

# Develop the Innovative and Pioneering Concepts for Photonics and Optics Outreach Program

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## ABSTRACT

Optical and laser engineering are not only prevalent in science fiction movies but find numerous technological applications ranging from additive manufacturing over machining of micro/nano-scale features to biomedical imaging or space telescopes applications. In a related context, science simplification lectures with diverse visualization techniques and OSA optics suitcase can be utilized to bring attention and inspire careers in future technologies.

The suggested work focuses on developing the outreach program to train the trainees (as photonic ambassadors) specifically in the field of photonics and optical applications which is the expanded programme for multidisciplinary outreach activities for school students over 10 years (or pre-university students in the future) [1]. The extended activities can support a wide range of students in Ireland, Europe, and the international prospects as well, which increases the possibility of promoting photonics technology careers in the future.

The paper will explain the guidelines and topics of the proposed practical workshop (INNOVATIVE WAYS TO PHOTONICS FUTURE "TRANSFER THE KNOWLEDGE") which can help trainees and give them some techniques for engaging targeted students and creating an interactive environment. The detailed characterization of the workshop structure and related pragmatic sessions will be illustrated in this work as well as the systematic steps of the developed program outline.

**Keywords:** Education and training in multidisciplinary environments, Outreach education in optics and photonics.

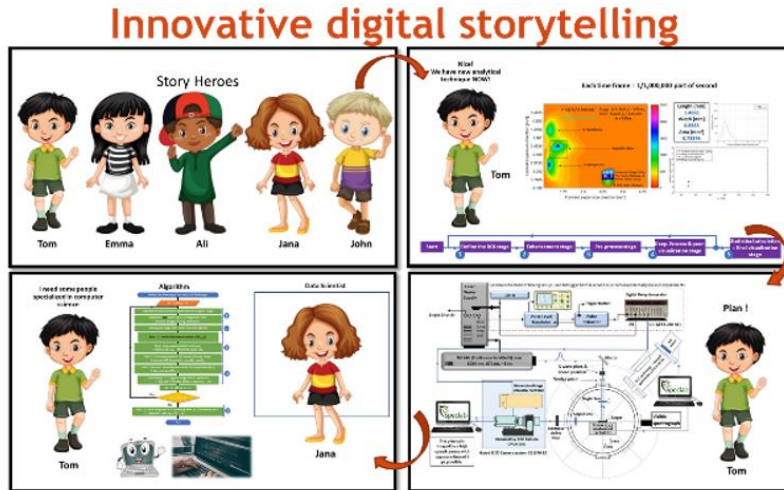
## 1. INTRODUCTION

The rapid acceleration of technological advances in our era seems faster than ever before in human history. Yet, there remain many challenges to improving society and creating a more sustainable, equitable as well as enjoyable future for all humankind, especially in the field of photonics and its wide applications.

One approach for youth and school education focuses on inspiring stories and interactive simple experiments which can provide more explicit knowledge transfer. For this reason, the Interactive Digital Storytelling (IDS) platform can be improved based on real and modern examples embedded with the narrative approach, as well as some in-class experiments using individual take-home theme packets [1].

The work will explain the design concepts of an integrated training workshop to transfer the core knowledge regarding preparing and deliver the outreach program effectively and how can involve the suggested optics/photonics activities which include different categories that are arranged and designed to make it easy and understandable for students in school classrooms. Additionally, optics/photonics activities might be suitable to excite the youth's interest in careers in technology using experimental techniques that can be customized to highlight the presenter's interests, job, and work environment.

The first session of the training workshop will involve the knowledge transfer that emphasises the inspiring interactive presentation as a part of an expanded program for multidisciplinary outreach activities as shown in Figure 1(a), while the following sessions will cover the optics suitcase that includes both reusable and giveaway supplies as shown in Figure 1(b), where the optics suitcase is an educational outreach tool developed by Dr Stephen D. Jacobs and the OSA Rochester Section (OSA-RS) with the busy professional in mind [2,3].



(a)

## Optics Suits in Carlow/Ireland



(b)

**Figure 1.** (a) slide samples of the innovative storytelling showcase as a part of an interactive inspiring presentation, (b) Photographs of the Optics Suitcase and part of digital storytelling show-time.

## 2. DESIGN THE WORKSHOP STRUCTURE

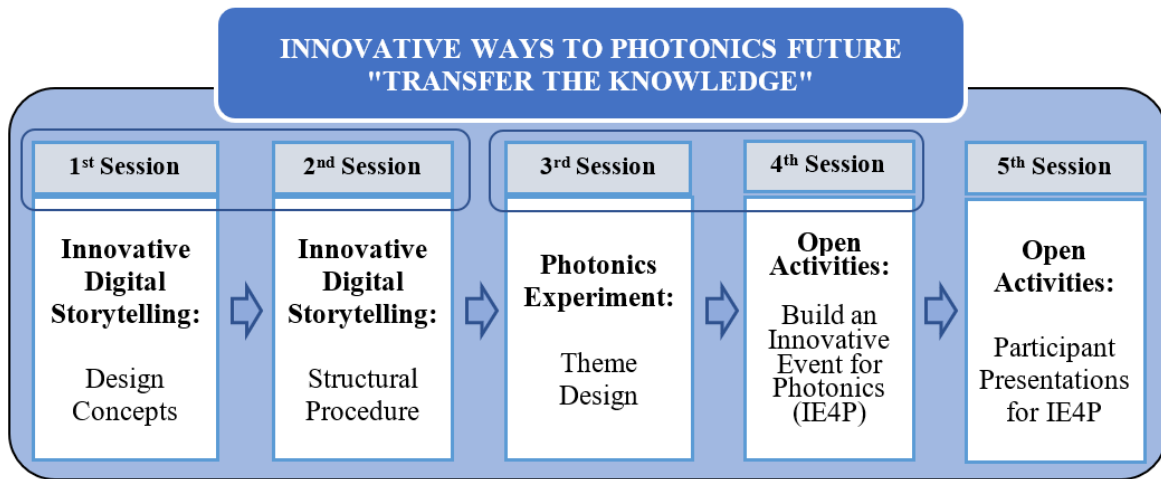
The training of trainers workshop, under the suggested title (INNOVATIVE WAYS TO PHOTONICS FUTURE "TRANSFER THE KNOWLEDGE"), will be based on five core sessions. The first two sessions deliver the skills and scheme of Innovative Digital Storytelling (IDS), and the next session explains the detailed information about targeted photonics experiments. The fourth session will help to explain the concepts of building the innovative classroom event for photonics before giving the chance to the participants to prepare the draft version of their own showcase. The general sequences of the workshop are illustrated in Figure 2.

### 2.1 Innovative Digital Storytelling

One of the new approaches which try to involve computer facilities, photonics, and light-based technology for learning, can describe as; "it is precisely about fun and engagement, and the coming together and serious learning and interactive entertainment into a newly emerging and highly exciting medium" [4], furthermore, Carolyn H. Miller [5] explained a few deep questions related that, as follow;

- How does the use of interactivity radically change the way an audience experiences a work of entertainment?
- How does the use of interactivity radically change the material itself?

- Why do interactive works so often incorporate some elements of gaming, and is it possible to construct an interactive story that has no game-like components?



**Figure 2.** Suggested workshop structure of training the trainees.

Therefore, in the first and second sessions of this workshop, the interactive digital storytelling concepts will be explained mainly in the context of students' group discussions. Every slide would be designed and supported by provable information, images and related movies, where Figure 1(a) gives an example regarding that. Besides that, the Reference [1] explains other rich information regarding the guide of the suggested innovative digital storytelling and some required skills for the presentation.

## 2.2 Photonics Experiments (Optics Suits)

To draw the attention of school students (or pre-university students in the future) to some additional photonics technology and related contents, a portable demo kit (i.e., optics suitcase) can be used, where the third session of the workshop will focus on photonics kit.

The take-home flyer (THF), as shown in the upper-right corner of Figure 1(b), can be designed that help to explain some initial information about optics and photonics techniques to the students. The fourth session of this workshop will deal with the THF subject systematically therefore the participants (photonics ambassadors) will have enough experience to prepare the required (take-home flyer "THF") for their scientific showcase.

There are more than one experiments that can the students discover such as the rainbow peephole™ - color by redirecting (i.e., diffraction) and magic stripes - color by polarized transmission (i.e., polariscope). Table 1 illustrates the available experiments that can involve, and be a part of the designed showcase based on the presenter's experiences and background.

In the final workshop session (the fifth session), the trainees will have the chance to sort and organize an initial version of their integrated scientific showcase for training and arbitration committee that can help to optimize the trainees practices and enhance their skills in time management and presentation techniques before starting to organize real/actual outreach program for optics and photonics in the schools.

Generally, the workshop sessions and related outcomes try to illustrate some suggested and successful ways with several related tips and a typical lesson plan for giving a presentation of photonics sciences.

### 3. CONCLUSIONS AND FUTURE WORKS

The training workshop was design in this paper to support the efforts of transfer the required knowledge and scientific skills to the target trainees. Additionally, the work explained the presentation guide which might help presenters and give them some techniques for engaging students during the presentation and create an interactive environment for these demonstrations, moreover, the primary goal of this workshop is to introduce and train the trainees (i.e., scientists or engineers) in subjects of an interactive demo presentations and lessons to students at the school classrooms, as well as how the new digital technologies can be used to construct rich entertainment experiences in field of photonics and optics.

**Table 1:** List of standard optics suitcase reusable or/and giveaway supplies.

Quantity	Item – Reusable Supplies
1	Durable suitcase with room for other items that can be added to customize
1	Instruction guide on laminated sheets
1	USB-stick with supplemental Optics Suitcase materials
1	Hot Snapz – heat pad
1	Set of Arbor Scientific “Happy and Unhappy” balls
1	Slinky
1	50 mm Silicon wafer, one side polished to a “mirror” finish
1	Silica glass lens
2	5” x 5” pieces of high-quality sheet polarizer
4	Transparent plastic cups
1	Set of transparent plastic tableware: fork, spoon, knife
1	6” x 6” sheet of temperature-sensitive microencapsulated liquid crystal sheet
Quantity	Item – Giveaway Supplies (can be re-supplied)
50	Rainbow Peephole: Color by Diffraction
50	Magic Stripes: Color by Polarized Transmission
50	Magic Patch: Color by Selective Reflection
50	Periodic Table of Elements

After train the trainees and then start to organize outreach programs in several schools, one of the important outcomes from these activities (i.e., outreach programs) might help to motivate the students to take science and math courses, thereby "keeping the door open" for finding further training after school to enter and increase the knowledge in new technological fields.

Furthermore, the research goals seeking to extend these activities and training workshop internationally and outside Ireland to motivate the students with multi-languages and give them the necessary awareness and knowledge regarding photonics and optics technologies. Some initial efforts are in progress to find partners in the middle east universities and Asia to arrange and organize these workshops for selected trainees using the English language and after that, the trainees have a chance to present the outreach program in the schools using the local language or English that can help the schools’ students to understand the scientific concepts and reach the aimed goals of these activities via interactive inspiring presentations and photonics experiments as well.

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