Cross-Sections of a Cube in VR

An Interactive Application for Learning Solid Geometry

Introduction

For students, it is often hard to imagine how a plane section of a solid will look like. Traditionally, students learn the construction of plane sections by drawing them on paper or by using some computer software. Unlike traditional learning methods, VR provides an interactive learning environment in which students can directly explore geometric objects. It enables a student to move around a 3D model, observe it from various sides and angles, and gain a better understanding of the resulting plane section. The main advantage of using VR in education is the potential to increase students' motivation and interest. Research has shown that VR technologies help students develop various skills, for example problem solving, creative thinking, collaboration, and digital literacy [3]. The aim of this project is to demonstrate how VR can be used in learning of solid geometry. The application will contain several tasks with individual steps of construction.

Google Cardboard VR Headset

A Google Cardboard (fig. 1) is a virtual reality platform designed to be used with a smartphone inserted into the headset. It is primarily created from cardboard and contains two lenses. Users can either buy it or assemble it themselves according to a manual. The headset has a single button that allows users to interact with the application. Interaction with compatible application can also be performed by looking at some element (gaze-based), or by voice commands. Compared to many other VR headsets, the Google Cardboard is much more affordable, as it uses a smartphone as its display and does not require any additional equipment.

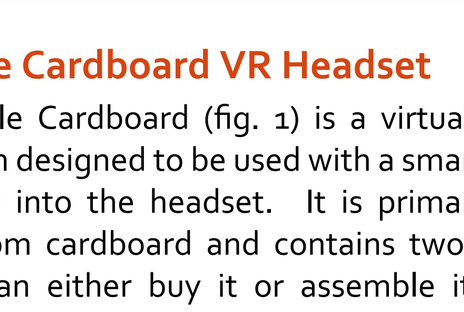


Figure 1. Google Cardboard with inserted mobile phone [1].

Plane section construction rules

To construct a plane section of a cube (fig. 2), we can use several geometric rules. Firstly, if two points of the section lie on the same face of the cube, we can connect them and obtain a part of the plane section. Secondly, opposite faces of a cube lie in parallel planes. If we already have a line of plane section in one face of the cube and a point belonging to the plane section in parallel face, we can draw a line through that point parallel to the known line. Finally, if we need to find another point of the plane section, we can extend the edges of a cube or the lines of the plane section that have already been constructed. The intersection points can help us in construction. [2]

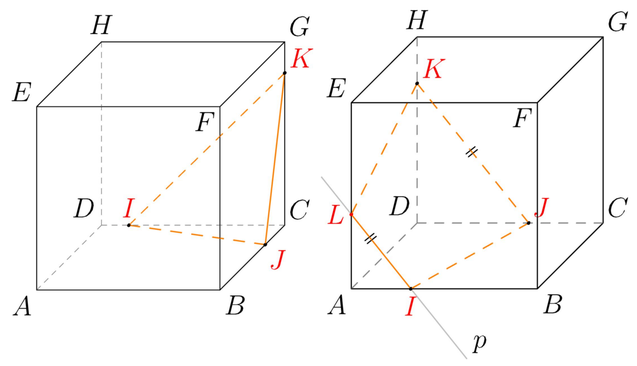


Figure 2. Construction of plane section using only the first rule (left) and both the first and second rules (right).

Application Interface

The cube model is placed in a room resembling a classroom (fig. 3). Next to the model, there is a green chalkboard with the task written on it. The user interacts with the application either by pressing a button on the VR headset or by using gaze-based interaction.

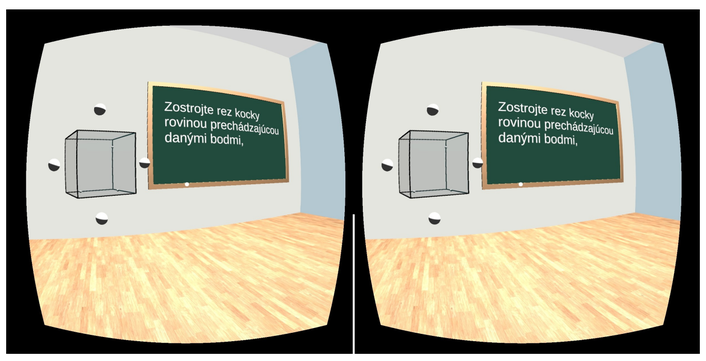


Figure 3. Created application. Smartphone screenshot.

Learning with the application

The student is given a task about plane section construction with some of the points needed for the construction. In the application there will be tasks of varying difficulty, allowing students to practise applying the geometric rules and gradually improve their understanding of plane sections.

The user can interact with the 3D cube model by using rotation controls. By looking at one of these controls (fig. 4), the cube starts rotating in the selected direction. In this way, the student can observe the cube from various sides and angles. The construction is divided into individual steps. By pressing the button on the Google Cardboard headset, the student proceeds to the next step of the construction. In this way, the student can follow these steps and observe how the given points are used to construct the correct plane section. The student can better visualise the construction steps and the spatial relationships, which may be difficult to imagine when working with a drawing on paper.

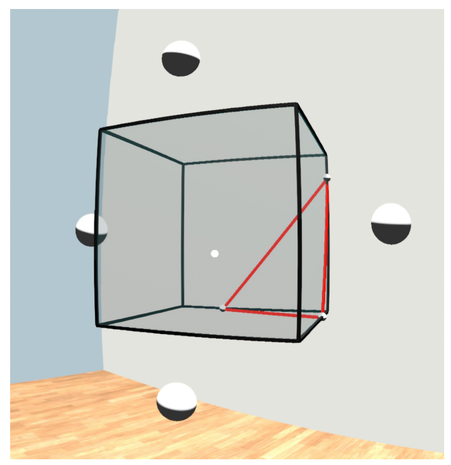


Figure 4. Cube model with rotation controls in the application.

References

[1] https://developers.google.com/vr/discover/cardboard, 2024. Accessed: Nov 17, 2026.

[2] Zbyněk Kubáček. *Matematika pre druhý ročník gymnázií, prvá časť.* Orbis Pictus Istropolitana, spol. s. r. o., 2009.

[3] Hajar Zekeik, Mohamed Chahbi, Mohammed Lamarti Sefian, and Imane Bakkali. Augmented reality and virtual reality in education: A systematic narrative review on benefits, challenges, and applications. *EURASIA Journal of Mathematics, Science and Technology Education*, 21(9):em2699, 2025.

This work was supported by KEGA 070UK-4/2026 and KEGA 038UK-4/2024, carried out at Comenius University in Bratislava.

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