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INTERDISCIPLINARY APPROACH AND EMERGENCE OF A NEW SCIENTIFIC FIELD BETWEEN LIGHTING AND LIGHTING DESIGN. THE MISSING “X” FIELD

*The report is dedicated to the 80th anniversary of the University of Ruse
and the 175th anniversary of the birth of Angel Kanchev.*

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Abstract: *The European academic community is undergoing a conscious transformation that will aim to prepare future generations for the time when they will take on this responsibility. It is this transformation, the rethinking of existing assets, that hints at the need for an interdisciplinary ad-hoc approach like the Light Sfumato Idea, a "new academic DNA" that this report suggests. Light Sfumato or just Sfumato is an experimental creative field that aims to attract to itself ideas, concepts and useful models that reveal new perspectives in the development between the fields of lighting and lighting design.*

Keywords: *Light, Lighting, Lighting Design, Higher Education, ESG, The Missing “X” Field, Ad-hoc approaches, Light Sfumato, Culture Of Waste, Global Warming, Global Overillumination.*

INTRODUCTION

Modern European universities make a significant contribution to the development of scientific research, and this is largely reflected in the quality of life. Increasingly, scientific circles are focusing on the quality of higher education, as evidence of this is the ESG system (Standards and Guidelines for Quality Assurance in the European Higher Education Area, 2015), which presents the priorities, which will be pursued in higher education in the near future.

At the Conference of Ministers responsible for higher education in the European Union, held on May 14-15, 2015. in Yerevan, Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG) were approved. The main objective of the Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG) is to contribute to the general cross-border cooperation among all interested parties, in the assurance of quality in learning and teaching. A decisive role in this system is played by scientific research and innovation, developing flexible learning models in which students occupy a central place. The ESG system encourages higher education to respond in a new way, forming a common framework for learning and teaching at European, national and institutional level.

Education in lighting and lighting design, nationally and internationally, is visibly developing. By decision of the 68th UN General Assembly (20.12.2013) 2015 was declared the International Year of Light and light-based Technologies (IYL 2015). The year 2015 marked extraordinary events in the field of lighting that took place in the last 1000 years (including round anniversaries), (Table 1).

Table 1. Important events in the field of lighting

Year	Event
1011-1021	1000 years since Ibn al-Haytham published his seminal work on optics.
1815	200 years since the creation of the wave theory of light by Augustin-Jean Fresnel.
1865	150 years since the creation of the electromagnetic theory of light (1865) by James Maxwell.
1889	135 years since the invention of the incandescent lamp by Thomas Alva Edison, which laid the foundations of modern electric lighting.
1916	100 years since Albert Einstein was inducted into the Hall of Fame for his General Theory of Relativity, confirming the centrality of light in space and time.
1965	50 years since the discovery by Arno Penzias and Robert Wilson of the cosmic microwave background radiation, an echo from the origin of the universe.

1995	20 years since the invention of white light-emitting diodes by Japanese scientists Isamu Akasaki and Hiroshi Amano, as well as Japanese-born American citizen Shuji Nakamura. It wasn't until 2014 that they shared the Nobel Prize in Physics.
2012	In 2012, UNESCO's executive board approved 2015 as the International Year of Light and Light-based technologies (IYL2015).
2013	In December 2013, the International Year of Light and Light Technologies (IYL2015) was proclaimed by the General Assembly of the United Nations (UN).
2015	At the Conference of Ministers responsible for higher education in the European Union, held on May 14-15, 2015. in Yerevan, Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG) were approved. Celebrating 2015 as the International Year of Light and Light-based Technologies (IYL2015) under the auspices of UNESCO
2018	On December 2, 2015, a national seminar "Ahead of 2015 - International Year of Light and Light-based Technologies" related to the celebration of UNESCO was held in the Kanev Congress Center of the University of Ruse "Angel Kanchev". On April 1, 2018 Pope Francis draws attention to the "Culture of waste" ("Urbi et orbi" ("To the city and to the world")), formed over time and categorically subject to rejection - Easter Message of Pope Francis.
2019	The question posed by Peter Boyce in Lighting Research and Technology: Editorial: Is there a science of lighting design?

EXPOSITION

Artificial light is the civilizational choice of modern society. This motivates its general availability. Changes in the light environment have a significant impact on the quality of life of modern society and on the quality of higher education. However, the use of artificial light these days has resulted in the practical waste of electrical energy. Pope Francis draws attention to the "*Culture of waste*" formed over time and categorically subject to rejection ("*Urbi et orbi*" - "*To the city and to the world*" - Easter message of Pope Francis, 04/01/2018). As an example of such a "*Culture of Waste*", in the field of modern lighting and lighting design is the waste of light.

In the international lighting engineering community, a number of professionals with a long lighting engineering practice are united around the general thesis that the main cause of light scattering is the result of external artificial lighting, forming light pollution (Boyce P.R., 2009, 2014; Wordenweber B., J. Wallaschek, P. Boyce, D. Hoffman, 2007; Narisada K., D. Schreuder, 2004). Particular concern is expressed about the lack of practical synchronization of the individual directions in lighting, including the interaction between lighting and lighting design, despite the rapid technological progress in the lighting industry. This is explained by the lack of imperative interconnection and interaction in all possible spheres of artificial lighting, with the achievement of the common goal of improving modern living conditions. This raises the question of the need to create a new interdisciplinary field in the field of modern lighting and lighting design.

Above all, attention should be paid to the development of the two main directions - lighting and lighting design. From the very beginning, with the emergence of lighting design as an independent professional activity, there have been complaints about the existence of a gap between lighting and lighting design. To some extent, this is inevitable because lighting is considered a science, while lighting design is considered more of an art. Science is characterized by quantification and repeatability Art is characterized by subjective judgments and innovation. So the question that arises is is there a science to lighting design? (Boyce P.R., 2019). According to *Peter Boyce*, there is no science in lighting design. Science is usually about the ability to test whether a hypothesis is correct or not. It is this process that makes science self-correcting. In lighting, technical recommendations and standards are usually the subject of hypothesis testing, but in lighting design this is rarely the case. Typically, lighting design is supported by assertions rather than hypothesis testing. The difference between science and art is not a matter of semantics, but a matter of process (Boyce P.R., 2019).

Based on this analysis, the next question that arises is wether it is possible to have an intermediate interdisciplinary field between lighting and light design. Some contemporary researchers rely on conceptual models that have a direct relationship with lighting and lighting design, but these are rarely recognized as working by lighting engineers. At the same time, lighting designers often use the technical recommendations related to the amount, spectrum, distribution and stability of the provided light -

important elements in any design (Boyce P.R., 2019). It is apparent that lighting engineering follows a more conservative line of behavior, while lighting design allows for greater creative freedom. However, the two groups of specialists (engineers and designers) solve the same problems, but from a different position. Apparently, both groups of specialists mutually benefit from the accumulated bilateral experience.

If we hypothetically assume that there is such an intermediate field, which lighting engineers and designers should benefit from, the question immediately arises as to what it is and what problems it could solve. In all cases, it should provide easy and quick access to the information needed by both lighting engineers and lighting designers. This should greatly facilitate the work of both groups of specialists, i.e. engineers could "see" things like designers, hence, they would have the opportunity to develop their creative potential, while designers would be able to follow the logical connections that engineers follow.

Historically, this trend of interdisciplinary thinking was found by the work of Leonardo da Vinci. He left a significant contribution to the development of a number of directions in science and art, incl. design. He is credited with the appearance of the so-called "*Sfumato*" effect - he described it as painting technique "*without using lines or borders*". This is a painting technique first used by Leonardo. It features layering of semi-transparent layers of velour, shifting the contours of each subsequent layer. This gives the picture a peculiar, blurred aerial perspective and greater background depth (Wikipedia).

Similarly, the blurring of the visible boundaries between science in the face of lighting and art in the face of lighting design would lead to a new understanding of the use of artificial light. This would make a significant contribution to the quality of life, including the quality of higher education, where the application of an interdisciplinary approach has long been encouraged. Figure 1 presents a conceptual model of the relationship between the application of natural and artificial light, in the context of lighting and lighting design. The model identifies the emergence of a new interdisciplinary field ("*X*" Field or *Light "Sfumato"*). Light Sfumato or just Sfumato is an experimental creative field that aims to attract to itself ideas, concepts, useful models that reveal new perspectives in the development of lighting and lighting design without setting requirements and/or limitations.

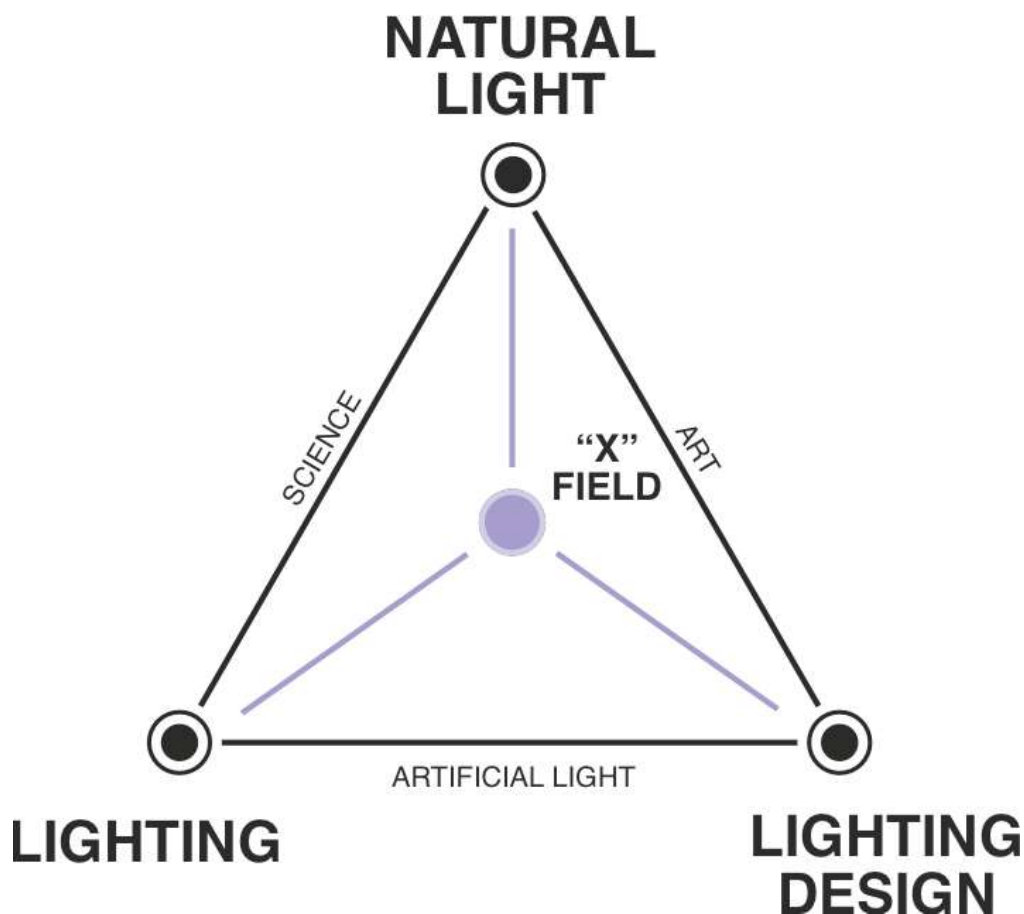


Fig. 1. Emergence of a hypothetical interdisciplinary field, ("*X*" Field), emerging between lighting and lighting design (*Light "Sfumato"*).

As a development of *the idea of Light Sfumato*, a sample sequence of suggestions is presented, which to some extent draw attention to the nature of the new interdisciplinary field. The ad-hoc list is an open non-linear system that can be supplemented, (Table 2).

Table 2. Suggestions about the emergence of a new interdisciplinary field between lighting and lighting design

Keywords	Description
CONTRIBUTIONS	A database facilitating the handling of arrays of information that include major contributions to the development of lighting technology and lighting design over the years.
ARRAYS OF INFORMATION	Considering light as a carrier of arrays of information (e.g. applying the Light-Fidelity (Li-Fi) technology).
INNOVATIVE AND CREATIVE THINKING	The promotion of innovative and creative thinking in the search for new hypothetical solutions.
CONCEPTUAL MODELS	The development of conceptual models (working hypotheses) seeking solutions to existing problems in lighting and lighting design.
ABSTRACT MODELS	Encouraging the construction of fractals, abstract irrational models, revealing the creative potential of the solution-seeking person (researcher).
APPLICATIONS	Defining perspective in development of models as a set of individual and mutually complementary applications.
CALCULATION METHODS	The development of models that facilitate the use of calculation methodologies in the field of lighting (quick and easy access to database related to the calculation of a given case study in lighting).
LIGHT "SFUMATO"	Defining the intermediate boundaries (light "sfumato") of lighting and lighting design. The development of useful systematizations clarifying the nature of the studied matter.
ARTIFICIAL INTELLIGENCE	The introduction of Artificial Intelligence (AI) in the search for potential solutions. Using artificial intelligence smartly and pragmatically.
SYNCHRONIZATION	The search for solutions that promote the synchronization (working together) of the individual directions in lighting and lighting design.
HARMONIZATION	The search for solutions promoting the harmonization (state of synergy) of the lighting environment during the day and night.
IDENTIFIER ON NEW PROBLEMS	The development of an identifier of new problems in the field of lighting and lighting design.
NEW LIGHTING TECHNOLOGIES	Encouraging the search for new lighting technologies.
KNOWLEDGE TRANSFER	Possibility of knowledge transfer from other fields of science and art, with the possibility of considering a given case from a side angle (from a non-standard point of view).
EXTERNAL SOURCES	The introduction and use of additional external sources of information - Internet, Internet of Things (IoT), music and others.
SCIENTIFIC RESEARCH BELLES-LETTRES	Encouraging the writing of scientific research belles-lettres as a way of expression in order to bring the author closer to his audience, incl. the presentation of emotional stories that accompanied the research process.
ETHICAL DOCTRINE	The development of an ethical doctrine, guaranteeing benevolence, loyalty, usefulness.

CONCLUSION

Apparently, the European academic community is undergoing a conscious transformation that will aim to prepare future generations for the time when they will take on this responsibility. It is this transformation, the rethinking of existing assets, that hints at the need for an interdisciplinary ad-hoc approach like the Light Sfumato Idea, with the introduction of an identification code or the so-called "new academic DNA" that this report suggests. The quality of higher education implies solving of existing problems in a number of spheres, including lighting and lighting design.

It is essential when the average citizen and business representatives will take into consideration the current state of lighting, in which light pollution and visual glare do more harm than good. Thanks to the ad-hoc interdisciplinary approach presented in this report, it motivates a rethinking of the borders consciously and continuously being made between lighting and lighting design where artificial light is still overdosed, misdirected and mismanaged. The three questions that logically follow are: Will the "culture of waste" continue to shape our contemporary life and for what cost? Will global warming be followed by global overillumination?

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