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THE ROLE OF EDUCATIONAL SPACE COLOUR DESIGN IN FOSTERING ORGANISATIONAL CULTURE AND STUDENT SOCIO-COGNITIVE-EMOTIONAL FUNCTIONING*

Introduction: The physical space of a school, understood as a visible dimension of organisational culture, contributes to the learning environment. One of its important, yet often marginalised components is colour (the colours of walls, furnishings, and teaching materials), which can influence stimulation, mood, and cognitive processes.
Research Aim: The aim of this article is to review and synthesise the results of empirical research on the impact of colours (warm and cold, with varying saturation and brightness) on emotional, social, and cognitive functioning of students, as well as to indicate implications for conscious management of educational space.
Evidence-based Facts: The collected research shows that colour can modify attention, memory, and task performance, but the effects depend on the context (task type and difficulty, colour parameters, lighting) and the characteristics of the subjects (age, gender, individual reactivity, and preferences). In many studies, cool shades (especially blue and green) were associated with calmness, improved well-being, and support for longer concentration, while warm colours (e.g., reds and yellows) were more often associated with increased arousal and better performance on simple and detail-oriented tasks. At the same time, the results are not always consistent, and some studies have methodological limitations (e.g., small samples, lack of control groups).
Summary: Colour schemes should be treated as a tool for designing the learning environment and an element of shaping school culture. The choice of colours should be consistent with teaching objectives and student needs, and design decisions should be based on evidence and supplemented by further, well-controlled research.

Keywords: classroom colour scheme, education, organisational culture, cognitive-emotional-social functioning

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INTRODUCTION

The physical space of educational institutions can be treated as a material symbol of the school's organisational culture. Therefore, conscious design and arrangement of the school (including the choice of colours) becomes one of the tools for shaping this culture. In his classic definition, Jacques (1951) emphasised that organisational culture is an established way of thinking and acting that employees must learn and accept in order to be recognised as full members of the organisation (Sikorski, 2002). In education, school culture consists of, among other things, patterns and values transmitted in teaching and upbringing, common rituals (class and school), and the way the space is arranged (Stolp & Smith, 1995).

Deal and Peterson (1990) note that school culture can be seen as soon as one enters the school: it is revealed in communication, but also in the space, which displays accepted values and norms, as well as important symbols. These may be personal (e.g., patrons, distinguished students, and teachers presented as role models; see Sikorski, 2002) or behavioural (i.e., related to upheld traditions and rituals and how the organisation functions on a daily basis: how a routine day goes, how people communicate and make decisions; see Kinal, 2022). In school, behavioural symbols include, among others, the teacher's style of conducting lessons, the way the headteacher and teachers conduct meetings, as well as customs, holidays and ceremonies considered important.

Schein (2009) distinguishes three levels in organisational culture:Top of form-Bottom of form 1) the level of cultural assumptions, which is the least visible element for external stakeholders and is often unconscious to employees, resulting from the assumptions adopted by the founder of the organisation (in the case of a school, this may be the headteacher; at class level, it may be the teacher – see Schein, 2009); 2) the level of norms and values, which can be observed by analysing the organisation's strategy, goals, and philosophy (in the context of an educational institution, this may include the institution's statutes, documentation, mission, and priority tasks, and at the classroom level – adopted codes and teachers; educational and teaching plans; see Schein, 2009); 3) the level of artefacts, which is most visible to people outside the institution and is contained in all external stakeholders' observations regarding space, communication with employees, decorations, etc. (in the case of schools, the colour scheme, spatial arrangement, notice boards, architectural space, decorations, etc. should be taken into account). The artefact level may have a secondary impact on the norms and values promoted within the institution (Schein, 2009).

As Aniszewska (2007) points out, an organisation uses symbols such as spatial architecture, logos, communication methods and behaviours (traditions, customs, and ceremonies) to "visualise its organisational culture" (p. 15). For this reason, educational architecture should be analysed not only in terms of learning effectiveness or the mental well-being of students and teachers, but also as an area requiring

responsible and conscious management on the part of teachers and headteachers. Approaching the shaping of school space as a tool for developing a specific type of organisational culture assumes the pursuit of consistency in architectural solutions and can lead to intended changes in communication and interpersonal relations. The literature on the subject distinguishes many typologies of organisational cultures.

Harrison and Handy (see Kinal, 2022) distinguished four cultures: power (highly centralised and poorly formalised), tasks (low centralisation, high formalisation, based on teamwork), roles (highly formalised and centralised, Dorczak, 2013) associates it with bureaucratic culture), and person (Kinal, 2022) lists those as weak centralisation and formalisation). Deal and Kennedy (see Czerniachowicz, 2008) distinguished four cultures, using the degree of risk taken and the speed of feedback as criteria for classification: risk-takers, routine-followers, balanced and individualists. Cameron and Quinn (2006) chose as their criteria flexibility and freedom of action/stability and control, as well as orientation towards the environment and diversity/orientation towards internal matters and integration, distinguishing between the following cultures: clan, adhocracy, hierarchy and market.

Focusing on the typical school environment, Schoen and Teddlie (see Tłuściak-Deliowska & Dereniowska, 2018) developed four dimensions of organisational cultures. The first is professionally oriented and relates to commitment to personal development and development of the entire teaching staff. Indicators include personal development plans, teacher training, degree of community spirit, degree of professionalism and support for employees.

The second dimension is organisationally oriented. It supports change through formal and informal organisational structures, with indicators including leadership style, communication structure, institutional mission, traditions and norms (Tłuściak-Deliowska & Dereniowska, 2018). Next comes the dimension that is focused on the quality of the learning environment. It is about the degree of student engagement in active and conscious knowledge acquisition. Indicators in this dimension include assessment methods, individualisation, and progress monitoring (Tłuściak-Deliowska & Dereniowska, 2018). The final dimension is student-oriented and centres around the extent to which the norms and values adopted in the school enable each student to achieve educational success. Its indicators include support provided to students, methods of motivation, as well as balance between standardisation and individualisation (Tłuściak-Deliowska & Dereniowska, 2018).

The authors of the above typologies do not distinguish the role of architectural space in shaping the organisational culture of an institution in their descriptions, but the organisational culture assessment sheets contain the following statements, which indicate that space is one of the elements that determine the organisational culture of an institution: "I create an atmosphere conducive to engagement and participation in decision-making" (Cameron & Quinn, 2006, p. 159), "I create working conditions so that both colleagues in equivalent positions and subordinates learn from each other

and support each other in their development" (Cameron & Quinn, 2006, p. 161), while Schoen, analysing the strengths and weaknesses of studied schools, cites as a strength the fact that the school environment is safe and orderly ("the campus is safe and orderly" Schoen, 2005, p. 416) and that "classes are held in bright and cheerful classrooms equipped with motivational and informational displays" (Schoen, 2005, p. 408). There is a research gap concerning how the arrangement of space can influence interpersonal relationships, communication, psychological well-being, and the building of formal structures – elements of organisational culture.

Kocki et al. (2015) emphasise that the physical space of a school should evolve in line with economic, social, cultural, and technological changes. It can therefore be assumed that its appearance should correspond to the educational paradigm declared in educational documents and in the statutes of a given institution. The authors also note that the issue of school space is rarely addressed in Poland and is sometimes treated as less important than teaching or upbringing, even though the impact of the environment on the functioning of the individual (social, emotional, and cognitive) is well documented in social psychology research (Kocki et al., 2015).

Kocki et al. (2015) also point out that schools' modern design can contribute significantly to improving the quality of education and achieving its goals and objectives. These issues do not only concern teaching and the education process during lessons, but also include extracurricular activities at school, in particular issues related to the proper use of children's and young people's free time (Kocki et al., 2015, p. 35). Among the environmental factors influencing the effectiveness of student learning, the following are distinguished:

1) lighting – when designing classrooms, care should be taken to ensure that they have as much natural light as possible, which means that the windows should be large. At the same time, care should be taken to ensure that classrooms are adequately darkened so that modern technologies can be used freely and to prevent excessive sunlight on warm days. Adequate lighting also affects the atmosphere in places such as corridors, reading rooms, and quiet rooms;
2) acoustics – educational institutions should be located in such a way that noise from outside the building does not disturb students' concentration on their tasks. Attention should also be paid to noise inside the building, which should be minimised by creating buffer zones between classrooms and common areas, such as the canteen. To minimise reverberation in classrooms, sound-absorbing materials should be used – fabrics, carpets, natural materials;
3) humidity and air temperature – when designing new buildings, architects should ensure that they face south-east or south-west. It is also worth ensuring that rooms have mechanical ventilation or air conditioning;
4) air quality and ventilation – it is important to ensure adequate ventilation not only from the outside, but also inside the building (e.g., by locating

classrooms on the leeward side so that smells from the canteen do not spread throughout the school);

5) colour – the colour on the outside of the building attracts attention and influences the attitude of pupils and parents towards the school, while inside the building it affects emotions, concentration, and learning efficiency;
6) space management – this is an important factor in supporting children's learning processes. Diversifying the educational space allows pupils to choose their preferred way of working, for example at tables or on the carpet, which helps to adapt the environment to their individual developmental needs. Configuration of tables in the classroom also influences the choice of teaching methods used by the teacher. For example, arranging tables in a way that encourages teamwork (e.g., groups of four) promotes cooperation, communication, and student activity. On the other hand, the traditional frontal arrangement, characterised by a row of tables, supports lecture-style teaching methods, in which the teacher plays a dominant role. Therefore, it is crucial to ensure that the classroom is sufficiently spacious to allow for flexible modification of the layout, depending on the educational objectives and preferred teaching methods;
7) the size of the school and classes, as well as their number (Polak, 2016).

Writing about the arrangement of educational space, Polak (2016) sums up: a school should be a place where students want to come. We should not be surprised that they do not want to come to a school that has been designed like a prison, with small classrooms and narrow corridors where there is nowhere to hide (p. 23). Pacewicz (2016) points out that the learning environment is shaped by three dimensions: socio-cultural, virtual-technological, and physical-architectural. The author emphasises that the physical space acts as a "third teacher" (p. 24) – its arrangement significantly affects both the quality of learning and the well-being of students and employees of educational institutions. Tanner (2008) notes that many stakeholders in education (teachers, headteachers, parents, politicians) continue to marginalise the importance of school space, which means that even new buildings do not take into account key elements such as proper air circulation, thoughtful colour schemes, meeting places for students and teachers (also in relation to parents) or adapting classrooms to the requirements of modern teaching. The author recommends viewing the school as a set of interconnected environments that influence learning as well as behaviour and attitudes of students. In this approach, the basic cultural assumptions of the institution, its accepted norms and values, and the philosophy of teaching and education should be reflected in the physical space – both in fixed and movable elements (Tanner, 2008).

Colour is described using several parameters: hue (e.g., red – blue), brightness/value (light – dark), and saturation/chromaticity (vivid – muted). These parameters are related to affective responses associated with two dimensions: valence (pleasant

– unpleasant) and arousal (coherent – active). This is important in an educational context because arousal and affect together shape attentional readiness, self-regulation, and task engagement. Importantly, the reported effects of colours are rarely universal: they may depend on the characteristics of the task (e.g., detail-oriented accuracy or creative thinking), exposure time, and individual differences such as age, gender, and sensory sensitivity. Therefore, colour should be treated as a contextual design variable whose effects are conditional rather than deterministic.

This approach is well illustrated by the findings of Valdez and Mehrabian (1994), who, using colour samples in the Munsell system and the Pleasure-Arousal-Dominance (PAD) emotion model, showed that emotional responses are strongly influenced not only by hue, but above all by brightness and saturation. In their analyses, greater brightness was associated with a higher rating of stimulus pleasure, while higher saturation clearly increased the level of arousal. This suggests that the stimulating nature of an educational space may result not only from the choice of warm or cool colours, but also from the intensity of colours and their visual saturation. Importantly, the effect of brightness was similar for chromatic and achromatic colours, indicating that solutions based on white, grey and black may also be significant (Valdez & Mehrabian, 1994). The perspective of empirical aesthetics and cognitive psychology, which emphasises the role of ease of stimulus processing, is also helpful in interpreting the results of colour research. Reber et al. (2004) point out that stimuli that are easy to perceive and process cognitively are more often rated as more pleasant and comfortable, while those that are more difficult to process may increase cognitive effort. In the context of educational spaces, this means that intense, contrasting, or visually "dense" colour schemes can reduce processing fluency, promoting distraction and attention fatigue.

Neuroaesthetic approaches emphasise that the characteristics of aesthetic stimuli modulate emotions and attention (Chatterjee & Vartanian, 2016). Research on the complexity-arousal-preference relationship indicates that excessive stimulation can increase arousal and does not always promote optimal functioning (Marin et al., 2016). This means that the impact of colour on learning should be analysed not only in terms of colour, but also in terms of intensity and potential stimulus load, which sets the framework for the problem and objective of this study.

RESEARCH PROBLEM AND AIM

Colour is one of the elements of physical space that influence well-being and cognitive functioning are colours. It is present, among other things, in the colour of walls, furniture (benches), teaching aids, and is also used deliberately as a method to support learning and memorisation. As a component of the educational environment, colour is not perceived in the same way by everyone: its impact depends

on individual reactivity and sensitivity of a person. As Bańka (2016) notes, the environment itself affects people with varying degrees of intensity, as a result of which the behaviour of various people in the same environment may differ (p. 89). The author points out that space can affect people in a specific way (resulting in direct visual, olfactory, and auditory impressions) and in a non-specific way (resulting in such individualized behaviours as specific emotional reactions related to a person's degree of reactivity). Analysis of the literature on the subject reveals a research gap on this topic in Poland, and the topic has not been sufficiently explored in the international literature, either. Research on the role of colour in educational institutions focuses primarily on three areas: (1) the impact of warm and cool colours in rooms on the teaching process, including the meaning of lighting colours; (2) the impact of the colour of work surfaces on cognitive processes; and (3) the role of the colour of teaching materials in content retention. The aim of this article is to review and synthesise the results of empirical research on the impact of colours (warm and cool, with varying saturation and brightness) on the emotional, social, and cognitive functioning of pupils and learners, as well as to indicate implications for conscious management of educational space.

METHODOLOGY

The review is narrative (integrative) in nature and is based on a targeted search for empirical literature on the impact of colour schemes in educational spaces on the emotional and cognitive functioning of students. The search was conducted in the Google Scholar and (for indexed publications) Scopus and Web of Science, using combinations of keywords in English: *classroom colour/colour*, *wall colour*, *learning environment*, *primary/elementary school*, *student emotion*, *well-being*, *attention*, *memory*, *cognitive performance*, as well as their logical combinations (e.g., *classroom colour AND attention*, *learning environment AND colour AND emotion*, *elementary school AND wall colour*). In addition, a snowballing strategy (i.e., analysis of the bibliographies of articles already identified and references to publications frequently cited within this research trend) was used.

Inclusion criteria were as follows: (1) peer-reviewed empirical articles (experiments, quasi-experiments, field studies), analysing the impact of colour or its parameters (hue, brightness, saturation) on at least one of the following areas: emotions/well-being, attention, memory/learning; (2) primarily studies conducted in a school environment, with particular emphasis on primary school; (3) publications in English (and, additionally, Polish theoretical studies on the educational space and organisational culture of schools, if they supported interpretation of the results). Exclusion criteria included: (1) non-empirical works or those without measurable indicators of emotions/cognitive functions; (2) popular science and non-

peer-reviewed texts; (3) publications in which colour was only a secondary element, without the possibility of attributing it an impact on the variables under study.

The selection was carried out in two stages. First, titles and abstracts were analysed and then full texts of papers that met inclusion criteria were analysed. Identified studies were organised thematically according to the dominant dependent variable (emotions/well-being, attention, memory and learning), and the discussion took into account methodological limitations (e.g., sample size, laboratory vs. naturalistic conditions, exposure time), which formed the basis for formulating cautious conclusions.

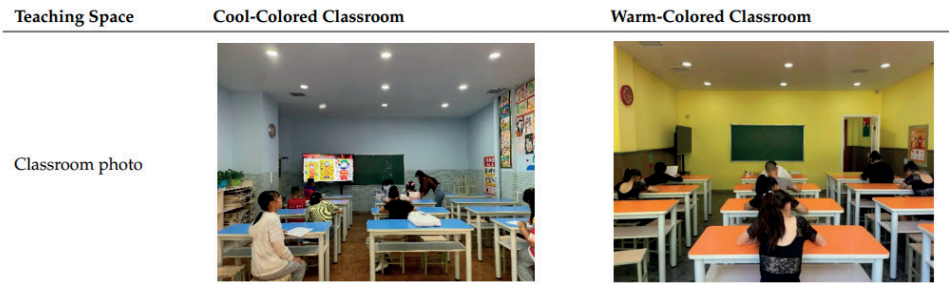
EVIDENCE-BASED FACTS

Colours and Emotions and Well-being

Sun et al. (2024) investigated how warm and cool colours affect students' emotional attitudes. The study involved students in grades 3-6 of a primary school in north-western China, and the Positive and Negative Affect Scale for Children (PANAS-C) was used for measurement. The authors emphasised that mental health difficulties can manifest themselves as early as in primary school, which is why it is important to analyse and shape the environment in which children spend about 5-6 hours a day. They assumed that physical environment affects cognitive and neurophysiological processes and that emotions evoked by colour stimuli translate into students' well-being and can reduce social stress. In this context, the authors also referred to Taylor's (1924) observation that colour regulates the atmosphere of a space and influences the decisions and behaviour of individuals.

The study was conducted in two identical rooms, differing only in the colour of the walls and desktops: the "cool classroom" had light blue walls and blue desktops, while the "warm classroom" had yellow walls and orange desktops (see Fig. 1 below).

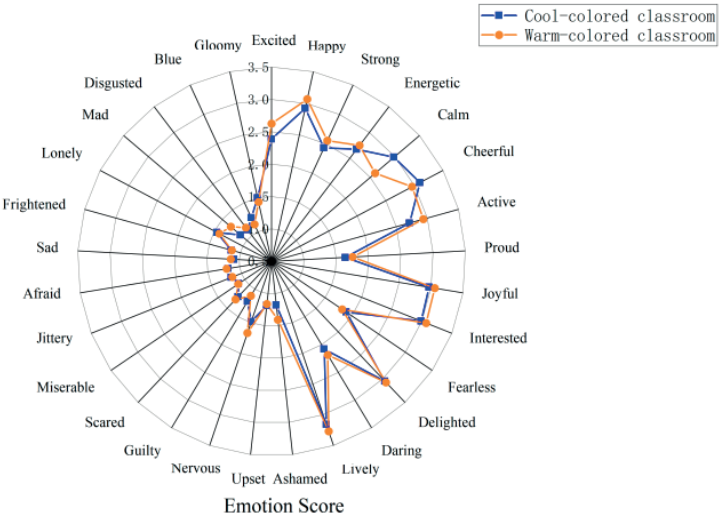
Figure 1
Classroom with cool and warm colours



Source: Sun et al. 2024, p. 6.

The authors concluded that both warm and cool-coloured classrooms affect students' emotions, with positive emotions being amplified more often than negative ones. In both types of classrooms, the most frequently reported positive emotion was *lively*. In rooms with cool colours, the highest-rated negative emotion was *gloomy*, while in rooms with warm colours it was *nervous* (see Fig. 2 below).

Figure 2
Positive and negative emotions felt by students in rooms with cool and warm colours



Source: Sun et al.,2024, p. 9.

Sun et al. (2024) emphasise that classrooms decorated in cool colours are conducive to calming both positive and negative emotions: the average intensity of both types of emotions was higher in classrooms with warm colours. In "cool" classrooms, students more often reported feeling calm and less often reported such negative states as anger or shame, while in "warm" classrooms, emotions such as *mad* and *nervous* were more common. On this basis, it can be cautiously concluded that students who have difficulty calming down or who are prone to excessive activity might function better in spaces with cool colours. At the same time, the authors noted correlations between the intensity of emotions (positive and negative) and the age and gender of the subjects. However, it should be noted that the study has limited generalisability: it concerns a specific group of students, and no control group was used (e.g., studies in a room with white walls). For this reason, Sun et al. (2024) propose that the study be repeated and expanded.

Colours and Attention Levels

The study by Duyan and Ünver (2016) examined whether the colour of classroom walls could affect students' attention levels. The experiment was conducted in Istanbul, in one public and one private school, involving the total of 78 children, aged 8-9 from different socio-cultural backgrounds. Attention was measured in five classrooms with different wall colours: red, green, purple, blue and yellow (see Fig. 3 below). To limit the effect of additional stimuli, teaching aids (e.g., maps, charts) and newspapers were removed from the rooms. The ceilings were left white, while the remaining elements of the furnishings (including the floor and cupboards) were kept in dark grey. The Bourdon Attention Test was used for the measurement: within 2 minutes, the pupils had to find the letters "b, d, g, i, p" among 440 characters. The study lasted five weeks, with the pupils working in a different classroom each week (Duyan & Ünver, 2016).

Figure 3

Arranged educational spaces

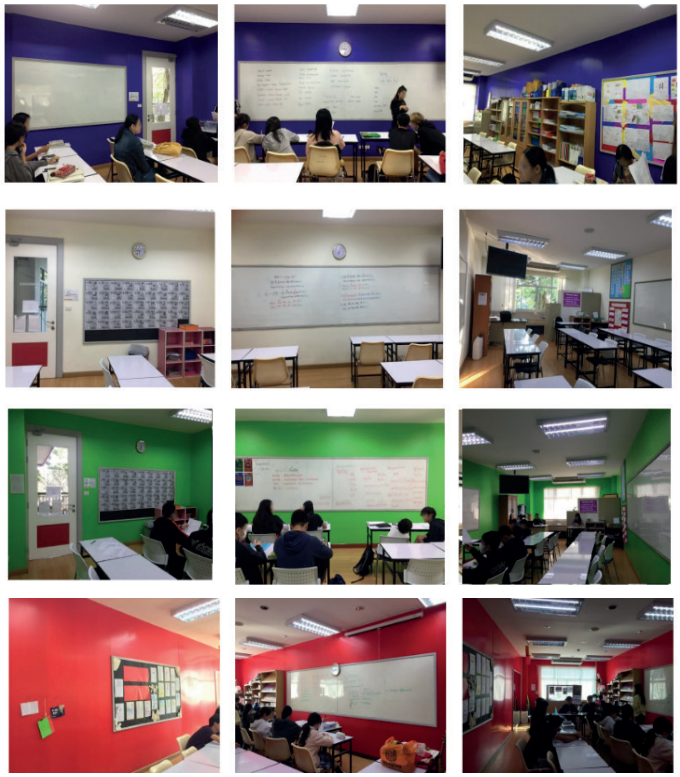
Source: Duyan & Ünver, 2016, p. 76

Based on the results of the experiment, Duyan and Ünver (2016) determined that students from both schools achieved the highest results in the attention test in the room with purple walls, followed by the blue, green, and yellow classrooms, with the lowest results in the red classroom. The authors noted that the results obtained in the purple, blue, and green classrooms were similar, which led them to conclude that "cool" wall colours affect students' attention to a similar degree. At the same time, it was found that private school pupils achieved higher results than public school pupils, regardless of the colour of the classroom. However, the researchers did not confirm a correlation between the level of attention, the colour of the walls, and the socio-cultural status of the pupils (Duyan & Ünver, 2016).

Ogita and Pothong (2021) addressed a similar research problem by examining whether the colour of the walls affects students' attention levels. Referring to Grube's thesis (2013), they assumed that creation of a safe and comfortable learning environment is a prerequisite for concentration. The study design was planned as a modification of the experiment by Duyan and Ünver (2016): both the number of colours analysed and the age of the participants were changed. The sample consisted of 34 eighth-grade students (aged 13-14) at an international school in Thailand. During the experiment, the young people studied in classrooms with purple, red,

and green walls, while the other elements of the interior design (tables, chairs, ceilings, floors and curtains) were kept in neutral colours (see Fig. 4 below). Attention levels were measured using the Bourdon Attention Test, with measurements taken before (pre-test) and after the intervention (post-test; see Ogita & Pothong, 2021).

Figure 4
Control classroom, in purple, red, and green



Source: Ogita & Pothong, 2021, pp. 4-5.

The results obtained by Ogita and Pothong (2021) indicated a relationship between students' attention levels and wall colour. The authors found that the strongest effect was associated with the colour red: students learning in a red classroom showed the greatest increase in scores on the Bourdon Attention Test. A slightly smaller increase (by approx. 1.5%) was observed in the group working in green classrooms. The differences between the pre-test and post-test also suggest that the longer the students spent in classrooms with distinct colours, the more their attention levels improved. At the same time, methodological limitations should be taken into account: the study was conducted on a small sample, and the selection

of participants was voluntary (*voluntary response* selection), which contributes to sample bias (Ogita & Pothong, 2021).

In 2022, Duyan and Ünver revisited the topic of the impact of classroom wall colours, this time analysing their relationship with student behaviour, attention levels and emotions. Thirty-five children aged 8-9 participated in the experiment. Classrooms with different wall colours were prepared: red, orange, yellow, green-yellow, green, blue-green, blue, purple-blue, purple, red-purple, as well as white and grey (see Fig. 5 below).

Figure 5

List of classrooms with different wall colours: 1st row: red, orange, yellow; 2nd row: green-yellow, green, blue-green; 3rd row: blue, purple-blue, purple; 4th row: red-purple, grey, white

Source: Duyan, & Ünver, 2022, p. 633.

Based on obtained results, Duyan and Ünver (2022) concluded that students' attention levels increased when they took the Bourdon Attention Test in classrooms with yellow and red-purple walls, while they decreased in orange, red, blue, and purple classrooms. It is worth noting that in the 2015 study, purple was identified as the colour that promoted student attention (Duyan & Ünver, 2015), suggesting the ambiguity of the effect and the importance of research context. The

authors also asked students about their preferences regarding wall colours. The most popular choice was green-yellow, followed by blue-green and orange, while grey was rated the lowest.

The summary by Duyan and Ünver (2022, pp. 639-640) included three dimensions: teachers' observations of behaviour, the position of the colour in students' preference ranking (1/12 = most liked; 12/12 = least liked), and the change in attention level measured by the Bourdon Attention Test. In the red classroom, the teacher noted excessive nervousness and agitation as well as difficulty concentrating; this colour ranked 7/12 in the preference ranking, and attention scores fell by 2.35 ($p < 0.01$). In the yellow class, the pupils were energetic, cheerful, and interested in the lesson; nevertheless, yellow scored 11/12, while attention scores increased by 1.89 ($p < 0.01$). In the green class, the colour had a calming effect and facilitated transition to focused work; it ranked 5/12 in the preference ranking, and attention scores increased by 1.84 ($p > 0.1$). In the blue class, greater discipline and efficiency in performing tasks were observed; the colour scored 6/12, and attention scores fell by 2.58 ($p < 0.05$). In the purple class, the teacher described stagnation during independent learning and frequent conversations; purple scored 4/12, and attention scores fell by 4.03 ($p < 0.05$). In the orange class, the pupils were cheerful and more engaged, and the colour ranked high in preferences (3/12), but attention scores fell by 14.01 ($p < 0.01$).

Among the intermediate colours, the green-yellow class showed greater concentration, less noise and complaints, and calmness among students (with some anxiety among girls); it was the most popular colour (1/12), with a simultaneous decrease in attention scores of 0.49 ($p > 0.1$). In the blue-green class, the teacher noted chaos, noise, and an increase in arguments; the colour scored 2/12, and attention scores increased by 1.23 ($p > 0.1$). The purple-blue class did not show any significant changes in behaviour ("normal" course of classes); the colour scored 10/12, and attention scores increased by 0.16 ($p > 0.1$). In the red-purple class, high concentration and no disturbances were observed during independent work; at the same time, this colour was rated relatively low in preferences (9/12), while attention scores increased by 3.39 ($p < 0.01$). In the grey class, students appeared apathetic and bored, perception was slowed, and communication and activity were limited; grey was the least liked (12/12), with a minimal increase in attention of 0.07 ($p > 0.1$). In the white class, behaviour was rated as inconsistent (focus during independent work, but high reactivity to minor stimuli); white scored 8/12, and attention scores decreased by 0.72 ($p > 0.1$). In the statistical significance analysis (p), significant differences between the pre-test and post-test were noted for the following classes: red ($p < 0.01$), yellow ($p < 0.1$), blue ($p < 0.05$), purple, orange, and red-purple ($p < 0.01$), while for the other colours, values of $p > 0.01$ were obtained (Duyan & Ünver, 2022).

The discrepancies between the results of the studies discussed may be due to methodological differences (sample selection, group size, exposure time, number

of colours compared and measurement conditions) and different institutional and cultural contexts. These factors may limit the possibility of simple generalisation of colour effects. In addition, some of the effects may depend not only on hue, but also on brightness and saturation of colours and the scale of their use in a room.

Colours, memory, and learning

The study by Al-Ayash and co-authors (2016) analysed the impact of colour on the educational environment, focusing on the mood and performance of individuals aged 20-38. The experiment used shades of blue, yellow, and red with high brightness, while varying the saturation level (high versus low). The results suggested that blue colours promoted calmness, while highly saturated colours were associated with significantly better results. Analysis of reading comprehension tasks also showed that students performed better in colourful environments than in rooms with white walls. Similar observations were also noted by Kwallek et al. (1996). In their study, office workers made more mistakes in rooms with light colours than in rooms with saturated colours, indicating that colour parameters can affect the quality of tasks performed.

Mehta and Zhu (2009) analysed whether red or blue promotes cognitive efficiency. In a series of experiments conducted on a total of approximately 600 participants aged 17-39, they showed that red supports performance of tasks requiring accuracy. The findings indicated that red intensifies the focus on avoiding mistakes and facilitates concentration. Blue, on the other hand, proved to be more beneficial in creative tasks, as it promotes creative risk-taking (Mehta & Zhu, 2009).

These findings were referred to by Xia et al. (2016) when studying the impact of background colour (red, blue and grey) on task performance depending on task type (creative and detail-oriented) and difficulty (easy and difficult). The results suggested that a red background improved performance on simple tasks, while a blue background promoted better results on difficult tasks. Furthermore, blue was associated with better results in both simple and difficult creative tasks, while red and grey backgrounds did not benefit creative activities (Xia et al., 2016).

Dehvari et al. (2023) studied 180 children aged 6-7, analysing the relationship between colour preferences and the influence of colours on cognitive functioning. Eight colours were considered: blue, green, yellow, red, purple, black, grey, and white. In the first part of the study, the children indicated their preferred colour, and in the second part, they performed a memory task: they looked at pictures placed on a sheet of paper in a given colour and had 30 seconds to memorise the elements on the sheet.

The results showed gender differences in preferences: boys more often chose green, yellow, and blue, while girls chose blue, purple, and red. However, the authors did not confirm a clear relationship between favourite colour and better memorisation of content presented on that background; the correlation appeared

only in specific cases (for boys with a red background and for girls with a grey background). At the same time, regardless of preference, boys achieved better memory results with yellow, blue, and black backgrounds, while girls remembered elements better against green, blue, and yellow backgrounds. Overall, blue proved to be the most favourable colour for both genders in terms of memory (Dehvari et al., 2023).

A summary of the results of the analysed studies is presented in Table 1 below.

Table 1
Summary of research results concerning impact of colour on emotions and cognitive abilities

Authors (year)	Country	Age of subjects	Colours	Area	Conclusion
Sun et al., (2024)	China	Grades 3–6	„Cool" classroom (light blue walls and blue desktops) and „warm" classroom (yellow walls and orange desktops)	Emotions/ well-being	Both colour schemes modulate emotions; warm colours promote higher arousal (more emotions, including negative ones), while cool colours are more often associated with calmness (lower overall emotional intensity).
Duyan & Ünver (2016)	Turkey	8–9 years	Classes: red, green, purple, blue, yellow; additional stimuli removed; neutral background furnishings	Attention	Best results were achieved by pupils in following classes, in order: purple, then blue, green, yellow, and the worst in red.
Ogita & Pothong (2021)	Thailand	13–14	Class: purple, red, green	Attention	Greatest increase in attention was observed in red, followed by green.
Duyan & Ünver (2022)	Turkey	8–9 years	red, orange, yellow; green-yellow, green, blue-green; blue, violet-blue, violet; red-violet, grey, white.	Attention, behaviour, emotions	Level of attention of pupils increased in classrooms with yellow and red-purple walls, while it decreased in orange, red, blue and purple classrooms; pupils' preferences do not correspond 1:1 with attention results (which means that a liked colour does not necessarily improve concentration).

Al-Ayash et al., (2016)	Australia	20-38 years	Blue/ yellow/ red with high brightness, varying saturation.	Emotions, cognitive abilities	Blue colours promoted calmness, and highly saturated colours were associated with significantly better results in cognitive tasks. Students performed better in a colourful environment than in rooms with white walls.
Kwellek et al. (1996)	USA	Adults	Walls in red, white, green, orange, yellow, blue, beige, grey and purple.	Task performance	Environment with distinct colours may promote better task performance than a neutral/white environment, measured, among other things, by number of errors made.
Mehta & Zhu (2009)	Canada	17–39	Red and blue background	Cognitive efficiency	Red reinforces error avoidance, blue promotes exploration and creativity.
Xia et al. (2016)	China	Students	Red, blue and grey background	Cognitive efficiency	Colour effect is conditional: red helped with simple tasks, blue supported more difficult tasks and creative tasks.
Dehvari et al. (2023)	Iran	6–7 years	Backgrounds: blue, green, yellow, red, purple, black, grey, white	Memory and preferences	Preferences vary by gender, but favourite colour rarely supports memory best. For both genders, most „consistently beneficial" colour for memory was blue .

Note. Author's own study.

SUMMARY

An analysis of available research indicates that the colours of the environment have a significant impact on the emotions, attention, and cognitive functions of pupils and students. Such warm colours as red, orange, and yellow evoke stronger emotions and increase arousal, which can lead to difficulty concentrating and increased stress levels. In some contexts, red promotes improved attention, but this effect depends on the nature of the task and individual characteristics of the subjects. On the other hand, cool colours, primarily blue and green, have a calming effect,

helping to reduce negative emotions and improve concentration, which translates into better results in tasks requiring attention and precision. Colour preferences and emotional responses also vary depending on the age and gender of students, highlighting the need to consider these factors when designing educational spaces. In addition, colour saturation and hue affect the final result, suggesting that colour choices should be conscious and tailored to specific characteristics of the group and the type of tasks performed. The results of the analysis confirm that appropriate selection of colours in the school environment can be an effective tool for supporting learning processes and emotion regulation, which is important for optimising educational conditions. A vast majority of conducted studies originate from North America, Asia, and Europe. Few studies were conducted in Africa and South America. Based on literature analysis, it can be seen that the vast majority of experiments were conducted in laboratory conditions or using virtual reality, with few studies conducted in real-life conditions. Studies conducted in staged classrooms were devoid of any elements that would interfere with colour perception, but which are present in many classrooms every day and bring additional colours to the space – newspapers, colourful furniture, toys, teaching aids, or decorations. In addition, many studies were conducted on small research groups, in specific socio-cultural conditions, which means that obtained results cannot be extrapolated as general recommendations for the use of colours in educational spaces. Most studies are one-off, covering a specific group – students or (less often) primary school children. There is a lack of longitudinal studies on the lasting impact of colour in spaces on the academic performance and mental well-being of children and adults; studies that would take into account various architectural aspects. There is a particular research gap concerning younger schoolchildren and children with special educational needs. It is also worth considering the use of appropriate lighting colours that will have a stimulating effect and will depend on the type of performed tasks (see Quiles-Rodríguez & Palau, 2024; Quiles-Rodríguez et al., 2025).

CONCLUSIONS

When analysing the presented research from the perspective of pedagogical practice, it is worth treating the educational space, including its colour scheme and lighting, as a real, albeit not the only factor contributing to well-being, self-regulation, and attentiveness of pupils, and not merely as a "background" or aesthetic issue. This means that decisions about classroom design should be more conscious and grounded in educational goals (e.g., some conditions are conducive to quiet work requiring concentration, while others are conducive to creative activities or collaboration), while limiting excessive stimuli and random, competing accumulations of colours in the space. As the research results are largely contextual and

many experiments have methodological limitations, changes in schools should be cautious and iterative (e.g., piloting in one classroom, observing student behaviour and engagement) rather than based on simple, universal recipes. In the Polish context, the issue of responsibility for the classroom space is also of particular importance, especially in the case of shared classrooms, as the lack of a "host" encourages visual chaos and random decisions that can undermine the comfort of working and learning. At the same time, striving for an architecturally and symbolically coherent space reinforces the organisational culture of the institution: what values and norms are displayed in it, how order, safety, cooperation, and student autonomy are understood. In this sense, the way in which space is designed and maintained also becomes a message about how the school "sees" the student – whether it plans the environment with their needs and differences (including sensory sensitivity) in mind, or whether it assumes that the conditions are neutral and that the student "has to cope" regardless of their surroundings.

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KOLORYSTYKA PRZESTRZENI EDUKACYJNEJ JAKO CZYNNIK WSPIERAJĄCY KULTURĘ ORGANIZACYJNĄ I FUNKCJONOWANIE PSYCHOSPOŁECZNE I POZNAWCZE UCZNIÓW

Wprowadzenie: Przestrzeń fizyczna szkoły, rozumiana jako widoczny wymiar kultury organizacyjnej, współtworzy warunki uczenia się. Jednym z jej istotnych, a często marginalizowanych komponentów jest kolorystyka (barwy ścian, wyposażenia i materiałów dydaktycznych), która może wpływać na pobudzenie, nastrój oraz przebieg procesów poznawczych.
Cel badań: Celem artykułu jest przegląd i syntetyczne uporządkowanie wyników badań empirycznych dotyczących wpływu barw (ciepłych i zimnych, o zróżnicowanym nasyceniu i jasności) na funkcjonowanie emocjonalne, społeczne i poznawcze uczniów, a także wskazanie implikacji dla świadomego zarządzania przestrzenią edukacyjną.
Stan wiedzy: Zebrane badania pokazują, że kolor może modyfikować uwagę, pamięć i jakość wykonania zadań, jednak efekty zależą od kontekstu (rodzaj i trudność zadania, parametry barwy, oświetlenie) oraz cech badanych (wiek, płeć, indywidualna reaktywność i preferencje). W wielu pracach chłodne odcienie (zwłaszcza niebieskie i zielone) wiązano z wyciszeniem, lepszym samopoczuciem i wsparciem dłuższej koncentracji, natomiast barwy ciepłe (np. czer-

wienie i żółcie) częściej łączono ze wzrostem pobudzenia oraz lepszym wykonaniem zadań prostych i zorientowanych na szczegóły. Jednocześnie wyniki nie zawsze są spójne, a część badań ma ograniczenia metodologiczne (np. małe próby, brak grup kontrolnych).
Podsumowanie: Kolorystykę warto traktować jako narzędzie projektowania środowiska uczenia się i element kształtowania kultury szkoły. Dobór barw powinien być spójny z celami dydaktycznymi i potrzebami uczniów, a decyzje projektowe warto opierać na dowodach oraz uzupełniać dalszymi, dobrze kontrolowanymi badaniami.

Słowa kluczowe: kolorystyka klasopracowni, edukacja, kultura organizacyjna, funkcjonowanie poznawczo-emocjonalno-społeczne