การใช้โฮโลแกรมเทียม เพื่อสาธิตการสร้างโฮโลแกรมเทียม
USING PSEUDO-HOLOGRAM TO DEMONSTRATE
HOW TO MAKE PSEUDO HOLOGRAM

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บทคัดย่อ

หลักสูตรครุศาสตรบัณฑิต สาขาวิชาวิทยาศาสตร์ทั่วไป คณะครุศาสตร์ มหาวิทยาลัย
ราชภัฏบ้านสมเด็จเจ้าพระยา เป็นหลักสูตรที่ได้รับการออกแบบและพัฒนาขึ้นภายใต้การ
ควบคุมและดูแลของกระทรวงศึกษาธิการ ให้เป็นสถานศึกษาระดับอุดมศึกษา เพื่อผลิต
บัณฑิตให้เป็นครูวิทยาศาสตร์หรือบุคลากรทางการศึกษาด้านวิทยาศาสตร์ในอนาคต
นักศึกษาที่เรียนอยู่ในหลักสูตรนี้จะถูกฝึกฝนให้เคยชินกับการเรียนการสอนวิทยาศาสตร์ด้วย
การใช้วัสดุต้นทุนต่ำ แต่ให้ความเข้าใจทางวิทยาศาสตร์ได้สูง ผ่านกิจกรรมซึ่งเน้นการทดลอง
แบบทำได้เอง โดยงานวิจัยฉบับนี้เกี่ยวข้องกับการสร้างภาพโฮโลแกรมเทียมจากวัสดุที่
สามารถหาได้ง่าย ด้วยการนำปกพลาสติกใสมาตัดและประกอบให้เป็นรูปทรงพีระมิดยอดตัด
แล้วจึงนำมาวางบนหน้าจอโทรศัพท์มือถือสมาร์ทโฟน รวมถึงการปรับปรุงลักษณะของภาพ
โฮโลแกรมเทียมให้มีคุณภาพดีขึ้น ได้แก่ การเพิ่มความคมชัดของสี และการลดแสงสะท้อน
ภายในห้อง นอกเหนือจากนี้ เพื่อเป็นการส่งเสริมให้นักศึกษาสามารถสร้างสื่อการสอนแบบ
ตอบโต้ได้ด้วยตนเอง อีกทั้งยังสามารถนำไปประยุกต์ใช้กับวิชาต่าง ๆ ที่ตนเองสนใจ เรายังได้

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สร้างขั้นตอนการทำคลิปวีดีโอโฮโลแกรมเทียมจากโปรแกรม PowerPoint อีกด้วย เราเชื่อว่า งานวิจัยฉบับนี้มีประโยชน์ในด้านการส่งเสริมกระบวนการจัดการเรียนการสอนด้าน วิทยาศาสตร์ระดับประถมและมัธยมศึกษาที่เน้นผู้เรียนลงมือกระทำเป็นสำคัญ

คำสำคัญ: โฮโลแกรมเทียม, การสอนแบบตอบโต้, กิจกรรมทำมือทางวิทยาศาสตร์, การทดลอง แบบทำได้เอง, สอนวิทยาศาสตร์แบบ STEM

Abstract

The General Science Program, Faculty of Education, Bansomdejchaopraya Rajabhat University provides education to undergraduate students to be science teachers or educators in future. Students enrolled in this program are familiar with teaching and learning with economical materials but strive towards understanding of science through hands-on activities. Here, we report the Pseudo-hologram, which enables basic physical phenomena to be studied through simple, flawless, and instructive hands-on activities. This work describes such activities on a pseudo-hologram projector constructed by implementing a smartphone and a plastic frustum, together with an improved technique to enhance color contrast of illusion and reduce the reflection of ambient room light. In addition, it also presents a procedure in a beginning level to create the pseudo-holograph teaching video using PowerPoint program as an interactive teaching tool, which is capable of adopting the student knowledge to various interesting subjects. We envisage that this work would promote the active teaching and learning of science in primary or secondary levels of education.

Keywords: Pseudo-Hologram, Interactive Teaching, Science Hands-on Activities, Homemade Experiments, STEM Education.
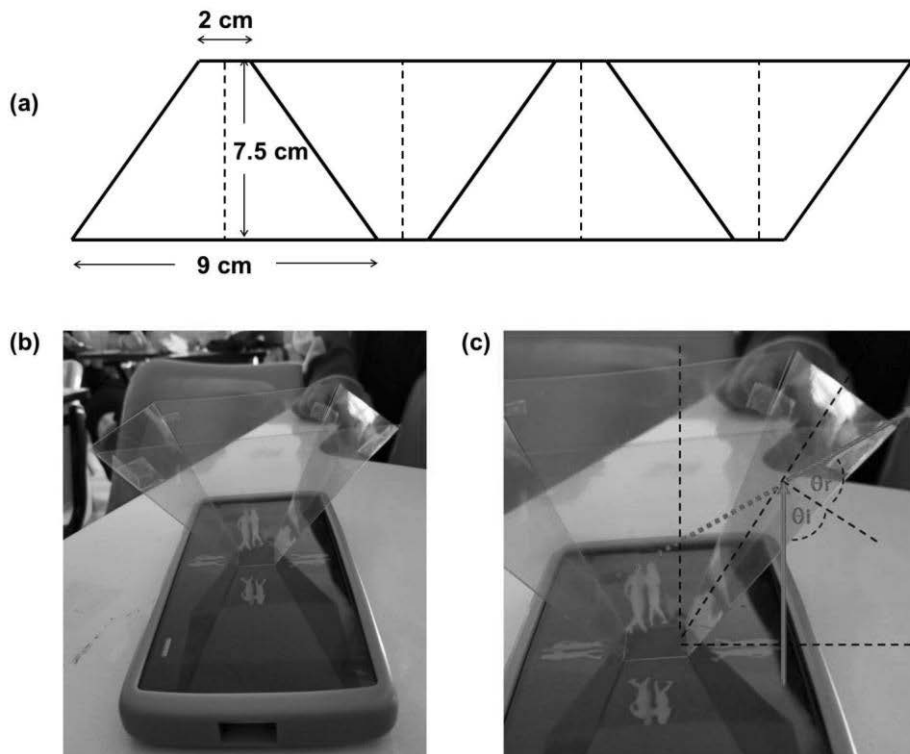
Introduction

Program of General Science, Faculty of Education, Bansomdejchaopraya Rajabhat University is designed and developed under the Royal Thai Ministry of Education as a multifaceted resource to coach the undergraduate students being science teacher or education personnel for their future career path (Thai Law Online, 1995). Students coached within this program are promoted getting used to teaching and learning with low-cost materials but strive toward an understanding of science through hands-on activities (Lancis, Fernández-Alonso, Martínez-León, Tajahuerce, Mínguez-Vega & Zghal, 2014: 92891C). Some activities together with either computer or mobile phone utilities combine a wide range of appropriate multimedia materials such as text, audio, images, animations, video and interactive content in order to provide the integrated learning settings (Martinez & Garaizar, 2014: 40-43), (Ciobanu, Naaji, Dascal & Virag, 2017: 108-118).

The subject matter of this paper relates to implement video clip and interactive screen experiment to demonstrate how to make a pseudo-hologram. We firstly convert our smartphone into a pseudo-hologram projector with a plastic frustum (the portion of a pyramid which remains after its upper part has been cut off) that suction cups to the mobile screen and apply to hologram channel video in YouTube. We further compare the illusions of pseudo-hologram made from the transparent plastic frustum with that from color one to optimize the color and brightness for better contrast. We finally establish our teaching procedure using PowerPoint program as a pseudo-hologram video which enables playing with a set of smartphone and frustum. We envisaged that our work would be a guidance activity not only suited to learning light (reflection and visual perception) through experiment but also attracted the attention of students for other subjects.

Pseudo-Hologram Projector

The protocol how to make a frustum from the useless CD case has been described in detail elsewhere (Anthony, 2016). Nevertheless, we adopted this idea by using the transparent plastic book cover instead of an old CD case to construct the pseudo-hologram projector as shown in Fig. 1. In brief, we draw the four shapes of trapezoid with dimensions: top 2 cm, height 7.5 cm, and base 9 cm on the paper (Fig. 1 (a)), place a plastic cover on, cut them off, and bind four plastic pieces together to form a frustum (Fig. 1 (b)). After we choose a holograph video from YouTube and place the frustum on the smartphone, the video played on our smartphone appears to float in the air and stay inside the frustum (Fig. 1 (b)). This illusion appears according to the law of reflection: angle of incident (θi) = angle of reflection (θr), in other word, the virtual image appears the same distance from the reflective surface as the object actually is (Fig. 1 (c)) (Vishnu, Balamurugan & Tony, 2017: 763-768).

Fig. 1: (a) Sketch of four shapes of trapezoid to make a plastic frustum from the book covers (b) Implement of smartphone and frustum for constructing the pseudo-hologram projector (c) Working principle of pseudo-hologram projector to illustrate the virtual image of the object from light reflection property.
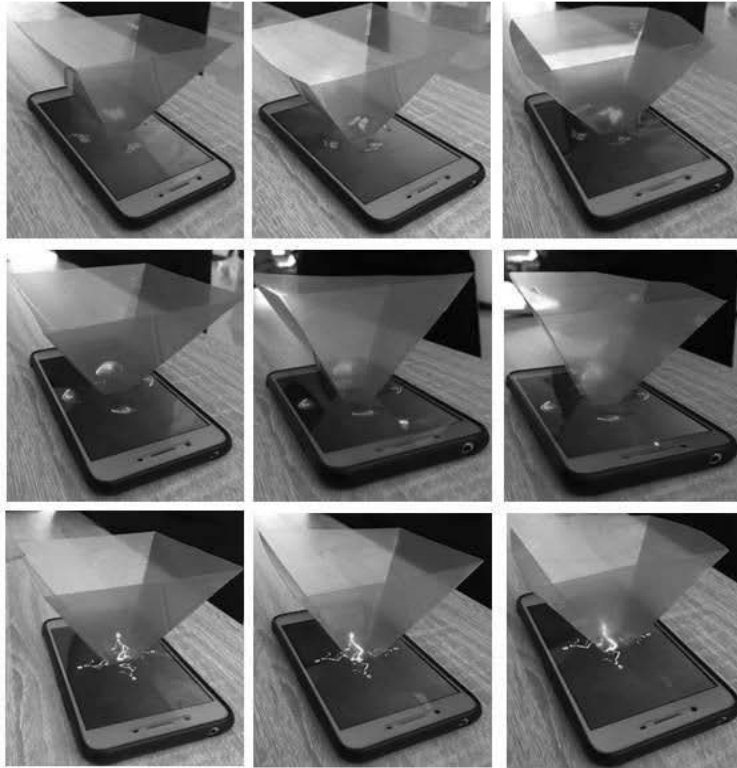
Display Contrast

As the improved experiment, we then consider the display contrast in color and brightness perception to our illusion. A convenient way to investigate this effect is changing the frustum from invisible to color-transparent plastic book covers. Fig. 2 presents our results: the improvement in color contrast occurs when frustum's color is designed to be different from image's color (Fig. 2 (a)) whereas the enhancement in brightness contrast

shows insignificant different when using the mix-color or invisible frustums (Fig. 2 (b)).

Since the difference in appearance of two colors of field seen is responsible for the color contrast, illusion with different color from its background hence provides better contrast (Hurlbert & Wolf, 2004: 145-160). Accordingly, the color frustum is useful to present the holograph illusion with the most color contrast. In addition, we note that our experiment leads quickly to the demonstration in which the light absorption can be ignored when the thickness of color-transparent reflector is very thin (approximately 1 sheet of paper).

Although the color frustum is not suitable for illusion of the same color, it might reduce the visual noise from the room light. To examine this idea, the mixed-color frustum (invisible, red, green, and blue) has been made. Comparing illusions observed from the mixed-color frustum with invisible one, they provide comparable brightness. However, the mixed- color frustum can reduce the reflection of ambient room light.
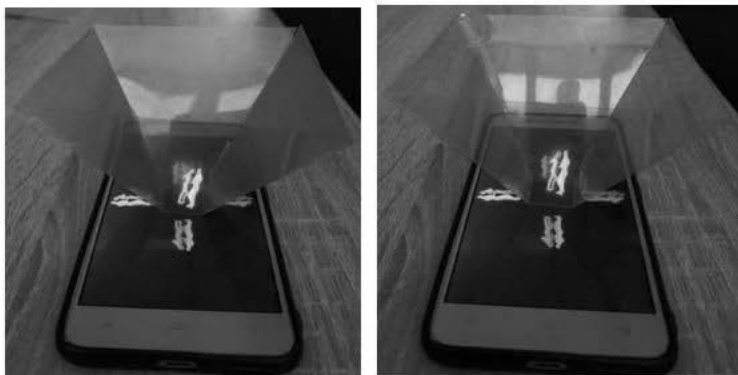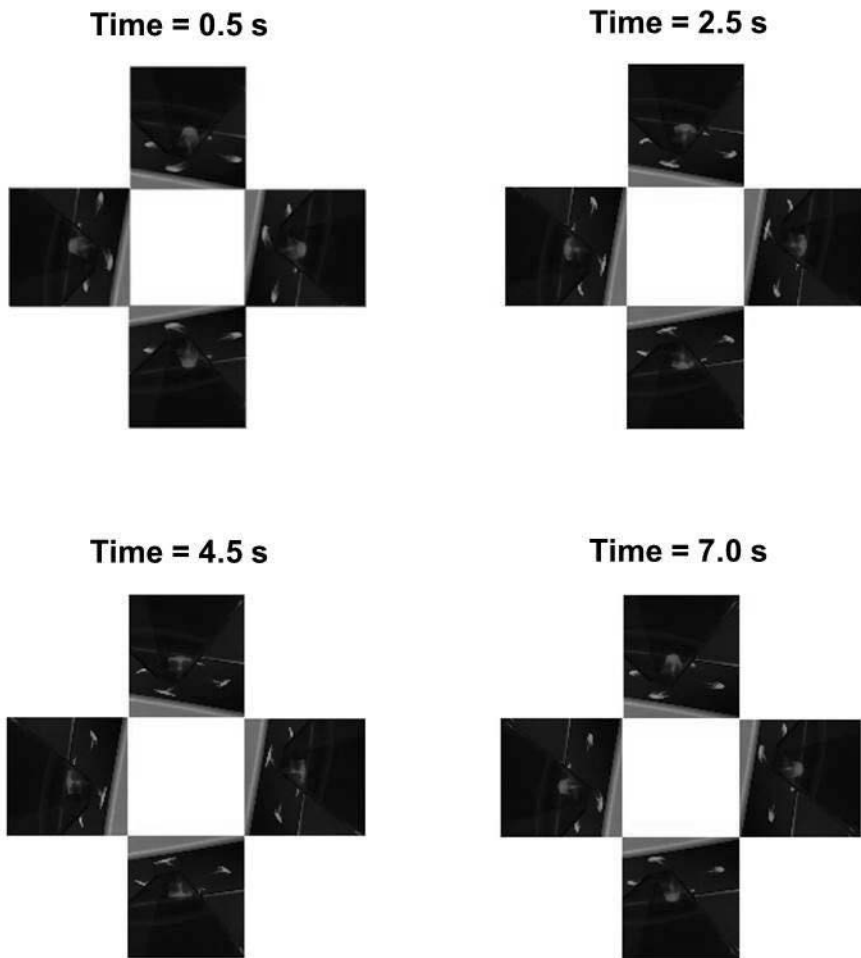
(a) Color contrast

(b) Brightness contrast

Fig. 2: Comparison of display contrast in (a) color and
(b) brightness perception to the illusion.

Pseudo-Hologram Video Teaching

To eliminate the need of using an additional software and also encourage the students to make their own teaching video, we further establish the pseudo-hologram video using PowerPoint as our interactive teaching material. The detail of creating holograph video has been described elsewhere (PowerPoint Spice, 2016). In brief, (i) Insert the video: Insert --> Video --> Video from file --> Choose the interesting video --> Insert, (ii) Select only a specific region: Double click at video --> Crop it, (iii) Produce the three identical videos: Copy and paste for 3 times, (iv) Rotate three videos with the angle difference of 90 degree: Double click --> Rotate right 90, Rotate left 90, Flip vertical, (v) Align all videos in proper position, (vi) Synchronize all videos to start playing at the same time: Select all videos --> Animation --> Animation Pane --> Select trigger 1 choose "Start On Click" --> Select trigger 2 choose "Start With Previous" --> Select trigger 3 choose "Start With Previous" --> Select trigger 4 choose "Start With Previous", and (vii) Playing our holograph videos: Select all videos --> At Re-Order, click arrow up --> Click Play. Fig. 3 presents our demonstration: as shown in the time series of images, all videos is playing at the same time. With this demonstration, student might come up with the idea to link their knowledge to a specific subject: not only to facilitate the understanding of the abstract subject but also to gain more the attention of their future students.

Fig. 3: Time series of images captured from our holograph video which are synchronized to play at the same time.

Conclusion

We have presented the interactive teaching tool through hands-on activities on pseudo-hologram in order to facilitate its potential for boosting the understanding of the abstract subject and also improving the attention of students. These activities are very economical but give the students valuable insight into experimental methods. The first set of papers is to transform the

smartphone into a pseudo-hologram projector with a plastic transparent frustum. The second one is to maximize the color contrast of illusion and reduce the reflection of light noise through the use of color frustum. The final part is to provide a procedure in beginning level for making the teaching video using PowerPoint program.

Acknowledgement

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