

BRIGT

Erasmus+ strategic partnership for Higher Education

**BOOSTING THE SCIENTIFIC EXCELLENCE AND INNOVATION
CAPACITY OF 3D PRINTING METHODS IN PANDEMIC PERIOD**

O3 - BRIGT CAE virtual laboratory room

Project Title	Boosting the scientific excellence and innovation capacity of 3D printing methods in pandemic period 2020-1-RO01-KA226-HE-095517
Output	O3 -BRIGT e-learning virtual laboratory platform – description of CAE virtual laboratory room and supporting capabilities
Date of Delivery	July 2022
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1 Introduction

As it has been described in the main report related to the BRIGHT virtual laboratory platform that has been conceived in the BRIGHT project (main concept and vision), The BRIGHT Virtual Laboratory has been conceived as a web-based platform, that is accessible by WWW browser. BRIGHT virtual laboratory platform contains a number of basic modules – virtual rooms that are accessible from a main, web-based interface.

The scheme provided in Figure 1 presents the initial idea of the BRIGHT Virtual Laboratory platform. As one may notice in the first concept, it was assumed that there will be 4 rooms, each with a specific purpose – CAD, CAE, 3D Printing and testing. In each room, it was proposed that – apart from standard educational content – there will be integrated solutions, such as VR or AR applications.

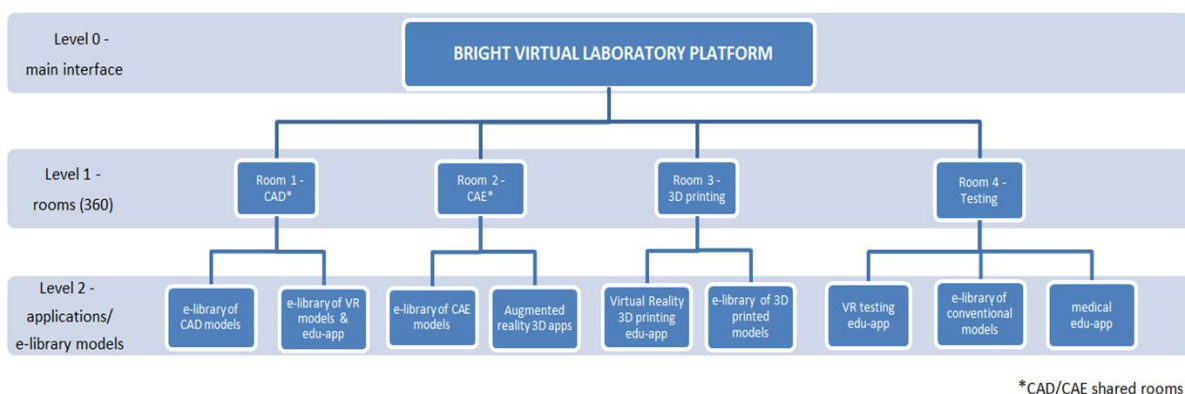


Figure 1. Initial concept of the Virtual Laboratory platform in the BRIGHT project

Taking into consideration this the initially planned “rooms” were mapped as following in terms of thematic rooms (according to the experience and expertise of BRIGHT consortium partners):

1. CAD: main room at TUCN + supporting capabilities in PUT, UNI and STU rooms
2. CAE: main room at TUCN + supporting capabilities in BIZZCOM
3. 3D Printing (Rapid Manufacturing): main room at PUT + supporting capabilities in TUCN and BM Plast
4. Testing: main room at UNI + supporting capabilities in STU, UNIPU, BIZZCOM and BM Plast

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In this report there are provided details about **the thematic CAE virtual laboratory room (room number 2)** which is relying on basic main room that has been constituted at TUCN partner, being completed with the supporting capabilities in BIZZCOM, like shown in Figure 2. Scheme realized in Figure 2 has been conceived, realized and has been posted on the BRIGHT project website from where the BRIGHT platform can be accessed before going to visit the rooms of the BRIGHT institutions (see: https://bright-project.eu/?page_id=320). In this way like shown in Figure 2, anyone who is accessing the virtual laboratory in order to take one visit on several BRIGHT institutions in virtual way can do it much better oriented before starting to visit the laboratories, by doing according to the steps that are necessary related to the conceiving, manufacturing and testing of medical parts. CAE (Computer Aided Engineering) is the second step that is following after CAD design of new medical product, being necessary to validate the solutions that have been proposed in the designing stage in terms of constructive shape of the models, materials to be selected for manufacturing of the medical parts by 3D printing processes, etc.

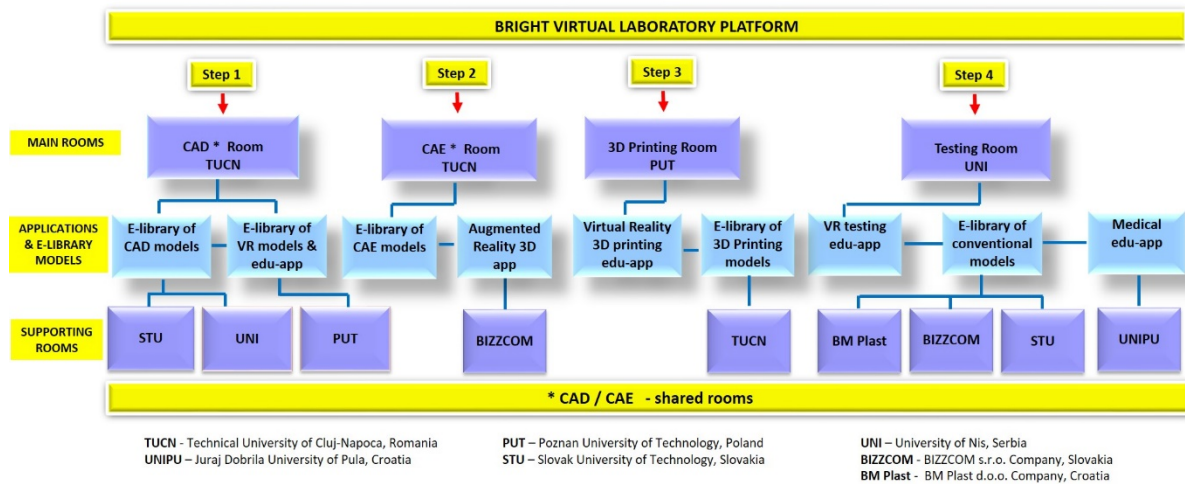


Figure 2. Main concept of BRIGHT virtual laboratory platform in terms of thematically rooms and apps

Since CAD and CAE topics are very closed linked (in both cases being used similar programs (e.g. SolidWorks for CAD, SolidWorks Simulation module for CAE analyses and since main rooms for CAD / CAE has been attributed to Technical University of Cluj-Napoca, it has been decided (even the steps needed for realizing the medical parts are different – CAD comes first, CAE following right after for validating the CAD in terms of realizing one

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new medical product), to keep the same room /to share rooms in this case, by sharing the information for CAD and for CAE in different corners in the same room, this aspect being mentioned to the users who are accessing the BRIGHT laboratory platform before starting to realize the visit (as shown in Figure 2 and on the BRIGHT website: (see: https://bright-project.eu/?page_id=320).

Teaching facilities have been used by the BRIGHT professors (coming from all BRIGHT higher educational institutions) in time of pandemic in relation with their students and have been used also during the BRIGHT summer school 2021 edition held in Cluj-Napoca and 2022 edition held in Croatia and Multiplier Event held in 2022 also in Croatia, in which more than 150 students and pupils had the chance to experience the platform, to test the facilities and to download and use the existing resources that can be found on the BRIGHT virtual laboratory (including the ones in the CAE room).

2. Virtual CAE laboratory room description

2.1. Accessing the virtual CAE laboratory room from the BRIGHT platform

As one may notice in Figure 1, in order to access the 3D printing laboratory rooms, this can be done from the main www BRIGHT virtual laboratory interface. The main interface of the Virtual Laboratory platform is available through the main website of the BRIGHT project - <https://bright-project.eu/> . After accessing the website, there is a link in the upper panel, named “Virtual Laboratories” (Figure 3).

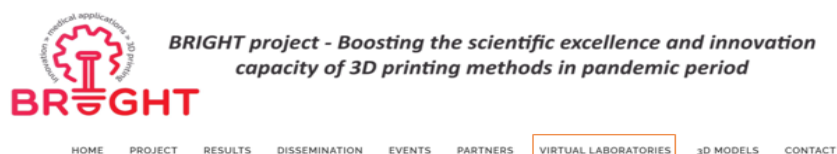


Figure 3. BRIGHT project website – access to WWW interface of Virtual Laboratory

Selecting the link related to Virtual laboratories this will lead further on to the opening of the interface (located at https://bright-project.eu/?page_id=320). It contains map of Europe, with pins representing laboratories of project consortium partners. Clicking on the name of each partner opens a new window, in which the selected virtual laboratory is presented and can be directly interacted with.

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2.2. Virtual CAE laboratory room of Technical University of Cluj-Napoca

Accessing of the TUCN virtual laboratory rooms can be done after selecting the main interface of the BRIGHT virtual laboratories shown in Figure 3 (by opening of the interface (located at https://bright-project.eu/?page_id=320). Containing the map of Europe, pin representing laboratories of TUCN has to be selected (see Figure 4). To access the CAE laboratory room of TUCN is possible also to be made by accessing the following link: <https://nessy2022.viewin360.co/share/collection/79pbg>



Figure 4. Access to CAE room of Technical University of Cluj-Napoca (TUCN)

Starting point of this Virtual laboratory is in the front of the TUCN main building (see Figure 5), while after entering into the building (main corridor) it is possible to get inside the CAD / CAE virtual laboratory of TUCN (see Figure 6).

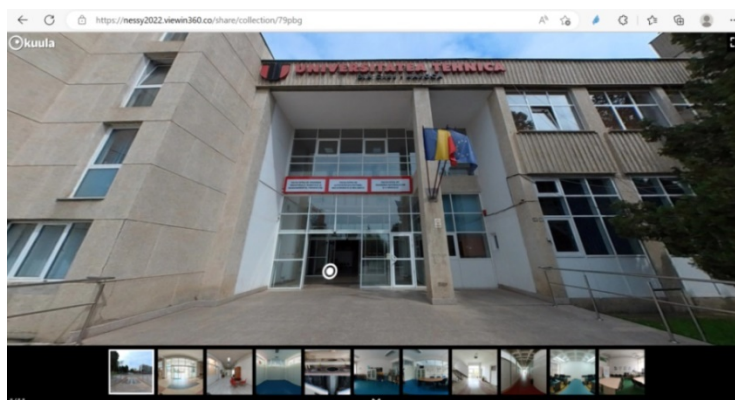


Figure 5. Main entrance of TUCN

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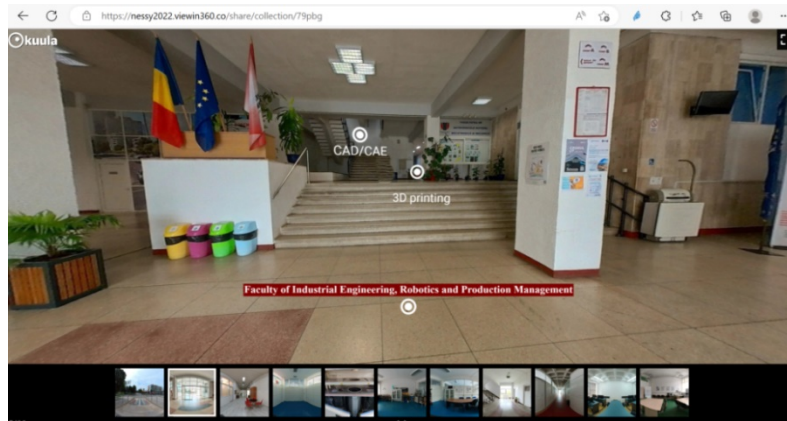


Figure 6. Main entrance corridor of TUCN

Virtual CAE laboratory room of TUCN (which is common with CAD room at the level of TUCN, but is unique on the level of BRIGHT project consortium directly linked with CAE, being the single room that has integrate teaching resources related to CAE in the BRIGHT virtual platform) has been created using Insta 360 camera and processed images have been processed using Kuula software, integrating in this way teaching resources in relation with CAE analyses of specific case studies that have been analysed in the BRIGHT project.

Therefore, one first category of teaching resource that has been integrated into the CAE virtual laboratory room was related to the CAE course module that has been produced within O1 and presentation of this module that has been realized during the BRIGHT International summer school in 2021, along with other similar made presentations about CAE as shown in Figure 7.

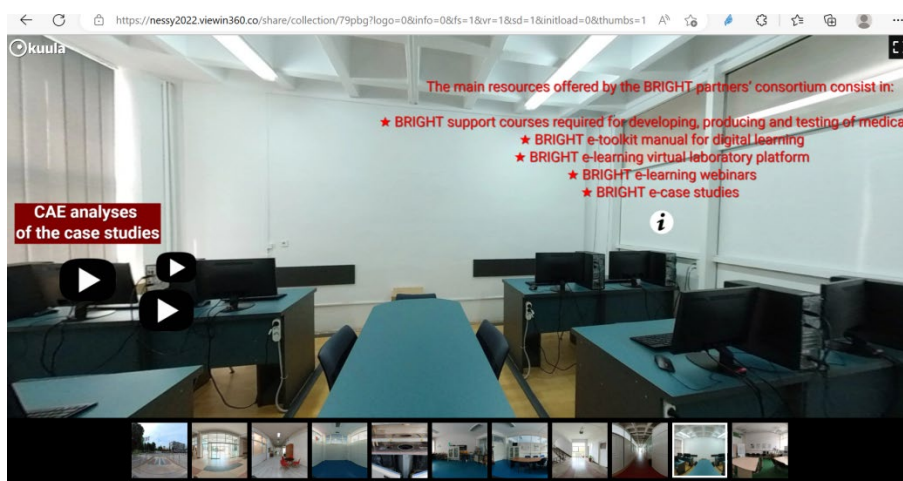


Figure 7. CAE course module and presentation held at BRIGHT International summer school

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Since practical aspects of the CAE analyses is important to be comprised by the students, within the CAE virtual laboratory room, there have been integrated practical case studies and results of the analyses that have been performed by the students which have been working on validating the solutions in terms of size, shape, type of material to be selected for 3D printing in relation with specific medical case studies that have been analysed on the BRIGHT International summer school 2021 edition: orthoses, face shields and robotic hand (see Figure 8).

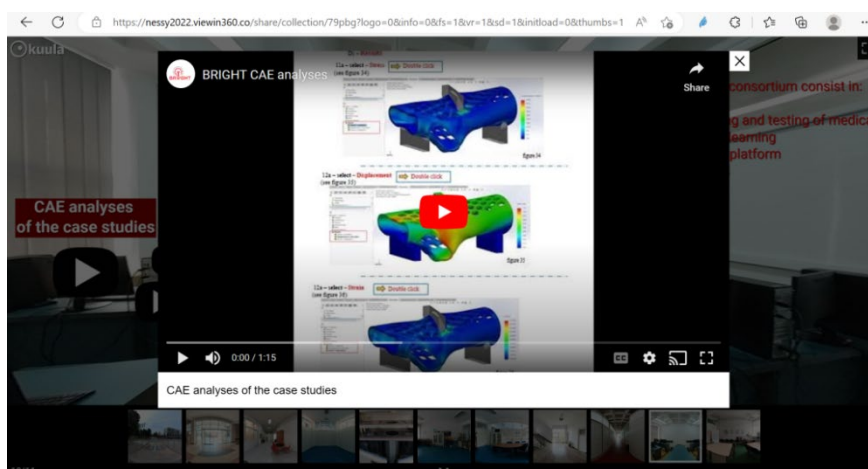


Figure 8. CAE analyses of the case studies analysed on BRIGHT International summer school

Other important resources has been represented by videos that have been produced in relation to the case studies that have been analysed, together with the webinar related on CAE which has been produced by TUCN in the frame of O4 (see Figure 9).

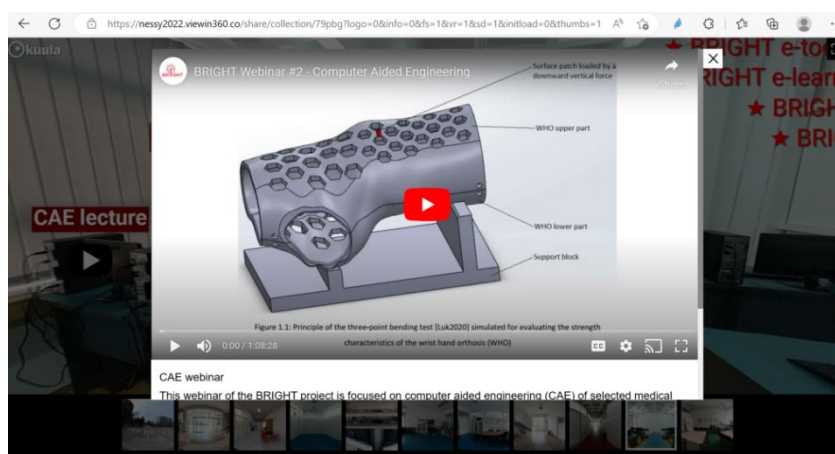


Figure 9. Videos and webinars about CAE analyses of medical parts

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One collection of analysed models (e-library of CAE analysed parts) have been also created, these models being downloadable on personal computers in “free mode” in order to be able to be accessed by other users to check the results, to realize new analyses starting from the realized ones, so they would be able to comprise easier the main steps that are needed to perform such types of analyses and to comprise much better the importance of reached results. E-library of CAE models has been stored in one specific area of the CAE virtual room at TUCN, as one may notice in Figure 10.

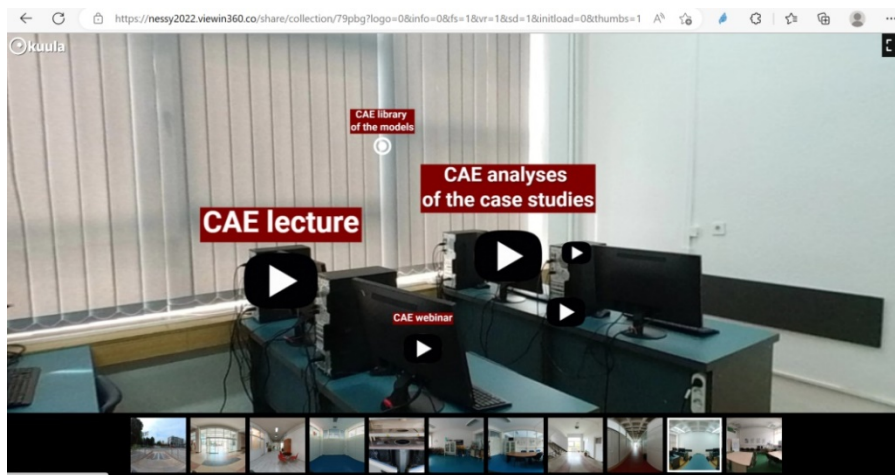


Figure 10. Collection of models (e-library of CAE analysed models)

2.2. Supporting capabilities in terms of AR applications realized by BIZZCOM

Additional support related to CAE virtual laboratory main room of TUCN has been provided by BIZZCOM in their virtual laboratory room (like shown in Figure 3). Supporting capabilities offered by BIZZCOM are not directly linked in terms of CAE analyses, but are important and can be considered as an important step before going to CAE analyses. Right before going to CAE analyses, the users can do one very important checking in AR in order to see in a digitalized way if some additional steps would be necessary to be done after the part has been finalized in CAD in terms of aesthetics, to do some last corrections in some areas of the model if needed, etc. Then CAE analyses can be performed. Accessing of the BIZZCOM virtual laboratory rooms can be done after selecting the main interface of the BRIGHT virtual laboratories shown in Figure 3 (by opening of the interface (located at https://bright-project.eu/?page_id=320). Containing the map of Europe, pin representing SMEs companies has to be selected (see Figure 11).

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Figure 11. Access to virtual laboratory of BIZZCOM

The Virtual laboratory of Bizzcom company presents unique capabilities of this industrial partner to the BRIGHT consortium therefore. The main focus of Bizzcom VL are Augmented Reality applications, aside from prototyping, testing and transporting equipment. The laboratory can be accessed through the BRIGHT virtual laboratory platform (https://bright-project.eu/?page_id=320) but also by accessing the following link: <https://nessy2022.viewin360.co/share/collection/79pDP>.

By accessing the above provided links, the user is being lead to the starting point – outside the main company headquarters (Figure 12), then through the reception, in which user is allowed to check various EU projects in which BIZZCOM partner is being involved (including BRIGHT project) (Figure 13), user can reach the showroom (Figure 14) and engineering hall (Figure 15).

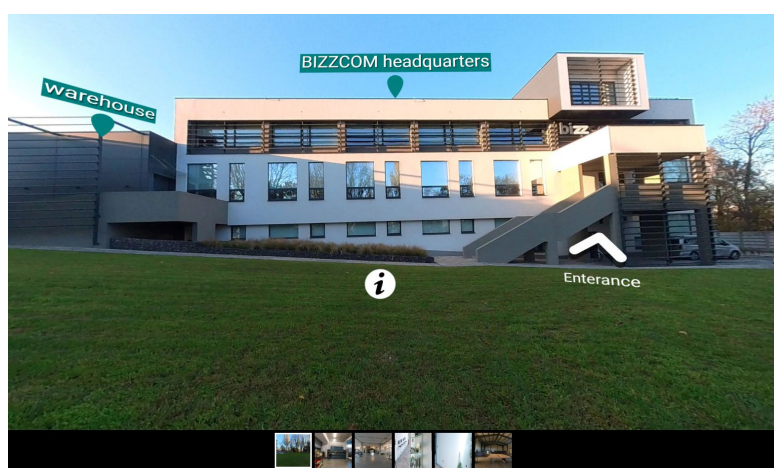


Figure 12. Bizzcom – starting point

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Figure 13. Bizzcom – reception

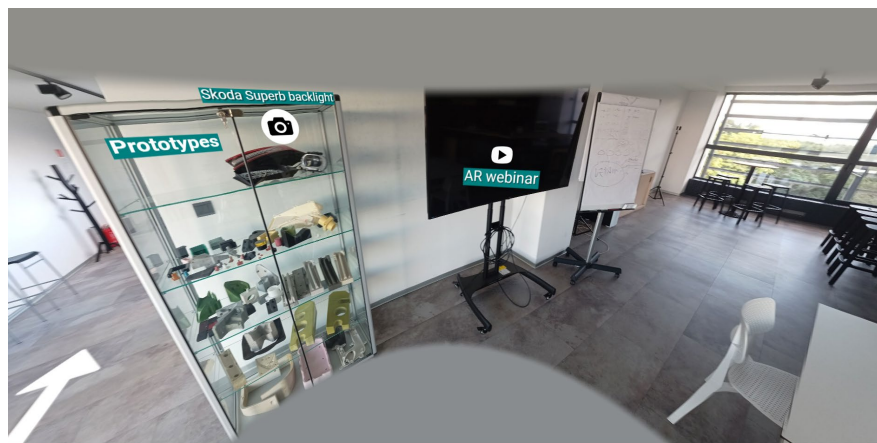


Figure 14. Bizzcom – showroom

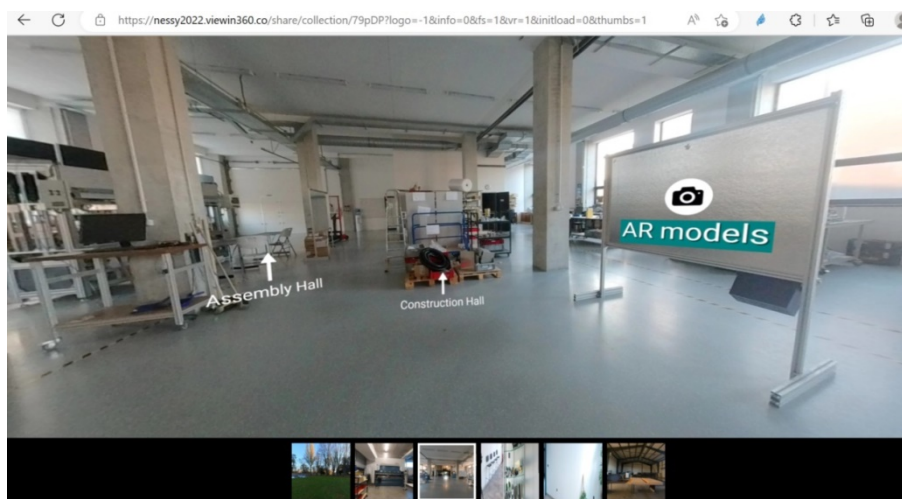


Figure 15. Bizzcom – engineering hall (with AR marker visible)

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As one many notice in the BIZZCOM laboratories, important information has been introduced related to the producing of AR applications (AR webinar), as well as an important collection of AR models that have been produced by BIZZCOM representatives in relation with medical products. By accessing the AR models in BIZZCOM room, users are being guided to different models and applications that can be visualized using QR codes on the tablets, laptops, mobile phones, etc., being able to download for free all these models (orthoses, face shields, robotic hands, medical implants, etc.) if they are interested to analyze or use them in different applications based on AR afterwards (see Figure 16).

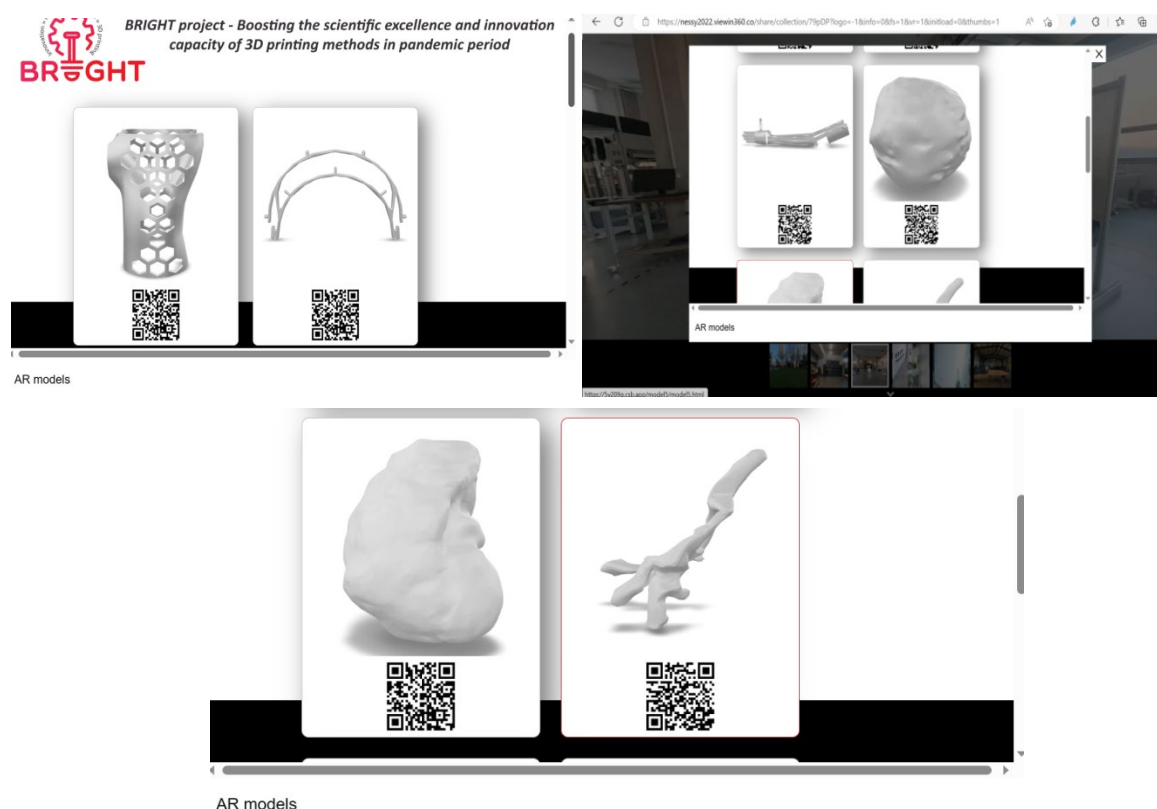


Figure 16. Examples of AR models included in the e-library of BIZZCOM company

3D models, corresponding mostly with BRIGHT case studies are associated with their respective QR codes as shown in Figure 17. Each model can be clicked and opened and it will be available for simple interaction at the screen of computer or any other device (see: Figure 17). Certain models are animated, e.g. wrist hand orthosis has an exploding view, enabling to view its parts separately.

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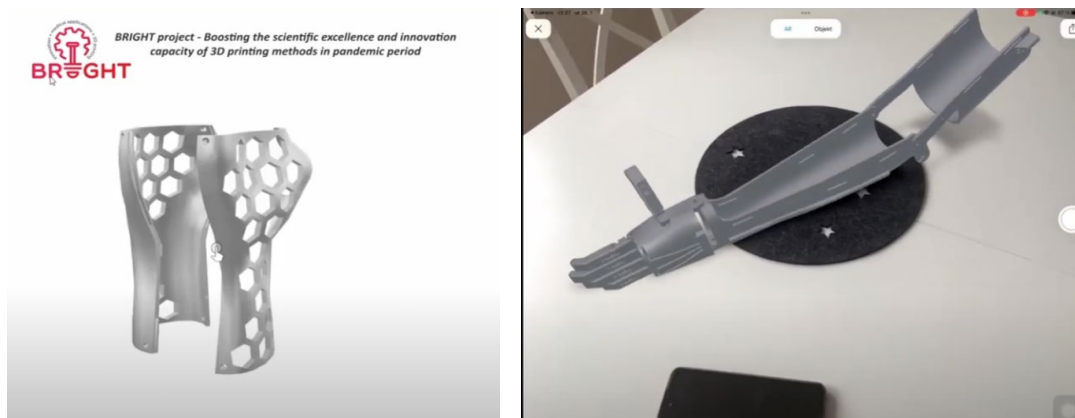


Figure 17. View of specific models in AR

Using the QR codes, user is transferred to a web application, where AR capabilities are used. The whole experience was developed on the basis of freely available toolkits, such as “model viewer” provided by the Smithsonian Digitization Programs Office (modelviewer.dev). Through smart device (cellphone / tablet) camera, real world is visible. Then, the 3D model of a medical part can be superimposed on it, enabling the user to take part in Augmented Reality experience (Figure 17). The model can be freely transported around and simple interactions can be done with it, such as rotating, scaling and exploding (in selected cases).

The Augmented Reality experience with medical 3D models is a compelling way to get students familiarized with certain shapes and designs. It allows simple, everyday use device (smartphone) to be utilized as a 3D model viewer, also enabling smooth mixing of the model with real environment. These models, part of interactive experience in the BRIGHT virtual laboratory platform, have very high importance in teaching, what is proven by their use in the BRIGHT project itself – they were used by the students of the summer school and pupils who attended the Multiplier Event in Pula (Croatia), with great fun, interest and to a great educational effect. The base of models can be further developed and more interactions can be also added, enabling to expand the educational effect. In Figure 18 are presented few images that were taken at the BRIGHT Multiplier Event organized by Juraj Dobrila University in Pula (Croatia) in September 2022, event through which 110 pupils coming from Medical School of Pula (Croatia) have attended and have expressed their interest and positive feedbacks in using such modern ways of teaching, like the ones that are based on AR.

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Figure 18. Prof. Magdalena Zukowska (PUT) showing AR applications to one group of pupils during the Multiplier Event organized by Juraj Dobrila University of Pula in September 2022

3. Conclusions

The CAE virtual laboratory room realized by TUCN completed with supporting capabilities in terms of AR applications realized by BIZZCOM partner as part of the BRIGHT virtual platform that has been developed within O3 of the BRIGHT project contains most of knowledge developed during the project regarding CAE analyses and AR analyses (Augmented Reality 3D apps), these resources being extensively used during the BRIGHT

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project activities, including the summer school and Multiplier Event carried out after the platform was finished. CAE laboratory room that is available at TUCN and AR 3D apps realized by BIZZCOM can be accessed easily through the web platform of BRIGHT project and represents an important teaching resource that was used and will be used in continuing in any form of remote learning, when access to laboratory is restricted or when conducting remote classes for international students online. The teaching resources provided within the CAE & AR laboratory rooms of TUCN and BIZZCOM gives a new insight to the students that can remotely visit different laboratories rooms that are available at these institutions, having the chance to get familiarized with how CAE methods can be used in validating the design of medical products that are aimed to be realized by 3D printing technologies from different types of materials that are suitable to be used for these types of applications (medical products). The educational content of CAE virtual laboratory room that is available at TUCN, completed by the modern methods of using AR in visualizing of medical products / for teaching can and will still be developed even after ending of the BRIGHT project, by adding or updating teaching resources with the aim of expanding it with results of student diploma theses for further references and use of the teaching resources in terms of CAE for validating / testing new types of medical products / new types of materials that are suitable for these types of products and are especially needed to support hospitals in time of pandemic.

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