Photo Integrated Experience Challenge (PIEC): An Innovative Active Learning Method for Teaching Ophthalmology Residents

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Abstract

Background: Active learning has emerged as a cornerstone in medical education, promoting superior knowledge retention and social-cognitive skills compared to traditional methods. For ophthalmology residents, developing proficiency in interpreting ophthalmic images is paramount, as over 80-90% of ocular diagnoses rely on ophthalmic images from digital slit lamp and other ophthalmic devices. In light of this, we introduce the Photo Integrated Experience Challenge (PIEC), an innovative active learning method that leverages the combined strengths of ophthalmic image diagnosis, personal knowledge and experience sharing. This research aims to evaluate the advantages and effectiveness of PIEC, along with gathering student feedback on its implementation.

Methods: PIEC class is implemented every week throughout an academic year. Each session includes 5-6 residents from first year to third year and lasts for 50 minutes. Initially, first year residents initiate the discussion by sharing their existing knowledge and observations related to pre-assigned eye disease images which are shared on the monitor. Subsequently, second and third year residents expand upon the initial insights, offering additional perspectives and integrating their personal clinical experiences about the disease. Throughout the process, the instructor helps facilitate the discussion, share expert knowledge and experience about the disease from clinical practice, and synthesize key learning points at the session's conclusion. To objectively assess knowledge acquisition, 29 participating residents completed pre- and post-course self-evaluations on each covered topic. Additionally, we employed a feedback questionnaire to evaluate student experiences and perceptions of PIEC.

Results: This research found a statistically significant increase in residents' self-reported knowledge acquisition, as evidenced by a jump in mean scores from 52.70% to 82.60% between the pre- and post-course evaluations ($p < 0.05$). This improvement was particularly pronounced in the areas of disease investigation (40.96% gain) and treatment (37.02% gain). Qualitative feedback revealed that the PIEC method fostered deeper understanding, engagement, and critical thinking. Residents reported the method being fun, easy to prepare for, and less stressful than traditional lecture-based instruction. Additionally, they felt increased confidence in communication and knowledge integration.

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Conclusion: PIEC effectively enhances ophthalmology residents' critical thinking, communication skills as well as knowledge integration with clinical experience, suggesting its potential as a valuable active learning tool in medical education.
Conflicts of Interest: Authors have no conflict of interest.
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Introduction

Traditionally, medical education relied heavily on passive learning methods, such as lectures and textbooks, where students primarily act as recipients of information.[1] However, research suggests that active learning approaches, which encourage student participation and engagement, lead to superior knowledge retention, deeper understanding, and improved social-cognitive skills compared to passive methods.[2-4] Edgar Dale's Cone of Experience (Learning Pyramid) visually represents this concept.[5] The pyramid positions passive methods like lectures and reading at the bottom, suggesting lower knowledge retention. Conversely, active methods like discussions and teaching others occupy the upper tiers, indicating progressively greater knowledge retention.

In the field of ophthalmology, accurate interpretation of visual information like fundus photographs and scans is crucial for diagnosis and treatment,[6] as over 80-90% of diagnoses rely on images obtained from digital slit lamps and other devices. Active learning methods can be particularly beneficial in fostering these skills, as they encourage students to actively engage with visual information and develop their image interpretation abilities.

This article introduces the Photo Integrated Experience Challenge (PIEC), an innovative active learning method designed specifically for ophthalmology resident education. PIEC leverages the combined strengths of ophthalmic image recognition and personal experience sharing to promote deeper understanding, critical thinking, and communication skills. We present the results of a study evaluating the effectiveness of PIEC and gathering student feedback on its implementation.

Methods

Study Design and Participants: This was a single-center, prospective study involving 29 ophthalmology residents from Department of Ophthalmology, Thammasat University, Thailand.

PIEC Implementation: The PIEC sessions were implemented weekly throughout the academic year. The program employed a small group format, with each session involving 5-6 residents from the first to third year of residency. An interactive session which lasts for 50 minutes, focusing on a specific ophthalmic topic was carefully chosen to be relevant to the participating residents' level of training and clinical practice. An experienced ophthalmologist selected pre-assigned ophthalmic images for each session, ensuring they effectively represented the chosen topic and offered valuable diagnostic information. Examples of the covered topics are presented in Table 1. The sessions adhered to a well-structured format designed to maximize resident engagement and learning (Figure 1).

1. Junior Resident Presentation (10 minutes): A first-year resident initiated the discussion by presenting their existing knowledge and observations related to the pre-assigned image. This initial presentation encouraged residents to actively review the image beforehand, drawing upon their foundation knowledge and stimulating critical thinking. Residents were expected to describe the anatomical structures depicted in the image, identify any pathological findings, discuss relevant scientific concepts, and propose potential diagnoses based on their understanding.

2. Peer Discussion and Knowledge Integration (30 minutes): Second- and third-year residents built upon the initial presentation by offering additional insights, drawing from their personal clinical experiences and relevant medical literature. This could involve sharing similar cases they had encountered, discussing alternative diagnoses, and exploring the management implications of the presented case.

3. Expert Facilitation and Summary (10 minutes): The designated instructor, an experienced ophthalmologist, played a crucial role in facilitating the discussion, ensuring all residents had the opportunity to contribute and ensuring effective knowledge exchange. The instructor addressed any misconceptions presented during the resident discussions, providing expert insights and clarifications based on their extensive clinical experience and current medical knowledge. Additionally, the instructor summarized the key learning points from the entire discussion, solidifying the residents' understanding of the presented topic and ensuring all residents acquired a comprehensive and accurate understanding of the covered concepts. (Figure 2)

Table 1: Examples of covered topic in PIEC

Vernal keratoconjunctivitis	Allergic conjunctivitis	Congenital Ptosis
Approach to leukocoria	Retinoblastoma	Retinopathy of prematurity
Congenital glaucoma	Congenital cataract	Persistent fetal vasculature
Congenital optic nerve abnormalities	Morning glory syndrome	Nasolacrimal duct obstruction
Dacryocele	Phacomatosis	Ocular toxoplasmosis
Ocular toxocariasis	Ophthalmia neonatorum	Coloboma
Pediatric refraction	Retarding progression of myopia	Infantile ET
Congenital anterior segment anomaly	Congenital posterior segment anomaly	Public eye health
Amblyopia	Color deficiency	Nystagmus
Pediatric refractive error	Visual development	Pediatric uveitis

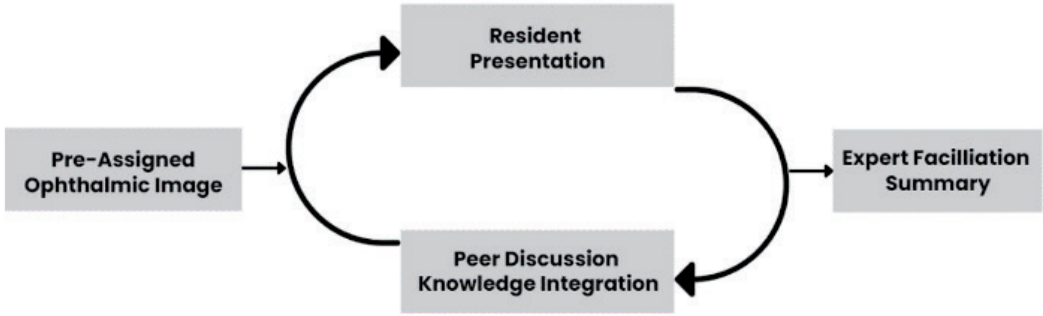

Figure 1: PIEC Implementation Framework

Figure 2: PIEC session environment

Evaluation: To objectively assess knowledge acquisition, all participating residents completed pre- and post-course self-evaluations. The questionnaire, as shown in Figure 3, utilized a 5-point Likert scale to assess residents' self-reported knowledge in each covered topic. Residents were asked to rate their level of agreement with the statement "I am confident in my knowledge of..." for each topic in terms of natural course of disease, clinical findings, investigations, differential diagnosis, treatment and prognosis, with response options ranging from 1 (strongly disagree) to 5 (strongly agree). This approach allowed researchers to quantify residents' perceived knowledge before and after participating in the PIEC program.

Additionally, a qualitative feedback questionnaire was employed to evaluate student experiences and perceptions of PIEC. The feedback questionnaire utilized open-ended questions to gather residents' opinions on the effectiveness, engagement, and overall value of PIEC, including aspects such as the clarity of the learning objectives, the appropriateness of the chosen images, and the overall facilitation of the sessions.

Throughout the PIEC sessions, instructors also evaluate residents' participation in discussions, their ability to analyze the presented images, and their application of knowledge to clinical scenarios appropriate to their level of training. Then, instant feedback was provided at the end of the session.

Please rate yourself from 1 (strongly disagree) to 5 (strongly agree) according to the statement "I am confident in my knowledge of..." in each topic.

Topics	Topic 1	Topic 2
Natural course of disease		
Clinical Findings		
Investigations		
Differential diagnosis		
Treatment		
Prognosis		

Figure 3: Pre - post course self-evaluating questionnaire in each covered topic

Statistical Analysis: Pre- and post-course self-evaluation scores from 1 (least known) to 5 (best known) were compared using paired t-tests to determine statistically significant differences in knowledge acquisition. Statistical significance was set to p-value <0.05. Qualitative data from the feedback questionnaire was analyzed to identify recurring themes and patterns.

Results

Knowledge Acquisition: Our analysis revealed a clear improvement in residents' knowledge acquisition after participating in the PIEC program. Their self-reported knowledge scores, measured on a 5-point scale, jumped from an average of 52.70% to 82.60% following the program ($p < 0.05$). This 29.9% increase with a statistically significant p-value (less than 0.05) demonstrates a substantial positive impact of PIEC on knowledge acquisition. This suggests that PIEC effectively facilitated learning and knowledge acquisition of the covered ophthalmic topics for the ophthalmology residents (Table 2). Knowledge gain in each aspect of covered topics is listed in Table 3. This improvement was particularly pronounced in the areas of disease investigation (40.96% gain) and treatment (37.02% gain).

Table 2: Results of self-course evaluation utilizing Likert scale on knowledge confidence of covered topics in PIEC sessions.

	Pre-course evaluation	*Post-course evaluation*	*t*	*p-value*
Knowledge confidence of covered topics in percent (Means ± SD)	52.70 ± 13.26	82.60 ± 6.34	9.73	0.000002*

*p < 0.05

Table 3: Knowledge gain in each aspect of covered topics

Aspects of Disease	**Mean Knowledge Gain (%)**
Natural course of disease	36.07
Clinical Findings	35.05
Investigations	41.0
Differential diagnosis	36.1
Treatment	37.0
Prognosis	33.8

Qualitative Feedback: Analysis of the qualitative feedback questionnaire revealed positive results as following:

Deeper understanding: Residents reported that PIEC fostered a significantly deeper understanding of the presented topics compared to traditional lectures. They appreciated the opportunity to actively engage with the image, discuss it with peers, and explore various perspectives. This went beyond rote memorization, allowing them to grasp the nuances of the condition and its underlying mechanisms.

Increased engagement: Residents highly valued the interactive nature of PIEC, which kept them engaged and motivated throughout the sessions. They enjoyed the collaborative learning environment and the opportunity to learn from both their peers and the instructor.

Improved critical thinking and problem-solving: Residents felt that PIEC encouraged critical thinking and problem-solving skills as they analyzed the images, discussed various diagnoses, and explored potential management strategies. This active learning approach helped them develop the skills necessary to approach complex clinical scenarios effectively.

Enhanced communication skills: Residents reported increased confidence in their communication skills due to PIEC. The discussions fostered clear and concise communication as they presented their findings, shared their experiences, and interacted with their peers and the instructor.

Discussion

The findings of this study suggest that PIEC is an effective and valuable active learning method for ophthalmology resident education. The statistically significant improvement in knowledge acquisition demonstrates its ability to enhance residents' understanding of key ophthalmic concepts. Additionally, the positive qualitative feedback highlights the various benefits of PIEC, including its ability to promote deeper understanding, increase engagement, and foster critical thinking, problem-solving, and communication skills.

PIEC's unique combination of ophthalmic image recognition, personal experience sharing, and facilitated discussion creates a dynamic learning environment that encourages residents to actively engage with the material, collaborate with their peers, and apply their knowledge to clinical practice.

Conclusion

This study demonstrates that the Photo Integrated Experience Challenge (PIEC) is an effective and well-received active learning method for teaching ophthalmology residents. PIEC not only significantly improves knowledge acquisition but also fosters deeper understanding, engagement, critical thinking, and communication skills. These findings suggest that PIEC has the potential to be a valuable tool in enhancing the overall quality of ophthalmology resident education.

Acknowledgements and conflict of interest

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