# TP3.0: HOW CAN VIRTUAL REALITY ENRICH PRACTICAL TEACHING?

**Aude Caussarieu[1], Julien Bribet[1], Jean-Christophe Delagne[2,3], Laurent Dutertre[1], Baptiste Fabre[2,3], Ludovic Lescieux[1], Rania Mrabet[1], Eric Cormier[3,4,1].**

[1] *Alphanov, 33400 Talence, France*

[2] *Laboratoire CELIA, UMR 5107, CNRS-CEA-Université de Bordeaux, 33 400 Talence, France*

[3] *Laboratoire Photonique, Numérique et Nanosciences, UMR 5298, CNRS-IOGS-Université Bordeaux, 33400 Talence, France*

[4]*Institut Universitaire de France (IUF),1 rue Descartes, 75231 Paris, France*

aude.caussarieu@alphanov.com

## ABSTRACT

In recent years, virtual reality headsets have become more accessible thanks to developments in technology. Educational applications for training in physics, and in particular in optics, can be found on the market today. We fully understand that these digital tools will never replace real world teaching, but they offer legitimate opportunities for learning by doing. In this presentation we will provide an overview of the opportunities offered by virtual reality in optics tuition at university and in continuing education. 

**KEYWORDS:** *training; virtual reality; education; laser*

## 1. INTRODUCTION

Every technological innovation, from the beginnings of TV to the current fashion of artificial intelligence, echoes in the educational world with the promise of a pedagogical revolution [1]. The virtual reality craze dates back several years, but recent technological developments now allow for use in ordinary classrooms. In fact, the cost of the equipment has fallen sharply (a virtual reality headset costs a few hundred euros) and the improvement in the computing performance of the headsets has made it possible to detach them from computers. These developments have allowed the commercialization of several educational applications within virtual reality, including the Immersive Photonics Lab for optics. In this statement we are not claiming that virtual reality will revolutionize the teaching of optics. We propose a didactic approach to analyze the learning opportunities offered by such apparatus. We will start from an analysis of the specificities of teaching physics, and in particular optics. We will then offer a very probably still incomplete panorama of the possible uses in training. We will conclude with the prospects for studies to be carried out to validate the usefulness of such devices in training.

## 2. DIDACTIC ANALYSIS OF OPTICAL TEACHING

Physics is an experimental science which makes connections between objects and phenomena of the world as well as the models and theories which make it possible to understand and predict them [2]. Therefore, practical work plays a key role in the teaching of physics. The American Association of Physics Teachers (AAPT) drew up in 1998 an inventory of the objectives assignable to practical work in optics [3]:

1. Learn to conduct experiments

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2. Learn experimental techniques and analyze data
3. Better understand the concepts of physics by making the link between theory and practice
4. Understand the role of experiments in building knowledge in physics
5. Develop transferable skills: communicate, work in a team, ...

The teaching of optics, as a thematic of physics, therefore pursues the same objectives. However, it should be noted that optics are also at the service of the engineering sciences. Thus, the optics lessons also have the objective of:

6. Mastering certain operating procedures
7. Learning to handle equipment safely

## 3. LEARNING OPPORTUNITIES OFFERED BY VIRTUAL REALITY

In view of the didactic analysis above, we think that the contribution of virtual reality is particularly obvious for everything related to procedural learning, and therefore points 2, 6 and 7. Virtual reality obviously makes it possible to embark into augmented reality which has already demonstrated its usefulness in helping students to better understand the concepts of physics (point 3) [4].

The use of this technology makes it possible to take on several very interesting dimensions for the teaching of optics:

- Use equipment that is usually inaccessible (too expensive or too fragile; or else handled outside of practical work rooms)
- Propose learning scenarios with support that allows you to learn gradually and independently to perform procedures. This dimension draws on all the expertise of the video game world.
- Increase the number of training situations to repeat gestures and thus master procedures.
- Access data that is usually inaccessible, such as the number of times the laser beam has left the optical table in order to learn to handle equipment in total safety.
- Access inaccessible physical representations (augmented reality) such as the polarization of a beam or its wavelength to better understand physical phenomena.

## CONCLUSION

This is an a priori analysis of the opportunities offered by virtual reality for teaching optics which have guided the development of an educational application: The Immersive Photonics Lab. The in-situ study of the use of this device and its effectiveness makes up part of the prospects of this work.

## REFERENCES

[1] D. Muller (Veritasium), « This Will Revolutionize Education ». Youtube, 1 dec. 2014, https://www.youtube.com/watch?v=GEmuEWjHr5c

[2] Giere, Ronald N. « How Models Are Used to Represent Reality ». Philosophy of Science 71, nº 5 (décembre 2004): 742-52. https://doi.org/10.1086/425063 .

[3] AAPT. « Goals of the Introductory Physics Laboratory ». Am. J. Phys. 66, nº 6 (1998): 4.

[4] Furió, David, Stéphanie Fleck, Bruno Bousquet, Jean-Paul Guillet, Lionel Canioni, et Martin Hachet. « HOBIT: Hybrid Optical Bench for Innovative Teaching ». In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems, 949-59. Denver Colorado USA: ACM, 2017. https://doi.org/10.1145/3025453.3025789.http://word.mvps.org/