepoznavanja slikarskih tehnik, njihove uporabe, uvajanja interdisciplinarnega pedagoškega pristopa ter osveščanja učencev o skrbi za kulturno dediščino pri pouku likovne dejavnosti v osnovni šoli ter drugih podobnih vsebinah. Likovna dela so lahko primerno orodje za spodbujanje interesa in spoznavanje posebnih naravoslovnih vsebin pri učencih, na primer določanje kemijskih lastnosti egipčanskih artefaktov (Giménez, 2015), raziskovanje sestave različnih materialov predmetov v muzejskih zbirkah (Brown, 2014) ali materialov na freskah (Gaquere-Parker, 2012) in podobno. Prihodnji učitelji razrednega pouka (PURP) tako lahko pri naravoslovnih vsebinah spoznavajo posebnosti likovnih materialov in obratno ter s povezovanjem vsebin spoznanja uporabljajo pri likovnih dejavnostih (Potočnik in Devetak, 2018). Pristop poučevanja s kontekstom na splošno (Seel, 2012; Šindić, Pribišev Beleslin in Ratković, 2019) in v naravoslovju lahko zmanjša kognitivno obremenitev učencev, dijakov in študentov in predvsem spodbudi zanimanje za učenje (Parchmann, Blonder in Mroman, 2017). Nekatere raziskave kažejo, da študenti poglobijo razumevanje naravoslovnih pojmov pri uporabi konteksta pri poučevanju in učenju kemije ali naravoslovja na splošno (Leite, Dourado, Afonso idr., 2017). Naravoslovno znanje o likovnih materialih lahko koristi tudi prihodnjim likovnim pedagogom (PLP). Pomaga jim pri ozaveščanju o možnostih in omejitvah določenega likovnega materiala znotraj posameznih likovnih tehnik (Potočnik, 2017). Poznavanje materialov likovnih del je lahko pomembno tudi pri ozaveščanju o potrebah v okvirih skrbi za kulturno dediščino znotraj osnovnošolskega izobraževanja (Potočnik, 2018). Razredni učitelji in likovni pedagogi so naklonjeni vsebinam, povezanim z izobraževanjem o skrbi za kulturno dediščino, vendar te vsebine redko vključujejo v svoje likovne dejavnosti (Potočnik, 2017). Razen predstavitve različnih vrst kulturne dediščine učitelji pogosto ne posredujejo vsebin o primernih in neprimernih posegih v kulturno dediščino (Gaskell in Owen, 2005) ali o neponovljivosti in edinstvenosti materialov (Stanley-Price in King, 2009). Pri ocenjevanju stopnje študentovega razumevanja problematike v povezavi z likovnimi materiali lahko uporabimo različne diagnostične inštrumente. Eden od možnih načinov je uporaba diagnostičnih preizkusov znanja z večdelnimi nalogami izbirnega tipa, ki so v različnih oblikah in jih je mogoče uporabiti za prepoznavanje napačnih ali nepopolnih predstav prihodnjih

učiteljev (NP), kot predlaga Treagust (1988). Dvodelni preizkus znanja je zelo primeren za tovrstno raziskovanje, zato je bil uporabljen v številnih študijah na področju naravoslovnega izobraževanja (Odom in Barrow, 1995). Ta oblika ne more razlikovati pravilnih odzivov na podlagi tega, ali so ti posledica ugibanj ali neznanja oz. nerazumevanja vsebine. Takšne omejitve je mogoče znatno odpraviti z uporabo trodelnih ali štiridelnih diagnostičnih preizkusov znanja. V teh inštrumentih se doda ocena zaupanja (običajno na lestvici od zgolj ugibanja (1) do popolne gotovosti v pravilnost izbranega odgovora (6)). Če je stopnja zaupanja dodana obema stopnjama ločeno, je instrument štiridelni in kadar je potrebna ocena zaupanja v odgovor skupna tako za odgovor in razlago, je inštrument tridelni. Ker imajo ravni odgovorov in razlogov različno težavnostno stopnjo, je smiselno domnevati, da bodo imeli študenti različno stopnjo zaupanja za obe stopnji (Caleon in Subramaniam, 2010; Gurel, Eryilmaz in Mcdermott, 2015), in zato je štiridelni preizkus znanja smiseln.

Glavni namen te raziskave je bil identificirati napačna razumevanja prihodnjih učiteljev razrednega pouka (PURP) in prihodnjih likovnih pedagogov (PLP) o materialih (na primerih izbranih umetniških slik) ter definirati oceno težavnosti predstavljenih nalog.

Glede na problem raziskovanja so bila oblikovana tri raziskovalna vprašanja (RV):

- *RV1: Katera so napačna razumevanja PURP in PLP o materialih, ki definirajo najpogostejše vrste slikarskih del?*
- *RV2: Kako prepričani so PURP in PLP o razumevanju materialov najpogostejših vrst slikarskih del glede na napačne predstave?*
- *RV3: Kako obe skupini prihodnjih učiteljev ocenjujeta težavnost predstavljenih nalog?*

V raziskavi je sodelovalo 93 študentov Pedagoške fakultete Univerze v Ljubljani; 21 (22,6%) je bilo PLP in 72 (77,4%) PURP. Moških je bilo sedem (7,5%), povprečna starost pa je bila 22,8 leta (SD = 1,2 leta). Vsi študentje so bili v četrtem letniku dodiplomskega študija. Podatki so bili zbrani s Preizkusom poznavanja materialov umetniških slik (PPMUS). PPMUS je bil razvit kot diagnostični preizkus znanja z uporabo metodološkega okvira za ugotavljanje napačnih predstav prihodnjih učiteljev (NP), kot je predlagal Treagust (1988). PPMUS je vseboval šest nalog. Vsaka naloga prikazuje drugo slikarsko likovno delo, na primer: na kamnu, lesu, steni ali drugem materialu; vsaka naloga ima dva različna dela. V prvem delu so morali udeleženci določiti vrsto slikarskega nosilca, v drugem pa materiale slikanega sloja. V tretjem delu vsake postavke pa so udeleženci raziskave podali svoje mnenje o zahtevnosti predstavljenih vsebin.

Rezultati kažejo, da več kot polovici PLP (56%), ki so bili vključeni v raziskavo, primanjkuje znanja o materialih umetniških slik, PURP pa kar v 90%. Največ nerazumevanja PLP lahko vidimo v okviru materialov, ki sestavljajo slike na leseni podlagi. 24% PLP napačno razume, iz katerih materialov so sestavljeni nosilci za slikanje – tj. lesa, na katerega je nanešena plast krede ali gessa, pomešanega s kolagenom. Prav tako je 14% PLP napačno razumelo, da vezivo jajčne tempere sestavlja jajce. Nerazumevanje v kontekstu poznavanja posebnosti jajčne tempere na lesu je bilo opaženo tudi pri 7% PURP. PLP napačno razumejo sestavo materialov oljnih slik na platnu (5%) ter materialov tapiserij (tkanih slik) (5%). PURP izkazujejo podobno nerazumevanje materialov tkanih slik (tapiserij). Študija razkriva, da le 11% PLP in 3% PURP zlahka prepoznajo materiale umetniških slik, predstavljene v tej raziskavi. Glede na rezultate

so PURP težko opredeli materiale na vseh slikah, PLP pa materiale, ki sestavljajo slike na lesenem nosilcu (slike na lesu) in tapiserije.

Povzeti je mogoče, da je potrebno več poudarka nameniti razvijanju razumevanja likovnih materialov glede na možnosti, omejitve in v kontekstu interdisciplinarnosti (naravoslovje in likovna umetnost/osveščanje o skrbi za kulturo dediščino) v skladu s smernicami učnih načrtov za likovno vzgojo in naravoslovje. Večji poudarek je treba nameniti tudi likovnemu ustvarjanju z likovnimi materiali, ki jih prihodnji učitelji likovne umetnosti med študijem pripravljajo sami (s praktičnimi izkušnjami spoznavanje posebnosti in potreb določenih materialov). Likovna dela so lahko odlično orodje za interdisciplinarne pristope k poučevanju vsebin naravoslovja in likovne umetnosti (Greenberg in Patterson, 2008). Omejitve študije predstavlja majhen vzorec prihodnjih učiteljev in da so bili v raziskavo vključeni študenti četrtih (zadnjih) letnikov univerzitetnega izobraževanja. Nadaljnje raziskave bi se lahko podrobneje osredotočile na vsebinske analize univerzitetnih predmetov, vključevanje vsebin v dejavnosti šolskega okolja (Batič, 2019) ter na splošno na obravnavo materialov različnih likovnih področij oziroma v okvirih sodobnih likovnih praks (Zupančič in Čagran, 2016). Za obe skupini prihodnjih učiteljev, ki sta sodelovali v raziskavi, bi bilo smiselno oblikovati interdisciplinarne pristope ter jih ovrednotiti in optimizirati z namenom učinkovitega razvoja pedagoških kompetenc. Pomembno bi bilo tudi določiti kompetence bodočih učiteljev o likovnih materialih glede na vsebine aktualnih vzgojno-izobraževalnih programov osnovnošolskega izobraževanja.

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