REPORT OF THE INTELLECTUAL OUTPUT: **IO4 - Validated methodological approach**

English Version

DELIVERABLE IO.4
EMPOWERING EDUCATION:
Unveiling NLITED's Three-Year Journey and Impact

Abstract

This report provides an overview of the three-year NLITED project (New Level of Integrated Techniques for Daylighting Education) and its key accomplishments. It outlines the development of the NLITED curriculum, highlighting the involvement of experts, and emphasizes the methodology and outcomes. Additionally, it discusses the creation of an e-learning platform with educational modules, which serves as the foundation for practical applications in the form of summer schools. Lastly, it presents a qualitative analysis of results obtained from surveys administered to participating students. This report sheds light on the transformative journey and impact of NLITED in the field of daylighting education

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Short Description	This report provides an overview of the three-year NLITED project (New Level of Integrated Techniques for Daylighting Education) and its key accomplishments. It outlines the development of the NLITED curriculum, highlighting the involvement of experts, and emphasizes the methodology and outcomes. Additionally, it discusses the creation of an e-learning platform with educational modules, which serves as the foundation for practical applications in the form of summer schools. Lastly, it presents a qualitative analysis of results obtained from surveys administered to participating students. This report sheds light on the transformative journey and impact of NLITED in the field of daylighting education.
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1. Introduction

1.1. The NLITED project

New Level of Integrated TEchniques for Daylighting education (NLITED) is an educational project co-founded by the Erasmus+ Programme of the European Union (Project Ref: 2020-1-IT02-KA203-079527).

The project aim is to improve le knowledge on daylighting of both students and professional of the building sector.

NLITED is a proposal for a new education project with the following objectives:

filling existing knowledge gaps by introducing a comprehensive blended learning model for knowledge and better integration of daylight into architectural projects, starting from theory to state- of-the-art daylight simulation,

raising awareness and knowledge among experts in the field on shortcomings of knowledge transfer in BPS realm.

1.1.1. The strategic partnership

The concept of NLITED has been developed by a partnership of four European universities:

Four universities from different European countries carrying out its implementation.

• Università Niccolò Cusano – Italy (Headleader)

• Danmarks Tekniske Universitet – Denmark

• Politechnika Gdańska – Poland

• Lunds Universitet – Sweden

Choice of partners

The four partners involved in the implementation of the education package represent three distinct European geographical areas facing different challenges in daylighting design.

• **Northern Europe countries** (Denmark and Sweden)

face daylight design challenges in terms of significantly changing availability of daylight during the year and low solar angles, increasing, e.g., risk of glare.

• Central Europe countries (Poland) must deal with the often-cloudy sky and constantly changing weather conditions.

• Southern European countries (Italy) face challenges in terms of excessive solar heat gains

during some months.

In addition to the main academic partners, a local network of stakeholders has been built for each participating country.

Their role is to ensure that the training proposal can have a real impact on the social context of the territories involved. They have been included as associated partners and divided into five categories:

- Universities
- Building Associations
- Building Companies
- (day)Lighting Associations
- Dissemination sector as trade journals, professional magazines (Figure 2).

Associated partners are involved in defining educational needs, recruiting learners, and publicising the proposal and its results.

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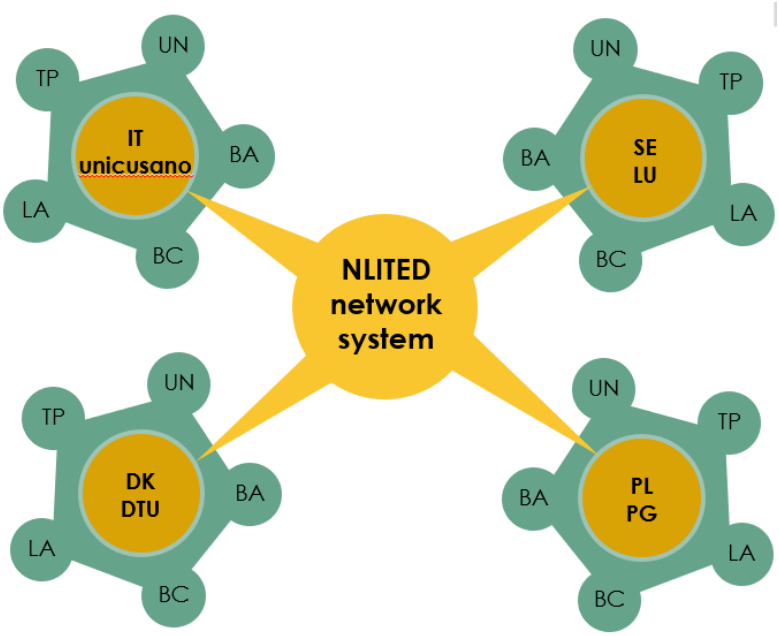

Figure 1: The NLITED network includes associated national partners. They are other Universities (UN), Building Associations (BA), Building Companies (BC), (day)Lighting Associations (LA) and bodies from the Dissemination Sector (DS).

1.2. About this report

This report summarizes three years of work on the NLITED project. The report begins by briefly describing the process that led to the creation of the NLITED curriculum ("Competence Definition (O1)"). The focus is on the methods used and the main outcomes. A comprehensive report on "Competence Definition (O1)" is available online.

The report then provides an overview of the e-learning platform that was created, including specific content. Finally, the report describes the analysis of the platform and the results of surveys administered to participating students. The construction of project activities should be understood as a coherent and interconnected working methodology so that each activity has led to the subsequent ones (Figure 2). Each result has been analysed and monitored to support the subsequent areas of work. This report is intended as a potential guide for the development of similar educational projects.

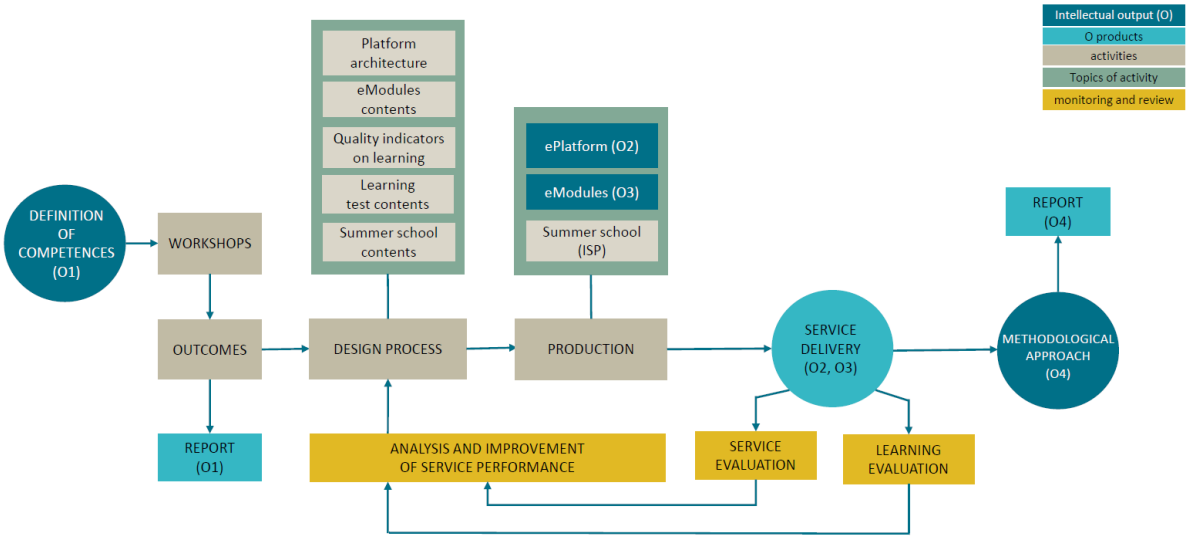

Figure 2: Distribution of activities leading from the first intellectual output (O1) to the last one (O4).

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2. O1 – Definition of the competences

Short paragraph summarizing the Intellectual Output O1. Please see the report O1 "Mapping Competences in Daylighting: Insights from Stakeholder Workshops and Surveys across Four European Nations" available on the NLITED website and on the Epluslink.

2.1. Method

Since the eLearning programme also targets professionals, the project coordinators decided to involve the stakeholders since the development phase of the curriculum. Such approach allowed the creation of a curriculum tailored to the needs of the target groups. The process documented in this paper supported the definition of an accurate need- based educational proposal. Online workshops in the form of focus groups were conducted in the four partner countries. Each country organised three to four workshops with up to eight participants each. Invited participants were selected from the national networks of stakeholders. In total, 14 workshops were arranged, with 64 participants, 37% of them coming from companies (architectural 11%; consultancy 21%; manufacturing-producing window manufacturers 5%), 5% from national bodies dealing with building legislation, and 58% from academic teaching staff (university professors 47%; consultant 11%).

A standardised procedure was adopted for the workshops, with the scope of ensuring consistency of responses across the four countries. All steps, including invitations to participants, questions to be asked, online questionnaires, were drafted and collected in a guidance document.

2.1.1. Standard for workshops

Three dates in each country were selected for workshops. At least one month before the first workshop, each country coordinator sent out an invitation email to possible interested people or departments. The participants could select one of the three dates and a limit of five participants was set for each workshop. In some cases, the limit had to be stretched and up to eight participants joined a single workshop. In such cases, more of the participants represented a single company; the scope was to make sure that everybody could have chance to discuss their working routine.

The invitation email provided a brief overview of the NLITED project, described scope and duration of the workshop, and invited to forward the information to other interested colleagues. A note on ethical matters, like use of recordings and informed consent, was also provided. A copy of the invitation email is provided in **Error! Reference source not found.**.

One week before each workshop, the country coordinator sent out a reminder email that included a detailed agenda and the link for the digital workshop, and a draft version of the NLITED curriculum. A copy of this email is provided in **Error! Reference source not found.**.

After the workshop, a final thank-you email was sent out to the participants. The mail included links for two questionnaires dealing with the definition of competences and a quality survey about the workshop. Email and surveys are provided in **Error! Reference source not found.**.

A first draft of the was created and sent out to the participants some days before the event curriculum (Annex A.4). Such draft curriculum resulted from a previous brainstorming between the coordinators of NLITED. The reason for sending it was to have participants with a common understanding about the subjects to be discussed during the workshop (Table 1).

One of the key features of such document was that teaching topics were divided into modules, conceived as minimum learning units. Other key points were that the modules were independent of each other (mix-and-match), self-paced, and with no prerequisites required. The modules were created to grant 1 ECTS each.

Each workshop lasted between 180' and 240'. Depending on the audience, it was conducted in either English or the national language. It consisted of two parts.

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1. The first part was a traditional focus group based on a semi-structured template to address the following subjects: daylight design practice and education, definition of necessary competencies, practicalities about e-learning, and opinions on the summer school. The template included main questions and detailed questions to be used in case of deadlock or to deepen concepts that have emerged (Table 1).

2. The second part consisted of a questionnaire distributed to the participants at the end of the workshop. It consisted of closed-ended questions asking for each daylight topic whether it was strategic to be included in the curriculum.

Topics		Questions
Daylight design / education	**Main question**	**Why and how do you design for daylighting?**
	Follow-up / Detailed questions	Which is the goal of daylighting design in your job? Do you have a group working on daylighting design? How do you assess daylight in practice? (Can you describe the typical workflows, software, tools, …?) Which type of daylight assessment do you usually perform? (including metrics)
Definition of competences (eModules)	**Main question**	**You have read our draft proposal for the course curriculum. How would you improve the proposal?**
	Follow-up / Detailed questions	Would you have liked to see something else there? Would you make use of the whole curriculum? Are there modules which are irrelevant for you?
ELearning – practicalities	**Main question**	**How and under which conditions would your work benefit from this online course?**
	Follow-up / Detailed questions	How would your career benefit from it? How would your company benefit from it? Which conditions would allow you (or your colleagues) to join the course?
Summer school	**Main question**	**The educational package we are creating includes a summer school. In your view, which conditions would make the summer school attractive to you?**
	Follow-up / Detailed questions	How do you think a summer school may support learning from the course?

Table 1. Semi-structured interview template

After that all workshops took place, another questionnaire was developed and spread through social media to potential trainees of the eLearning programme (Annex A.3). Also, this second questionnaire contained the list of topics of the draft curriculum (Annex A.4). In this case, the respondents were asked to indicate which topics (listed in Table A1) they would be interested in following through the eLearning platform. 99 questionnaires were returned. A total sample of 153 responses was therefore collected through the two rounds of questionnaires.

Goal	Have the following or similar statements been mentioned during the workshops?
Normative goals	▪ There are legal requirements for daylight design, then I must do that ▪ It is part of my company policy/workflow to make this type of assessment, then I must do that ▪ There are the requirements for daylight standard and/or certificates that I must follow ▪ It is parts of sustainable building design (associated with energy-saving, good indoor environment, health and well-being) that I, as an professional, feel obligated to do
Gain goals	▪ Working with daylight design is a way to enhance my skills, knowledge and competences ▪ It is a way to advance my professional development as a daylight expert/daylight specialist ▪ It is a way to increase values of my work (e.g. aesthetics, pleasantness, and good quality architecture) ▪ Having competences in daylight design would attract more clients/students as well as those who concern about the importance of daylighting
Hedonic goals	▪ Working with daylight design is interesting and/or exiting ▪ Daylight design is challenging and carrying out the task is my great achievement ▪ There are strategies, methods and tools available to me and make it easier to work with daylight design (in general and also, at different design stages) ▪ Daylight design is a pleasure task to work with and would bring about many benefits

Table 2. Analysis matrix for the motivation driving daylighting design, based on the Goal-Framing Theory.

2.2. Main findings

The discussions on daylight design workshops with experts and stakeholders from multiple countries reveal a comprehensive set of key takeaways that emphasize the evolution and improvement of daylighting in architectural practice and education. While these takeaways were derived from different geographical contexts, they collectively present overarching trends and recommendations.

Motivations for Daylight Design:

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Professionals across different regions are motivated by various factors, including regulatory compliance (normative goals), the development of tools for enhanced simulations (hedonic goals), economic gains for companies (gain goals), client-driven demands, and a holistic approach that values both qualitative and quantitative aspects of daylight.

Educational Aspects:

Education in daylight design is central, with an emphasis on practical and theoretical components. A balanced approach between quantitative knowledge and qualitative observations is recommended. The introduction of gamification and interactive tools is encouraged to enhance learning. Flexibility in course topics and adaptability to regional needs are considered important.

Challenges and Barriers:

Challenges persist, such as outdated regulations and the need to convey the value of daylighting to stakeholders. Integrating daylighting early in the design process and adopting a multidisciplinary approach that includes light, colour, and materials are acknowledged as effective strategies.

Simulation Software:

Simulation software tools play a crucial role in daylight assessment, with a desire for more integrated software suites that streamline the design process.

Community and Collaboration:

Creating a network of daylighting professionals and enthusiasts is fundamental to promote knowledge-sharing and collaboration among students and professionals. Engaging stakeholders from various fields, including urban planning, is essential.

Urban and Green Design:

A growing interest in topics related to urban design highlights the importance of exploring the connection between nature and daylighting and appreciating qualitative aspects such as sky and nature views. Daylighting in urban context is also considered an area of great interest that needs better investigation. A key message was that urban planners should need some fundamentals of daylighting education, as their decisions affect the later possibility of buildings to comply with daylighting requirements.

Overcoming Regulatory Barriers:

Across regions, the need to overcome regulatory barriers, whether in building compliance or urban planning, is a common theme.

In conclusion, these cross-over workshops underscore the multifaceted nature of daylighting in architectural design and education. They highlight the significance of addressing motivations, overcoming educational challenges, emphasizing the role of simulation software, building a strong community, integrating biophilic design, and tackling regulatory barriers to create well-rounded professionals capable of navigating the complexities of daylighting in architectural design.

All this valuable information was collected and incorporated for the creation of the NLITED project's training offer.

3. Definition of the educational framework

Based on the O1 results, the NLITED's training offer was refined in every detail, so as to gather feedback from the reference network.

Figure 3 shows the first hypothesis of the NLITED curriculum that was submitted to the workshop participants, while Figure 4 reports the final curriculum, which was defined also based on the discussion with the experts and the suggestions emerged during the workshops. The specific content of each module is also based on inputs from the workshops.

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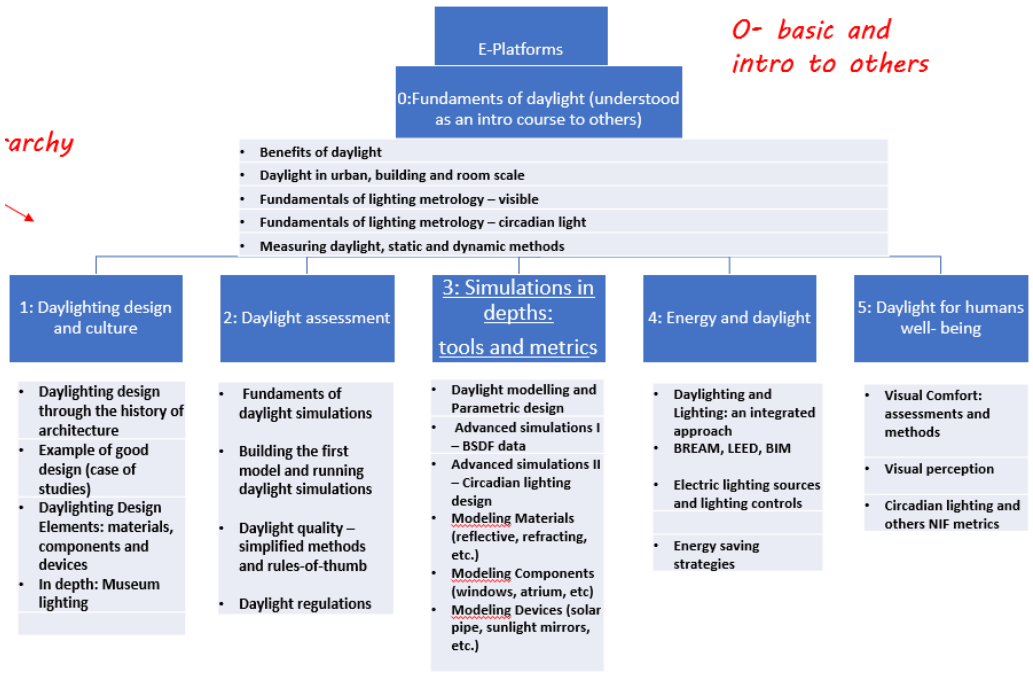

Figure 3: First hypothesis of the NLITED curriculum, as submitted to the experts who participate in the workshop.

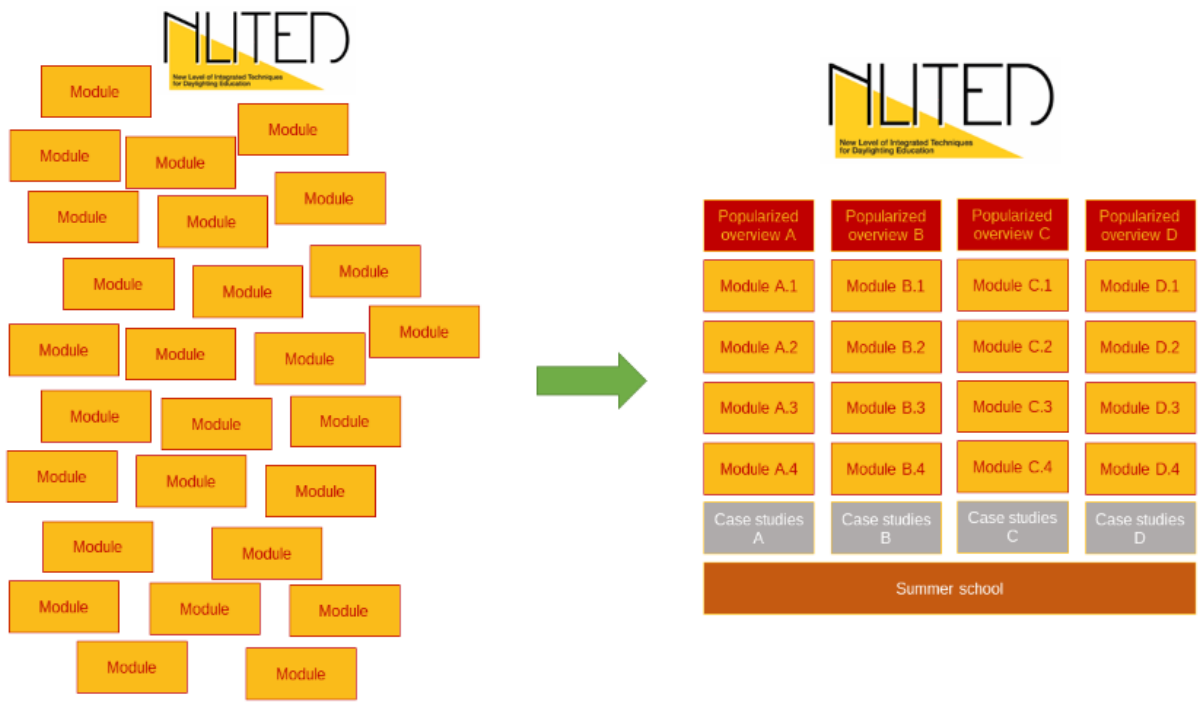

Figure 4. Structure of NLITED. Initially intended mix-and-match approach (left) versus final mix-and-match approach (right).

The NLITED eLearning Platform is thought for traditional students and life-long learners. There are no pre-requisite, only a self-assessment of knowledge, and the learner chooses freely the module(s) (*mix-and-match*).

- Traditional students, who are typically enrolled in specific programme, normally have similar objectives and dedicated time for studies, and they can be provided with well-structured learning curricula. NLITED, instead, provides access to education even to learners who cannot attend traditional educational programmes. They may have different motivational and educational needs (Watted and Barak 2018).

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- Lifelong learners, especially those with an employment, have different reasons and needs when joining online courses, and their motivations are different from those of traditional learners (Watted and Barak 2018). Although lifelong learners are extremely varied in terms of backgrounds, motivations, and needs, Lee et al (2019) claims that they can rather be seen as an homogenous group with similar characteristics. In particular, they need an educational proposal which 1) is suitable for family and work time balance, 2) is important for their profession, 2) provides some kind of certification, and 3) gives some social influence (Luik, Lepp et al. 2020). Failing to meet such needs largely increase the risk of dropout (Aldowah, Al-Samarraie et al. 2019).

Therefore, the final structure of NLITED online platform consist of thematic blocks suggesting potential learning paths, although each module in the block can be seen as independent. The first module is always an introductory module providing a popularized overview on the topic covered by the block. This type of modules is a sort of popularized introduction thought for novices or professionals indirectly involved in daylighting design, e.g. urban planners. These students do not need a specialistic education, but they would largely benefit from gaining awareness on the topic.

Following the specialist modules, the block is closed by a case studies block. The overarching definition of “case study” implies a practical application of the learnings acquired in the other eModules. That could the definition of minimum daylight requirements in local legislation, or the illustration of exemplary daylighting designs.

A community is created via an annual summer school organized by a limited number of the students attending the online learning.

Moving towards the specific skills that the professionals interviewed thought were important for the daylighting specialist of tomorrow, they could summarized as follows:

- Gaining knowledge on the potential benefits of daylight, in terms of both visual comfort and increased health for the occupants, by addressing the visual and non-visual effects of light, which play a crucial role in the circadian entrainment of the occupants.
- Developing a culture and a sensitivity on how to approach a daylighting design, which includes knowledge on daylighting outside buildings (with a special attention to sunlighting), on transparent and shading components, and on material properties with regard to daylight;
- Capability of understanding the influence of daylighting on the energy demand for electric lighting for a building, which includes the knowledge of the dedicated European standard, the LENI index (Lighting Energy Numerical Indicator), the integration between daylighting and electric lighting and the use of lighting control systems;
- Capability of assessing daylighting (sunlighting and skylighting) in both qualitative and quantitative terms, including both simplified tools and metrics and advanced metrics based on a climate-based daylighting modelling approach (CBDM);
- Knowledge on reference guidelines and standards, which include international, European, and local regulations used in the four countries who set up the project;
- Sensitivity and ability to run daylighting simulations and sensitivity in reading the simulation output, from the scratch to advanced simulations, which include modelling of advanced materials and daylight components.

More information on the definition of the educational framework for NLITED are provided in the report 01 and in peer reviewed publications.

Figure 5 shows the final version of the training offer.

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4. Online platform

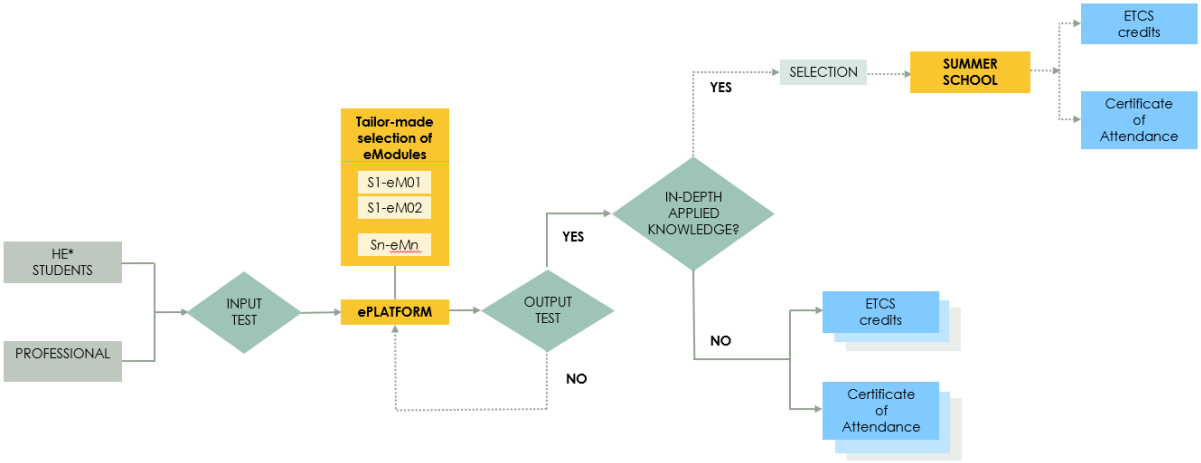

Figure 4: Training path for learners. To provide a tailored educational proposal, the system requires an admission test that serves the purpose of understanding the initial knowledge gaps and guiding towards modules that could address the identified gaps. The results serve as guidance and following the recommended modules is not mandatory.

4.1. Structure

Following the input from the workshops and defined educational framework, a total of 28 modules were designed, involving lecturers from the strategic network.

Coherently with the results from the workshop, some of the key features of the curriculum that have determined the architecture of the platform are that:

- **The curriculum is designed for heterogeneous users.** Within each block is a fundamental knowledge eModule '0' and other eModules with increasingly advanced knowledge. In this way, the ePlatform is suitable for a broader audience ranging from neophytes to researchers and professionals.
- **The eModules are independent of each other.** Therefore, users are not required to follow the entire learning path but can fill their knowledge gaps through a flexible and tailored curriculum (Figure 5). To facilitate the recognition of users' knowledge gaps, an 'admission test' is mandatory as the first step after registering into the platform. The test covers all knowledge areas of the curriculum and directs users to the modules whose answers were incorrect. It avoids taking modules that may be too easy or too difficult. The results from this test only suggest which modules to pick from the catalogue, but users are left free to choose the modules they prefer or are interested in.
- **the eModules are self-paced.** No deadline is given for the completion of a module, and lectures and case studies are pre-recorded. It means that participants can attend every module and get the ECTS credit at their best convenience in terms of time; furthermore, they can re-attend parts of a module for more in- depth analysis and understanding.

4.2.ePlatform architecture

The access to the module requires that a mandatory admission test (input test) is first completed (Figure 5). To provide a tailored educational proposal, the system requires an admission test that serves the purpose of understanding the initial knowledge gaps and guiding towards modules that could address the identified gaps. The results serve as guidance and following the recommended modules is not mandatory. Results from the admission test are used by the NLITED team to assess the entry level of all students.

Once the test is finalized, the student will access the "course catalogue" where all modules are organized under the respective thematic blocks, see Figure 6.

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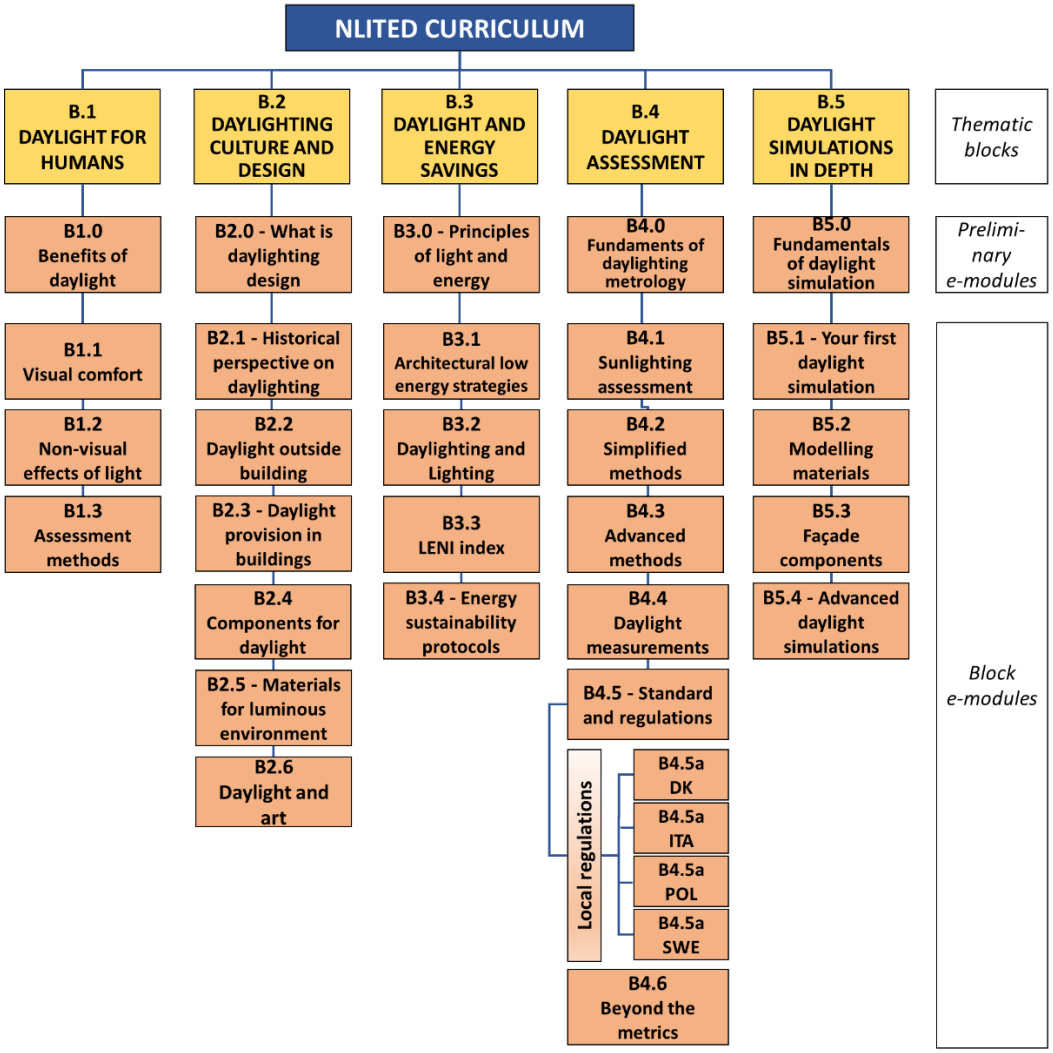

Figure 5: Final curriculum for the educational platform NLITED.

The final curriculum presents five thematic areas (called "blocks") that represent the main macro-topics of interest in daylighting:

(1) health;

(2) daylighting design;

(3) energy aspects;

(4) daylight assessment;

(5) daylighting simulation.

For each block, there are consistent and coordinated lectures (called 'eModules') to provide all the knowledge on that specific topic.

The "zero modules" are to be considered introductory modules intended for students who have no prior knowledge of the subject matter within the block. They are not mandatory, but they may be recommended for those who lack the minimum preparation to continue with the other modules in the same block.

When subscribing to a specific module, the structure of the module will open. This consist of a list of short learning units within the module (Figure 7). While each module is planned to last about 3 hours, the learning units are at most 20' minutes long, often significantly shorter. This supports learning of people having fulltime study or jobs, that can follow a single module over time, still finalizing small learning units during spare time.

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Each module is designed to account for 1 ECTS, so the student workload should be calibrated at around 25 hours. On average, it can be assumed that a module can be completed in approximately one week of intensive study.

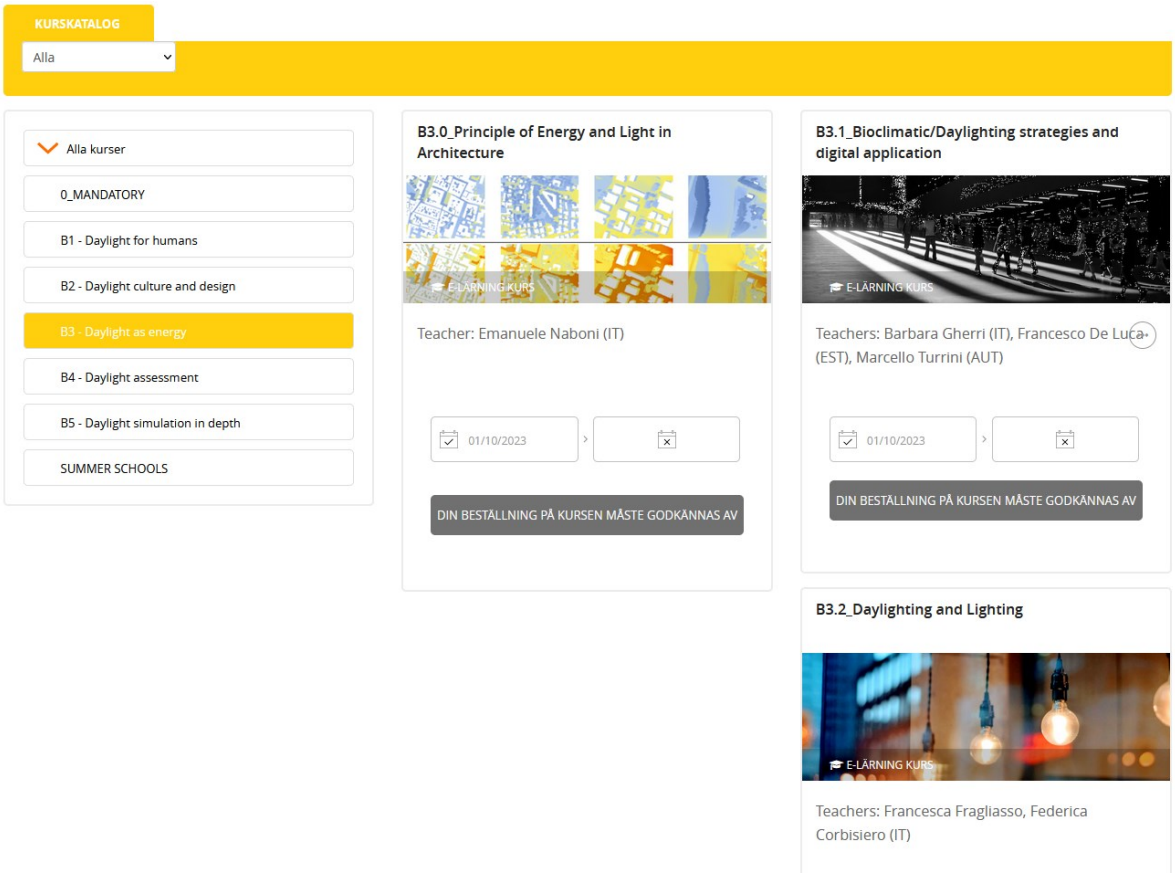

Figure 6: Screenshot from the course catalogue. Thematic blocks are listed on the left menu, while the eModules are previewed on the right-hand side.

The very first activity in the module is a 5' introduction where the learning outcomes for the module are presented. Then, the actual learning units can be followed. In this case, it is important to follow them in the right order; therefore, the platform prevents the user to jump to other units before having finished the previous. While most learning units consists of slide-based lectures, some "e-tivities" are also included. These are exercises that the students can perform independently. For example, in the module "B1.3 Assessment methods", among other things, the students are invited and instructed on how to measure the luminous environment in their own room. The last activity is called "Evaluation" and it consists of a final test (closed-ended questions with shuffling of questions) and a course evaluation.

While building the modules, efforts were made to have a balanced amount of material in each module so that each module would account for the above mentioned 3 hours of learning material (lectures) and 20-25 hours of self-study, including exercises.

In total, NLITED accounts for over 80 hours of learning material – including the modules currently being finalized - divided into the aforementioned 28 modules.

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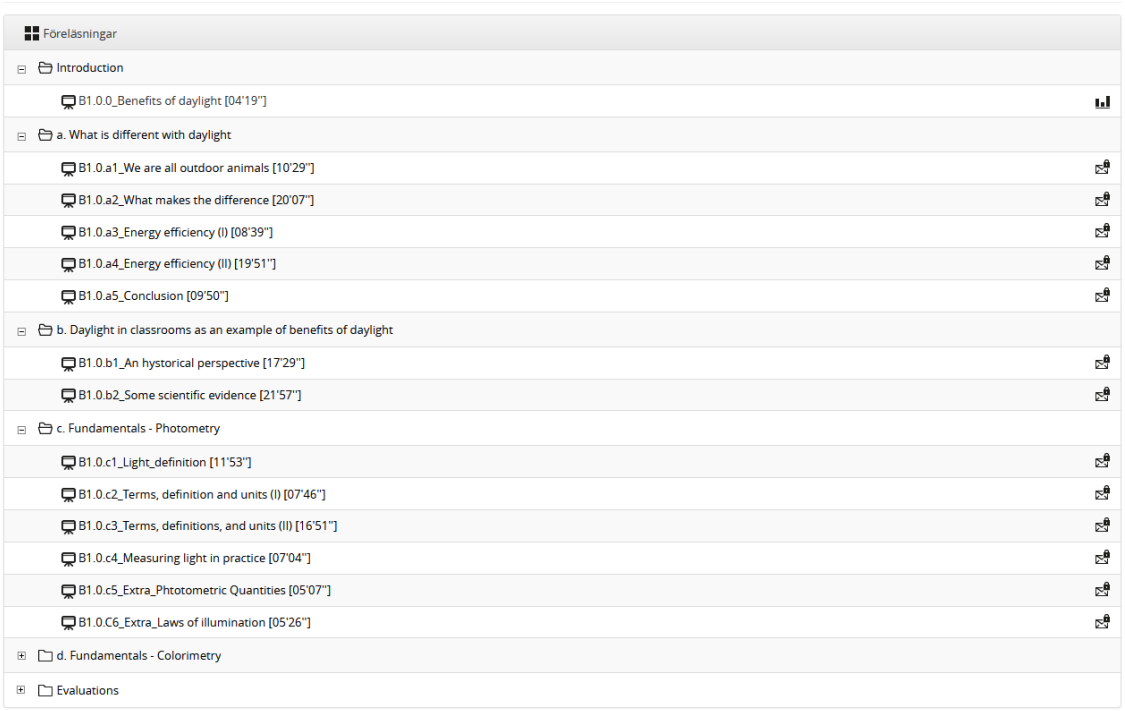

Figure 7: Learning units in the "Benefits of daylighting" eModule, one of the introductory eModule in the NLITED platform.

5. Summer schools

The NLITED Specialized Summer School, "Daylighting in buildings," marked the inaugural edition of a one-week intensive study program within the New Level of Integrated Techniques for Daylighting Education (NLITED) initiative.

The first edition of the summer school was conducted at Technical University of Denmark (DTU) from the 16th to the 22nd of August 2022. This event was closely linked to the IBPSA-Nordic 2022 conference, held in Copenhagen, Denmark, from the 22nd to the 23rd of August 2022. During this event, summer school participants presented their projects in a poster session as part of the conference. In 2023, the second edition of NLITED summer school was held in Gdansk and organised by DTU and Polytechnique Gdansk. In a similar structure, the participants presented their final work at Gdynia Design Day event.

The main objectives of the summer school were to:

1) **Foster an Engaging Learning Experience:** Develop an interactive and captivating approach to learning. All elements of the summer school, i.e., lectures, group discussions, pitches and presentations, throughout the week and the directed project-based work in collaboration with the teachers, lecturers, and industry experts were designed to allow for interaction and knowledge exchange to every detail of the project at the hand.

2) **Provide Comprehensive Work Exposure:** Allow participants to gain holistic work experience. The project-based approach and group work were the two major elements of the summer school that allowed for a real-life representation of a task in Industry. Each group was shaped to allow the group members exposure to diverse set of levels of experience, study background, as well as level of knowledge in each group. Throughout conceptualization of the training program adopted in the two summer schools we ensured that the main elements of a real working environment are adopted in the training process, i.e., :

    1) Problems solving
    2) Exchange of knowledge

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3) Communication in group
4) Diverse expertise and skills
5) Teamwork
6) Dissemination

3) **Facilitate Networking with Industry Experts and Firms:** Create opportunities for participants to connect with professionals and companies in the industry. The summer school is taught by a team of experienced daylighting professionals from different European universities and industry partners. Participants had the opportunity to learn from the experts, gain practical experience in daylighting design, and network with other professionals in the field.

4) **Designed for Both Master's Ph.D. students and Professionals:** Tailored to benefit not only master's and PhD students but also professionals seeking an immersive study program.

5) **Culminate in a Presentable Final Product (Event/Competition):** The projects were to be concluded by creating a tangible and presentable final project, to be presented in a larger event and a larger audience of peers in building industry with possibly different background and fields.

5.1. Program

The program spanned a week, including a training program, technical tours, and a final poster competition in conjunction with the BuildSim Nordic conference.

The primary aim of the summer school was to execute an entire daylighting design project. Students were organized into groups of four, with two teachers accompanying each group throughout the project.

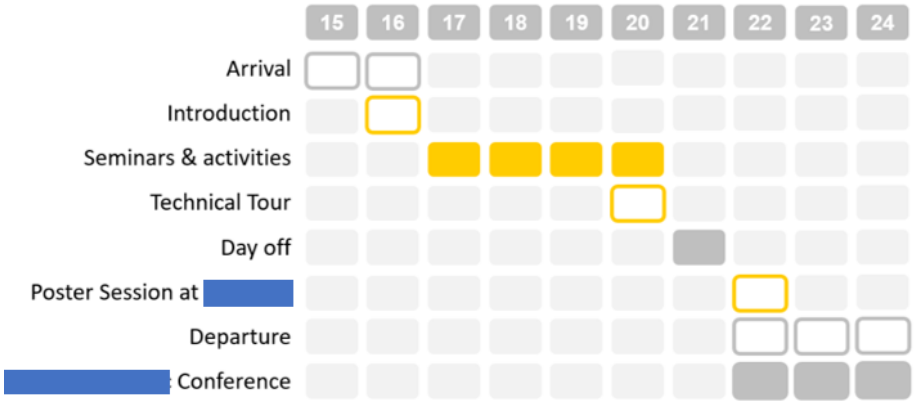

Figure 8: *Overview of the summer school. Sensitive references are blind (blue boxes) for peer review.*

The training program took place over four days, with daily lectures addressing the task at hand, supervised by various lecturers. The fourth day was allocated for project finalization and presentation/communication aspects. The program included a guided Technical Tour of each hosting city.

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Figure 9: *Pictures from the Summer School ed. 1*

5.1.1. The training concept used in summer school Summer School ed#1

The students were grouped and went through a set of tasks with clear learning objectives towards understanding of photometric measurements, design, and intervention to enhance the daylight conditions of a building, and finally evaluate the design through simulation.

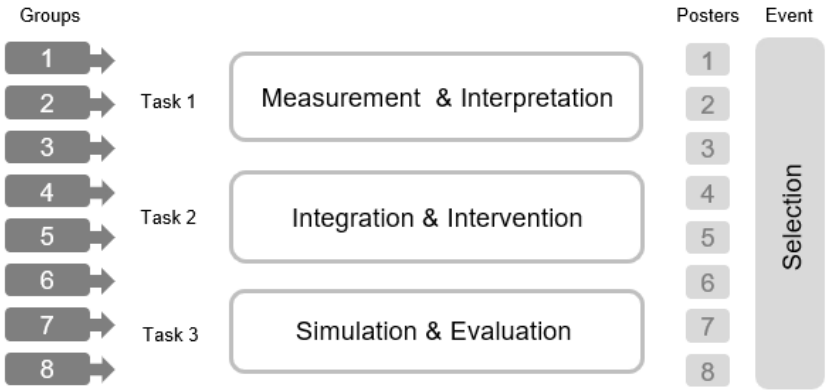

Figure 10: *The summer school educational programme was defined to complement the ePlatform content for a more hands-on and realistic experience.*

The teaching and learning activities were structured around three core tasks designed to provide a more hands-on and realistic experience:

- **Task 1: Measurement and Interpretation**: The learning objectives of this task were to familiarise the students with basics of physics of light and photometry through measurement and understanding the quantities behind the numbers. This involved measuring light intensity, colour, spectral distribution, and visual comfort-related parameters.

- **Task 2: Integration and Intervention**: This task focused on integration of daylighting concepts and interventions into the design process. The participants together with the tutors would define the problems in the building at the hand and examine different architectural solutions theoretically.

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- **Task 3: Simulation and Evaluation**: Centred on simulating daylighting scenarios and evaluating their impact, the strategies, solutions, and designs examined in the previous task were put to test and evaluation. The learning objectives of this task was focused on understanding the daylighting simulation and strategies through hands-on work, listing & remembering the daylighting metrics, evaluating the metrics through a comparative assessment, and to finally evaluate the daylighting design.

Tasks and Objectives*

Task 1 - Measurement and Interpretation

The objectives of Task 1 were to explore physical light quantities using common measurement techniques, encompassing light intensity, colour, spectral distribution, and visual comfort measurements. Completing this task, the participants were able to:

- Remember the photometric quantities relevant for daylight and lighting.
- List the definition of the different photometrical quantities and their relations.
- Remember the different daylight metrics developed and the measurements behind their calculations.
- Describe the concept of measurement onsite and in simulation and the dynamic nature of daylight.
- Describe the differences between the quantities and metrics.
- Perform a hands-on lighting measurement and interpret the results.

Task 2 - Integration and Intervention

This task aimed to integrate daylighting concepts and interventions into the design process. It included lectures and supervision from relevant experts. At the ned of this task the students were able to:

- List several daylighting strategies and concepts developed through time.
- List architectural generic architectural components that can be used in daylighting.
- Remember the architectural strategies though façade, form, orientation, etc. that can enhance the daylighting conditions.
- Describe the different aspects of solar geometry and methods and tools that can be used to incorporate them in design process.
- Identify the problem and create a problem statement related to the project.
- Develop and examine several daylighting solutions and strategies to tackle the problem and in a group work.

Task 3 - Simulation and Evaluation

Task 3 emphasized daylighting simulations and evaluations, including tips and tricks, climate-based simulations, and feedback from experts. Bu the end of this task the students were able to:

- Revisit their skills and understanding of the simulation strategies in daylighting.
- Remember tools and methods for daylighting evaluation through simulation.
- Design a simulation and calculation strategy to evaluate their intervention and architectural daylighting design.
- Develop results for further evaluation of their strategies.
- Evaluate and interpret the results with critical overview of the metrics and assessments used.

SCIENTIFIC BOARD**:**

The Consortium coordinators were the main responsible of the activity and active part of the scientific board. Some teachers involved also in the ePlatform were invited ad Lectures and Mentors to guide the participants throughout the Summer School Experience.

AWARDING OF ECTS POINTS**:

The NLITED summer school was designed to have the workload equivalent to 1 ECTS. However, the awarding of credits was at the discretion of the participants' home institutions. Participants received

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certificates of attendance, and the conversion of these certificates into credits was the responsibility of the participants.

The training concept used in summer school Summer School ed#2

In this edition the training program used a more architectural design process approach to the problem solving and as the core training concept.

To be added

5.2. Admission criteria

The admission to the summer school was based on the following criteria:

1. **Affiliation of the candidate.** Order of priority.
    a. Candidates from the four institutions
    b. Candidates from the four countries (students first, then professionals)
    c. Candidates from European countries (students first, then professionals)
    d. Candidates from other countries (students first, then professionals)
2. **Prerequisite.** Being familiar with basic knowledge of physics of light, the principle of daylight assessments, and building simulation.
3. **NLITED eModules passed.** Candidates must have passed at least **4 NLITED eModules.**
    a. Certificates of attendance for the modules passed must be attached to the application form within the ePlatform. Extra-modules **B4.5a**, **B4.5b**, **B4.5c**, **B4.5d**, **B4.6** will not be considered.
    b. The list of the modules passed must include at least two (2) of the following modules: B1.0, B4.1, and B5.1. Such modules are considered a prerequisite for entry to summer school. Alternatively, applicants must provide proof of equivalent preparation of the two modules selected (e.g., certificates of external courses). Certificate of attendance of such modules, or equivalent certificates, must be attached to the application form.
4. **Candidate motivation.** In the application form there is a field to express the motivation to participate in the summer school.

Applicants were required to submit a completed form in Word or PDF format, along with certificates of attendance for passed NLITED modules. The B4.3 module certificate or its equivalent was mandatory. No discrimination was made, and a selection process was in place for filling available slots. If a selected student declined, candidates on the waiting list were called until all 24 slots were filled.

These scholarships will be managed by the partner institutions of the NLITED consortium:

- Italian students: University of Niccolò Cusano – Italy
- Danish students: Technical University of Denmark - DTU - Denmark
- Polish students: Politechnika Gdańska – Poland
- Swedish students: Lund University – Sweden

Based on the applications received, a selection of participants was made based on the following criteria. If a selected student declined, the first candidate on the graduation list will be called. Calling from the list will continue until the maximum number of participants in the summer school has been filled (24 places).

5.3. Summer School ed#1

The inaugural summer school took place in Copenhagen in 16th to 22nd August 2022, involving 25 students from partner universities and additional paying participants. Twenty-four candidates were

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selected from Denmark, Italy, Poland, and Sweden. Scholarships were provided to students from Italy, Poland, and Sweden through their respective institutions.

The students worked in groups of three and on predefined projects on existing buildings. Fifteen educators participated as instructors, resulting in a daily attendance of around 35 individuals. Spanning eight days, the program adopted an intensive boot camp format. Each day centred around a distinct theme, with students grouped in threes, led by two tutors. Expert instructors reviewed student work in the afternoons. Themes covered various daylighting aspects such as Daylight Quality, Design, Simulation, and Dissemination. Student projects focused on designing and verifying daylight control solutions for buildings within the DTU campus. After an intensive one-week training program on daylighting in buildings, the participants of the summer school, presented their work in BuildSim Nordic conference and the hosted by DTU 22nd-23rd August 2022. The summer school participants presented their projects in a poster session within the conference.

Figure 11: *Final event combined with BuildSim Nordic 2022 (above); Technical tour of Copenhagen (down).*

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5.2.1. Schedule

The program stretches over a week with an activity including a training program and a technical tour and a final poster competition in connection with the BuildSim Nordic conference shown in the schematic (Figure). The participants arrived on 15th and 16th of August with the commencing of the school on August 16th morning at 8:30. The participants were welcome by Mandana Sarey Khanie, the Danish coordinator.

Figure 12: *Lectures during the Summer School.*

After the introductions the students were equipped with all the necessary tools, material, and information for their work and projects in the week to come. The teachers presented the three tasks of the summer school. And each group started working with their supervisors towards a product. The following three days, they were engaged in a daylighting project with the teachers towards a final evaluation and results. On day 5, August 20th, a technical tour was held through Copenhagen city. Indulging in the bicycle city of Copenhagen, the participants went on a guided tour organised by local experts were fine daylight architecture of Danish and Scandinavian architecture were explored (Figure

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12b). The students were free day on the 21st. On the 22nd, they presented their projects in the form of a poster in a dedicated poster session at the BuildSim-Nordic conference held at DTU, between the 22nd and 23rd of August. At the end of the poster session, the best projects will be announced. The winners will be able to participate to a future Velux event (Figure 12a).

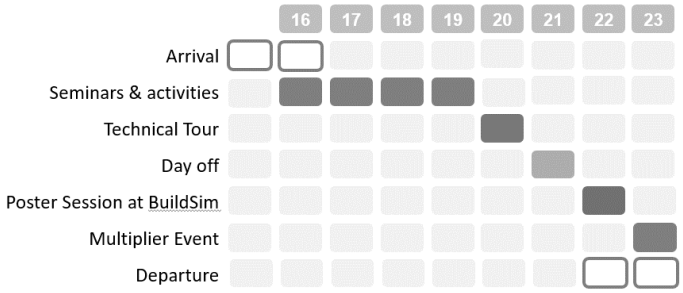

Figure 13: *Lectures during the Summer School.*

5.2.2. Training Program concept

As mentioned in section XX in detail, the initial training concept of the summer school ed# came from a more engineering and architectural engineering perspective with a setup that allowed a constructive alignment with the building industry from a technical point of view. Hence the focus was not on the design, but rather on the technical applications of a design strategy and its performance. The participants who were in groups of three after the training program completed three main set of learning objectives or tasks which took them understanding of photometric measurements, to design, and intervention to enhance the daylight conditions of a building, and finally evaluate the design through simulation. They were guided to communicate their results in scientific poster where they would introduce their projects, state the problem, layout the methodology they used for understanding and enhancing the problem, and showing some results of their evaluation. They were to conclude the performance of their intended design with a scientific and engineering point of view, "did it work? What can be done in future? ".

5.2.2 Projects

Eight projects were defined based on actual conditions on problems in different buildings across DTU campus. The project covered a range of daylighting problems from orientation, facade components, skylights, and surrounding shades such as trees.

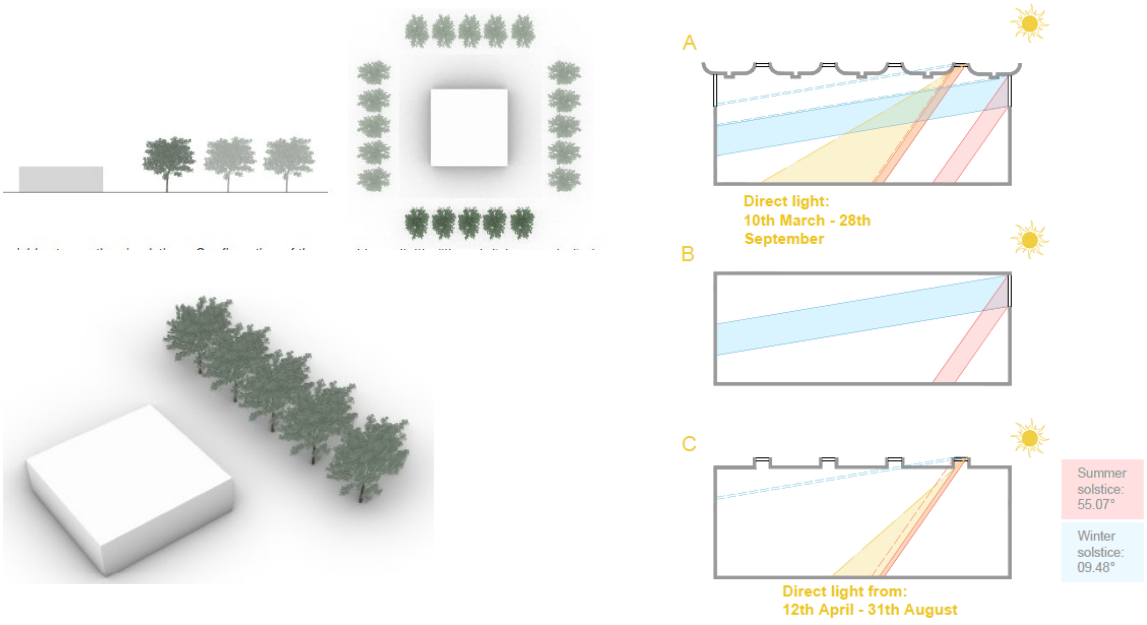

Figure 14: *Example of the project task*

5.2.2 Presentation and Communication Preparation

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The day allocated to poster preparation included lectures on scientific reporting and poster creation. A lecture day with several examples on presentation and communication skills in general and specific to daylighting. The groups were then set to further evaluate their work and design a poster to convey their findings from the practice. Examples show two different projects tacking a similar issue in two different buildings with distinct ways of communicating the results and their findings.

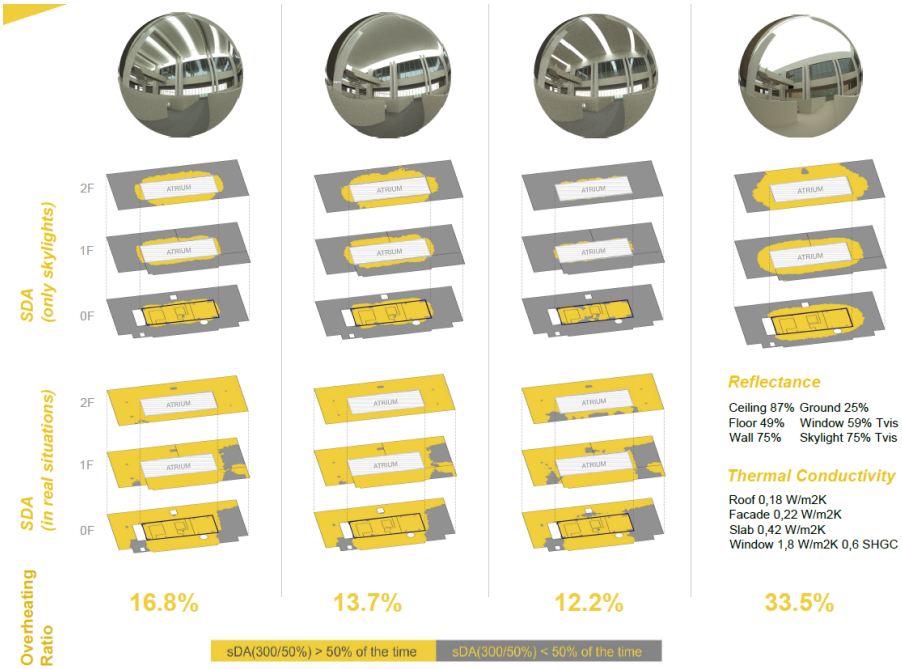

Figure 15: Example of one of the group's poster. *Lectures* during the Summer School. *A Skylight form and opening ratio were tested in this project and its impact on a 9-meter distance on floor.*

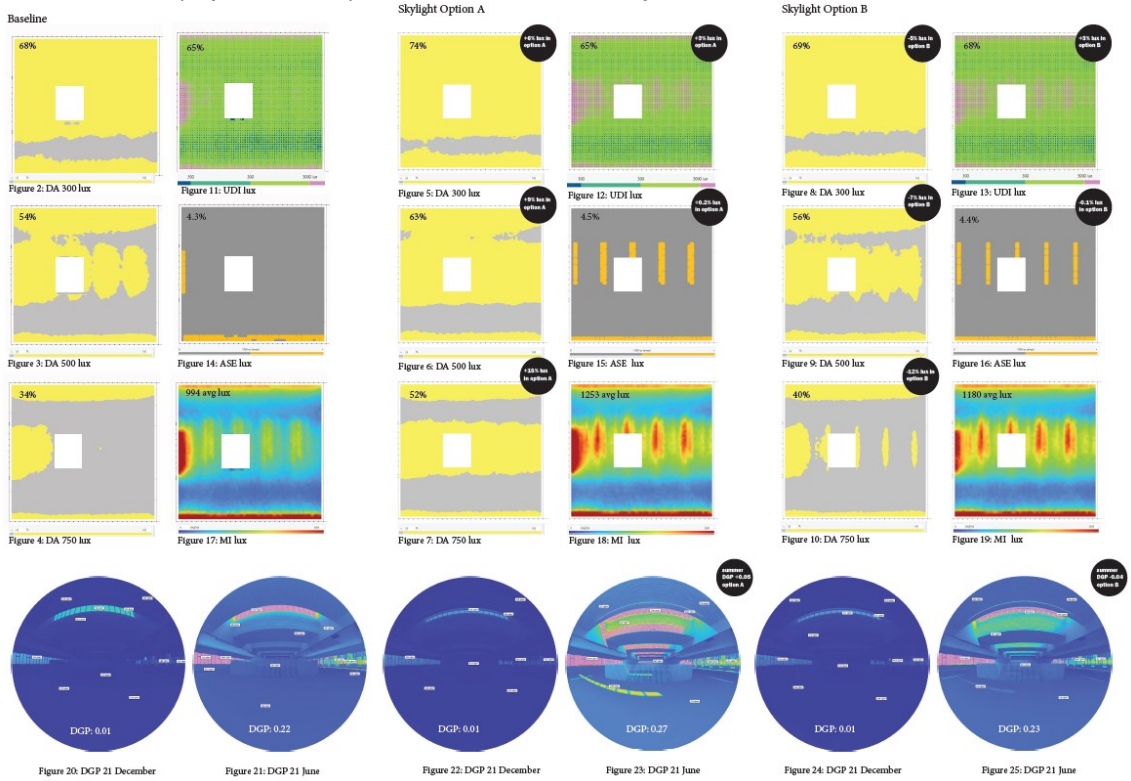

Figure 16: Example of one of the group's poster. It shows simulation results of three different scenarios and evaluation of daylight composition in field of view.

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Group Leaders

Group leaders were assigned to each group to provide guidance and support throughout the project.

Figure 17: Image of Groups Engaged in Various Activities at the Summer School

5.4. Summer School ed#2

The second summer school took place in Gdansk, Poland, in August 2023. It attracted 19 in-person and 7 online participants, including master's and doctoral students alongside professionals. Retaining the thematic divisions from the first iteration (Daylight Quality, Design, Simulation, Dissemination), groups of three were preserved (totaling six groups). The key deviation was in the afternoon student-teacher interaction, which allowed independent work, with consolidated feedback sessions held at

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day's end. The schools started with a technical tour and the day of the open to public presentations at the Gdansk University of Technology. In a similar structure as during the first summer school, the participants presented their final work in a public event at the Polish institution the PPNT (Pomorski Park Naukowo-Technologiczny). The event was co-host by Gdaynia Design Days.

Figure 18: NLITED Summer School Group, Edition 2, at the Gdansk University of Technology.

5.4.1 Schedule

The NLITED summer school lasted from August 26th to August 31st, 2023. This time the school started with the technical tour in Gdansk area. The objective of the tour was to learn about architectural and urban solutions with an emphasis on daylight for residential areas in Gdansk through the last 250 years and to visit the case studies. The learning objectives of the technical tour guided by the local architect and urban planner were to observe how urbanist and architect imagined the residential areas for people thought the centuries and how daylight was treated on a building and the urban scale. The summer school training program started with the open to public lecture session on daylight quality at the Gdansk University of Technology. The training session were held in university resort centre in Sopot where students and teachers will work side by side for a week. The final event took place in association with Gdynia Design Days in the neighbouring city of Gdynia.

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	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6	EVENT DAY
topic		TECHNICAL TOUR	DAYLIGHT QUALITY	DAYLIGHTING DESIGN	SIMULATION	DISSEMINATION	
venue	Eureka Hotel		Gdansk Politechnika	Eureka Hotel			Eureka/GDD
7:15-8:15	ARRIVAL DAY		commuting by train	yoga on the beach	yoga on the beach	yoga on the beach	yoga on the beach
7:00-9:00		breakfast	breakfast	breakfast	breakfast	breakfast	breakfast
9:00-9:30		commuting by private bus	Mandana - A summer school on daylighting: the experiecne from 2022 Copenhagen	Valerio RMLV - vetri (25)	Mandana - Solar Shading. From concept to calucaltion	Tristan - How to disseminate your work	Groups Work (1h30)
9:30-10:00			Niko -All about the metrics	Federica - architectural aspects (25)		Tristan & Milena - How to disseminate your work	
10:00-10:30		Gdansk architectural tour - part 1 (2h30)	Paul & Angel - Beyond the metrics	Emanuele N - Climate Change implication on Facade Design	Mandana - Daylighting in simulation	Luca & Tiziano - Video editing	
10:30-11:00			coffee break (30')	coffee break (30')	coffee break (30')	coffee break (30')	coffee break (30')
11:00-11:30			Katarina Wulff - Adaptiveness to light from molecular to community level	Agnese - Solar access urban level (25')	A Simulation workshop: Mathias, Mandana	Katarina Wulff -	Groups Work (1h30)
11:30-12:00			Aicha - non-imaging forming potential in urban settings	PIM - perception (25')			
12:00-12:30			Luca Tiziano	Kynthia - perception (40')			Lunch time (1h15') 12:00-13:15
12:30-14:00		Lunch boxes (45')	Lunch time (1h30')	Lunch time (1h30')	Lunch time (1h30')	Lunch time (1h30')	commuting by train
14:00-14:30		Gdansk architectural tour - part 2 + case study site visit (1h30)	Case study site visit (1h30)	Groups work (1h30)	Groups work (1h30)	Groups work (1h30)	EVENT AT GDYNIA DESIGN (4h)
14:30-15:00							
15:00-15:30							
15:30-16:00			coffee break (30')	coffee break (30')	coffee break (30')	coffee break (30')	
16:00-16:30	Natalia - Short welcome (30')	Tea break (1h)	Groups work (1h30)	Groups work (1h30)	Groups work (1h30)	Groups work (1h30)	
16:30-17:00	Key-note by Marie-Claude (1h)	commuting by private bus					
17:00-17:30		free time					
17:30-18:30	Presentation of the case study		Collective Brainstorming (1h)	Collective Supervision (1h)	Collective Supervision(1h)	Collective Supervision(1h)	
18:30-19:00	pause (18:00)	commuting by train	commuting by train	pause	pause	pause	commuting by train
19:30-21:30	dinner at Eureka	dinner at Eureka	dinner at Eureka	dinner at Eureka	dinner at Eureka	dinner at Eureka	GALA DINNER

Figure 19: The NLITED *Summer School ed 2 simplified schedule.*

Like the previous year, summer school second edition had a boot camp formula and was held in a hotel by the sea in Sopot where students and teachers worked side by side for a week. The students presented the results of their design at an open public event co-organized with the local design organization called Gdynia Design Days in the form of video clips. This event was hybrid, and many emphases were placed on disseminating daylight topics to a diverse audience.

Figure 20: The NLITED *Summer School#2 leaflet inviting the public for the final event.*

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5.4.2. The role of chronobiology lectures

The novelty proposed during this school were chronobiology lectures focused interactive lighting, daylight exposure and well-being. At the beginning of the summer school, an introductory lecture on non-visual aspects of light was delivered (the 28th). Then, at the end of the week (the 31st), a critical session with an invited chronobiology experts (2h) was offered. The idea is to allow students to evaluate their projects also from a chronobiological point of view, after having considered all other aspects as well. The chronobiology expert also had a dissemination lecture on circadian aspects of light and impact on our life for the general audience at the final hybrid event (on the 1st of Sept). The chronobiology lectures are offered to expand the training offer of the NLITED summer school with greater multidisciplinary in the field of daylighting, with chronobiological knowledge. Additionally, to dissemination of knowledge on visual and non-visual effects of daylight on physiology among the young designers and people keen on sustainable design.

Figure 21: The chronobiology lectures.

5.4.3 Projects

The summer school students could choose form 7 task - projects developed by the NLITED teachers for two buildings: office buildings and one dormitory for international students located on the Gdansk Tech campus (virtual walk of the campus: https://campus.pg.edu.pl/).

Figure 22: The dormitory building (A)- case study for the students at the summer school.

The projects focused on the following tasks:

Project 1: DORMITORY BUILDING FAÇADE DESIGN: Exploring the effect of window size, glazing type, or any other changes in facade design on enhancing the indoor lighting conditions. Daylight levels, Visual Comfort, and non-visual health potentials can be considered as the main two quality indicators. The following objectives can be considered:

- Evaluating the facade existing facade design
- Exploring facade design relevant to the building typology.
- Testing the new design.
- Evaluation of the design based on daylight indicators such as daylight levels, visual comfort, health potentials.

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Project 2: DORMITORY BUILDING INTERIOR LAYOUT: Exploring interior layout, furniture setting and view direction as well as the shape of the room, i.e., room depth. Daylight levels, Visual Comfort, and non-visual health potentials can be considered as the main two quality indicators. The following objectives can be considered:

- Evaluating the daylight provision based on different room sizes
- Exploring visual comfort for different view direction
- Evaluating furniture settings to avoid visual discomfort
- Exploring non-visual potential of the space
- Evaluation of the design based on daylight indicators such as daylight levels, visual comfort, health potentials

Project 3: DORMITORY BUILDING SOLAR PROTECTION: Exploring the effect of solar system controls on enhancing the indoor lighting conditions. The following objectives can be considered:

- Creating a list of solar control devices
- New windowing / glazing
- External elements (e.g., light shelves, balconies)
- Requirements based on daylight standard

Project 4: URBAN DENSIFICATION: Reach higher urban density, while assuring daylight provision for Building A. Specific issue: Building A is surrounded by other buildings. Imagine that the municipality wants to demolish all the other buildings but A. The municipality assigns to you as developer with a maximum building density of 3.5 m3/m2 for 250 m radius around Building A. You, as developer, have all interest to reach the highest density, but all buildings in the finalised development should comply with the minimum daylight provision as defined by EN17037:2018+A1.

Explore how different building shapes and urban densities affect daylight provision in Building A. Possibly propose a design which maximises density while guaranteeing compliance with EN17037:2018+A1.

It is possible to modify both the volume and the façade of Building A but not its height.

Figure 23: The office building-case study for the students at the summer school. *A. Northern Façade with a connector to Main Building.* *b.* View form the building 2nd floor with western exposition c. *View from the office on the 1st floor toward the northern side and greenery.*

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Figure 24: The office building- case study for the students at the summer school- *Plan of the ground floor. Source: https://campus.pg.edu.pl/.*

Project 5: OFFICE BUILDING FAÇADE DESIGN: Exploring the effect of window size, glazing type, or any other changes in facade design on enhancing the indoor lighting conditions. Daylight levels, Visual Comfort, and non-visual health potentials can be considered as the main two quality indicators. The following objectives can be considered:

- Evaluating the facade existing facade design
- Exploring facade design relevant to the building typology.
- Testing the new design.
- Evaluation of the design based on daylight indicators such as daylight levels, visual comfort, health potentials

Project 6: OFFICE BUILDING INTERIOR LAYOUT: Exploring interior layout, furniture setting and view direction as well as the shape of the room, i.e., room depth. Daylight levels, Visual Comfort, and non-visual health potentials can be considered as the main two quality indicators. The following objectives can be considered:

- Evaluating the daylight provision based on different room sizes
- Exploring visual comfort for different view direction
- Evaluating furniture settings to avoid visual discomfort
- Exploring non-visual potential of the space
- Evaluation of the design based on daylight indicators such as daylight levels, visual comfort, health potentials.

Project 7: OFFICE BUILDING SOLAR PROTECTION: Exploring the effect of solar system controls on enhancing the indoor lighting conditions, the following objectives can be considered:

- Creating a list of solar control devices
- New windowing / glazing
- External elements (e.g., light shelves, balconies)
- Requirements based on daylight standard

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5.4.4 Presentation and Communication Preparation

The summer school participants demonstrated their progress on design tasks every day, except the day allocated to a short movie presentation and the final event. The groups were asked every day by different tutors to evaluate their work and design an explanatory movie to convey their findings from the practice to communicate the selected design solutions to general audience. The emphasis was put on suggesting design solution in relation to the non-visual effects of light.

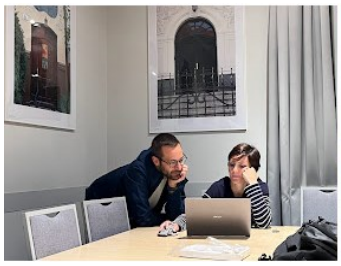

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Figure 25: Image of participants engaged in various activities during the Summer School

6. Verification of the project quality

6.1. Platform and modules

6.1.1. eModule evalutation test

All NLITED learners are asked to fill out an "e-module evaluation" (EE) survey after attending an e-module. This consists of 29 questions or statements addressing various aspects of the e-module:

- Learning expectations, e.g., "the e-module content consistent with the learning outcomes."
- The time needed for completion, e.g., "the amount of time it took to complete the e-module was appropriate."
- E-modules structure and contents, e.g., "the case studies were pertinent/inspiring", "the links to external resources were useful", or "the final test adequately covered the content of the e-module."
- e-modules structure and contents, e.g., "the case studies were pertinent/inspiring,"; "the links to external resources were useful", or "the final test adequately covered the content of the e-module."

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- Learners' engagement, e.g., "the e-module was inspiring", "I am confident about the knowledge I gained after attending the e-module".

The data collection is descriptive and based on the number of users in the NLITED e-platform (www.lms.nlited.eu) from January 31st, 2022 (launch day) until July 15th, 2023. How e-learners have used the e-platform was observed through the records of the enrolments. The satisfaction and judgments of e-learners were analysed through an e-module evaluation test (EE), which participants fill after attending each e-module. It contains questions and statements regarding expectations, timing, educational content structure, and learners' engagements. Questions are based on a 4-point scale (1 = not at all agree; 4 = totally agree). For the analyses, the responses were categorised into two groups: scores 1-2 = low agreement; scores 3-4 = high agreement.

As of July 15th, 2023, the NLITED platform has 802 users, with an average of 3.69 daily registrations. There are 517 active users (64.5% of the total) on the e-platform. A share of 265 (33%) enrolees are 'inactive' users: they registered to the platform but never completed the admission test. The various e-modules have been completed 403 times, which means an average of 0.79 per person: this is the average value between active users who still need to complete the e-module and users who completed several e-modules. Overall, the evaluation of the modules was quite positive, see Figure 20.

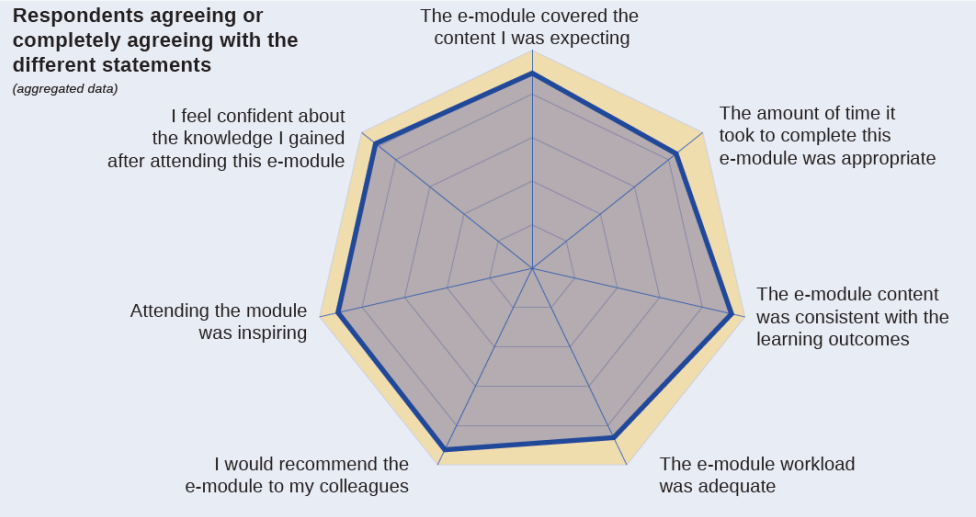

Figure *26*: *Some key results of the quality assessment of the NLITED e-learning platform. Picture from CIE 2023 poster presentation of Sokół, N, Giuliani, F, Gentile, N, Sarey Khanie, M & Lo Verso, VRM 2023, Training on sustainable daylighting: the NLITED project. in D Gašparovský, T Novák, P Janiga & M Mokráň (red), CIE 2023: Proceedings of the 30th Quadrennial Session of the CIE. Ljubiana, Slovenia, 2023/09/16.*

Most selected modules

More than half of the active users (59.4%) enrolled in the basic module B1.0 - Benefits of daylight. The other most selected e-modules cover various topics, such as B.1.1 - Visual comfort (36.9%); B.5.1 - your first simulations with Ladybug tools in Rhino+Grasshopper (28.8%); B1.2 - Non-visual effects of light (27.1%); B5.0 - Fundamentals of daylight simulation (24.8%); B4.1 Sunlighting assessment (24.0%); and B4.6 - Beyond the metrics (21.7%). However, in terms of course completion, the e-modules with the highest completion rate are B4.6 - Beyond the metrics (48.2%), B1.0 - Benefits of daylight (35.8%), and B4.1 Sunlighting assessment (33.9%). It should be noted, though, that e-modules B4.6 (Beyond the metrics) is a short e-module lasting 30 minutes: this suggests that a shorter time may result in a higher completion rate.

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E-module frequency and completion rates

An average of 36% of learners who started a module have completed it. The most significant number of dropouts occur before a participant followed 25% of the eModule, while most NLITED students who passed this threshold make it to the end: indeed, 67% of users who passed 25% of the module would eventually complete it. It is worth stressing that a share of 7.8% of learners who completed an eModule did not download the certificate of attendance.

The module with the highest completion rate ("B4.6 - beyond the metrics") is not among the eModules with the highest subscriptions. Similarly, the eModule ("B1.2, 'non-visual effects of light'") is the third more frequently completed, but it is not among those with higher subscription frequencies.

Quality of the e-modules

The quality of the e-modules was assessed by analysing the data of the e-module evaluation tests (EE) through the following categories: 1-2: low agreement; 3-4: high agreement. The data collection is based on 372 EE tests of 18 e-modules. In detail, the following considerations can be drawn:

- **Learning Expectations: content**: when asked if the e-module "covered the expected content", the respondents gave high agreement scores (3-4) for 17 of 18 e-modules. Notably, nine of them (B5.1, B2.0, B5.0, B3.2, B4.5a, B2.6, B4.5b, B41.3) received 100% of judgments with scores of 3 and 4.
- **Time for completing an e-module**: when asked if the "time needed to complete an e-module was appropriate", respondents expressed high agreement scores (3 or 4) for 17 out of 18 e-modules. In more detail, e-modules 2.2, B2.6, B4.5a, B4.5b, and B4.5 received 100% of judgments with scores of 3 and 4.
- **Consistency with the learning outcomes**: When asked if "the e-module content was consistent with the learning outcomes", over 80% of respondents expressed a high agreement score. Specifically, 100% of the judgments expressed a score of 3 or 4 for modules B2.2, B2.3, B2,6 B4,5a, B4,5 B5.0, B5.4.
- **Adequacy of the workload**: when asked if "the workload of an e-module was adequate", respondents expressed high agreement (scores 3-4) for 17 of the 18 modules, in a range of 57%-100%. The high agreement was 100% of scores 3-4 for seven e-modules. In contrast, all scores were equal to 1-2 ("low agreement) for module B5.4.
- **Recommending an e-module to colleagues**: about the question "I would recommend the e-module to my colleagues", between 80% and 100% of respondents said they would recommend the e-module they attended. For six e-modules (B2.0, B4.2, B4.5a, B5.5b, B4,5, B5.4), 100% of the judgments scored 3 or 4 points.
- **Attendance as an inspiring experience**: about the question "attending the module was inspiring", between 60% and 100% of respondents expressed a high agreement score (3-4). For eight e-modules (B2.2, B2.6, B4.2, B4.5a, B4.5b, B4.5, B5.0, B5.4), 100% of the judgments expressed a score of 3 or 4 points. For nine e-modules (B2.0, B5,1, B1, B4.6, B4.1, B2.3, B3.2, B1.2), the 'totally agree' (score 4) was expressed by 87.1% of respondents. For six modules (B2.0, B4.2, B4.5a, B5.5b, B4,5, B5.4), 100% of the judgments scored 3 or 4 points.
- **Learners' knowledge confidence**: About the question "I feel confident about the knowledge I gained after attending this e-module", 73% and 100% of respondents expressed a high agreement score (3-4). 100% of scores were 3 or 4 for eight e-modules (B5.0, B2.3, B4.2, B4.5a, B2.6, B4.5b, B4.5, B5.4).
- **Detail of high agreement scores**: Figure 21 shows the detail of high agreement scores (3-4) that were expressed for each e-module on each of the seven questions considered in the analyses, while Figure 22 shows the average score of the seven questions that resulted for the 18 e-modules: it emerges a generally high degree of satisfaction, with over 80% of judgments through a high agreement score (3 -4). The lowest satisfaction was shown for the e-module B5.4: all scores were 1-2 (low agreement) for three questions concerning the expected

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content, the completion time, and the workload. It resulted in a low average score of 57.1%. Such a trend is due to the advanced simulation competence concerning the e-module.

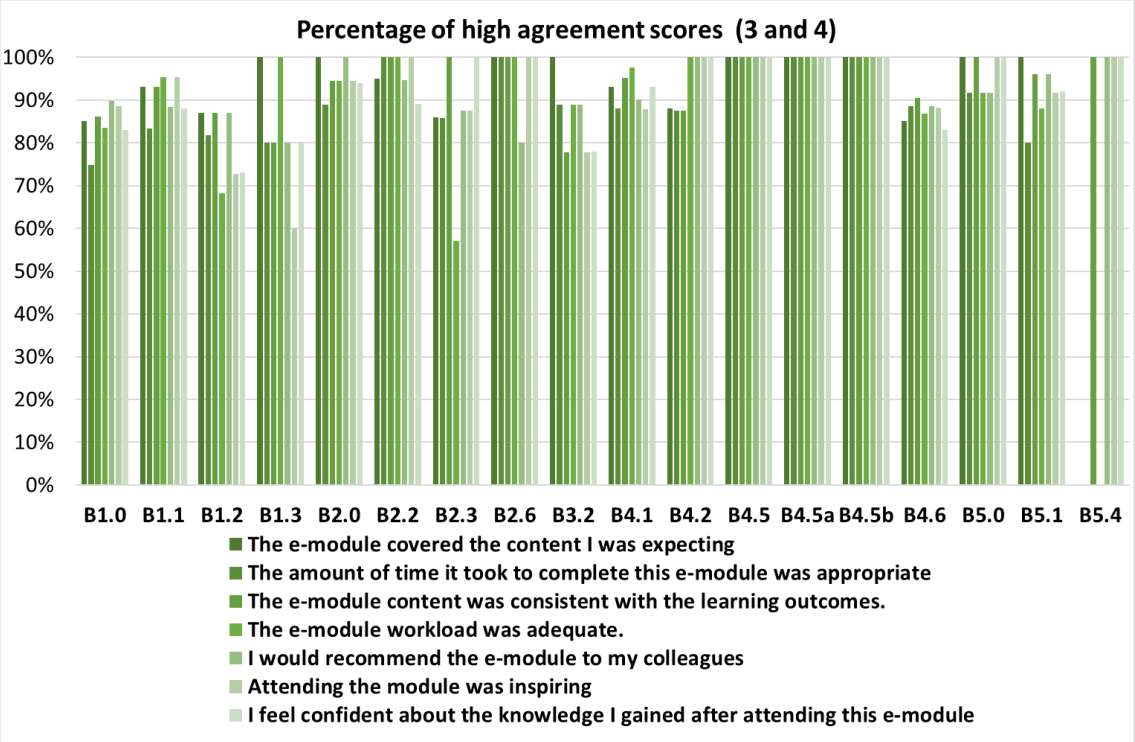

Figure 27: *High agreement scores (3-4) expressed for 18 e-modules. Detailed of responses to 7 questions is presented.*

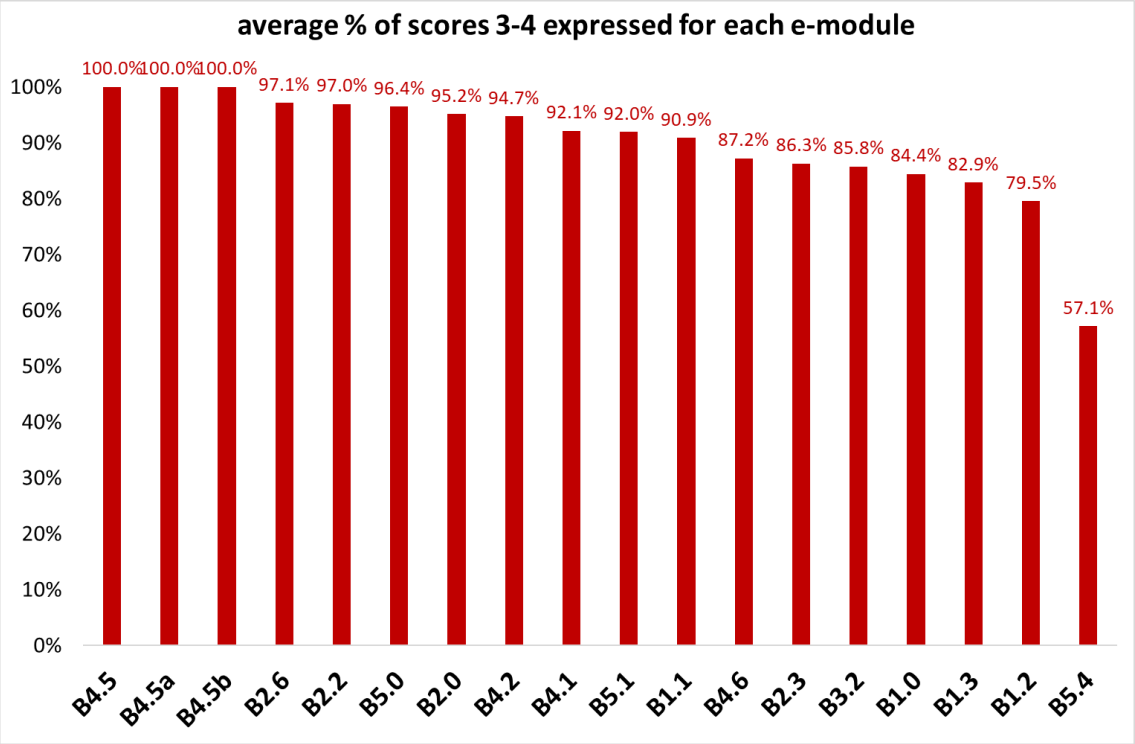

Figure 28: *High agreement scores (3-4) expressed for 18 e-modules: average score on 7 questions.*

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Dropout from the platform

517 out of 802 users (64.5%) of the enrolees are active on the platform, while the e-modules have an average completion rate of about 36%. Previously, a rate of 29% was found (Guliani et al., 2022). The content of the new e-modules offered may interpret this increase.

In general, the sustainability of online learning can be diminished by high dropout rates. The main reasons behind high dropout, as described by the literature, are dissatisfaction with the educational content (Goopio and Cheung, 2021) and the individual selective needs of the e-platform users. For many learners, e-platforms are an additional channel to acquire knowledge (Sun and Shen, 2017). The dropout rate is estimated to be around 90% for Massive Open Online Courses (MOOCs) (Goopio and Cheung, 2021). Onah's et al. (2014) indicate that many e-learners who may be classified as dropouts because they do not complete the necessary course components to gain a certificate may still participate. It is worth stressing that the dropout rate in the NLITED e-platform is lower than what is reported in the literature (Freeman, Gharaibeh and Jamhawi, 2014; Onah, Sinclair and Boyatt, 2014; Eriksson, Adawi and Stöhr, 2016; Zhou, Zhao and Zhang, 2020).

E-platform user type

As mentioned earlier, the e-modules with the highest enrolment rates are dedicated to the benefits of daylight, visual comfort, simulation, and non-visual effects of light. 59.4% of active e-platform users selected the basic module "B1.0 - Benefits of daylight". During the first analysis, after four months, it was 50.4% (Guliani et al., 2022). The popularity of this e-module may be explained by the fact that many learners are attracted to the conceptual rudiments of daylighting and start their educational path with the introductory e-modules. The other popular module, "Your first daylight model with Ladybug. tools in Rhino+Grasshopper", with subscriptions of 28.8% (30% after the first four months), offers daylight simulation training for beginners. The fact that a predilection for choosing basic e-modules was detected may indicate that there is still a need for basic daylight design education, as it had concluded during mentioned before project DAYKE (Giuliani et al., 2021; Lo Verso et al., 2021), and during the workshops with the experts when the educational content was defined (Khanie et al., 2021; Gentile et al., 2022).

Limits of the current analysis

The data for the current analysis relay on the first 18 months of the NLITED e-platform activity. During this time, 56% of the curriculum (18 e-modules out of 28) were fully active. The learners' behaviour may be affected by the e-module status. Thus, the users could subscribe to the e-module even if it is inactive. The complete analysis of the enrolee's behaviour and educational trends within an e-platform would be fully known after the activation of all the modules.

User evaluation of the quality of the modules

It is noted that the learners who completed the chosen e-module, passed the FT (final test), and filled out the EE (e-module evaluation) expressed favourable judgments on the quality of the educational content within the e-module.

Overall, 'higher agreement' (scores 3-4) was given on the learning expectations, the time for completion of the e-modules, the consistency with learning outcomes, the adequacy of the workload, and the general appraisals of the e-module (attendance as an inspiring experience, the learners' knowledge confidence, possibility to recommend the e-module). The negative appraisals for mentioned above topics were between 0 and 40%.

It is important to note that e-platform users who completed the modules and filled out the evaluation questionnaire found the modules' quality satisfactory. The low dissatisfaction ratings and lower than reported in the literature dropout rate indicate the overall satisfaction of the learners with the content and design of the e-platform after four (Guliani et al., 2022) and 18 months of usage.

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Time duration of e-modules

As pointed out earlier, the time needed to complete an e-module was generally found to be appropriate (with over 74.8% of scores equal to 3 or 4). This finding demonstrates an opposite trend to the one observed in the previous analysis, done after the first four months of e-platform use (Guliani et al., 2022). The new trend may be a reaction to introducing three more mini e-modules on daylight regulation with reduced 30-minute duration (B.4.5a, B4.5b, B4.5d).

Motivation for completing an e-module

Among e-platform users (403 participants) who completed an e-module and passed the final test were 31 who still needed to fill out the 'e-module evaluation' (EE) and could not download the certificate of attendance. For 7.8% of e-platform learners, the offered certificate with recognition of 1 ECTS point was not a motivation to complete the e-module. For such users, a motivation to attend an e-module was related to acquiring new skills and competencies on sustainable daylighting rather than obtaining proof of attendance.

These findings have been presented in a dedicated publication (Sokol et al., 2023).

6.2. Summer School evaluations

Both editions received favourable responses from participants. Students appreciated the educational model and the opportunity for close interaction with their instructors. While design topics were well-developed, certain weaknesses surfaced. In the first edition, students noted concerns about limited time following afternoon reviews. Educators expressed reservations about the demanding pace. The second edition aimed to specialize case studies and reduce discretion; however, feedback still indicated ongoing time constraints. Additionally, teachers observed overly simplistic projects, lacking creativity, and focused excessively on verification, as outlined by project guidelines.

From the experiences of these initial summer school editions, valuable insights have emerged regarding teaching daylighting principles to young students and professionals in field of architecture and building design. Results underline that there is no singular teaching approach for daylighting. Enhanced collaboration between architects and engineers is anticipated to yield a more holistic proposal in upcoming editions, effectively reconciling creative and performative knowledge. Notably, the most compelling aspect of these summer schools remains the interaction between students and experts, facilitating deeper knowledge acquisition and delivering a valuable educational experience for all participants.

From the 41 participants present at both editions of the summer school, 25 responses were collected, representing a 61% response rate. This level of participation suggests a strong degree of engagement and interest from the participants in evaluating the summer school editions.

The survey responses reveal a host of positive feedback from participants, shedding light on the many strengths of the NLITED Summer School program:

- **Appreciation for the Educational Model**: 65% of participants rated the educational model with a 4, reflecting their appreciation for the chosen educational approach. This positive feedback underscores the program's effectiveness in delivering educational content.
- **Collaboration Between Architects and Engineers**: A significant 75% of participants found the Summer School curriculum to be consistent with the learning outcomes, and an equally impressive 75% found the Summer school workload adequate. These findings highlight the program's success in promoting

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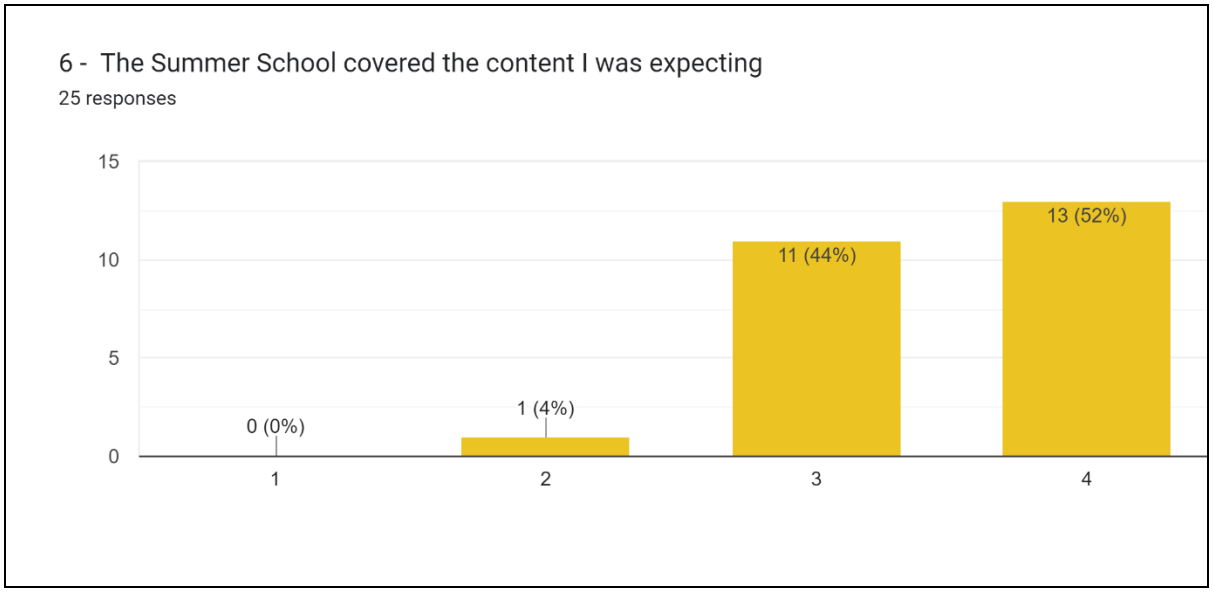
collaboration between architects and engineers, fostering a comprehensive understanding of daylighting principles, and achieving a balance between creativity and performance.

- **Interaction Between Students and Experts:** One of the standout aspects of the Summer School was the interaction between students and experts. An overwhelming 100% of participants found the tutoring provided by teachers to be useful and helpful.
- **Inspiration and Enjoyment**: A striking 100% of participants found attending the Summer School to be inspiring, and 95% reported enjoying the Summer School. This positive feedback emphasizes the program's ability to motivate and engage participants, making it an enjoyable and fulfilling educational experience.
- **Relevance to Career and Academic Development:** 90% of participants felt confident about the knowledge they gained, indicating the educational content's relevance to their career and academic development. Additionally, 85% found that the concepts they learned were useful for their academic curriculum or professional career.
- **Recommendation:** A substantial 95% of participants expressed their willingness to recommend the Summer School to their colleagues, underscoring their confidence in the program's quality and value.

In summary, these findings paint a picture of a Summer School program that has been well-received by participants. While some time-related challenges were noted, the overall response is overwhelmingly positive. The program's educational model, emphasis on collaboration, and the valuable interaction between students and experts have contributed to its success. Participants have not only gained knowledge but have also been inspired and have found the program relevant to their careers. The high recommendation rate further reinforces the program's quality. To further enhance future editions, addressing time constraints and possibly extending hands-on practical work could be considered. These findings offer a comprehensive view of the program's strengths and areas for improvement, which can inform recommendations for future editions.



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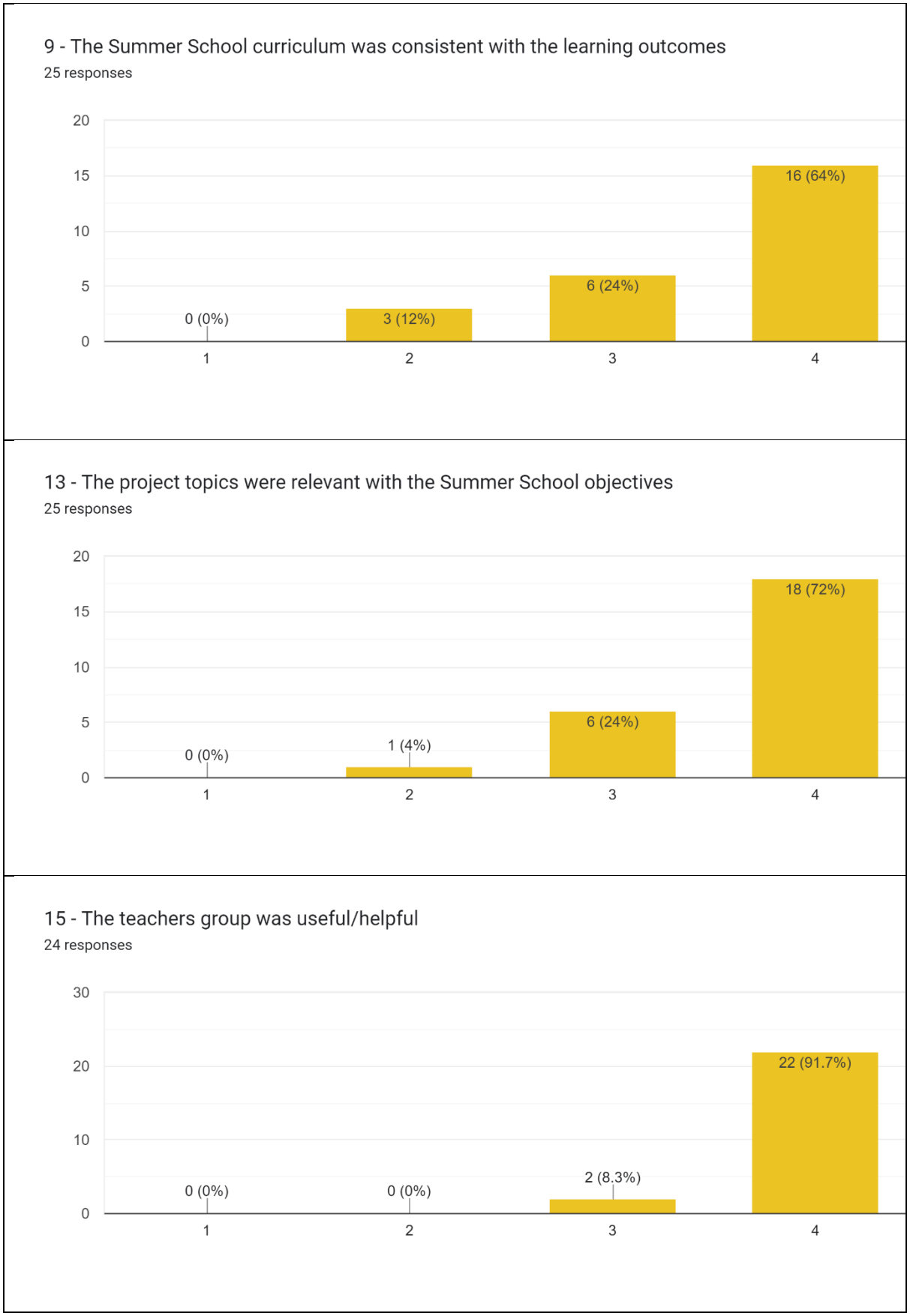

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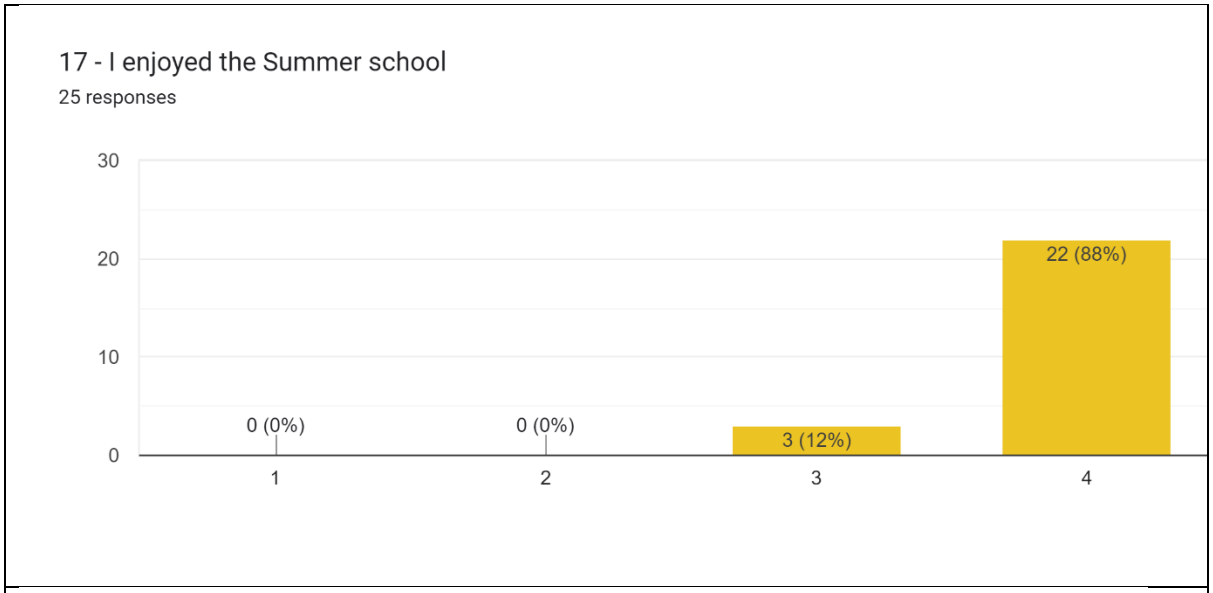

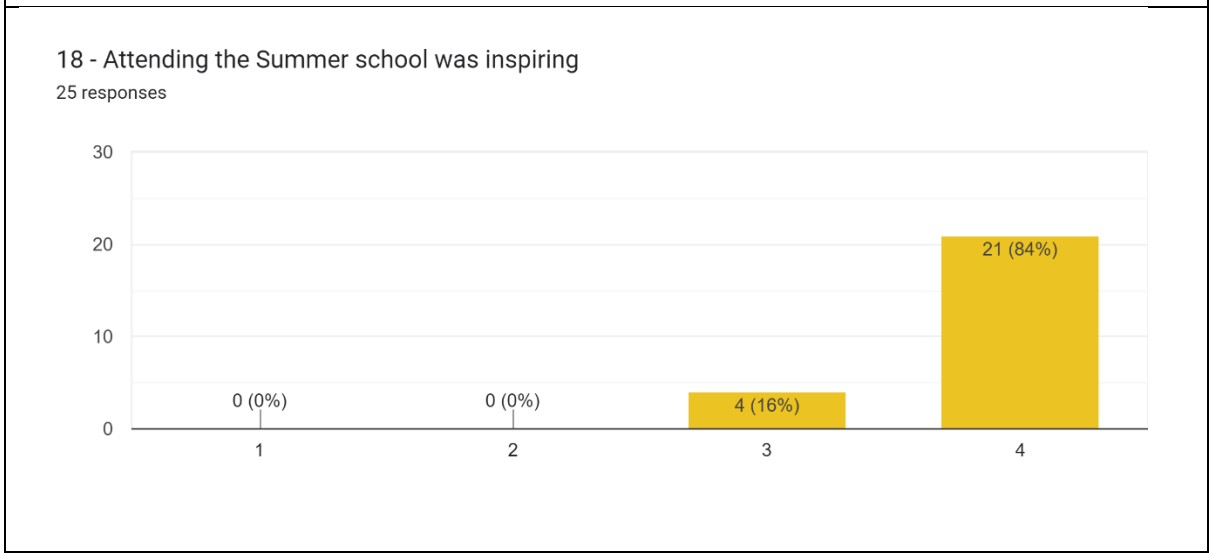

6.3. Outreach

The NLITED project is a three-year educational initiative aimed at improving knowledge of daylighting in the building sector. It involves the development of a comprehensive curriculum, an e-learning platform, and specialized summer schools. The curriculum covers topics such as daylight design, energy aspects, and daylight assessment, and was created based on input from stakeholders. The e-learning platform offers modules that can be completed at the learner's own pace, and surveys indicate high satisfaction with the content and structure of the modules. The summer schools provide an intensive study program where participants work on daylighting design projects and learn from experts in the field. The project has received positive feedback and generated interest from professionals and students in the building industry. Overall, the NLITED project aims to enhance understanding and implementation of daylighting strategies in the building sector through educational initiatives and practical experience.

One of the EU priorities is to impact society by involving stakeholders. In this sense, the project is based on a dense network of interested parties. A wide range of partners have been involved in each country (Denmark, Italy, Poland, Sweden), including educational institutions, building associations, construction companies, daylighting associations, and technical publishers.

Today, the NLITED network comprises:

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- Italy: Politecnico di Torino, Università degli Studi di Napoli Federico II - Dipartimento di Ingegneria industriale, AIDI - Associazione Italiana di Illuminazione, Traverso Vighy, ARlighting, VELUX Italia
- Denmark: The Royal Danish Academy (Architecture, Design, Conservation Dep), VELUX, Henning Larsen
- Poland: Poznan University of Technology, Silesian University of Technology, International Society of City and Regional Planners ISOCARP, LED Academy (magazine, professional press)
- Sweden: The Light Collaboration Network (academia/industry network), KTH (University), ACC Glass and Façade Consultants, InterIKEA, White, Skanska, WSP, Sweco, The Swedish Authority for the Work Environment, Fojab, RISE.

Efforts have been made to promote the project in various contexts, targeting both traditional students and professionals. These efforts include a massive and active presence on social media, presentations at selected industry events, and presentations at disciplinary conferences.

Both the NLITED platform and the associated Summer School became a brand over recent years. The NLITED Summer School is now internationally recognized as a must-go event for daylighting. Enquires about future summer schools are daily received by the NLITED team. Many of the people involved as external teachers in the platform or in the summer schools are now “NLITED endorsers”, further promoting the project (see Figure 23).

More details about the NLITED outreach are provided below.

Links
Web: www.nlited.eu
Instagram: @nlited.eu (160 followers)
LinkedIn: https://www.linkedin.com/in/nlited2020/ (over 500 professional followers)
Facebook: https://www.facebook.com/profile.php?id=100083698714806

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Figure 29. *A LinkedIn post from one of the teachers participating in NLITED. LinkedIn and the enthusiasm of the NLITED network significantly contributed to dissemination of the project activities.*

Contributions to scientific conferences

- Sokół, N, Giuliani, F, Gentile, N, Sarey Khanie, M & Lo Verso, VRM 2023, *Training on sustainable daylighting: the NLITED project*. in CIE 2023: Proceedings of the 30th Quadrennial Session of the CIE. Ljubiana, Slovenia, 2023/09/16.
- Gentile, N, Giuliani, F, Sarey Khanie, M, Sokół, N, Lo Verso, VRM, Caffaro, F, Kofod Pedersen, M, Pompili, F & Mattsson, P 2023, *A Shared Curriculum For Daylighting Education To Meet The Educational Needs Of Society*. i W Bustamante, M Andrade & P Ortiz E. (red), Proceedings of Passive and Low Energy Architecture conference PLEA 2022: PLEA STGO 2022: Will cities survive?. vol. 2, 1627, PLEA (Passive and Low Energy Architecture) Association, s. 86-91, PLEA

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2022, Santiago, Chile, 2022/11/23. https://plea2022.org/wp-content/uploads/2023/03/PROCEEDINGS-ONSITE-FINAL-MARZO.pdf

- Giuliani, F, Sokół, N, Gentile, N, Sarey Khanie, M, Lo Verso, VRM & Caffaro, F 2022, *NLITED - New Level of Integrated Techniques for Daylighting Education: preliminary data on the use of an e-learning platform*. in LUX Europa 2022: Proceedings of the 14th European Lighting Conference, Prague, Czech Republic, p. 138-146 , Prague, Czech Republic, 2022/09/20.
- Giuliani, F, Sarey Khanie, M, Sokół, N & Gentile, N 2020, *Discussing daylight simulations in a proposal for online daylighting education* in BuildSim Nordic 2020 – International Conference Organized by IBPSA-Nordic, 13th-14th October 2020, Oslo: Book of Abstracts., 7.8, Oslo Metropolitan University (OsloMet), Oslo, p. 86-93, Oslo, Norway, 2020/10/13.

Presentation at events with the industry

- Natalia Sokół presented the NLITED project at the Polish light fair in Warsaw, March 2023. https://www.facebook.com/events/s/swiat%C5%82o-zintegrowane-cz%C5%82owiek-/1851697001876731/
- Federica Giuliani lectured on NLITED educational method during the Environmental Design lectures at Mario Cucinella's School of Sustainability (SOS) postgraduate school. November 2022.
- Federica Giuliani and Niko Gentile at the online event Illuminamente, organized by the Italian Lighting Design association https://www.facebook.com/events/1247353396219047. March 2022.
- Launch of the NLITED platform, hybrid event (at Lund University and online) https://www.nlited.eu/2021/12/01/launch-of-the-platform/. January 2022.
- Presentation of the NLITED platform in the 9th VELUX Daylight Symposium in Copenhagen. November 2021. Velux is an Associated partner of the project. https://buildforlife.velux.com
- Natalia Sokół presented the NLITED project at VELUX Poland, Warsaw. https://www.velux.pl/profesjonalisci/architekci/aktualnosci/daylight-forum-2021. October 2021.
- Niko Gentile and Federica Giuliani presented at the webinar "Hur vi skapar hälsosamma ljusmiljöer för alla" of White Arkitekter (Associated partner in Sweden). https://whitearkitekter.com/se/nyheter/ljuswebbinarium-sa-skapar-vi-halsosamma-ljusmiljoer/. April 2021.

Other dissemination

- Article in Unicusano online magazine https://www.tag24.it/267787-nlited-corso-gratuito-luce-diurna/
- Niko Gentile presented the NLITED project at PLEA 2022, Santiago de Chile. https://www.linkedin.com/posts/energy-and-building-design-lund-university_netzero-carbonemission-carbonneutrality-activity-7006259669287456769-uetG/. November 2022.
- Federica Giuliani at the Erasmus+ event in Lazio, Italy. https://www.indire.it/2022/12/12/erasmus-in-lazio-percorsi-di-inclusione-cittadinanza-sostenibilita-ambientale-e-innovazione-digitale/

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7. Conclusion

In the dynamic landscape of modern education, the emergence of e-learning has proven to be a versatile and accessible method for disseminating knowledge. The NLITED project, with its focus on daylighting design, exemplifies the efficacy of e-learning in serving a diverse audience, encompassing traditional students and working professionals. This comprehensive report, which delves into the project's structure, stakeholder engagement, course content, and user experiences, has yielded a series of significant conclusions that shed light on the project's effectiveness, course quality, and participant motivations.

Crucially, the NLITED project has demonstrated a remarkable ability to adapt its offerings based on feedback, as well as reduce dropout rates. These achievements underscore its relevance in the ever-evolving landscape of e-learning. This synthesis brings together the central findings from a series of reports and texts, offering a holistic perspective on the NLITED project and its contributions to the realm of daylighting design education.

Drawing from the NLITED experience, the following key aspects serve as a valuable guide for future initiatives of a similar nature:

1. Structure of the Training Program:

The NLITED project has successfully developed a flexible training structure, offering tailored e-learning modules to both traditional university students and professionals seeking continuous education. The educational offerings are thoughtfully designed to be accessible to a broad spectrum of participants, with a particular focus on accommodating the needs of working professionals and individuals with family commitments.

2. Stakeholder Engagement:

The NLITED project has effectively engaged a diverse range of stakeholders, including experts in the field of daylighting. This engagement has been instrumental in aligning the educational offerings with industry needs and expectations.

3. Course Structure and Educational Content:

The e-learning modules offered by NLITED comprehensively cover various aspects of daylighting, including technical elements and theoretical concepts. The course structure has been meticulously crafted through workshops and consultations with industry experts, ensuring it meets the requirements of a diverse participant base.

4. Summer School:

NLITED's inclusion of a Summer School component provides students with hands-on experience in daylighting design, allowing them to apply their acquired knowledge in practical scenarios.

5. Assessment of E-Learning Courses:

The NLITED project has introduced a robust course evaluation process through EE (e-module evaluation) surveys. This method effectively gauges course effectiveness and student satisfaction.

6. Use of the E-Learning Platform:

The NLITED e-learning platform has witnessed substantial enrolment, with over 800 participants and a significant percentage of active learners.

7. Quality and Satisfaction Assessment:

Analysis of EE surveys reveals a high level of student satisfaction with course content, completion times, alignment with learning objectives, and workload adequacy.

8. Lower-Than-Average Dropout Rate:

The NLITED project boasts a dropout rate that falls below the average reported in the literature for online courses, signifying the efficacy of its educational approach.

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9. Student Motivations:

A notable number of NLITED participants pursue knowledge and skills, rather than mere certificates of participation, reflecting a genuine commitment to learning.

10. Content Updates and Adaptations:

NLITED's adaptability and commitment to course improvement, guided by valuable feedback, are evident in its continuous evolution and enhancement of the educational experience.

In essence, the NLITED project stands as a testament to the success of a well-structured e-learning initiative in the realm of daylighting design. Course evaluations, student satisfaction, and a lower-than-average dropout rate are positive indicators of the effectiveness of this innovative educational approach. Furthermore, the engagement of stakeholders and the project's agility in adapting to industry needs are fundamental aspects of NLITED's triumphant journey.

Conclusively, this report not only chronicles NLITED's achievements but also provides a guide for those who aspire to illuminate the path towards more accessible, effective, and impactful daylighting education. The NLITED project sets a shining example of how e-learning can empower and inspire, paving the way for a brighter and more sustainable future in education.

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Annex A

Annex A.1 – First mailing

To be sent 1 month before the first workshop

Text to be adapted:

Dear [*name*],

I am [name], from [name] University, and I am writing you on behalf of the NLITED team. NLITED is an Erasmus+ project aiming at creating a modular online course on daylight design of building (www.enlited.eu). You and your company supported us with the project application and we are delighted to say that the project has been approved. Thank you!

Now you have the chance to shape the course and influence its content. The course is thought for both traditional students and lifelong learners.

We have planned a workshop where we very briefly present NLITED and then we focus on the importance of daylight design in your work and the educational needs you have in your team or you see in the daily practice. The workshop will include max five [Danish/Italian/Polish/Swedish] professionals like you. It is estimated that it will take between an hour and a half and it will be held via the digital tool Zoom.

We prepared a short draft curriculum for the course, you will receive it about a week before the workshop. In our workshop, we will discuss mainly around that document. Give a look to that beforehand and try to think to what would be relevant, what irrelevant, and what competences are missing in today's professional arena.

Through your participation in the workshop, you will be able to make NLITED relevant for your team. Participation to the workshop is voluntary and you can leave whenever you want. The workshop is recorded and the answers will then be used in the context of NLITED project. The recorded video will be anonymized and data stored at [name] University.

The optimal is if you can be 1-2 people so I hope you can spread the invitation further to any interested colleagues. Registration is done via (Doodle).

Thanks in advance,
Mandana S. Khanie (DTU, Denmark)
Federica Giuliani (Unicusano, Italy)
Natalia Sokół (Gdańsk University of Technology, Poland)
Niko Gentile (Lund University, Sweden)
Pimkamol Mattsson (Lund University, Sweden)

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Annex A.2 – Second mailing

To be sent 1 week before the workshop where the partner has booked himself/herself

Text to be adapted:

Dear participant,

I would like to remind you about our online workshop concerning the Erasmus+ project NLITED, [date] 2021 13:00 – 14:30, link [link]

Agenda

- Brief round table presentations
- Presentation of NLITED
- Your view on daylight design in current practice
- Discussion on the draft of NLITED curriculum (attached to this mail)
- eLearning, practicalities
- Short conclusive survey

I would also like to remind that participation to the workshop is voluntary, and you can leave whenever you want. The workshop is recorded and the answers will then be used in the context of NLITED project. The recorded audio will be anonymized and data stored at [name] University.

Thanks in advance,
Mandana S. Khanie (DTU, Denmark)
on behalf of
Federica Giuliani (UniCusano, Italy)
Natalia Sokół (Gdańsk University of Technology, Poland)
Niko Gentile (Lund University, Sweden)
Pimkamol Mattsson (Lund University, Sweden)

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Annex A.3 - Survey

Questionnaire content

1. What is your role within a company/ university?
2. 2. Do you perform daylighting analysis in your work / projects?
3. Which daylight analysis do you usually use in your work / projects?
4. 3. What tools do you use for daylight analysis?
5. Would you be interested in attending online the follow daylight topics?
   [Scale: Not Familiar – Surely NOT - Probably NOT – Undecided - Probably YES - Surely YES]
   s1 - FUNDAMENTAL OF DAYLIGHT
   Daylighting benefits
   Physical aspects of light and daylight
   Fundamentals of lighting metrology – visible
   Fundamentals of lighting metrology – circadian light
   Standards and Regulations
   s2 - HUMAN-CENTRIC DAYLIGHTING
   Visual Comfort: assessments and methods
   Visual perception
   Non-image forming effects : advances and assessments
   s3 - ELECTRIC LIGHTING INTEGRATION AND ENERGY SAVING
   Energy management
   Energy protocols (LENI, LEED, etc.)
   Daylighting and Lighting: an integrated approach
   Energy saving strategies
   s4 - CALCULATION AND SIMULATING DAYLIGHTING
   Solar geometry
   Daylight quality – simplified methods and rules-of-thumb
   Measuring daylight, static and dynamic methods
   Fundamentals of daylight simulation
   Building the first model and running daylight simulations
   Daylight modelling and Parametric design
   s5 - SIMULATIONS IN DEPTHS: TOOLS AND METRICS
   Advanced simulations I – BSDF data
   Advanced simulations II – Circadian lighting design
   Modeling Materials (reflective, refracting, etc.)
   Modeling Components (windows, atrium, etc)
   Modeling Devices (solar pipe, sunlight mirrors, etc.)
   s6 - DAYLIGHTING DESIGN APPLICATION
   Daylighting design through the history of architecture
   Example of good design (case of studies)
   Daylight in urban, building and room scale
   Side-lighting , top-lighting, core-lighting
   Daylight Design Elements: materials, components and devices
   In-depth: daylighting for exhibition spaces
6. Would you like to see other daylight topics in NLITED?

[Socio-demographic information]

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