Received: 9 September 2022, Accepted: 13 July 2023,
Published on-line as Recently Accepted Paper: October 2023 DOI: https://doi.org/10.26529/cepsj.1522

# The Real and the Virtual in the Spatial Perception of Education Students

Bea Tomšič Amon[1]

The article presents an investigation conducted with education students at the Faculty of Education, University of Ljubljana. The aim was to determine whether the perception and image of urban space have changed over the years, as the same questionnaire was used in 2001 and 2019. The students had to choose which of the eleven questions contained in the questionnaire they wanted to answer in order to describe their favourite place in the city. Questions that were not significant to them were left unanswered. Here we present a comparison between the results from 2001 and 2019, analysed quantitatively and qualitatively. Despite the fact that spatial perception involves all of the senses, it was the sense of touch, as opposed to vision, that was mentioned the least in both cases. Our original assumption was that with the advance of digital media, perception of real space would be more concise. However, there were a number of students in 2019 who expressed themselves more accurately than those in 2001, suggesting that students have developed a greater sensitivity towards space. The general findings suggest that we should rethink the pedagogical process and some suggestions are presented in the conclusion.

**Keywords:** multisensory experience, pedagogical strategies, real space, urban space perception, virtual space

1 Faculty of Education, University of Ljubljana, Slovenia; Bea.Tomsic@pef.uni-lj.si.

# Realno in virtualno dojemanje prostora bodočih učiteljev

Bea Tomšič Amon

Članek predstavlja raziskavo, ki smo jo opravili s študenti razrednega pouka Pedagoške fakultete Univerze v Ljubljani. Namen je bil ugotoviti, ali sta se dojemanje in podoba urbanega prostora skozi leta spreminjala, saj je bil isti vprašalnik uporabljen v letih 2001 in 2019. Vseboval je enajst vprašanj. Študentje so morali izbrati, na katera vprašanja želijo odgovoriti, da bi opisali svoj najljubši kraj v mestu, in pustiti neodgovorjene tiste, ki jim niso bili pomembni. Predstavljamo primerjavo med obema rezultatoma, tj. iz let 2001 in 2019. Analizirani so bili kvantitativno in kvalitativno. Čeprav prostorsko zaznavanje vključuje vsa čutila, je dotik v nasprotju z vidom najmanj omenjen v obeh primerih. Naša prvotna predpostavka je bila, da bo z napredkom digitalnih medijev dojemanje realnega prostora bolj jedrnato, vendar pa je bilo leta 2019 kar nekaj študentov, ki so se natančneje izražali kot leta 2001, kar kaže na to, da so razvili večjo občutljivost za prostor. Splošne ugotovitve nakazujejo, da bi morali ponovno razmisliti o pedagoškem procesu. Nekaj predlogov je podanih v zaključku.

**Ključne besede:** multisenzorna izkušnja, pedagoške strategije, realni prostor, percepcija urbanega prostora, virtualni prostor

## Introduction

Issues related to perception in general and in the educational process have been addressed in various issues of the CEPS Journal over the years, such as Teaching and Learning through Art (Tomšič Čerkez, 2015), Sustainable Development in Education (Devetak & Krek, 2013), Visualization in Education (Devetak, 2011), and Physical Space and the Process of Education (Tomšič Čerkez & Zupančič, 2011). These articles show how spatial awareness is present in different aspects of the educational process. The present article aims to discuss students' awareness of the qualities and characteristics of a space. By comparing the results of a questionnaire on this topic that was first conducted in 2001 and repeated in 2019, we wanted to determine whether there were any differences between the results of the first and the second evaluation.

The interest in conducting the research presented here arose when we noticed that the results of an exercise conducted by our students, inspired by the particular image of the city that each individual creates through his or her life experience, had changed significantly over the years. The exercise consisted of creating a graphic representation of the journey from home to college, highlighting the mental schema created by the daily serial repetition of this experience (Cullen, 2006, p. 17). The idea was to determine how different urban elements become landmarks in individual perception (Lynch, 1990, p. 9).

We began conducting the exercise in 2001 and over the years noticed that the individual schemas were losing richness. Many students perceived fewer elements and were less attentive to what was going on around them.

In an informal conversation with the students, we shared our observations with them and asked whether they could identify any reason why this had changed over the years. Many of them gave a very simple but logical answer: they are more focused on their digital devices, such as cell phones, and are no longer aware of their surroundings, which no longer occupy their attention as much. It is obvious that students' lives, mindsets and habits have changed a lot in the last two decades.

After this exercise, the students completed a questionnaire with eleven questions about the characteristics of their general spatial awareness. The aim was to determine which elements of space attract their attention in order to develop appropriate pedagogical strategies to improve spatial awareness based on this information.

***About the perception of space***

Perception in general assumes that the brain organises and interprets sensory information. The sources of information are elements in the space surrounding the observer. Before this information can be processed by the brain, it must first be received. This is done through receptors, which, in the case of humans, are the five basic senses: sight, hearing, smell, taste and touch.

A comparison of the perception of the environment by the human senses shows that the sense of sight predominates with 83%, followed by the sense of hearing with 11%, the sense of smell with 3.5%, the sense of touch with 1.5% and the sense of taste with 1% (Skaza, 2019, p. 4). Although the data presented show the overwhelming superiority of the sense of sight, the other senses should not be ignored. It is necessary to point out some characteristic features that distinguish the senses from each other. Since some receptors in the eye are responsible for colour detection and others for brightness detection, vision can be considered as a sense consisting of two separate senses. One needs to see much more than what our eyes perceive. One should hear and feel much more than what the receptors of our nervous system register.

At the same time, one must take into account the simultaneity of sensory stimuli related to pressure, temperature, balance (related to the labyrinth of the ear) and proprioception (the sense of the relative position of one's body parts and muscle tension) (Skaza, 2019, p. 4). On the other hand, in humans, even if a correct form of perception is observed, the content of the observation may not correspond to reality. It should also be taken into account that the involvement of each sense in the perceptual process varies, since some stimuli are more important for the receiver and others are merely complementary to the perceptions (Franchak, 2020).

Until relatively recently, perception was viewed as a largely passive and inevitable response to stimuli (Bintari, 2018). Although this notion is still valid, several studies add elements that complement and enrich the possible definitions of perception (Skaza, 2019; Bintari, 2018; Mitrache, 2013; Banaei et al. 2017).

Contemporary cognitive scientists explain perception as an active process in which the brain treats external stimuli as raw material that is shaped using our past experiences. Perceptions are shaped by three sets of influences: the physical properties of the stimuli, the relationship of the stimuli to their environment, and the conditions within the individual. With respect to stimuli, the last group of influences is the only reason why perception is a personal characteristic. The factors that influence this frame of reference include learning experiences, attitudes and personality (Bintari, 2018; Rocha, 2017), but perception is also influenced by several other factors, such as mood, physical

abilities to experience sensations, motivation, the social and physical context in which things are perceived, and the physical composition of the stimuli received (Bintari, 2018).

The view of the last two decades assumes that perception and its conceptualisation are not instantaneous. Rather, humans perceive first, think second and conceptualise or express their thoughts third (Franchak, 2020). Conceptually, the perceptual experience of urban space is related to sensory pleasure, a fleeting action or reaction triggered by a particular context. Generally, it is considered as an internal feeling perceived by each individual according to his or her personal interpretive filters, with cultural and social dimensions; however, it can also be recognised as a feeling shared by a community with a common denominator. Both the enjoyment and the appropriation of space by its inhabitants give it properties that complete its semantic and physical definition. The experience does not emanate directly from the space, but is created in part by the inhabitant, who changes, defines and completes it through his or her active and creative appropriation. The inhabitant is a producer and creator, rather than a mere spectator of an "empty container" (Coelho, 2015). Embodied experience means that we relate to space with all of our senses in motion, so that qualities that were considered secondary in the Cartesian tradition – such as colour, texture, the glint of sunlight on a windowpane, the echo of footsteps – become primary to space. Thus, spatial sensibility can be defined as the unconscious awareness of the transient fusion of sensory signals that make up the sense of place at a given moment (Mitrache, 2013, p. 545).

***The individual in space***

Our perception of space is not continuous, but partial and fragmentary. All of the senses are in action and the image we receive is a combination of them all with none predominating, except in moments of concentration on something specific. It is a multisensory experience. We are sure of the characteristics of some aspects of space, while other are less obvious (Rossi, 1984).

Through the selection and combination of materials, colours and shapes, the architect creates messages that we not only see, but also hear, smell and feel. Although we are often unaware of the quantity of stimuli, we nonetheless respond to them. We may perceive a living room as cool or warm, regardless of the actual temperature in the room; the acoustics of a large cathedral uplift and excite us, while a small chapel gives us a sense of intimacy; we may feel claustrophobic in an elevator; the acoustics of an open space can create a sense of freedom, but also of uncertainty; based on the characteristics of sounds in a room, we can guess whether we are in a public or private place. Although the variety of

sensory impressions helps to create an internal experience of an external reality, it is different for each user and depends on his or her previous experiences and sensitivity, as well as on culture (Blesser & Salter, 2009, pp. 2–3).

Pallasmaa (2011, p. 50) reinforces these ideas by saying that the image is generally considered from a purely visual point of view, whereas the qualitative characteristic of our senses is their tendency to integrate: the visual image is always accompanied by connotative effects that encompass all of the senses. The author highlights fundamental aspects of perceptual experience in space, such as individuality, subjectivity and originality. It is indeed a specific experience of each person. In *Art as Experience*, Dewey (1980) says that the properties of the senses – touch, taste, sight and hearing – have aesthetic qualities, not in isolation, but connected in a whole in which they interact, rather than functioning as separate entities. These entities are never related to themselves, colour to colour or sound to another sound.

On the other hand, the perception of space does not only refer to the material aspects. Tschumi (2001) argues that the disjunction between spaces and their use – between objects and events, being and meaning – is not accidental. This disjunction can turn into a confrontation in which a new relationship of desire and violence at the same time inevitably emerges (Tschumi, 2003).

Today, the world of architecture offers new experiences. A space without boundaries and almost without predictability is slowly replacing the traditional architectural space centred on the human body.

***Virtual space***

In recent years, many students have emphasised the increasing use of digital media resulting in reduced perception of the features of the environment. We therefore consider it necessary to review the importance of the virtual space in which they are immersed.

Vidler (2001, pp. 6–7) claims that the contemporary graphic effects of digital space owe a great deal to the representational experiments of modernism, in ways that imply important features in theorising about the virtual. It is true that although the forms and approaches of presentation techniques are multiplying, little has changed in the notion of space. Perspective is still the law in virtual and real environments. However, the simulation technique has changed, as has the location or position of the subject, the traditional viewer of the representation. Most questionable in this context is the self-generation of the computer program and its blindness to the presence of the viewer. The screen is located in a place that is indeterminate for the subject. On the other hand, the individuality of the gaze confirms the existence of different

"spectatorial techniques" and a particular attentional awareness in perception as a model for the way the subject builds a coherent conception of the world. The model is not only visual, as perception is not measured exclusively in terms of proximity or timeliness. According to Crary (2001, pp. 2–13), perception is a function that ensures activity, productivity, adaptability and predictability, as well as the social integration of the subject. He argues that a reconceptualisation of perception is therefore very important in the transformation of mass culture, and that it may be necessary to recognise that digitisation has changed the way we look at and see space. In terms of the importance of seeing, Grau (2003, p. 17) affirms that what we call reality is simply a statement of what we can actually perceive, what we see.

Dynamic digital imagery presupposes immersion in a virtual reality. Interactive media has transformed our notion of the image into a multisensory, interactive experiential space with a timeframe, as Grau points out. Most virtual realities, which are almost fully experienced, hermetically isolate the viewer from external visual impressions, widen the perspective from real space to illusion space, pay attention to scale correspondence and colour, and use effects to make the image appear like the real source. The term "virtual reality" is a paradox, a contradiction in terms, describing a space composed of illusory sensory directions. Furthermore, and for this very reason, virtual reality is essentially immersive (Grau, 2003).

Digitisation has also changed the way we perceive our bodies. It promises the possibility of interaction between one or more subjects, spatially dispersed but able to interact with each other in a shared environment through a computer terminal, acting invasively in increasingly complex situations characterised by increasingly hybrid and subtly designed technology (Hoelzl, 2021, p. 19). Much of the excitement generated by virtual reality has to do with the expendability or redundancy of the body. It is a unique and unchanging body that is much more liberal than restrictive, argues Grosz (2001, p. 51).

It is in this broad context that we can understand and frame the importance of the research we present below: major changes in the conceptualisation, perception and evaluation of events in real space, parallel to major transformations in the pedagogical sphere, the emergence of a new "spectator" and rapid functional changes in his or her life and self-perception.

The main problem we wanted to investigate was a comparison between the results of the questionnaire that was first conducted in 2001 and repeated in 2019, in order to verify whether there were differences between the results of the first and the second evaluation. We wanted to identify which aspects of spatial perception had changed and which had not. In addition, we sought

to determine why there were differences and how the experiences of virtual and real space interacted in the students' perceptions of them. In conclusion, there is a need to determine which pedagogical tools can be used to reshape and enrich these worldviews despite the growing role that technology plays in students' lives.

## Method

In order to answer the main question of the investigation, we needed to obtain a more detailed picture of the situation. For this purpose, we distributed a questionnaire with eleven questions. The students had to choose which questions to answer in order to describe their favourite place in the city, but were instructed not to answer questions that they felt were unimportant. Here we present a comparison between the results of the questionnaire when it was first administered in 2001 and the results obtained in 2019, thus enabling us to identify any differences.

### *Sample*

In both 2001 and 2019, the questionnaire was administered to 60 final-year education students at the Faculty of Education, University of Ljubljana. The sample included students from different cities of Slovenia, and special attention was paid to the competencies they had acquired, as the second group studied after the introduction of the Bologna reform (Sagadin, 1997, p. 216).

### *Research design and instruments*

The questionnaire was completed in written form, which allowed us to retain the material from 2001 and compare it with the responses obtained almost two decades later. In both cases, it consisted of following the general instruction: "Imagine describing your favourite place in your city to a blind friend. Answer only the questions that you think most convincingly, clearly and completely describe that place." We should emphasise that the goal of alluding to blindness was to motivate students to think beyond the traditional five-senses-based approach to remembering space. It was not a limitation. This detail was explained to the students before the work began. Each student was asked eleven questions related to each of the typical senses for estimating and perceiving space and spatial features:

1. What can you hear?
2. What can you smell?
3. What can you feel with your fingertips?

4. How would you describe the temperature of the space?
5. How would you describe the light in the space?
6. How would you describe the humidity in the space?
7. How would you describe the space in general?
8. What colours do you perceive?
9. Describe your sense of size. Do you feel constrained or limited in any way?
10. Do you feel free in this place?
11. Would you suggest anything else or add anything to your description?

The questionnaire had been previously tested in a pilot group of 20 students from a statistically similar population. The nature of the responses in the pilot test allowed for the construction of a scale and the elaboration of categories to classify the responses. The responses were analysed in two phases: first, the number of positive responses was considered, i.e., the number and type of questions each student answered because they felt the information was important in describing the place, then the content of the positive responses and the type of information given were analysed. Five categories were developed to classify the responses:

A. Narrow objective description: no more than two objective descriptive elements are mentioned.
B. Broad objective description: more than two objective descriptive elements are mentioned.
C. Narrow subjective description: no more than two subjective elements are mentioned.
D. Broad subjective description: more than two subjective elements are mentioned.
E. Positive or negative answer without description.

It is important to indicate the meaning of objective and subjective adjectives in the classification. Objective adjectives refer to facts that can be measured, numbered or clearly specified (such as colour, name and type of materials used, etc.), whereas subjective adjectives are descriptions in which adjectives predominate, as in the case of very personal, metaphorical or non-measurable events (e.g., the statement "In this place I feel like a bird"). The number of items for each category was determined based on the results of the pilot test. Three evaluators assessed the answers to ensure the validity and objectivity of the evaluation, and the results were analysed with descriptive statistics.

## Results

Table 1 shows the comparative results expressed as percentages for each of the questions in the first phase of the study in 2001 and the second phase in 2019. Approximate figures are used in the subsequent text, as the detailed totals and percentages are clearly presented in the table.

**Table 1**

*Comparative results*

| Questions | Year | Answers | |
|---|---|---|---|
| | | Results | |
| | | Percentage of answered questions | Percentage of unanswered questions |
| 1. What can you hear? | 2001 | 65.13 | 34.87 |
| | 2019 | 75.15 | 24.85 |
| 2. What can you smell? | 2001 | 56.78 | 43.22 |
| | 2019 | 61.79 | 38.21 |
| 3. What can you feel with your fingertips? | 2001 | 41.75 | 58.25 |
| | 2019 | 35.07 | 64.93 |
| 4. How would you describe the temperature of the space? | 2001 | 65.13 | 34.87 |
| | 2019 | 68.47 | 31.53 |
| 5. How would you describe the light in the space? | 2001 | 63.46 | 36.54 |
| | 2019 | 81.83 | 18.17 |
| 6. How would you describe the humidity in the space? | 2001 | 43.42 | 56.58 |
| | 2019 | 56.78 | 43.22 |
| 7. How would you describe the space in general? | 2001 | 75.15 | 24.85 |
| | 2019 | 56.78 | 43.22 |
| 8. What colours do you perceive? | 2001 | 85.17 | 14.83 |
| | 2019 | 80.16 | 19.84 |
| 9. Describe your sense of size. Do you feel constrained or limited in any way? | 2001 | 83.50 | 16.50 |
| | 2019 | 85.17 | 14.83 |
| 10. Do you feel free in this place? | 2001 | 88.51 | 11.49 |
| | 2019 | 75.15 | 24.85 |
| 11. Would you suggest anything else or add anything to your description? | 2001 | 33.40 | 66.60 |
| | 2019 | 25.05 | 74.95 |

Most of the students considered the information about the sense of touch irrelevant when describing a space: slightly more than 58% of the students did not answer the question in 2001, while the results were even higher in 2019, with almost 65% not answering. Similarly, the majority of the students, slightly more than 56%, did not answer the question about the description of the humidity of the place in 2001. In 2019, the number of students not answering this question

decreased by more than 10%. The question about the sense of smell was answered by almost 56% of the students in 2001 and decreased by almost 10% in 2019.

The above figures are relevant because they are different from the results for the topics related to the sense of hearing and the description of the temperature and light in the space. In these cases, an average of 65% of the students answered the questions in 2001, compared to 75% in 2019. The highest scores were for the question about the colours and general characteristics of the space. In 2001, an average of 86% of the students answered these questions, whereas an average of 77% responded to these questions in 2019. The two questions related to the feeling of size or limitation in space and to the feeling of freedom in general were answered by a high number of respondents: about 83% for the first question in 2001 and 85% in 2019. The question about the feeling of freedom in the place was answered by 88% of the students in 2001, but only about 75% in 2019. Just over 66% of the students did not answer in 2001 when asked if they would add anything to the description, and a much higher percentage, nearly 75%, did not answer in 2019.

Table 2 shows the relationship between the different ratings. The type of data refers to the percentage (%) and the number of students who responded in a particular way (*N*). The letters refer to each of the categories analysed.

**Table 2**

*The relationship between the different ratings.*

| Questions | Year | Answers | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Type of data | Positive responses in the first phase | Categories | | | | |
| | | | | A | B | C | D | E |
| 1. What can you hear? | 2001 | % | 65.13 | 81.92 | 12.8 | 0.00 | 2.54 | 2.54 |
| | | *N* | 39 | 32 | 5 | 0 | 1 | 1 |
| | 2019 | % | 75.15 | 86.58 | 6.66 | 2.22 | 4.44 | 0.00 |
| | | *N* | 45 | 39 | 3 | 1 | 2 | 0 |
| 2. What can you smell? | 2001 | % | 56.78 | 82.32 | 8.82 | 5.88 | 0.00 | 2.94 |
| | | *N* | 34 | 28 | 3 | 2 | 0 | 1 |
| | 2019 | % | 61.79 | 81.00 | 5.40 | 2.70 | 8.10 | 2.70 |
| | | *N* | 37 | 30 | 2 | 1 | 3 | 1 |
| 3. What can you feel with your fingertips? | 2001 | % | 41.75 | 87.00 | 8.00 | 0.00 | 4.00 | 4.00 |
| | | *N* | 25 | 21 | 2 | 0 | 1 | 1 |
| | 2019 | % | 35.07 | 71.40 | 14.28 | 0.00 | 9.52 | 4.76 |
| | | *N* | 21 | 15 | 3 | 0 | 2 | 1 |
| 4. How would you describe the temperature of the space? | 2001 | % | 65.13 | 74.24 | 12.80 | 2.56 | 0.00 | 10.24 |
| | | *N* | 39 | 29 | 5 | 1 | 0 | 4 |
| | 2019 | % | 68.47 | 78.08 | 9.76 | 2.88 | 7.32 | 0.00 |
| | | *N* | 41 | 32 | 4 | 2 | 3 | 0 |

| Questions | Year | Answers | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Type of data | Positive responses in the first phase | Categories | | | | |
| | | | | A | B | C | D | E |
| 5. How would you describe the light in the space? | 2001 | % | 63.46 | 89.42 | 7.89 | 0.00 | 2.63 | 0.00 |
| | | *N* | 38 | 34 | 3 | 0 | 1 | 0 |
| | 2019 | % | 81.83 | 89.76 | 8.16 | 2.04 | 0.00 | 0.00 |
| | | *N* | 49 | 44 | 4 | 1 | 0 | 0 |
| 6. How would you describe the humidity in the space? | 2001 | % | 43.42 | 84.48 | 7.68 | 0.00 | 3.84 | 0.00 |
| | | *N* | 26 | 22 | 3 | 0 | 1 | 0 |
| | 2019 | % | 56.78 | 91.14 | 5.88 | 2.94 | 0.00 | 0.00 |
| | | *N* | 34 | 31 | 2 | 1 | 0 | 0 |
| 7. How would you describe the space in general? | 2001 | % | 75.15 | 66.60 | 31.08 | 0.00 | 2.22 | 0.00 |
| | | *N* | 45 | 30 | 14 | 0 | 1 | 0 |
| | 2019 | % | 56.78 | 49.98 | 20.58 | 14.70 | 11.76 | 2.94 |
| | | *N* | 34 | 17 | 7 | 5 | 4 | 1 |
| 8. What colours do you perceive? | 2001 | % | 85.17 | 82.32 | 15.68 | 0.00 | 1.96 | 0.00 |
| | | *N* | 51 | 42 | 8 | 0 | 1 | 0 |
| | 2019 | % | 80.16 | 79.04 | 20.80 | 0.00 | 0.00 | 0.00 |
| | | *N* | 48 | 38 | 10 | 0 | 0 | 0 |
| 9. Describe your sense of size. Do you feel constrained or limited in any way? | 2001 | % | 83.50 | 50.00 | 8.00 | 0.00 | 0.00 | 42.00 |
| | | *N* | 50 | 25 | 4 | 0 | 0 | 21 |
| | 2019 | % | 85.17 | 58.80 | 13.72 | 7.84 | 9.80 | 9.80 |
| | | *N* | 51 | 30 | 7 | 4 | 5 | 5 |
| 10. Do you feel free in this place? | 2001 | % | 88.51 | 58.28 | 3.76 | 3.76 | 0.00 | 33.84 |
| | | *N* | 53 | 31 | 2 | 2 | 0 | 18 |
| | 2019 | % | 75.15 | 59.94 | 15.54 | 6.66 | 8.88 | 8.88 |
| | | *N* | 45 | 27 | 7 | 3 | 4 | 4 |
| 11. Would you suggest anything else or add anything to your description? | 2001 | % | 33.40 | 25.00 | 5.00 | 5.00 | 0.00 | 65.00 |
| | | *N* | 20 | 5 | 1 | 1 | 0 | 13 |
| | 2019 | % | 25.05 | 26.64 | 0.00 | 6.66 | 0.00 | 66.60 |
| | | *N* | 15 | 4 | 0 | 1 | 0 | 10 |

Source: self-generated table.

As shown in Table 2, in the first implementation of the questionnaire in 2001, the majority of the students answered almost all of the questions with concrete facts; only the questions about colours and the description of the space had a better average. In the questionnaire administered in 2019, the majority of the students answered almost all of the questions with concrete facts, just as the students had 18 years earlier, but with a lower average of narrow descriptions than before, and with more subjective descriptions. In some cases, there was a much wider spread of results. The question related to hearing scored highly, with just over 88% in the narrow objective description category. The questions on smell and touch received more than 80% in 2001, while in 2019 the score for the sense of touch decreased by slightly more than 10%. The highest scores in this category were obtained in the questions describing the light at the site

and the humidity, with just over 90%. These results remained about the same in 2019. The results for questions about temperature, description of the space and colours were slightly lower in 2001, averaging 65%. In 2019, the scores for the questions on description of space and colours were more than 10% lower than two decades earlier. The lowest scores were for the last three questions on sense of size, sense of freedom and possible suggestions, with scores of 50%, 58.28% and 25%, respectively, in 2001. In 2019, the scores fell by slightly more than 10% compared to the first time the study was conducted. The questions about the description of space and colours obtained the best results in the category of broad objective description: more than two descriptive facts were mentioned. In each case, the results were around 30%. In 2019, the result of the question on colours increased by 5% and the description of space decreased by 10%. The questions on sense of size, the sense of freedom in the space and possible suggestions scored the best within the category of positive or negative responses without description. In 2001, the results were 42%, 33.84% and 65%, respectively. In 2019, the results decreased significantly only for the question about the feeling of freedom in space; the other results are comparable to those of 2001.

Relatively high results were also obtained for the remaining questions on sense of hearing, smell, touch, temperature, light in the space, humidity, sense of size, and possible suggestions in the aforementioned category, while touch and humidity had lower results in 2019. The highest scores for the category of narrow subjective description were reported for the questions on the sense of smell, touch, feeling of freedom in the place, and additional suggestions, with not a single student answering in this way in 2001. In 2019, the results are generally similar, with the exception of the question about the temperature in the space, which was answered by 4 students, or about 10%. The highest scores in the broad subjective description category are for the questions about hearing, humidity, general description of the space, colours, and occasional suggestions by students, with about 2% each in 2001. In 2019, the results are similar.

In general, when comparing the data from the two years, differences appear in relation to the third question on the sense of touch. In 2019, broad objective descriptions increase and narrow subjective descriptions occur, while 5% of broad subjective descriptions also occur, an increase of nearly 4.5%.

The largest differences between the two implementations of the questionnaire are evident in the questions related to the feeling of size, confinement or freedom in the space. The question about describing space received nearly 15% more in the narrow objective description category in 2019. In the broad objective description category, there was a 10% increase in the first round. Again, slightly more than 10% of the responses are narrow subjective descriptions and

broad subjective descriptions, which was not the case in 2001. In other words, the number of subjective descriptions increased significantly. There are almost no differences in the answers related to the question about colours, but remarkable differences can be seen in the answers to the question about the feeling of size and limitation in space. In 2001, about 50% of the students chose this question with narrow objective descriptions, while in 2019, 60% did the same. For the question about feeling free in the space, the number of responses with narrow objective descriptions is about 60% in both cases, while there are significant differences in the other categories. In 2001, the categories broad objective description, narrow subjective description and broad subjective description have minimum percentages, together amounting to about 7%, while the rest are responses without description. In 2019, however, there is an increase in the categories broad objective description, narrow subjective description, broad subjective description, and responses without description. When asked about the possibility of adding data, in both cases 25% of the responses are registered with a narrow objective description, while the responses without description reach slightly more than 60% in both implementations of the questionnaire.

## Discussion

In general, 36.24% of the students in 2001 and 36.17% in 2019 did not answer the proposed questions. In both 2001 and 2019, the highest numbers of unanswered questions were registered in the sense of touch and humidity of the place. In 2019, the questions about the shape of the space and the temperature were added to the list, while the question about the sense of smell is not far from these results either. However, it is not possible to draw definitive conclusions, especially in view of the increasing use of modern digital media and the low level of awareness about the physical senses.

The relevance of the sense of touch for describing the space is not clear. It could be argued that there is a kind of linguistic play when we question something that we do not consciously talk about but simply feel, and that it is therefore difficult to recognise that it concerns us. The same applies to the question of humidity. It is obvious that the highest proportion of positive answers corresponds to very circumscribed, objective and concrete questions, such as the description of colours. Moreover, this is directly related to vision, a sense that seems to predominate in the acquisition of information from the environment (Skaza, 2019).

The figures describing the qualitative way in which students responded to the questions are interesting. Despite the fact that many questions were not selected, there is a relative number of students who are certainly more sensitive

and gave more information in relation to almost all of the questions. This includes the question about colours in 2001 and the questions about the description of the space and the feeling of freedom or oppression in the space in 2019, which indicate personal feelings in the space, compared to the rest of the results. It is also interesting to note that the highest scores in subjective responses were obtained in the questions about smell and humidity, which are actually intangible phenomena.

The set of questions was particularly interesting and important because it focused on the characteristics of the perception of space from the point of view of individual students. This is confirmed by the ideas of Bintari (2018), Rocha (2017) and Skaza (2019) about the individuality of perception and the influence of several factors that affect its interpretation. Pallasmaa (2008) and Lynch (1990) also confirm this when they note that the experience of space is an individual experience of each observer. Not only did the majority of the respondents choose not to answer the question about the sense of touch, they also generally did not answer questions related to senses other than vision. It can be concluded that, according to the majority of the respondents, the characteristics of a place are perceived exclusively through the sense of sight, which confirms the traditional idea of the primacy of this sense in the perception of space (Skaza, 2019). The other senses are largely excluded, at least consciously, from this experience. The contradiction between these two notions suggests that we have been taught to value vision to the detriment of the other senses when perceiving space, which is also confirmed by theorists of digital or virtual space (Crary, 2001; Grau, 2003; Mitrache, 2013; Franchak, 2020). The results regarding the number of students choosing specific questions have not changed over a period of almost two decades, with the exception of the question describing space in general. It is noteworthy that in several cases the answers are more complex and comprehensive, as well as more subjective. This suggests that perceptions have diversified, that a minimum number of students have undergone a growth process over time in which they have developed a greater empathy for the characteristics of space and seek to describe it through individual experiences that they can draw from their memories. Immersion in virtual space is attractive. The giant strides of software development, giving us more options every day, simultaneously force us to use all of the digital media available to us more and more. Our daily life has reliably proven this since the beginning of the coronavirus epidemic. Teaching all classes remotely required us to examine how and by what means we can plan classes.

Immersion in virtual space cannot compete with the experience of real 3D space, which appeals to all of the senses, not just the eye. We remain a real

body inhabiting the real space we have created over multiple generations. From the research results, we can deduce a process that, although very slow, makes clear the awareness of the difference between the virtual and real experience.

Regarding the limitations of the study, the results cannot be generalised. The group of participants would have to be larger to obtain more accurate results. Since we used material from 2001, when 60 students answered the questionnaire, we had to repeat the conditions of the study in order to compare the groups. In order to obtain the relevant information in the most reliable and valid way, no changes could be made. It is possible that some students gave their answers in more or less detail, which is beyond our control. We can only refer to described patterns of behaviour or tendencies, which are difficult to describe with absolute precision. Nonetheless, the questions were clear and the analysis of the results reflects exactly what was asked of the students.

## Conclusion

The figures that emerged from the evaluation of the presented test and the comparison of the data over a period of almost two decades could be a kind of recognition of the fact that, in general, little attention is paid to the development and enrichment of spatial perception and the detailed observation of phenomena in programmes at all levels of education. It is particularly interesting that these results show a kind of lack of integration between the experiences of the different senses. Spaces are not necessarily places defined by experiences, memories, individual and collective meanings. Spatial intelligence needs to be complemented by spatial sensitivity, and both need to be equally important in education. In our opinion, this is a good starting point to think about the development and implementation of specific strategies in the field of art education and in other disciplines, since a rich perception of space and other phenomena around us is important in mastering any field of study. We think that, in the future, it will be important to pay attention to the pedagogical process in real space and to propose interventions in school spaces so that students identify positive or negative features of the spaces and try to improve them. They should use photography to identify details and make authentic and detailed observations. In this way, education students are also made aware of their individual responsibility for improving the educational environment in which they spend an important part of their daily lives together with their colleagues. We believe that it is necessary to teach perceptiveness in order to create ethical awareness.

We are often reluctant to leave the safe space of the classroom, but we have found that this is not enough to achieve certain goals. Digital media that

fail to provide multi-sensory experiences are also ineffective. The experience of space and the development of visualisation go beyond the often divergent forms of observation that individual disciplines propose (Ware, 2004). In this case, it is necessary for education students to be able to highlight and be sensitive towards the differences, as they will need to teach all disciplines in their careers as primary school teachers. Clearly, there is a need to develop visualisation strategies in order to optimise the way each individual perceives the visual information in the different areas of study. This would lead to greater clarity, usefulness, richness and specificity. As Banaei et al. (2017) note, perception is something that can be learned. When we recognise things in our environment, we gain experience, and this experience in turn improves our perception. Our perception of objects depends on our previous experience with them, and experience sharpens our ability to recognise details. The more we learn about objects and the more familiar they become, the more details we recognise. One of the ideas that emerged from the research findings is that changes and developments in the educational field are very slow processes that require constant review and development of appropriate strategies. In many cases, and considering the variety of means at our disposal in the didactic field, we are nevertheless slow in their application. We are often forced to experiment and improvise. For a future investigation and presentation, we need to develop didactic solutions that promote and definitively include real spatial experience. We can conclude that, in this case, making students aware of their feelings by verbalising and answering questions was a positive and content-rich start.

We live in a time when the image of our environment is changing drastically and becoming increasingly globalised, in many cases unfortunately losing the authenticity and uniqueness associated with place and space. The rapid development and widespread use of digital technologies should not be an obstacle to perceptual learning; on the contrary, we need to make it clear to our students that elements of real and virtual space enrich and sensitise us.

Space is a carrier of various socio-cultural meanings and functions, and we should familiarise students with the role of the individual as an active user and shaper of the place in which he or she lives. In this way, we enable the environment to take on new meaning in the lives of students and become a starting point for creative learning.

## Disclosure statement

The author has no conflict of interest to declare.

## References


Banaei, M., Hatami, J., Yazdanfar, A., & Gramann, K. (2017). Walking through architectural spaces: The impact of interior forms on human brain dynamics. *Frontiers in Human neuroscience, 11*, 360–373.

Bello, H. (2020). *Internet de los sentidos: Qué es y cómo cambiará nuestra vida* [Internet of the senses: What it is and how it will change our life]. IEBS Press. https://www.iebschool.com/blog/internet-de-los-sentidos-tecnologia

Bintari, B. (2018). *Spatial perception strategy in orientation design: How the environment creates harmony between human made and nature to help people to orientate*. Duta Wacana Christian University, Yakarta, Indonesia. https://www.irbnet.de/daten/iconda/CIB_DC22871.pdf

Blesser, B., & Salter, L. R. (2007). *Spaces speak, are you listening? Experiencing aural architecture.* The MIT Press.

Coelho, C. (2015). The living experience as a design content: From concept to appropriation. *Ambiances 1,* 1–19. Direction Générale des Patrimoines – DAPA.

Crary, J. (2001). *Suspensions of perception – attention, spectacle, and modern culture*. The MIT Press.

Cullen, G. (2006). *The concise townscape*. Elsevier.

Devetak, I. (2011). Visualization in education. *Center for Educational Policy Studies Journal*, *1*(4), 5–9.

Devetak, I., & Krek, J. (2013). Sustainable development in education (editorial). *Center for Educational Policy Studies Journal*, *3*(1), 5–8.

Dewey, J. (1980). *Art as experience*. Perigee Books.

Franchak, J. M. (2020). Looking with the head and eyes. In J. B. Wagman, & J. C. Blau (Eds.), *Perception as information detection, reflections on Gibson's ecological approach to visual perception* (pp. 205–220). Routledge.

Grau, O. (2003). *Virtual art. From illusion to immersion*. The MIT Press.

Grosz, E. (2001). *Architecture from the outside, essays on virtual and real space.* The MIT Press.

Hoelzl, I. (2021). Image-transaction, what you see is not what you get. In O. Grau, & I. Hinterwaldner (Eds.), *Retracing political dimensions, strategies in contemporary new media art* (pp. 19–32). Walter De Gruyter GmbH.

Lynch, K. (1990). *The image of the city* (2nd ed.). The MIT Press.

Mitrache, A. (2013). Spatial sensibility in architectural education. *Procedia - Social and Behavioral Sciences, 93*, 544–548.

Pallasmaa, J. (2011). *The embodied image. Imagination and imagery in architecture*. John Wiley & Sons Ltd.

Pérez-Martínez, A. (2020). *La revolución sensorial de la tecnología* [The sensorial revolution of technology]. Universidad del Pacífico, Lima, Perú. https://www.bbvaopenmind.com/tecnologia/futuro/la-revolucion-sensorial-de-la-tecnologia

Rocha, T. (2017, April 6). *Spatial perception and architecture.* tomasrochavision.com. https://www.tomasrochavision.com/percepcion-visual/2017

Rossi, A. (1984). *The architecture of the city*. The MIT Press.

Sagadin, J. (1997). *Poglavja iz metodologije pedagoškega raziskovanja* [Chapters from pedagogical research methodology]. Educational Research Institute, University of Ljubljana.

Skaza, M. (2019). Architecture as a consequence of perception. *IOP conference series: Materials science and engineering*, *471*(2), 1–8. https://doi.org/10.1088/1757-899X/471/2/022033

Tomšič Čerkez, B. (2015). Teaching and learning through art. *Center for Educational Policy Studies Journal*, *5*(3), 5–9.

Tomšič Čerkez, B., & Zupančič, D. (2011). Physical space and the process of education. *Center for Educational Policy Studies Journal*, *1*(2), 5–9.

Tschumi, B. (2001). *Architecture and disjunction*. The MIT Press.

Tschumi, B. & Cheng, I. (2003). *The state of architecture at the beginning of the 21st century*. The Monacelli Press, Inc.

Vidler, A. (2001). *Warped space – art, architecture, and anxiety in modern culture*. The MIT Press.

Ware, C. (2004). *Information, visualization, perception for design*. Morgan Kaufmann Publishers.

## Biographical note

**Bea Tomšič Amon**, PhD, is an assistant professor in the field of didactics of fine arts at the Faculty of Education at University of Ljubljana, Slovenia. Her research interests include problem solving and experience learning in art education, the role of didactical material, the relationship between art materials and art motifs in the different fields of expression. Her special interest is architectural design in elementary education.