

## TEACHING MICROSCOPY EFFECTIVELY THROUGH A COMBINED PEYTON'S FOUR-STEP APPROACH AND GAGNE'S INSTRUCTIONAL MODEL

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### ABSTRACT

**Objective:** To design a lesson plan for teaching microscopy using a combined Peyton's and Gagne's model.

**Study Design:** Qualitative study with scoping review

**Place and Duration of Study:** Khyber Medical University, Peshawar from April-September 2017

**Material and Methods:** We searched Pub Med through a variety of search strategies. The purpose of the search was to identify relevant articles (using an inclusion and exclusion criteria) on making a lesson plan for a psychomotor skill. After selection of articles, the evidence was synthesized including author's name, year of publication, country, key findings, model used to make a lesson plan and limitations of the study. From the synthesised evidence, a lesson plan was designed on microscopy. This is a qualitative study with scoping review, therefore, no quantitative analysis or software was used.

**Results:** In total, 130 articles were identified but after screening and assessment for eligibility five articles were selected. The synthesized evidence suggested that four articles had used Gagne's model, while one article had used a combined Gagne's and Peyton's model to design a lesson plan to teach psychomotor skills. We used the combined model to design a lesson plan for pathology students on microscopy. The microscopy skill was broken down into different parts and each learning step was integrated into the nine events of Gagne's model. The Peyton's model was combined to teach the actual microscopy skill for better learning and executing the skill.

**Conclusion:** The model combined Gagne's and Peyton's model, which was used to design an effective lesson plan to teach microscopy. This model could also help in delivering better teaching sessions for other psychomotor skills.

**Keywords:** Educational Models, Learning, Microscopy, Pathology, Peyton.

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### INTRODUCTION

Microscopy is at the core of pathology teaching and learning<sup>1,2</sup>. Developing the skills of microscopy is an essential skill that is required to be mastered by undergraduate medical students, medical laboratory technology students, microbiology students and post-graduate residents in pathology during training. Tissue based diagnosis from surgical specimens is still the gold standard in diagnostic pathology<sup>3</sup>. Microscopy is the most reliable method in tissue based diagnostic practice with high sensitivity and specificity<sup>4,5</sup>.

Microscopy can be performed using different

platform such as compound microscopes, fluorescent microscopes and multi-head microscopes. This is the usual practice in all pathology laboratories. However, virtual microscopy is also used in the diagnostic work-up of surgical specimens<sup>6,7</sup>. Virtual microscopy has also been used as a research tool<sup>8</sup>. In addition, it has been used in learning and in assessment strategies of pathology<sup>6,9</sup>. However, the use of microscopes in pathology laboratories (both diagnostic and research) is still regarded as a gold standard tool due to its easy handling and the ease of interpretation.

Evidence from literature exists whereby lesson plans have been made for psychomotor skills<sup>10,11</sup>. However, there is limited data on designing a lesson plan for teaching of microscopy. In addition, focused reviews on the

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Received: 08 Dec 2017; revised received: 14 Dec 2017; accepted: 15 Dec 2017

available evidence on using instructional models for making lesson plans are also limited. The current study is designed as a qualitative study with scoping review<sup>12,13</sup> to help in designing a lesson plan for microscopy using Gagne's nine events of instruction<sup>14,15</sup> and Peyton's four-step approach<sup>16,17</sup>. Gagne's nine events instruction model is a series of nine steps that helps in making an effective lesson plan for better teaching and learning. Peyton's model is a series of four steps (demonstration, deconstruction, explanation and performance) for teaching psychomotor skills.

Gagne's nine event instructional model can be used to teach psychomotor skills<sup>18,19</sup> such as microscopy. It has also been used in teaching slit lamp examination<sup>19</sup> and phlebotomy<sup>20</sup>. Moreover, Peyton's four step approach has been used<sup>21</sup> in teaching skills. The objective of the study is to design a lesson plan for teaching microscopy using a combined Peyton's and Gagne's model.

## **MATERIAL AND METHODS**

The study was conducted at Khyber Medical University, Peshawar from April 2017 to September 2017. The current study was a qualitative study with scoping review. We searched PubMed through a variety of search strategies using different search terms (table-I). The search terms used were "Gagne\*", "Peyton\*", "Lesson\*", "Skill\*", "Medic\*", "Education\*", Learning\*, Learn\*.

The purpose of the search was to identify the most relevant articles on making a lesson plan for a psychomotor skill. The inclusion criteria was any article which had used Gagne's nine events model and/or Peyton's four step approach for making a lesson plan for a psychomotor skill in medical education.

The identification and final inclusion of articles was planned to be divided into five steps, including: applying search strategies, identification, screening, assessment for eligibility and final selection of articles. In addition, an exclusion criteria (articles that were not from medical education, articles with assessment of a

procedural skill in an analytical study and articles in language other than English) was applied for the final selection of articles.

Afterwards, the evidence from these included articles was synthesized on a variety of parameters including: author's name; year of publication; country of publication; key findings in the article; model used to make a lesson plan; and limitation of the study.

Finally, from the synthesised evidence a lesson plan was designed on microscopy as a psychomotor skill. Each step of the lesson plan was linked with educational theories and diverse learning styles<sup>22</sup>.

This is a qualitative study with scoping review, therefore, no quantitative analysis or software was used. The study was approved by the Ethics Board of Khyber Medical University.

## **RESULTS**

After applying search strategies, a total of 130 articles were identified. The titles and abstracts of all papers were read and screened for eligibility and the inclusion and exclusion criteria were applied. Five articles were included for the scoping review and full text of these articles were read. Details of search strategy are given in table-I.

The synthesized evidence suggested that four articles had used Gagne's nine events of instruction to design a lesson plan to teach psychomotor skills (bone marrow aspiration, chest x-ray interpretation, ascitic drain and phlebotomy). While one article had used a combined Gagne's and Peyton's model for making a lesson plan on slit lamp examination in ophthalmology. Evidence from these articles was synthesized as shown in table-II.

The main limitation of the included articles was lack of discussion around linkage of Gagne's model with educational theories and/or diverse learning styles.

We used the combined model of Ng et al<sup>19</sup> from scoping review as a theoretical framework to make a lesson plan for pathology students on

microscopy. Following is a description of the lesson plan. The microscopy skills are basically psychomotor skills and it will be the focus of this paper.

The students are encouraged to revise the following areas prior to the microscopy session:

- Basic structure of a microscope.
- The structures of epithelium, basement membrane, stroma, muscles, nerves and vessels.

Know some of the common histology (e.g., normal colon) and histopathology (e.g., colon carcinoma).

This would enable the students to learn the psychomotor skill of microscopy more effectively.

- i. ‘Can you measure the size of an intestinal villous under the microscope’?
- ii. ‘Is it possible to identify tumour cells invading a vessel under the microscope’?
- Display a video of a pathology laboratory where pathologists are using microscope in real-time situation.

**Informing learners of Objectives**

It is important to clarify the learning objectives at the early stage of learning process. This will ensure that aim of the session and the aim of the students is aligned. Notably, the objectives should be clear, realistic, measurable and achievable as this would make the lesson more intriguing. The objectives are:

The students upon completion of this session

**Tables-I: Search strategy used for identification, screening and inclusion of relevant articles.**

Search Strategy	Number of Article Retrieved
Search (((Peyton*) AND Skill*)) AND Lesson* Sort by: Title	1
Search (Peyton*) AND Skill* Sort by: Title	20
Search (((Gagne*) AND Skill*)) AND Medic*) AND Education* Sort by: Title	8
Search (((Gagne*) AND Skill*)) AND Peyton* Sort by: Title	1
Search (((Gagne*) AND Skill*)) AND Learning* Sort by: Title	18
Search (((Gagne*) AND Skill*)) AND Learn* Sort by: Title	20
Search (((Gagne*) AND Skill*)) AND Lesson* Sort by: Title	5
Search (Gagne*) AND Skill* Sort by: Title	57
Total	130

The following description elaborates each of the Gagne’s events.

**Gaining Attention**

- Gaining attention is anticipated to enhance learning. To stimulate the students’ attention, the following events could be performed.
- Show a picture of Nobel Laureates in physiology and Medicine with a microscope and tell the students “loudly” that they received Nobel Prize through observing interesting biology using a microscope.
- Asking thought-provoking questions<sup>23</sup> that would enable the introduction of the topic to learner for example,

should be able to:

1. Manoeuvre the standard microscope
2. Measure the size of an intestinal villous
3. Identify a goblet cell in intestinal mucosa
4. Examine the normal intestinal mucosa and compare with abnormal mucosa

Identify a vascular invasion in colon carcinoma slide.

The above items are presented sequentially to facilitate learning of each item before going to the next objective. The objectives and competencies with which the students are participating in the session might be different. This might help in either omitting or paying

special attention<sup>10</sup> to some of the objectives. This approach has a clear advantage of helping me in adjusting for joint objectives for the session.

### **Stimulate Recall of Prior Learning**

Adults learn better when they construct their knowledge based on their prior learning and experiences<sup>24</sup>. Such recall could easily be facilitated through a focus group discussion on previous microscopy knowledge and skills that the students attempted during school and medical college.

To improve upon the process, the students will be asked about the significance of microscopy skills in pathology reporting. A virtual dynamic image (simulation) will be used to show the different parts of tissue and cellular architecture to the students. This will facilitate the learners in the identification of items listed in the objectives (objective 1-5). This constructivist approach leads to motivation for developing more detailed learning.

### **Presenting The Stimulus**

A schema of the different steps involved in microscopy (objective 1) will be provided to the students in advance of the session. A detailed Power Point (PPT) presentation of the different steps involved in microscopy will be given to the students. This will be followed by examples of histology (objective 2, 3) and histopathology (objective 4 and 5). This approach will help the students relate different steps involved in microscopy (e.g., the use of objective lens, the use of adjustments knobs etc.).

Based on the Peyton model to teach the actual procedure skills, the tutor will demonstrate microscopy step-by-step (simulation and role-playing a pathologist) as he would perform normally without any explanation (Peyton step 1).

### **Providing Learning Guidance**

The interactive learning session will be initiated through discussion on the different parts of the microscope and their functions; in relation to interpreting a pathology slide (objective 1).

Afterwards, the tutor will review the examination of a slide with a microscope (objective 2-5) with a full description of each step with useful tips from my experience (Peyton step 2). The students will be encouraged to stop the tutor at any point and ask question. The students would then explain each microscopy step and the tutor will follow their instruction (Peyton step 3).

### **Eliciting Performance**

'Learning by doing' is an old phrase and best describe this phase. A significant amount of time will be dedicated to this step. The students will be encouraged to perform autonomous microscopy (Peyton step 4). A microscope with a slide will be provided to each student and they will be asked to examine the tissue and cellular architecture (objectives 1-5). This step would thus ensure a stimulating laboratory environment for better teaching and learning.

### **Providing Feedback**

During the examination of slide session, the tutor would go around and provide guidance (if required) and feedback to students. At this point, the tutor would strongly encourage students to clarify the concepts, steps and tips during the individual microscopy session. Feedback on slide orientation, using the sequential use of objective lens, slit light and knob adjustment (objective 1), identification of required structure (objectives 2-5) will be provided to the students. Feedback can be provided by Agenda-Led Outcome-Based Analysis (ALOA model)<sup>25</sup>.

### **Assessing Performance**

Guided performance of microscopy skill and feedback has now provided the students with motivation and confidence to perform the procedure independently. They will now perform the procedure without any extraneous help or guidance. In this phase, the tutor will provide formative assessment to the students using a pre-defined checklist for using the microscope (objective 1) and interpretation of slides (objective 2-5). This will then be compared with the self-evaluation performed by students.

### Enhancing Retention And Transfer

At this stage the students will be provided with a slide from another patient (not the one that was given earlier). They will be given the task to identify a pathological state using the microscope

The session will be summarised by looking back into the objectives and whether they were met or not. This will be followed by a small question and answer session to ensure that the students have learnt what they were supposed to

**Table-II: Characteristics of included articles in the scoping review.**

Author	Year of Publication	Country	Study Type	Key Findings	Application in Medical Education	Model Used	Limitations
Ng JY <sup>19</sup>	2014	UK	Lesson Plan	A well designed lesson plan for teaching slit lamp examination through a combined Gagne’s nine event instruction and Peyton’s six step approach	This lesson plan will be very useful in effectively teaching slit lamp examination to both under graduate and postgraduate examination	Gagne’s and Peyton’s model	The study should have sufficient amount of references with more information from literature about the use of models discussed in the paper
Woo WH <sup>20</sup>	2016	Singapore	Lesson Plan	This study describes the lesson plan for phlebotomy as a procedural skill using Gagne’s nine events of instructions	This paper help in providing a framework for designing a lesson plan for procedural skills for medical staff, surgeons and nursing staff	Gagne’s model	The linkage of each step of Gagne’s model to a theory would have been very beneficial
Khadjooi <sup>16</sup>	2011	UK	Lesson Plan	This study uses Gagne’s nine event instruction to design a lesson plan of insertion of a peritoneal (ascitic) drain.	This could have a significant implications in teaching of procedural skills to the undergraduate and junior doctors	Gagne’s model	A holistic overview of the importance of the lesson plan might have been given by the authors for applications in everyday teaching.
Buscombe C	2013	UK	Lesson Guide	This study uses Gagne’s model for teaching psychomotor skills with bone-marrow aspirate procedure as an example	Again this model could potentially be used by haematology consultants to teach bone marrow aspiration to their post-graduate trainees	Gagne’s model	The link to educational theories would have made the article more interesting.
Belfield J <sup>11</sup>	2010	UK	Lesson Plan	This paper describes a lesson plan on chest x-ray interpretation using the nine events of Gagne’s model	This could be an excellent adjunct to the teaching practices of radiology field in general but could potentially be replicated in other fields.	Gagne’s model	The linkage with different learning styles and educational theories is missing and this could have helped the readers understand the model better.

(objectives 1-5). The evident advantage of this approach would be that they would appreciate the whole learning process and, thereby improve their learning. At this stage the students would feel confident enough to transfer the knowledge to other students through peer interaction<sup>1</sup>.

learn. After the students have evaluated the session, some reading materials and resources will be provided to students.

Microscopy remains at the core of pathology and students will be encouraged to practice and master the skills of microscopy on a regular basis.

## Simulation And Role Play

This could be an effective learning and teaching strategy in pathology teaching. Role play and simulation can be effective at Gagne's event 3, 5, 6 and 8. In addition, virtual microscopy and digital pathology can provide excellent simulation of real-life pathology reporting<sup>26,27</sup>.

## DISCUSSION

The current study has addressed an unmet medical education need in the field of pathology through designing a microscopy lesson plan using a qualitative study with scoping review. A search strategy was developed and used to include the most relevant articles. From these articles a better combined model was identified and used as a theoretical framework for the current study. An element of novelty was introduced as follows in the ensuing discussion to link the model to educational theories<sup>24,28,29</sup> and students with diverse learning style<sup>22</sup>.

Learning styles suited for Gagne's event 1 are visual and auditory learners<sup>29</sup>. In addition activists enjoy challenging tasks and brain storming activities (Picture of Nobel Laureates, asking questions). Finally, reflectors<sup>30</sup> are good observers and thus learn better through appreciation of observing the learning process (Video of a pathology laboratory)+. The educational theory link is that through imagery and discussion, a cognitive information processing (cognitivism)<sup>31</sup> is happening in the learner's mind.

Learning styles suited for Gagne's event 2 are learners with better logical, auditory, visual and social styles<sup>29</sup>. The objectives follow each other, and they are discussed with the assumption that this will involve working in groups and individually. The educational theory link is that students might well be prepared for the forthcoming events through positive reinforcement and behaviourist<sup>31</sup> approach by encouraging them through just saying "good job" when they respond to questions about the objectives.

Learning styles suited for Gagne's event 3 are that this method has the potential of engaging visual, kinaesthetic, linguistic and intra- and inter-personal intelligences<sup>28</sup> (multiple intelligence theories)<sup>28</sup>. The educational theory link is that it involves constructivist learning theory<sup>24,31</sup>.

Learning styles suited for Gagne's event 4 are that it is evident that this approach would lead to visual, auditory, linguistic and inter-personal intelligences<sup>28,29</sup>. The educational theory link is that the schema of microscopy, followed by Power Point presentation and then the demonstration of microscopy would involve cognitivism and to some degree sequential constructivism<sup>31</sup>.

Learning styles suited for Gagne's event 5 are that this comprehension phase allows the stimulation of linguistic, kinaesthetic and interpersonal learning styles<sup>29</sup> in students and would help in judging the understanding of students. This phase would allow reflectors<sup>30</sup> to learn better as they could better appreciate and understand the performer perspectives. The educational theory link is that the interactivity and practical demonstration with full possible description allow the link between learning process and encoding of memory through cognitivism and a degree of sequential constructivism<sup>32</sup>.

Learning styles suited for Gagne's event 6 are that this phase allows the stimulation of visual-spatial, linguistic, logical, kinaesthetic and intra-personal (solitary) learning styles<sup>29</sup> in students. Pragmatist students<sup>33</sup> are allowed the opportunity to try the technique of microscopy themselves. The educational theory link is that this phase is a mixture of learning theories namely: experiential learning theory, cognitivist and constructivist<sup>31</sup>. Moreover, the simulation and role play part as eluded to earlier on facilitate this stage of learning process.

Learning styles suited for Gagne's event 7 are that this phase allows the stimulation of linguistic, logical, visual, kinaesthetic, inter-

personal (social interaction) and intra-personal (solitary)<sup>28,29</sup> learning styles in students. Theorists<sup>34</sup>, who enjoy analysis would benefit most from this session. The educational theory link is that the facilitator goes around and encourage the learners thus this phase has a component of behaviourism<sup>31</sup>. Moreover, the students process the feedback from facilitator and represent the feedback in microscopy (cognitivism)<sup>31</sup>. The learning processes in behaviourism and cognitivism presented here is linear. Finally, at this stage the feedback leads to cyclic learning through meta-cognitivism and self-regulated learning<sup>35</sup>.

Learning styles suited for Gagne's event 8 are that this stage is anticipated to provide the learners with visual, kinaesthetic, logical, solitary and interpersonal intelligences<sup>29</sup>. Theorists and activists<sup>34,36</sup> who enjoy analysis and challenges would significantly learn from this session. The educational theory link is that experiential, cognitive and constructivist theories<sup>31,37</sup> explain best this phase of learning the microscopy skills.

Learning styles suited for Gagne's event 9 are that this stage is anticipated to provide the learners with visual, kinaesthetic, logical, solitary and social intelligences<sup>29</sup>. For pragmatists, this is a challenging situation and thus pragmatists<sup>33</sup> are anticipated to enjoy this session. The educational theory link is social constructivism<sup>38</sup>, that better explains this phase as the students are given the opportunity to learn through peer interaction and collaboration (social event) and building upon the knowledge (constructivism) that they already possess. Teachers may guide this process. At this stage the learning is continuous.

Each step involved in microscopy was planned carefully (using Gagne's and Peyton's model)<sup>19</sup>. The lesson plan is designed for pathology students in a small group setting with a special focus for accommodating the learning needs of students with diverse learning styles<sup>22</sup>. However, the model can be used for teaching microscopy in other fields. The linkage of the combined model with different learning styles

and educational theories will ensure better understanding and application of the model.

## CONCLUSION

The qualitative study with scoping review approach adopted in the current study identified a better model for psychomotor skills. The combination of Gagne's nine events with Peyton's four step approach facilitated in making a good lesson plan to teach microscopy effectively in pathology.

## RECOMMENDATION

The above-mentioned lesson plan could easily be integrated into the teaching practices where microscopy is used (undergraduate and postgraduate). The Gagne's nine events is an effective approach to designing a lesson plan and this is a valuable tool for learning and teaching purposes. The successive steps help the instructor to teach and assess learning goals of learners. The approach enhances learning, as appropriate time is allowed for each learning step. In addition, Peyton's four step approach could easily be integrated and combined with Gagne's nine step instructional model.

## CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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