Digital Problem-Based Learning: An Innovative and Efficient Method of Teaching Medicine

Khaylen Mistry[1], Natasha Casie Chetty[2], Puran Gurung[2] and Nick J Levell[1,2]

[1]Norwich Medical School, University of East Anglia, Norwich, UK. [2]Department of Dermatology, Norfolk and Norwich University Hospital, Norwich, UK.

ABSTRACT

BACKGROUND: The breadth of knowledge assimilated by undergraduates is substantial. Time must be utilised to impart knowledge and skills to ensure optimal training. Dermatology comprises a large portion of work in primary care; yet UK undergraduate dermatology training is short. Digital problem-based learning (PBL) is an innovative teaching method incorporating clinical images into intense, interactive teaching sessions.

AIM: To determine the efficacy of digital PBL sessions in teaching UK medical students during their dermatology module.

METHODS: In total, 59 second-year medical students at Norwich Medical School during their dermatology secondary care attachment completed two 2.5-h digital PBL sessions. One session was focused on lesions and the second on inflammatory diseases. During each session, students assessed 60 clinical cases each comprising an image with a brief history. In small groups, students discussed the cases, described the images, and agreed a diagnosis followed by a group discussion with the supervising clinician who provided feedback. Following each session, students completed a feedback questionnaire.

RESULTS: In total, 117 sets of feedback were received; 60% of students considered they learnt a great amount in a short time. The majority of students reported feeling more confident to make a dermatological diagnosis and more motivated in clinics as a result of the digital PBL; 64% of students found digital PBL more useful than real patient clinics. The most frequent negative comment was that 2.5 h was too long to concentrate.

CONCLUSIONS: Digital PBL was a popular, effective, and efficient teaching method. Digital PBL sessions should be introduced alongside clinics and other teaching methods for undergraduates.

KEYWORDS: dermatology, undergraduate, teaching, problem-based learning

Introduction

Undergraduate medical training typically occurs over a period of 5-6 years after which graduates are expected to competently diagnose and manage an array of conditions.

Dermatology encompasses over 2000 diagnoses.[1] While medical students do not require detailed knowledge of rarities, they must be able to diagnose common skin, hair, and nail diseases. Most diagnosis in dermatology is clinical, based on the history and examination. Acquisition of diagnostic skills is an essential learning outcome in the undergraduate dermatology curriculum.[2] This facilitates appropriate management of the patient and an understanding of when to refer to secondary care.

Most UK undergraduates will become general practitioners, and approximately 90% of dermatology is managed in general practice.[3] As the UK dermatology attachment can be as short as 3 to 14 days,[4] time must be utilised to impart knowledge and skills to meet key outcomes defined in the Dermatology Undergraduate Medical Curriculum.[5] This need must be balanced with the service commitments and workforce shortages in UK dermatology departments, a problem shared by most countries.[6] Educators must develop new teaching methods that maximise teaching impact within limited time.

A 2009 audit identified that most medical schools in the United Kingdom used problem-based learning (PBL).[7] In PBL, pre-set scenarios are discussed by students in small groups. Students use their knowledge and seek out resources to answer specific questions. The supervising facilitator encourages appropriate student behaviour to solve problems. Medical students, as adult learners, can be encouraged to learn by exposure to real or simulated experiences that raise awareness of the 'need to know'.[8]

The utilisation of digital images is widespread in many medical schools mostly in the form of lectures.[9] The Dermatology Department at Norfolk and Norwich University Hospital (NNUH) introduced an innovative way of teaching medical students during their dermatology attachment. We have incorporated clinical images into intense, interactive, PBL sessions, named Digital PBL.

The standard method of teaching diagnostic skills to students was exposure in outpatients; however, this is limited by which conditions happen to present in outpatients during a time-limited student attachment. This was reflected in the student annual evaluation feedback comments. The aim of this digital PBL was to maximise exposure to clinical scenarios to develop diagnostic skills, making maximum use of the limited time available for training and limited availability of dermatology doctors.

Methods

In Norwich Medical School, there is an integrated curriculum with clinical exposure in all 5 years. PBL forms a central part of this curriculum; therefore, the students were already familiar with the concepts and practice of PBL. The Norwich Medical School student cohort is split between three hospitals for two secondary care teaching weeks of a 6-week dermatology attachment. Digital PBL was piloted for 1 year with students based at one hospital, NNUH, with a view to extending the teaching to students at the other two hospitals if the feedback was favourable.

Digital PBL was implemented as extra teaching sessions during the 2-week secondary care period. The secondary care attachment already included three to four outpatient clinics, two structured patient-teaching sessions, ward teaching, and one to two surgical sessions. All students attended a half-day teaching session on describing dermatology signs at the beginning of their attachment, meaning that students were familiar with the terminology used to describe skin disease.

The remaining 4 weeks of dermatology undergraduate teaching included seminars on basic science and common skin diseases, primary care teaching and conventional, case-study-based PBL sessions. One of these 4 weeks occurred prior to the digital PBL sessions and covered basic skin anatomy, histology, immunology, eczema, psoriasis, and skin infections. In the pilot period, 59 second-year students undertook their secondary care placement at NNUH divided into six groups of 8 to 12 students.

Two 2.5-h Digital PBL sessions were delivered to each group by a dermatology specialist trainee doctor with a Postgraduate Certificate in Healthcare Education and familiar with PBL. The first session was on lesions, particularly skin cancers. The second session was on inflammatory skin diseases and rashes.

To begin each session, students were given a prompt sheet with a brief description of the diseases to be discussed. It comprised key features in the history and examination which should direct the student towards a correct diagnosis. The students then divided themselves into groups of two or three. The format of the session was explained, with reassurance that full participation but no prior in-depth knowledge was needed but rather seminar, clinic, and other teaching experiences should be shared among the group to build upon the collective scaffold of

the groups' initial understanding. This highlighted areas students understood and the gaps in their knowledge requiring further discussion. Groups were provided with laminated images, each with short stems on the reverse which briefly outlined the history of the presenting complaint. All images were of selected patients seen at NNUH who had given consent for their photographs to be used for teaching.

The students were given 15-20 min to review 15-20 clinical images. Most students saw the majority of images, depending on their pace of work. At the end of the 20 min, facilitated by the tutor, each case was discussed. Each student presented approximately two cases. During discussion, the students presented the examination findings and shared their thoughts on the diagnosis or differential diagnosis with the group. Accurate dermatological terminology was encouraged. Students were given feedback in a non-critical and supportive learning environment. Key features from each image were highlighted and clues in the clinical stem that helped establish the diagnosis were discussed. While the focus was on diagnosis, there was a brief discussion of further management and progress of most patients.

The session (Figure 1) was divided into three sections of 40-45 min with a 5-10-min break in between. Students who had encountered patients with these conditions in clinics were encouraged to share their experience during the discussion. The discussion also allowed spot diagnoses to be made from additional PowerPoint images of the diseases, based on repetition of key features that were previously encountered. Each session incorporated around 40-60 clinical cases with each student presenting 5-6 patients.

Anonymous questionnaires were given to all medical students receiving digital PBL. These were completed by students at the end of the session.

Results

A total of 117 anonymised sets of feedback were received with a 99% response rate (Figure 2). Most students found the teaching method useful, effective, motivating, and more beneficial over real clinics.

The most frequent negative comment was that 2.5 h was too long to concentrate, while at the same time, acknowledging that it was a useful session.

The separate University of East Anglia MBBS annual evaluation showed that 79% of the 42 students, who answered the student satisfaction questionnaire after completing the whole dermatology module at NNUH, were completely or very satisfied. By comparison, 51% were completely or very satisfied in the year before the introduction of digital PBL.

Digital PBL was mentioned in 18 out of 32 free text comments about the most useful aspects of the attachment, suggesting that the improvement in satisfaction can be attributed to the introduction of digital PBL. Some examples of the comments are shown in Figure 3.
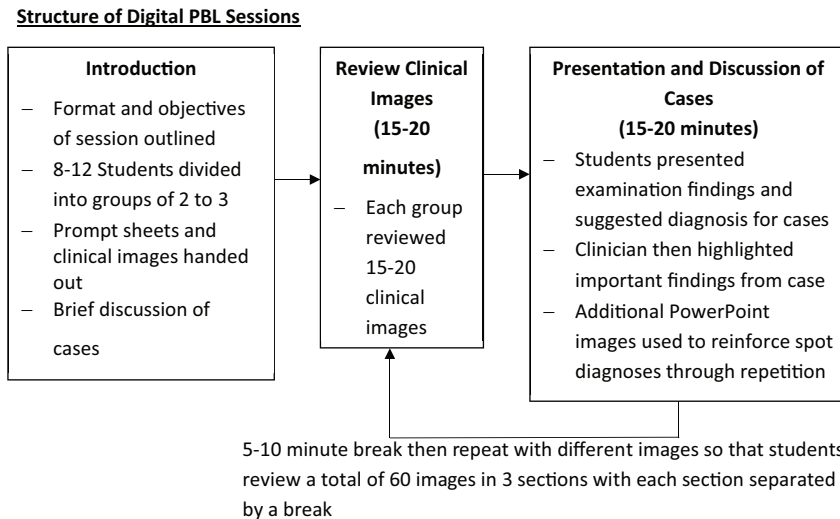
Structure of Digital PBL Sessions

Introduction	Review Clinical Images (15-20 minutes)	Presentation and Discussion of Cases (15-20 minutes)
– Format and objectives of session outlined – 8-12 Students divided into groups of 2 to 3 – Prompt sheets and clinical images handed out – Brief discussion of cases	– Each group reviewed 15-20 clinical images	– Students presented examination findings and suggested diagnosis for cases – Clinician then highlighted important findings from case – Additional PowerPoint images used to reinforce spot diagnoses through repetition

5-10 minute break then repeat with different images so that students review a total of 60 images in 3 sections with each section separated by a break

Figure 1. Structure of digital PBL sessions – 59 students from Norwich Medical School were divided into six groups of 8-12. Each group had prior teaching on describing rashes and then underwent two digital PBL sessions on lesions and inflammatory diseases. PBL indicates problem-based learning.

Following the positive feedback, the teaching method was introduced in the following year at the other two hospitals which provide undergraduate dermatology education for Norwich Medical School.

Discussion

Digital PBL was shown to be a popular, effective, and useful teaching method. Student feedback showed there was clear relevance of the teaching to the students' future practice. Key curriculum objectives were addressed, in particular the ability to examine the skin and describe physical signs to reach a diagnosis.

The style of teaching placed the student in the position of the clinician faced with a diagnostic problem. During the session, the students were gradually equipped with the knowledge needed to make the diagnosis. By repetition of the diagnoses and exposure to phenotypic variations, as encountered in clinical practice, the students developed confidence in their own diagnostic capability. The opportunity to discuss and reflect upon their observations with an experienced clinician allowed for these encounters to be shared within the group and cemented in the students' minds.

Compared with the clinic setting, the students had exposure to a sixfold greater number of cases within a similar time period. The material was pre-selected and hence not opportunistic and variable in its relevance for the student. The students were active throughout the session, rather than being passive observers. The inclusion of dermoscopic images where relevant allowed the students to view and interpret dermoscopic signs, regarded as essential in the assessment of most cutaneous lesions. The digital PBL teaching allowed effective use of the clinician's time. Although the clinician was taken out of the clinic setting, more students were taught within the dedicated time. After the initial extensive preparatory work,

the materials were subsequently delivered to successive groups of students.

The most frequent criticism was that 2.5 h was too long to concentrate. One can surmise that since students often sit as observers in clinic for a longer time period, it was the intensity of work that students found challenging. This intensity is compatible with clinical practice, as a dermatology consultant, supervising several doctors, one may see 40-60 patients in a 4 h clinic session as do clinicians in other specialities. Training in the ability to concentrate and focus may therefore be useful for those entering medical practice. Furthermore, given the short duration of dermatology clinical attachments, this intensity of teaching helps impart the knowledge, skills, and competencies with which future generation of doctors should be equipped.

A limitation to this method of teaching compared with real patient encounters was the lack of opportunity for palpation. The teaching method was devised to target diagnostic skills and not other generic skills such as history taking or manual examination. The specific aims must be outlined to the student at the outset so that there is a shared understanding of the session objectives.

The feedback showed increased confidence in diagnostic skills; nevertheless, two 2.5-h sessions can only serve as an introduction. Although the questionnaire used immediately after the teaching session was not formally validated, the annual evaluation of student satisfaction used by the Norwich Medical School has been in place since the course began in 2002 and is used by the university as a key outcome for comparison between and within departments. Digital PBL was integrated alongside other teaching methods and students stated that the session motivated them to learn. Other clinicians observed that this was translated into greater enthusiasm in the clinic to maximise the real patient encounters and encourage further self-directed learning.
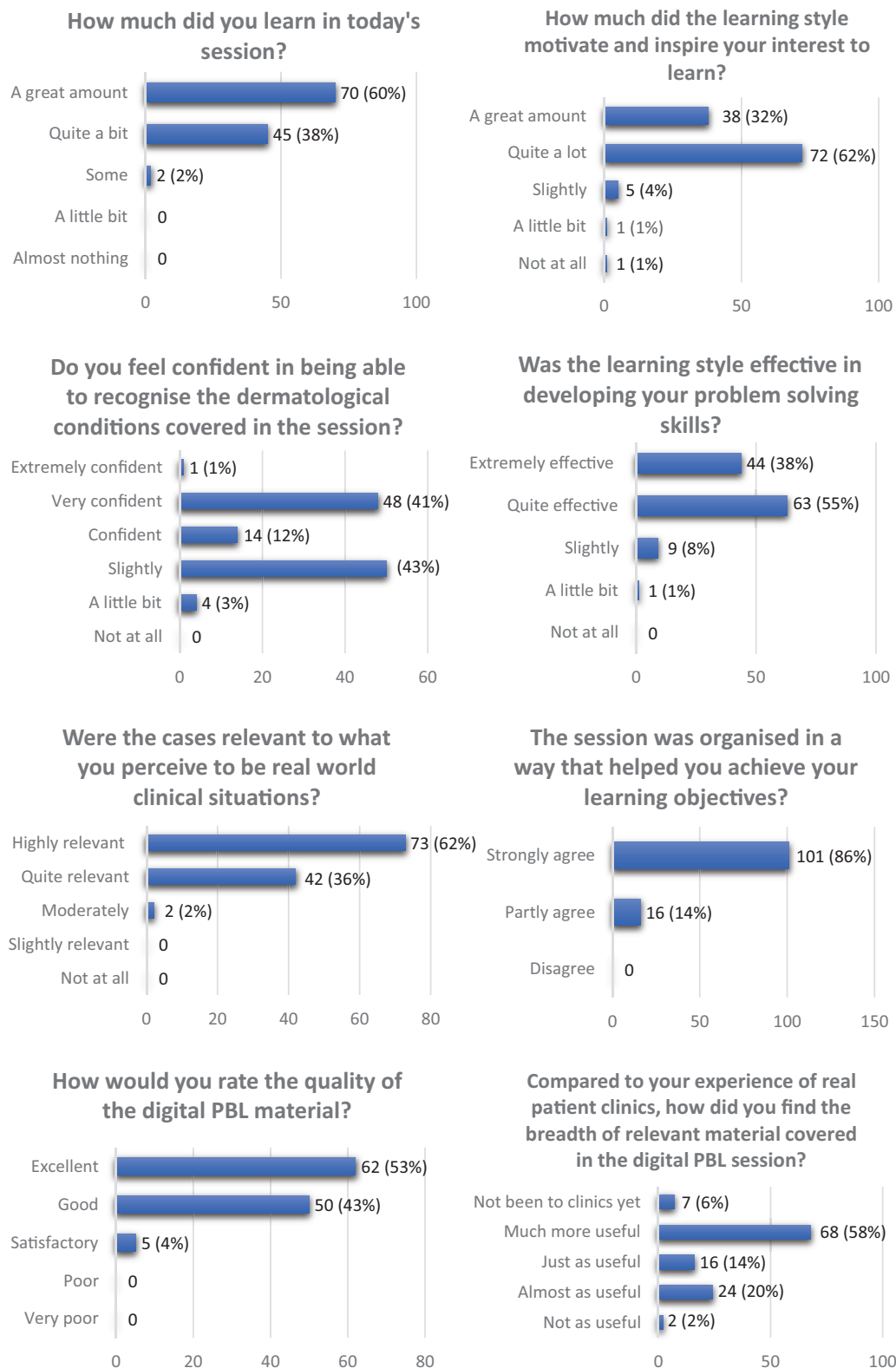
How much did you learn in today's session?

A great amount	70 (60%)
Quite a bit	45 (38%)
Some	2 (2%)
A little bit	0
Almost nothing	0

How much did the learning style motivate and inspire your interest to learn?

A great amount	38 (32%)
Quite a lot	72 (62%)
Slightly	5 (4%)
A little bit	1 (1%)
Not at all	1 (1%)

Do you feel confident in being able to recognise the dermatological conditions covered in the session?

Extremely confident	1 (1%)
Very confident	48 (41%)
Confident	14 (12%)
Slightly	(43%)
A little bit	4 (3%)
Not at all	0

Was the learning style effective in developing your problem solving skills?

Extremely effective	44 (38%)
Quite effective	63 (55%)
Slightly	9 (8%)
A little bit	1 (1%)
Not at all	0

Were the cases relevant to what you perceive to be real world clinical situations?

Highly relevant	73 (62%)
Quite relevant	42 (36%)
Moderately	2 (2%)
Slightly relevant	0
Not at all	0

The session was organised in a way that helped you achieve your learning objectives?

Strongly agree	101 (86%)
Partly agree	16 (14%)
Disagree	0

How would you rate the quality of the digital PBL material?

Excellent	62 (53%)
Good	50 (43%)
Satisfactory	5 (4%)
Poor	0
Very poor	0

Compared to your experience of real patient clinics, how did you find the breadth of relevant material covered in the digital PBL session?

Not been to clinics yet	7 (6%)
Much more useful	68 (58%)
Just as useful	16 (14%)
Almost as useful	24 (20%)
Not as useful	2 (2%)

Figure 2. Student feedback from digital PBL sessions – summary of student responses on feedback forms completed following the digital PBL sessions. PBL indicates problem-based learning.

The digital PBL was developed specifically for students who had almost no prior exposure to dermatology. However, there is potential to modify the cases presented based on the learners' prior knowledge, experience, and learning needs.

Dermatology is ideally suited to this method of teaching where there is little requirement for recourse to investigations. This method has potential applicability to dermatology teaching for postgraduates and nursing, or paramedic
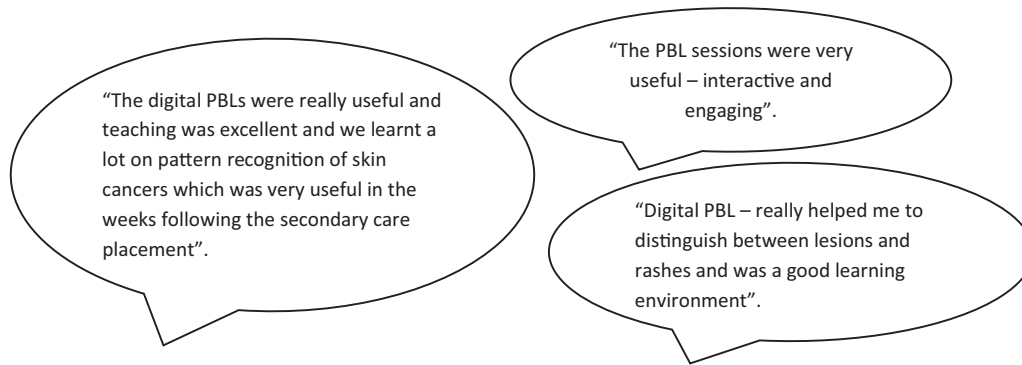
Figure 3. Student comments following digital PBL session. PBL indicates problem-based learning.

students. Other institutions should consider incorporating this method of teaching into their dermatology undergraduate modules.

The appeal to medical students of this high-intensity clinical scenario-based learning was clear. Similar supervised case-based learning with laboratory data or radiology images on multiple cases could be applied to other specialties. This training helps students to prepare for the pressures of clinical work where rapid assessments and decision-making is a particular challenge in early medical careers.

Author Contributions

NJL, NCC and PG contributed to the study concept, design, coordination and collection of data. KM and NCC analysed and interpreted the data. KM wrote the first draft. NJL edited the manuscript. KM and NJL revised the manuscript. All authors reviewed and approved the final manuscript.

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