Project objectives, progress and achievements

Table of Contents

1. Report Core ........................................................................................................................................................................ 3

2.1 Project Objectives for the project period 1\textsuperscript{st} March 2010 – 31\textsuperscript{st} August 2012 ........................................2

2.2 Work Progress and Achievements during the project ........................................................................................................ 3

2.2.1 Work Package 1: Project co-ordination, communication and dissemination............................................................... 3

2.2.2 Work Package 2: Development of the Photonics Explorer ............................................................................................ 12

2.2.3 Work Package 3: Field Tests and External Evaluation .................................................................................................. 26

2.2.4 Work Package 4: Sustainability .................................................................................................................................. 27

2. General Conclusion .......................................................................................................................................................... 30
List of abbreviations used in the EXPEKT Report

EXPEKT: Photonics Explorer – Developing a photonics educational kit for Europe’s secondary schools


NGO: Non-governmental organisation

EYEST: Excite Youth for Engineering Science and Technology

EAP: Educational Advisory Panel

SAB: Strategic Advisory Board

LAP: Local Associated Partner
1. Report Core

EXPEKT’s outreach activities aim to achieve a lasting, positive impact on the way photonics is taught in Europe’s secondary schools. Teaming up experts in photonics, scientists in pedagogy and teachers, EXPEKT has developed the Photonics Explorer as an intra-curricular educational kit that combines hands-on experiments with modern didactic techniques and thus equips teachers to really engage, excite and educate students about the fascination of working with light.

2.1 Project Objectives for the project period 1st March 2010 – 31st August 2012

The main objectives for the reporting period were as follows:
— To select and finalise 8 topics (modules) to be developed within the kit with feedback from EAP
— Complete the didactic framework (in English) for each module based on the ‘Review and Revise’ Process
— Source and collect components for the first fifty prototypes of the Photonics Explorer
— Provide LAPs with information for pilot teachers
— Select pilot schools and teachers for the field tests with LAP support
— Translate the didactic content into 6 additional EU languages
— Compile first 50 prototypes for distribution
— Initiate field tests in 7 EU countries at the first workshop
— Implement feedback collection and class visits during field tests
— Organise and co-ordinate second workshop for feedback collection
— Establish non-profit organization for sustainability
— Secure funds for the first 3000 kits
— Complete a final revised prototype

In order to achieve these objectives, the tasks were divided into four work packages. The sections below describe the general objectives, main achievements as well as progress made in each work package, within the project.

2.2 Work Progress and Achievements during the project

The following section describes the main objectives of each Work Package, as described in Part A of the Grant Agreement. The main goals for the project as well as the progress made in each task are described in detail. Any deviations in the use of resources for each work package have been reported. A summary of the use of resources is provided in Section 4.

2.2.1 Work Package 1: Project co-ordination, communication and dissemination

WP Leader: Prof. Hugo Thienpont

General Objectives

The objective is to ensure smooth and efficient communication and running of the project. Communication will be managed

— towards and between project actors; this comprises the project partner IPN, Educational Advisory Panel, Strategic Advisory Board and the Local Associated Partners.
— towards the European Commission and
— the public, in order to disseminate the project results and raise awareness for improved photonics education at secondary schools.

Furthermore, the work package includes the monitoring, steering of and reporting on the project progress and resources, as well as the compliance with contractual and legal issues.

**Main achievements during project:**

— Coordination of the project
— Development of Online Communication and Collaboration Platform (OCCP)
— Development, maintenance and updating of the Photonics Explorer website
— Disseminating information via articles, participation in events, attendance at conferences and meetings
— Broadening the scope of international dissemination
— Publishing and distribution of newsletters
— Organizing and collecting feedback from Strategic Advisory Board meetings
— Planning and organization of Workshop I, field tests and Workshop II
— Planning and organization of Intermediate and Annual Review Meetings

**Progress made during project:**

The progress made in tasks **Tasks 1.1, 1.2 and 1.3** are discussed in Section 3.2 ‘Project Management’. The section below describes the progress made in **Task 1.4 ‘Dissemination’**. Specifically the **national and international scope of the dissemination is discussed**. Information about the project was disseminated mainly by **establishing contacts and creating collaborations with companies, organizations and optical societies**, maintaining a presence in the media by **publishing articles and press releases** and participating in **meetings, workshops and conferences**. These strategies aimed to increase awareness about the project within the wider scientific community, involving industry and companies and establishing crucial contacts with teacher training networks.

**National dissemination activities** included participation in events such as conferences, workshops, science shows and meetings with a largely **national audience** comprising of students, teachers, organizations and industry within Belgium. The **European/International dissemination activities** included participation in events with an **international scope**, comprising participants from all over Europe and in some cases from around the world. These included conferences, trade-fairs, meetings and industry sponsored events and in some cases these events were held locally in Belgium. Additional dissemination activities include articles, press releases and publications that featured the Photonics Explorer.

**Task 1.4: Dissemination**

The dissemination activities have taken place on regional, European and international levels. The importance of dissemination at a regional level arises from the need to understand teachers’ requirements which is most effectively done with local teachers, the opportunity to pre-test the material with local schools as well as the opportunity to raise local awareness about the project by organizing and participating in regional events.
Regional Dissemination Activities

— The Photonics Explorer was presented at a workshop on Technology Day at Technopolis in October 2012. This provided the opportunity to reach several teachers and teacher trainers who attended the event.

— One member of the developer team conducted workshops at the Greenlight for Girls event held on 26th November 2011 and 13th October 2012 at the International School of Brussels. Over 70 girls aged between 12-16 years attended the workshops each time, where they had the opportunity to learn about optical telecommunication and polarization of light by doing hands-on experiments from the Photonics Explorer.

— The developer team was invited to participate in the Playful Science 6 event to present the Photonics Explorer. Over 150 teachers and science educators attended this event held on 10th February 2012.

*The following activities were previously reported*

— The developer team has regularly interacted with local students and teachers by organizing visits to the department and also by visiting schools. A member of the EXPEKT team participated in the Veluwe meeting on 20th November 2010 in Antwerp to establish contacts with potential secondary school science teachers via Prof. Marc Bedegoonodts of the GO! Network, thereby expanding the distribution base for the Photonics Explorer kit in Belgium.

— The developer team participated in the Greenlight for Girls “Science Day” on 20th November 2010 in Brussels. This event was attended by 300 girls, 12-15 years in age. Greenlight for Girls is an international NGO (non-governmental organization) whose mission is to encourage young girls to pursue a future in math, science, engineering and technology.

— The developer team also held three workshops during ‘Science Week’ hosted by the Vrije Universiteit Brussel from 22nd to 26th November 2010. This opportunity was used to test experiments from the ‘Light Signals’ and ‘Diffraction and Interference’ modules with over 50 students who attended the workshop. Positive feedback was received from teachers and students.

— One member of the developer team attended the ‘Playful Science 4’ event organized by Science on Stage Belgium in February 2010. This was an opportunity to meet several Belgian secondary school teachers and establish further links for dissemination.

— The developer team attended a meeting for science teachers in Leuze, Belgium in February 2010. The meeting was attended by over 30 secondary school physics teachers and the theme was ‘Optique ondulatoire, interférences et diffusion de la lumière’. The concept of the Photonics Explorer was explained to this audience and the teachers were very positive about the concept.

— One member of the developer team participated in the Photonics 21, Workgroup 7 meeting held in Brussels in February 2010. This opportunity was used to inform several prospective board members about the state of the project.

— A member of the developer team was also involved in the filming of ‘Matière Grise’ science show in which the Brussels Photonics Team (B-PHOT) was featured. The well-known science show of the French speaking national broadcasting company RTBF visited B-PHOT of VUB. Prof. Francis Berghmans provided explanations not only about the research and collaborations but also about programs within B-PHOT, such as the Photonics Explorer, that foster the technological awakening of young students. (http://www.b- phot.org/layout/set/cleanuppage/content/view/3456)

— The GO! network in Belgium comprises over 800 teachers and their support and interest has led to a fruitful collaboration. A member of the developer team held two workshops at the GOI Math-Science Day on 19th March 2011 in Gent, Belgium. Over 15 teachers attended the workshops and have already expressed their interest in the pilot testing as well as the use of the kit early next year. The developer
team has also been invited to give workshops at the Go! Network events on 11th November 2011 and March 2012. These will be crucial in the mass distribution phase of the Photonics Explorer.

— One member of the developer team presented a workshop at the ‘Playful Science 5’ event organized by Science on Stage Belgium on 19th March 2011. This was an opportunity to meet several Belgian secondary school teachers and establish further links for dissemination as well as identify potential pilot teachers in Belgium. Over 120 persons attended this event.

— A member of the developer team was invited to speak at the ‘International Women’s Day – CampusTalks’ event at the Vrije Universiteit Brussel on 8th March 2011. This event gave the opportunity to communicate the aims of the project to several female scientists and researchers.

— One member of the EXPEKT team was invited to give a Pecha Kucha style presentation at the Freestate Art Festival Pecha Kucha event held in Oostende, Belgium on 10th September 2011. The festival comprised of artists and scientists under the age of 35 who presented their work to a wide audience.

— One member of the EXPEKT team was invited to participate in the Pecha Kucha event held as part of the Academic Opening of the Vrije Universiteit Brussel held on 27th September 2011. This event brought together important alumni of the VUB including the Rector, Vice Rectors and professors from various faculties. It was a great opportunity to disseminate information about our work and raise awareness and interest among the scientific community.

— Two EXPEKT project members held two workshops at the Vlaamse Congres van Leraars Wetenschappen on 19th November 2011 in Antwerp, Belgium. Over 40 teachers attended the workshops and have already expressed their interest in using the kit in their classrooms. These workshops also gave us the possibility to ask teachers about which parts of the kit interested them most.

**European dissemination activities**

A special focus was given to dissemination on the European level in keeping with the European dimension of the project. Opportunities were taken to disseminate information to an international audience at conferences and other events.

— **Workshop II was held on 15th April 2012 in Brussels, Belgium.** This workshop brought together all LAP representatives to collect and consolidate feedback from the field tests. The 3rd Strategic Advisory Board meeting was also held at this time.

— CYMER Inc., the first industrial effective member of EYESTvzw, presented experiments from the Photonics Explorer kit at Technology Day organized by ASML in June 2012.

— **The Photonics Explorer was translated into Czech with the initiative of the New Technologies Research Centre and presented at a large scale event in the Czech Republic in August 2012.**

— **The Photonics Explorer was presented in Hudiksvall, Sweden in September and October 2012** at an event organized by the Mid Sweden University who will also distribute the kits to local schools.
*The following activities were previously reported*

— The developer team attended the **Jet-Net Event in Den Haag on Thursday, 18th November 2010**. Over 3200 students and 60 companies were part of this event and the opportunity was used to establish crucial industry contacts to companies such as Philips.

— **EXPEKT’s first Strategic Advisory Board meeting was held on 29th October 2010 in Paris** and attended by the board members. This meeting provided the opportunity to exchange ideas on gaining further visibility and support via the networks of the board members. The meeting report comprised Deliverable D1.2.

— Three members of the EXPEKT team participated in the **Photonics 21, Workgroup 7 meeting on 28th October in Paris**. This platform provided the opportunity to introduce the project to other attendees.

— The developer team also participated in **CSR Europe’s Enterprise 2020 Marketplace Event held in Brussels on 28th October 2010**. This is an event with a wide international participation of industry, companies and networks. This event provided the opportunity to establish contacts that will prove crucial in the sustainability of the program as well as sourcing of industry sponsored components for the mass production of the kits. As a result the team is currently in discussion with Panasonic and IBM.

— The developer team participated in the international event **Information and Communication (ICT) 2010 held between 27th and 29th September 2010, in Brussels**. The developer team initiated a competition between several teams of students to perform three experiments and discussed the EXPEKT project and the Photonics Explorer kit with the teachers in attendance. This generated a lot of interest within the local schools. This event also provided the opportunity to interact with representatives from European industry and other international organizations such as the Swedish Photonics Cluster.

— **Prince Philippe of Belgium, EU Commissioner for the Digital Agenda Neelie Kroes and Brussels Minister for Research Benoît Cereixhe visited the B-PHOT exhibition booth at the ICT 2010 fair organized by the European Commission at Brussels Expo.** Prof. Berghmans explained how B-PHOT is involved in the Photonics Explorer project. Mrs. Kroes appreciated how the B-PHOT team fosters technology-awakening of European students with Photonics Explorer.

— Several meetings were held between the developer team and various persons at the **SPIE Photonics Europe Conference in Brussels between 12th and 16th April 2010**. This is an international conference with a worldwide attendance of persons in the Photonics community. These included meetings with SPIE, Prof. Maria Calvo who is a board member as well as part of the LAP in Spain, Prof. Kishan Dholakia from University of St. Andrews which is the LAP in the UK and Mr. Clemens Homann from the European Network of Excellence, Photonics for Life. The main aim of these meetings was to keep these persons informed of the work progress as well as meet them in person. The main outcomes of these meetings were to establish networks and disseminate information to the persons involved.

— One member of the developer team was invited to attend the **‘50 Years of Laser’ event in Paris in June 2010 and establish contacts for the Photonics Explorer**. Contacts were established with Thalesgroup (ex Alcatel) in France. This opportunity was also used to update Prof. Laurent Sarger who is an EXPEKT board member and Prof. Laurence Maurines of the EAP regarding the module ‘A Scientist’s Job’.

— One member of the developer team participated in the **Photonics for Life (P4L, Network of Excellence in Biophotonics) Annual Meeting in St. Andrews in May 2010**. The main aim of this was to inform their consortium of the goals of EXPEKT and possibly collaborate with them on development of the biophotonics module.
— One member of the developer team attended the XXXIX National Conference on Physics Education, in Sofia, Bulgaria between 7th -10th April 2011. Over 50 persons attended the lecture on the Photonics Explorer program and it was a good opportunity to disseminate information about the project to a wide audience.

— The Photonics Explorer was showcased at the European Science On Stage Festival 2011, Copenhagen held from 15-19th April, 2011. The developer team attended this event and held a workshop to explain the development of educational material across cultures and educational systems to teachers and get their feedback and ideas. Over 15 persons participated in this workshop and over 300 teachers were present at the event several of whom visited the booth to discuss and share ideas and learn about the project.

— Experiments from some of the modules and components of the kit, such as the laser module, diffraction gratings and optical fibre were used at the ‘ASML Girls Day’ event in Eindhoven, Netherlands organized on 16th April 2011. Over 40 families attended this event and had the opportunity to work hands on with the material. The developer team will subsequently collect feedback from the organizers.

— The Photonics Explorer was showcased at a booth at the Fotonica Evenement, Netherlands, between 29-30th March 2011. This event is attracted over 800 international participants including companies. This opportunity was used to meet and create future collaborations with industry.

— The developer team participated as jury members in the European Schools Science Symposium held in Brussels between 21-23rd March 2011. Over 200 students from several European countries participated in this event and it was a good opportunity to speak to teachers and disseminate information about the project.

— One member of the developer team and PhD student Ms. Nina Cords from IPN, participated in the DPG Frühjahrstagung in Germany on 22nd March 2011. Ms. Cords, who is involved in the scientific evaluation of the project, presented her current work and it was an opportunity to incorporate feedback from experts in the field.

— Two members of the developer team attended the Didacta Fair in Stuttgart, Germany on 22nd February 2011. The fair exhibits educational materials and the opportunity was used to widen our knowledge of the available educational materials as well as meet with persons and gain feedback and ideas for development.

— Members of the developer team have met with representatives from DOW Chemicals in Netherlands on 11th March 2011 to discuss possible collaborations and raise awareness among the industry.

— The developer team attended the Photonics 21 Workgroup 7 Annual meeting in Brussels on 24th February 2011 and gave a presentation to the attendees. Contacts to an educational cluster in the UK were established and feedback was received on other sources of support that could be explored.

— The video from the module ‘A Scientist’s Job’ was shown to 49 students aged between 15-16 years at the ‘Technology Experience College’ event hosted by ASML, Netherlands in the second week of January 2011. Valuable feedback was received from the students and the responses to the video were also featured in an article in the local newspaper that covered the event.

— The developer team established collaboration with European Schoolnet and the Photonics Explorer Program was included in the Scientix Portal. The Photonics Explorer was also showcased at the Internal European Scientix Conference held from 6-8th May 2011 in Brussels. The conference brought together a large internal audience of over 300 participants from 37 countries. At this conference the developer team had the opportunity to give a plenary talk, a registered presentation as well as exhibit the kit at a booth.

— One member of the developer team was invited to attend a European Policy Dialogue on ‘Education for Inclusion’ held on 28th June 2011. At the event, several persons expressed interest in finding out more about the Photonics Explorer and our goals.

— The developer team presented 2 workshops and an invited presentation at the SPICE Summer Academy held in Prague, Czech in August 2011. The academy brought together various persons involved in EU projects and the opportunity to share results and best practices within the community.
Ms. Nina Cords from IPN presented the Photonics Explorer at the biannual European Science Education Research Association conference held in France in September 2011. This also resulted in a publication about the content of the Photonics Explorer and didactic framework based on IBL techniques.

One member of the developer team was invited to present at the inaugural Sea of Science event in Split, Croatia held in December 2011. The event provided the opportunity to present our work to over 20 secondary school teachers. The event was also reported in the local newspaper with an article.

The Photonics Explorer has been showcased at Fotonica Evenement held in March 2012 at the opening presentation and at the exhibition. The event is held in the Netherlands and provides the opportunity to interact with European Industry and inform them about our work.

One member of the developer team was invited to give a presentation at the Photonics21 Annual Meeting of Stakeholders held in March 2012. The event was an excellent opportunity to present our work to over 200 members of European photonics industry and also to the commissioner, Neelie Kroes who later commended the initiative in her keynote speech at the event.

The Union of Physicists in Bulgaria invited one member of the team to present a plenary talk at the XXXX National Conference on Problems in Physics Education: ADVANCED GOALS IN PHYSICS EDUCATION IN SECONDARY SCHOOLS AND UNIVERSITIES. This conference was held in Gabrovo, Bulgaria in April 2012. Over 200 teachers attended this conference from all over Bulgaria, several of them were already involved in field testing the Photonics Explorer at their schools. The conference also resulted in a publication in the proceedings.

The Photonics Explorer was showcased at the Innovation Village at the SPIE Photonics Europe Conference held in April 2012 in Brussels. The conference is the largest European conference on Photonics and brings together several industry personnel as well as the scientific community. The Photonics Explorer won a special category award for its novel approach to bringing science and photonics to secondary schools.

Workshop I was held from 30-31st August, 2011 at the DESY in Hamburg, Germany. The second Strategic Advisory Board meeting was also held during this workshop. The main aim of the workshop was to introduce the completed kit to the EAP, LAP and SAB members and officially launch the field tests. The prototypes were distributed to the LAPs at this meeting which initiated field testing in the seven test countries.

International Dissemination Activities

Through collaboration with SPIE, the Photonics Explorer was exhibited at the ‘Photonics for a Better World’ area as well as at the Student Outreach Olympics during SPIE Optics and Photonics Annual Meeting held in August 2012 in San Diego, USA. This provided maximum exposure to potential cosponsors. A member of the developer team also submitted a paper on the topic and gave a presentation at the Optics Education and Outreach II conference.

A member of the Educational Advisory Panel presented the Photonics Explorer at the NSTA 2012 National Conference on Science Education held in April 2012 in Indianapolis, USA.

*The following activities were previously reported*

One member of the developer team attended the SPIE Annual Meeting held in San Diego, CA, USA in August 2011. The Photonics Explorer was exhibited at a booth at the ‘Photonics for a Better World’ area. In August 2012 the team has been invited once again to participate in the conference this time with exhibits
at the Student Outreach Olympics as well as the main exhibition. There is also the opportunity to inform the audience at the Women in Optics Luncheon with a table top exhibit.

— The project is represented by the co-ordinator who is a board member of SPIE
— One member of the developer team is on the SPIE Educational Committee.
— An SAB member presented the project at the IEEE Photonics Society 23rd Annual Meeting on 7th November 2010, Denver, Colorado, USA. The talk was given in the session “Creative teaching methods” and received very positive feedback.

**Other Dissemination Activities**

— EYESTvzw has been recognized as a partner and part of the International Steering Committee for the UNESCO supported International Year of Light in 2015.
— A press release was issued and widely circulated by SPIE Newsroom [http://spie.org/x90835.xml](http://spie.org/x90835.xml) in October 2012 highlighting the first, positive results of the evaluation study performed by IPN.
— A promotional video was made to disseminate information about EYESTvzw and the Photonics Explorer to potential sponsors. The video was translated into Dutch and French and embedded on the EYESTvzw, Photonics Explorer and B-PHOT websites. It is also accessible on the YouTube channel of B-PHOT. So far, the video has been viewed over 700 times (total for all versions).
— An article was published in the proceedings of the XXXX National Conference on Problems in Physics Education by the Bulgarian Union of Physicists.
— An article ‘Photonics kit tested in seven European countries’ appeared in the European Optical Society newsletter in Jan 2012.
— The outcome of the Photonics21 Annual Meeting of Stakeholders and EYESTvzw in particular, was reported in the media in an SPIE press release [http://spie.org/x86708.xml](http://spie.org/x86708.xml) that was extensively circulated.
— Vice President of the European Commission, Neelie Kroes, mentioned EYESTvzw and the Photonics Explorer on her blog, twitter as well as in her keynote address at the Photonics21 Annual Meeting of Stakeholders.
— The Photonics Explorer and EYESTvzw were showcased in a 2 page spread in the Optics and Photonics News (OPN) magazine in the July/August 2012 issue. Development of the Photonics Explorer website ([www.Photonics-Explorer.eu](http://www.Photonics-Explorer.eu), [www.Photonics-Explorer.net](http://www.Photonics-Explorer.net), and [www.PhotonicsExplorer.eu](http://www.PhotonicsExplorer.eu)) was completed on 18th November 2009 and reported as milestone M2. Numbers for the access of the website indicate that over 2300 visits from 79 countries/territories since it was setup.

*The following activities were previously reported*

— Two newsletters have been sent out in March 2010, December 2010 and another is scheduled for end of April 2011. The newsletters are circulated to over 250 persons, organizations and institutions. The newsletters have been a way of keeping them updated with the progress of the work as well as informing them of upcoming events and encouraging contact and participation.
— The website has also served as a crucial point of information exchange with several companies, institutions and teachers contacting the developer team through the details on the website (e.g. The Design and Technology Association, UK, Mr. Jörg Haas and Mr. Dink Brinkmann, teachers from Germany.)
— The website also hosts a questionnaire for the module ‘A Scientist’s Job’. The questionnaire collected information from scientists and researchers working at universities, industry and non-profit organizations. Over 300 responses have been received through circulation within networks and more are expected. The results will be used as part of a statistical study in the first part of the module ‘A Scientist’s Job’, where students will compare their answers to those obtained via this questionnaire.
— The Photonics Explorer was featured in the Fotonica Magazine March 2011, Page 28 (‘Photonics Explorer – a kit with a difference!’). The magazine is distributed via the Photonics Nanocluster in the Netherlands to over 800 participants including networks, organizations and universities across Europe.

— EXPEKT has also been showcased in publications such as the SPIE Professional, June 2010 and The Wall Street Journal Europe, July 2010 (http://www.photonicsexplorer.eu/Media2/In-the-Media). These articles provided excellent visibility for the project and expanded our dissemination platform. The Vrije Universiteit Brussel also regularly reports on the project via the press releases published in internal and external communication.

— The JUMP network for women working in Science and Technology included an article on their blog and in their newsletter informing their networks about the survey for the module ‘A Scientist’s Job’. Through this circulation, several responses have been received from women working in science and engineering.

— The Photonics Explorer has also been showcased in articles published in the EOS and SPIE Professional magazines.

— The developer team along with Ms. Nina Cords of IPN published an article ‘Teaching optics with an intracurricular kit designed for inquiry-based learning’ in the IOP Journal ‘Physics Education’. By March 2012 this article was downloaded 250 times (only 10% of articles have been accessed over 250 times across all IOP journals).

**Planned Dissemination Activities**

— A ‘Launch event’ is planned for 12 December 2012 to launch the Photonics Explorer and provide a real boost in visibility on a European level. The launch event will be jointly hosted by TE Connectivity at their European Learning Centre facility in Belgium. TE connectivity is also a key large scale sponsor of the kit in Flanders.

— The Photonics Explorer and EYESTvzw will be present at the VeleWe meeting in November 2012. The Photonics Explorer has been part of this event since 2010 and this year we have the opportunity to reach several additional teachers.

— The Photonics Explorer will be showcased with 7 workshops during Science Week at the VUB in November 2012 reaching over 200 students.

— EYESTvzw and the Photonics Explorer will be showcased at the ‘Day of Science’ in the Atomium, Brussels on 25th November 2012.

— Members of the EXPEKT team will be present at the Edushock Leerfestival on 5th December 2012 with a workshop for teachers and a booth.
2.2.2 Work Package 2: Development of the Photonics Explorer

WP Leader: Amrita Prasad

General Objectives

The objective is to develop educational material for secondary school level that

— conveys the fascination of working with light
— allows the students to experiment hands-on and minds-on
— is up-to-date and scientifically accurate
— has a high didactic value
— gives better teaching results by engaging the students, teaching both understanding of physical concepts and research skills
— convinces teachers with its quality and motivates them to employ modern didactic techniques
— is easily adaptable to local curricula and schooling culture
— makes teachers feel confident with teaching photonics and reduces his preparation time
— can be easily translated and made available for many teachers in Europe
— can be produced in serial production at reasonable cost to allow for distribution free-of-charge

Main achievements for the reporting period:

— creation of the corporate design of the Photonics Explorer (logo, font, colour scheme)
— design of template for didactic material
— design of template for newsletter
— creation of a ‘character’ that can make abstract concepts easier to visualize and remember
— Selection and development of the didactic framework for 8 modules
  o This includes experiments with components provided
  o Supporting didactic framework
  o Developing suitable and interactive multimedia material
— Components for 50 prototypes for field testing were sourced
— Incorporation of feedback from EAP review for modules
— The didactic content of the 8 modules was completed in English
— The content was translated in the 6 additional languages
— The first 50 prototypes were distributed to commence the field testing
— The revisions were done based on the feedback from the field tests

Progress made during reporting period:

The section below describes the progress made in this Work Package. This includes the ‘Development Phase’ which consisted of Task 2.1 ‘Compilation of kit components’, Task 2.2 ‘Development of the Didactic Framework’, Task 2.3 ‘Creating and compiling multimedia material’, Task 2.4 ‘Translation’, Task 2.5 ‘Prototypes’ and the ‘Revision Phase’ which consisted of Task 2.6 ‘Preparation for serial production’.
Task 2.1: Compilation of kit components

All the experimental components were sourced for the first 50 prototypes of the Photonics Explorer\(^1\). Each kit contains a class set (10) of the components, except in the case of the optical fibre and diffractive optical elements (1 per class). With these components a class of 25-30 students (an average determined from pre-test studies) can experiment, hands-on, in groups of 2-3. While most of the components have been fully sponsored by supporting companies, some were only partially sponsored i.e. they were purchased at fabrication price. **With these 50 prototypes, in the field test phase, the kit reached over 1500 students.**

Specialized components such as the laser module, LED module, intensity masks and plastic lenses were made to certain specifications and fabricated with the Photonics Explorer logo (technical specifications can be found in Milestone M5\(^1\)). They have been specifically designed to be robust, safe (eye-safe laser power) and stable for experiments within the classroom and to be used easily by students. Table 1 below shows the components in the first prototypes of the Photonics Explorer kit along with the source, current status and a picture of the component.

**Table 1: Components in the first 50 prototypes of the Photonics Explorer**

<table>
<thead>
<tr>
<th>Component</th>
<th>Source</th>
<th>Status (for 50 prototypes)</th>
<th>Component Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polymer Optical Fibre (5m)</td>
<td>Luceat, Italy</td>
<td>Sponsored</td>
<td><img src="image" alt="Polymer Optical Fibre" /></td>
</tr>
<tr>
<td>Customised LED Modules (RGB)</td>
<td>YES Led, Hong Kong</td>
<td>Purchased</td>
<td><img src="image" alt="Customised LED Modules" /></td>
</tr>
</tbody>
</table>

\(^1\) Detailed descriptions can be found in Milestone M5
<table>
<thead>
<tr>
<th>Item</th>
<th>Supplier</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diffraction Gratings</td>
<td>Rainbow Symphony Inc., USA</td>
<td>Purchased</td>
</tr>
<tr>
<td>Diffractive Optical Elements</td>
<td>NEMO Edukit</td>
<td>Sponsored</td>
</tr>
<tr>
<td>Customised Intensity Masks</td>
<td>Lasertype, Germany</td>
<td>Partially sponsored</td>
</tr>
<tr>
<td>Mirrors</td>
<td>Alanod, Germany</td>
<td>Sponsored</td>
</tr>
<tr>
<td>Item</td>
<td>Supplier</td>
<td>Status</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Customised Laser module</td>
<td>YES Led, Hong Kong</td>
<td>Purchased</td>
</tr>
<tr>
<td>Plastic lenses (set of 3)</td>
<td>Lensel Optics Pvt. Ltd, India</td>
<td>Purchased</td>
</tr>
<tr>
<td>Polarisers (set of 2)</td>
<td>Nitto Denko, Czech</td>
<td>Sponsored</td>
</tr>
<tr>
<td>Colour filters (Red, Green, Blue, Cyan, Magenta, Yellow)</td>
<td>Rosco, UK</td>
<td>Sponsored</td>
</tr>
<tr>
<td>Plastic Boxes</td>
<td>DBP Plastics, Belgium</td>
<td>Purchased</td>
</tr>
</tbody>
</table>
Task 2.2: Development of the didactic framework

- The ‘corporate design’ of the Photonics Explorer has been developed. This includes designing a unique logo, colour scheme and layout for the website and all the didactic material. The logo was designed with a professional graphic designer as was the template and layout of the worksheets and website. This work was reported as Milestone M3.

- The developer team, working with an artist, created a ‘character’ called Fyke. This character is meant to add a degree of whimsy to the material by joining the students in their quest for understanding. The artist has also illustrated optical phenomena using drawings of this character, which makes them easier to visualize and remember. The drawings are used within worksheets to illustrate scientific concepts as well as complement the themes, make them easier to remember. For instance the illustration below was used in the ‘Career Preferences’ worksheet, in the module ‘A Scientist’s Job’, to illustrate various options that students have in terms of choosing a career. The shape of the character has been chosen to convey direction, movement and dynamism. The sketch-style with defined lines and boundaries was chosen for its simplicity and it can be clearly reproduced even in black and white reprinting of the worksheets.

Figure 1: Illustration of career options for students using FYKE

8 Modules were developed for the first version of the Photonics Explorer. The 8 modules (shown in Tables 2 and 3), out of a possible 16, were selected by the developer team after consulting the EAP. Specifically, all members of the EAP were asked to select 8 topics out of 16 that they would like to see developed and the topics they would like to review. The top 8 topics (modules) selected by the maximum number of EAP members were chosen.

A previous survey of the secondary school science curricula across Europe had shown that light and optics is introduced to students at two points in the curriculum. First, at the age of 12-14 (lower secondary) where optics is taught in inter-disciplinary courses and later at the age of 16-18 (upper secondary) when physics is taught in specialized courses. Hence, the developer team was easily able to divide the chosen topics into the two age groups and develop 4 modules for each age group.

The Educational Advisory Panel reviewers were allocated such that an international mix and a good balance of teachers and science education professors was maintained per topic.

The ‘review and revise’ process was especially designed to receive quick and detailed feedback from the EAP reviewers and make the iterative process more efficient. The process is as follows; when the first version of the module has been developed by the developer team, the module is sent for a 1st review to the EAP reviewers assigned to that module. This is usually done via email. The reviewers provide their responses.
This is usually discussed over email or in some cases over the telephone. The module is then modified with this feedback and sent for a 2nd review. This process continues until the module is deemed ready for field tests by both the EAP reviewers and the developer team.

The supporting didactic framework has been designed after careful review of the curricula of the different countries for each module. The modules were developed after carefully surveying the aspects that were already taught, the experiments that were already conducted in schools and the background the students had within each topic. Each module is designed to stand alone, such that it can be easily integrated into the existing curriculum by the teachers. Such a structure gives the teachers the flexibility they need while increasing the usability and feasibility of the Photonics Explorer within the classroom. The didactic framework consists of worksheets, factsheets, notes for the teacher and, where relevant, supporting multimedia material such as photographs or videos.

Material for students:

Along with the class set of components provided for hands-on experiments, the material for the students also consists of worksheets and factsheets.

The worksheets (1-3 pages) are designed to be used by students during the lesson. They begin with a motivation/background of the topic that is meant as a ‘teaser’ to motivate students towards the experiments and the learning experience. Students are then led through hands-on experiments, working in groups of 2-3, using the components provided. The worksheets do not describe the experiments as a ‘recipe’; instead students have the freedom to design their own experimental set-ups. They observe a physical phenomenon, discuss its origins within their groups and are guided to a reasonable conclusion about the basis of the particular physical effect. The worksheets use guided-inquiry based learning techniques where students are guided using leading questions to maintain the interest and discovery aspect of learning.

The fact sheet (1 page) is designed to be given to students at the end of the lesson. It contains the important concepts that need to be remembered after the lesson and which students may need to reproduce in a test or exam e.g. important formulae, relevant physical laws etc. The fact sheet is designed so that students can avoid incessant note-taking during the lesson and can concentrate on the hands-on experiments, developing their scientific skills and discovering the concepts by themselves. The fact sheet also provides current applications of the work that, in most cases, relate to the students’ daily lives. This enables students to link the scientific concepts to technologies that they frequently encounter. This in turn allows them to understand the role of photonics in their daily lives and think about a future in this field. In some modules, teachers go through some aspects of the factsheets with the students at the end of the lesson.

Material for teachers:

The Notes for teachers (5-11 pages) provides an overview of the lesson for the teachers. It contains a summary of the module, target age group and duration. It also informs the teacher of what prior knowledge students should have before working on the module and what they will learn during the lesson. There is a summary of the additional skills (besides the actual academic knowledge) that will be fostered in students by working with the module. The ‘Notes for Teachers’ suggests a lesson outline which can be used by the teacher to work through the module, step-by-step, with their students. It also provides background information on the topic for the teacher which helps to foster their knowledge and preparation prior to teaching the topic in class. This gives them confidence in teaching the topic and is efficient in terms of prior preparation time needed if they would have to source this information themselves. The ‘Notes for Teachers’ also has possible answers to questions that students might ask. These questions have been formulated
based on preliminary tests at local schools, feedback from the EAP and teachers as well as the feedback of the field tests (incorporated in the revision phase). Tables 2 and 3 show the 8 modules that have been developed for each age group along with the EAP reviewers for each module and the components used in the module.

**Table 2: List of modules for the age group 12-14 years**

<table>
<thead>
<tr>
<th>Module</th>
<th>Educational Advisory Panel Reviewers</th>
<th>Optical components within module</th>
<th>Status of didactic framework (worksheets, factsheets, notes for teacher and multimedia material)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light signals</td>
<td>Stuart Farmer, UK</td>
<td>- Optical fibre</td>
<td>Ready Material for 3 lessons</td>
</tr>
<tr>
<td>(light in telecommunication)</td>
<td>Heinrich Strietz, Germany Marc van der Schmidt, Germany Gunnar Friege, Germany Maria Calvo, Spain</td>
<td>- LED Module</td>
<td></td>
</tr>
<tr>
<td>Colours</td>
<td>Veronika Bratzel, Germany Pascal Daman, Luxembourg Cristina Palici di Suni, Italy Antoni Haraburda, Poland</td>
<td>- LED module</td>
<td>Ready material of 2 lessons</td>
</tr>
<tr>
<td>Redirecing light with glass</td>
<td>Guy Bourie, France</td>
<td>- Optical fibre</td>
<td>Ready material for 2 lessons</td>
</tr>
<tr>
<td>(refraction and optical instruments)</td>
<td>Tom Van Lier, Belgium Dobromila Szczepaniak, Poland Alberto Garcia Barriuso, Spain</td>
<td>- LED module, - Mirrors</td>
<td></td>
</tr>
<tr>
<td>Eye and Vision</td>
<td>Praveen Ashok, UK</td>
<td>- Plastic lenses</td>
<td>Ready material for 2 lessons</td>
</tr>
<tr>
<td></td>
<td>Michel Detambel, France Ilona Mirtcheva, Bulgaria Malgorzata Bak, Poland Malgorzata Kajser Stysiak, Poland</td>
<td>- LED Module</td>
<td></td>
</tr>
</tbody>
</table>

**Table 3: List of modules for the age group 16-18 years**

<table>
<thead>
<tr>
<th>Module</th>
<th>Educational Advisory Panel Reviewers</th>
<th>Optical components within module</th>
<th>Status of didactic framework (worksheets, factsheets, notes for teachers and multimedia material)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Making light</td>
<td>Alfons Moreno, Spain Denis Dumora, France Tsviatko Popov, Bulgaria Georg Gubik, Belgium</td>
<td>- Diffraction gratings - LED Module - Laser module</td>
<td>Ready Material for 2 lessons</td>
</tr>
<tr>
<td>(light sources, incl. lasers)</td>
<td>Rainer Müller, Germany Gunnar Friege, Germany Rob Auckland, UK Henri Eisendrath, Belgium</td>
<td>- Polarisers - Laser module</td>
<td>Ready Material for 1 lesson</td>
</tr>
<tr>
<td>Polarisation</td>
<td></td>
<td>- Diffraction gratings - Laser module</td>
<td>Ready Material for 3 lessons</td>
</tr>
<tr>
<td>(Biophotonics)</td>
<td>Ewa Debowska, Poland Andreas Konrad, Germany Sibylle Driemel, Belgium Aleksandra Podolska-Strycharska, Poland</td>
<td>- Intensity mask - Diffractive optical elements</td>
<td></td>
</tr>
<tr>
<td>Diffraction and Interference</td>
<td></td>
<td>- Diffraction gratings - Laser module</td>
<td>Ready Material for 3 lessons</td>
</tr>
<tr>
<td>A Scientist’s Job</td>
<td>Elly van Hiel, Belgium Laurence Maurines, France</td>
<td>Not applicable</td>
<td>Ready Material for 1-2 lessons</td>
</tr>
</tbody>
</table>
Overview of modules developed

The following section provides an overview of the 8 modules that have been developed in the Photonics Explorer. This section provides the module name, target age group, an overview of the didactic framework, a brief summary of the learning achievements of students and content within the module. Additional comments are provided with results of preliminary tests for some of the experiments conducted by the developer team with local students. Detailed descriptions of all the modules can be found in Deliverable 2.2.

Lower Secondary Modules: (12-14 Years)

Module 1: Light Signals

Didactic Framework: 3 worksheets, 1 factsheet, 1 Notes for Teachers

In this module students learn the following:

- That light goes fast and straight
- The concept that light paths are reversible
- The law of reflection
- How optical fibres guide light
- Teamwork
- Developing technical solutions under time pressure, while meeting specifications

This module is designed to help students learn the basics of optical telecommunication by presenting a situation between two villages. Students need to devise a system to allow these two villages to communicate with each other without using electricity and whilst meeting certain criteria, much like the requirements facing engineers working in industry. Once students establish that using light is the best means of communication they need to send an encoded message through the optical fibre using red, green and blue LEDs. Students also learn the laws of reflection via an experiment which uses a slit to direct light onto mirrors that then reflect the light.

Additional comments: The fibre communication ‘game’, involving encoding and decoding a signal was trialed with over 50 students, aged between 12-18, during ‘Science Week’ at the Vrije Universiteit Brussel in November 2010. Students were required to encode a signal using red, green and blue LEDs and transmit a 10 letter word which was then decoded by their colleagues in another room. The response of the students was extremely enthusiastic; they understood the rules of the game quite easily and often devised very efficient codes of communication.

Module 2: Colours

In this module students learn the following:

Facts:
- Sunlight includes all colours of the rainbow
- The colours in white light can be split, e.g. by refraction
- Colour filters and coloured objects appear coloured because they absorb parts of the visible spectrum
- Additive colour mixing, illustrated with computer screens
- Subtractive colour mixing, illustrated with computer screens
- Colour is a perception
Skills:

- Working with the scientific method
- Designing experiments to provide evidence for a hypothesis
- Distinguishing between observation and interpretation of experimental results

The worksheets of this module do not aim at “explaining” the phenomena of colours, but rather use the topic to make students familiar with the scientific method. Students have to choose a hypothesis, design and conduct their experimental results, and give evidence for their conclusion.

The module is structured in two chapters:

- Rainbow colours: students find out how colour filters work and use them to study the cause of the colours of the rainbow
- Colour mixing: Subtractive colour mixing is illustrated with colour printing, while additive colour mixing is demonstrated with computer screens.

**Module 3: Lenses and Telescopes**

Didactic Framework: 1 worksheet, 1 factsheet, 1 Notes for Teachers

Material for 1-2 lessons

In this module students learn the following:

- How different lenses focus light
- The physical concept of “focal point”
- The difference between real and virtual images
- How to build two types of telescopes
- How to work out the magnification of a telescope
- The concept of field-of-view

Skills the students will foster:

- Teamwork
- Working with lenses and ray diagrams
- Building their own experimental setups and relating observations to theories

Lenses are a basic optical component. However, understanding how they work is non-trivial! They have a wide variety of applications. One such use is in telescopes to allow us to look at astronomical objects. In this module, students will get to work with lenses and learn about interesting effects for themselves. More particularly they will learn how concave and convex lenses focus light. They also build their own Galilean and Kepler telescopes to look at distant objects.
Module 4: Eye and Vision

Didactic Framework: 2 worksheets, 1 factsheet, 1 Notes for Teachers

In this module students learn the following:

- To measure focal lengths
- Parts of a camera
- Parts of the human eye
- Function of each part
- Using thin lens formula to work out maximum and minimum focussing distances
- Accommodation in the eye and how it works
- Teamwork
- Relating tangible concepts (camera) with more abstract ideas (lens in the eye)
- Working with lenses and ray diagrams

In this module students compare the parts of a digital camera to the parts of the human eye and discover the function of each part and similarities and differences between the two. This is done using a puzzle where the students are given the parts of a digital camera and the parts of the eye. They cut out the parts and arrange them in the order in which light passes through them. They also discuss and note down the function of each part. Thus they understand the similarities and differences between the two. Students then measure the focal lengths of their own eyes and learn about ‘accommodation’ – the focusing mechanism of the human eye, by performing experiments with long and short focal length lenses.

Upper secondary modules: 16-18 years

Module 5: Making Light

Didactic Framework: 2 worksheets, 1 factsheet, 1 Notes for Teachers, 1 video (in production)

In this module students learn the following:

- the physics of different light sources
- incandescence and blackbody radiation
- the concept of photons
- working principle of a laser
- differences between types of light sources (LEDs, light bulbs, laser)
- organizing a research project
- teamwork
- presenting research finding with convincing arguments

This module allows students to conduct a research project wherein they are required to assess the present state of lighting within their school, research the efficiency of the given situation and come up with better proposals. Students also learn the different types of light sources, how the ‘colour’ of the light source when hot and cold can be a guide to the temperature of the light source and which kinds of light sources are more energy efficient.
This module also contains a video, currently under production. The video is in an animated form where the drawings on the worksheets have been animated for students to easily make the association between the worksheet and video. The video mainly describes the scientific concept of how different light sources generate energy and why laser light is different to other light sources. The video will include the physical processes behind incandescent light tubes, LEDs and lasers.

**Module 6: Polarisation (bio-photonics)**

Didactic Framework: 1 worksheet, 1 factsheet, 1 Notes for Teachers

In this module students learn the following:
- Measuring and rotating polarisation of light
- Building a polarimeter
- Using polarisers to measure the degree of rotation of polarisation of light by sugar molecules
- Applications of polarisation in LCD displays
- Safe handling of lasers

In this module, students build a polarimeter, which is a device widely used in the pharmaceutical industry as well as in the sugar industry. Polarimeters are used to determine the concentrations of various types of sugars and chemicals. Students perform an experiment to study how a sugar solution can rotate the polarisation of light from a laser using two polarisers. They then relate this effect to bio-photonics applications and are given information on how some animals can detect polarised light.

**Module 7: Diffraction and Interference**

Didactic Framework: 3 Worksheets, 3 Factsheets, 1 Notes for Teachers

In this module students learn the following:
- The safe handling of lasers (Laser safety)
- To measure the wavelength of light with the double slit (Young) experiment.
- Diffraction on a single slit and Babinet’s principle
- How to measure the width of a hair based on a diffraction pattern
- How the diffraction pattern of DNA lead to the discovery of its structure
- Diffraction on gratings in reflection and transmission
- How an optical spectrometer works
- That the spectrum of energy saving light bulbs consists of discrete colours – in contrast to the continuous spectrum of sunlight.

In this module students discover the **phenomena of diffraction and interference**. They perform diffraction experiments of laser light through a **double-slit, single slit and single obstacle** to view the diffraction patterns and understand the relationship between diffracting object and diffraction pattern. They also build their own **optical spectrometer** and measure the **wavelengths of different colours** emitted by an energy saving lightbulb with a discrete spectrum.
Module 8: A Scientist’s Job

Didactic Framework: 1 worksheet, 1 Notes for Teachers, 3 sets of statistics sheets, 1 video

In this module students learn the following:

- to identify her or his own preferences for a career
- what qualities are needed to work as a scientist
- whether men or women are better suited for a career in science
- the critical interpretation of statistics
- what a scientist does on a day-to-day basis
- what it means to study at a university

In this module students participate in a survey within the classroom answering two typical interview questions: ‘What qualities can you offer to your career’ and ‘What do you expect from a career’. Students then conduct a statistical survey of the answers to determine the most popular choices and if there is any significant difference between the answers of young men and women. This leads to discussion of the ‘gender-issue’ within the classroom.

This module also contains a video designed to introduce students to the daily life of three researchers; a university student, an industry researcher and an engineer using science for healthcare purposes. The video is shown in two parts. In the first part (2.07 mins) the students do not see the person or hear their voice. They are only shown the working environment, surroundings, interactions with colleagues etc. From these images students must glean the gender of the person, the work that they do and the kind of place they work in.

In the second part, students are shown an interview where the researchers answer these questions and discuss their working life (8 mins). In this way students are not just silent spectators to a video but get the opportunity to visualize themselves in such a research environment and think about whether or not such a career would interest/suit them. This video also aims to further the discussion of the gender-issue in science in the classroom initiated by the first worksheet and break existing stereotypes about women in science. To ensure that the video can be used in all countries, subtitles will be used for the interview part of the video.

Task 2.3: Creating and compiling multimedia material

- The videos were produced by ‘Mad Monkey Studios’, an organisation that specializes in producing videos for non-profit organizations.
- The module, ‘A Scientist’s Job’, consists of a video, 1-Scientist, which shows the students a ‘day-in-the-life’ of three researchers working at university, industry and using science for humanitarian causes. Two of the three researchers shown are women, thereby emphasizing female role models for young girls to identify with. The three persons involved were Ms. Alisia Peters (chemical engineer at ASML, company in the domain of lithography systems for semiconductor industry), Mr. Stijn Roelandt (PHD candidate at Vrije Universiteit Brussels) and Ms. Birgit Morlion (program manager at Interdisciplinary Institute for Broadband Technology, IBBT). Some footage for this video was also provided by ASML, IBBT and TONA, VUB.
- A second video was produced for the module ‘Making Light’ which uses animations of sketches used in the worksheets. The aim of the video is to highlight the different types of light sources and the physical mechanisms used by each to generate light. It also describes the working of a laser and how laser light is different from other types of light sources. Footage of applications of lasers in industry has been provided by TRUMPF, Germany.
Task 2.4: Translations

The Photonics Explorer was developed in English, and translated into six other European languages prior to field testing. The Photonics Explorer is thus available in 7 languages: Bulgarian, Dutch, English, French, German, Polish and Spanish. This also reflects the first 7 test countries for the first 50 prototypes.

A preliminary study of the number of students studying science at secondary schools across Europe (Eurostat 2006) indicated that the percentage of students within these seven countries constituted 63.6% of the total secondary school pupils Europe wide. Moreover, these 7 countries cover a wide range of cultures and educational systems whilst also covering economically ‘rich’ and poorer countries. With these languages, additional countries such as the Netherlands and Austria can also be included to participate without needing translation into an additional language.

Translations included the didactic material such as the worksheets, teacher notes and fact sheets, questionnaires for field tests as well as subtitling of videos. A crucial factor in the choice of translation service was maintaining the style of the didactic material which has been specifically formulated to be appealing to students of the specific age groups. It was also important to maintain consistency of the concepts presented in the translated material.

In many cases, the developer team was able to select the specific translator in order to maintain the quality of the translations. The subsequent field tests helped to determine the quality and also any changes that were needed. In August 2012 the didactic framework was also translated into Czech with the initiative and support of the New Technologies Research Centre, West Bohemia.

Task 2.5: Prototypes

The first 50 prototypes of the Photonics Explorer kits were created by integrating the components and the didactic framework. Each prototype contained a class set of experimental material and the didactic content was provided on a DVD. Each DVD contained the material in all 7 languages.

Revision Phase

Task 2.6: Preparation for serial production

Based on the feedback from the field tests it was established that the didactic content did not need any systematic changes. The main issues highlighted by teachers were the following:

— The worksheets can have more space for writing, calculations etc.
— The font size can be made bigger to make it more readable
— The Eye and Vision worksheet would need the most modifications with additional figures and diagrams
— The translations were not well done in the case of Polish and Spanish. However, the Local Associated Partner offered to handle the correction of translations at their level.
— The box used for the prototypes was not ideal to store the components and replace them.
The final design for the box of the Photonics Explorer kit has been changed to make it more suitable for teachers and use in the classroom. The following updates were made to ready the Photonics Explorer for serial production:

- The box includes separate compartments for each type of component. There is also a compartment provided for batteries and a folding insert that houses the DVD.
- The DVD has a print indicating that the material is copyrighted by EYESTvzw.
- The outer area of the box consists of the Photonics Explorer logo, EU logo as well as the website. There are images of Fyke, students working with components of the kit and it is indicated that the Photonics Explorer is an EYESTvzw educational initiative. Thus the box is appealing and has a clear visual identity.
- Each box contains a sticker with serial number on the spine. The serial number is unique to each kit and teachers can use this number to log onto the ‘Teacher Area’ of the Photonics Explorer website (under development) and download updates and interact on discussion forums.
- The size of the box is 28x40x7 cms and the weight of one full box is about 1 kg. Teachers have indicated that this type of box is ideal for the components since it is very easy to handle, the components are kept secure and separate. It is easy to take a final count of components once the lesson is finished and the box is easily transported between classrooms.
- The polarisers were changed so that they have a frame around each and a line indicating the polarisation direction (see image below).

A detailed report of the feedback can be found in Deliverable D3.2 and Milestone M10. The developer team has implemented the necessary changes and updated worksheets will be made available to teachers on the online platform. This will also facilitate teacher interaction and help to build an online community of teachers using the kit.
2.2.3 Work Package 3: Field Tests and External Evaluation

WP Leader: Nathalie Debaes

The main objective of the field tests and the external evaluation is to ensure that the serially-produced Photonics Explorer measures up to the targets set for the development in Work Package 2. The field tests give valuable feedback on:

— The impact of the Photonics Explorer on the image of photonics among students
— The acceptance of the Photonics Explorer by teachers and how they use the material
— How well the Photonics Explorer integrates into the various curricula and teaching cultures across Europe
— The quality of the translations

This information was used to revise the Photonics Explorer for serial production.

The accompanying evaluation study will give the European Commission, teachers and sponsoring companies alike a scientific basis to assess the impact of this outreach program and the educational value of the Photonics Explorer.

Main achievements for the reporting period:

— Generation of evaluation tools specific to the Photonics Explorer
— Plan for the field testing in the seven test countries is in development
— Promotional material was developed for pilot teachers
— Criteria for evaluation developed in collaboration with IPN
— Pilot schools and teachers for testing of the modules identified in collaboration with Local Associated Partners
— Organizing teacher training and field tests in the local country (Belgium)
— Organization of Workshop I to distribute 50 prototypes and kick off field tests
— Organization and co-ordination of visits to testing schools in countries
— Organization of Workshop II to collect and consolidate feedback

Progress made in the reporting period:

The tasks in this Work Package are divided into two phases. During the first reporting period progress was made in the ‘Development Phase’, in particular in Task 3.1 ‘Generation of Evaluation Tools’ and Task 3.2 ‘Preparation of the Field Tests’. A detailed description of these tasks can be found in Deliverable 1.3 ‘First Annual Report’. The tasks below are part of the ‘Revision Phase’.

Task 3.3 Workshop I

The aim for Workshop I was to bring together the LAPs from the testing countries, distribute the prototypes and kick off the field testing. The process of evaluation was also explained to the LAPs at this workshop.

A detailed report of Workshop I can be found in Deliverable 3.1 ‘Report on Workshop I’.

Task 3.4 ‘Local Instruction Course for Pilot teachers’, Task 3.5 ‘Monitoring field tests and technical support for pilot teachers’, Task 3.6 ‘Collect data for evaluation’ and Task 3.7 Workshop II are reported on in detail in Deliverable 3.2 ‘Report on Workshop II’.

Task 3.8 ‘Evaluation study’ is reported in detail in Deliverable 3.3.
2.2.4 Work Package 4: Sustainability

WP Leader: Prof. Hugo Thienpont

General Objective

The main objective is to achieve self-sustainable long-term program continuation with the goal to distribute the Photonics Explorer free of charge to schools in Europe. For this purpose a non-profit organization (NPO) will be set up, that is meant to serve for at least 10-15 years. This organization would need

- A Business Plan (Deliverable D4.1)
- By-Laws and Internal Order Regulations for the NPO (Deliverable D4.2)

Main achievements for the reporting period:

- Creation and finalising of the business plan for the NPO
- Drawing up of the statutes and internal order regulations of the NPO
- Naming of the organization
- Registration of the trademark for the organization
- Registration of the non-profit organization
- Funding and purchasing for first bulk production of the kits
- Determination of Founding members, first board members and general assembly members
- Completion of first and second Board Meeting
- Determination of memberships and sponsoring options
- Completion of General Assembly meeting
- Dissemination
- Fund Raising

Progress made during reporting period:

A Non-Profit organisation ensures the mass production and distribution of the Photonics Explorer kit throughout Europe. A non-profit structure was chosen to allow fast and independent actions and reactions through an organisation that would be active on a European scale. It also allows transparency of operation and the opportunity for stakeholders to participate actively and influence the direction of the organisation.

Registration of the NPO

Logo:

NPO Name: EYESTvzw – Excite Youth for Engineering Science and Technology

Official address: De Selliers de Moranvillelaan 26, 1082 Sint-Agatha Berchem

Website: www.eyest.eu

Email: info@eyest.eu
Registration completed on: 18th November 2011

Functions within the organisation:

Chairman: Prof. Hugo Thienpont

Secretary & Treasurer: Nathalie Debaes
The secretary is responsible for writing the minutes of the Board Meetings and these have to be signed by the Chairman and Secretary.

CEO: Dr. Amrita Prasad
The CEO is responsible for the daily management of the organisation. He/she is also responsible for preparing the agenda of Board Meetings and can represent the organisation to external parties.

Mission of the NPO
The mission of the NPO is to raise the interest in science and engineering among young people from primary and secondary education through the creation and dissemination of educational programs, mainly to schools.

- The association will be pursuing this goal in a non for profit way in the sense that these educational programs will be made available for free to schools, teachers and pupils.
- It may also execute all activities that can promote this goal. It may in that sense, but only incidentally, perform commercial activities as long the revenues are spent to support the purpose for which it was founded.

Founding Members
The founding members of the organisation are:

Prof. Hugo Thienpont
Ms. Nathalie Debaes
Dr. Robert Fischer
Dr. Amrita Prasad
Vrije Universiteit Brussel
## Funds Secured and distribution in the period March 2012 – October 2012

EYESTvzw has been successful in creating visibility and raising funds in the period specified above. The following table outlines the sponsors, sponsorship amount, region of distribution and number of kits and students reached.

<table>
<thead>
<tr>
<th>Sponsor</th>
<th>Region</th>
<th>Number of kits</th>
<th>Amount (Euro)</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Belgium, Bulgaria, France, Germany, Poland, Spain, UK</td>
<td>50</td>
<td>Field Test Phase</td>
<td>Distributed</td>
</tr>
<tr>
<td></td>
<td>Brussels, Belgium</td>
<td>60</td>
<td>14999</td>
<td>Distributed</td>
</tr>
<tr>
<td></td>
<td>Brussels, Belgium</td>
<td>64</td>
<td>12100</td>
<td>To be Distributed</td>
</tr>
<tr>
<td></td>
<td>Vorarlberg, Austria</td>
<td>110</td>
<td>16500</td>
<td>To be Distributed</td>
</tr>
<tr>
<td></td>
<td>EU wide</td>
<td>15</td>
<td>2250</td>
<td>To be Distributed</td>
</tr>
<tr>
<td></td>
<td>Kerala, India</td>
<td>3</td>
<td>300</td>
<td>Distributed</td>
</tr>
<tr>
<td></td>
<td>Scotland, UK</td>
<td>30</td>
<td>3000</td>
<td>Distributed</td>
</tr>
<tr>
<td></td>
<td>EU wide</td>
<td>10</td>
<td>1500</td>
<td>To be Distributed</td>
</tr>
<tr>
<td></td>
<td>Scotland, UK</td>
<td>21</td>
<td>3150</td>
<td>Distributed</td>
</tr>
<tr>
<td></td>
<td>Hudiksvall, Sweden</td>
<td>10</td>
<td>1500</td>
<td>To be Distributed</td>
</tr>
<tr>
<td></td>
<td>EU wide</td>
<td>7</td>
<td>1000</td>
<td>To be distributed</td>
</tr>
</tbody>
</table>

EYESTvzw has raised over 39K Euro with the support of sponsors in the period March 2012 – October 2012. This translates to a distribution of over 300 kits (including field tests) reaching at least 7500 students per year.

The tasks and deliverables in this work package provide further details about the organization, legal structure, members, daily operation as well as the progress made in terms of gaining effective members, sponsors and distribution of the kit.
The main progress in Task 4.1: Business Plan and by-laws for non-profit-organisation (NPO) is reported in detail in Deliverable 1.3 ‘First Annual Report’.

The main progress in Task 4.2 ‘Set up non-profit organisation’ and Task 4.3 ‘Fund Raising’ are reported in Deliverable 1.6 ‘Second Annual Report’.

Deliverable 4.4 reports on securing the funds for the first 3000 Photonics Explorer kits. It also provides details on the progress made in terms of gaining sponsors and visibility for the organization.

2. General Conclusion

The EXPEKT project resulted in the development of an intra-curricular photonics kit to excite, engage and educate students about working hands-on, with light. This kit – the Photonics Explorer – was developed with over 35 teachers and science education professors in 11 European countries so that it could be easily integrated into the different curricula and be accepted and used by both teachers and students.

In the project period all the goals laid out in the Grant Agreement were achieved. The Photonics Explorer was developed, extensively tested and successfully implemented in the various teaching systems and curricula across Europe. Extensive efforts have been made towards the national and international dissemination of the project information within the wider scientific community. A non profit organization, EYESTvzw, was established to sustain the program beyond the EU funded phase and handle the assembly and mass distribution of the Photonics Explorer kits throughout Europe. EYESTvzw has already distributed over 300 kits with the support of local governments, industry sponsors and organisations.

The didactic content has also been translated into Czech and additional countries like Austria, Sweden and Italy are in the process of implementing the kit in their classrooms.

Thus, the Photonics Explorer program is well on the way to achieving its goal of reaching over 2.5 million students, Europe wide in the years to come.