Student Training with Virtual Peripheral Blood Smears

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PROBLEM 1

Limited class time and learning curve limits smear evaluation practice

Teaching first year Clinical Laboratory Science students peripheral blood smear evaluations is a major portion of our Clinical Hematology Laboratory course. Smear evaluations are part of the Erythrocyte and Leukocyte course modules and are performed alongside other laboratory testing procedures during scheduled class. Use of a microscope is limited to these class times.

Physical operation of a microscope is important for students to learn smear navigation through stage manipulation, plane focusing by course and fine adjustments, and cell morphology identifications using different magnification objectives. There is a learning curve that accompanies this combination of tasks, compounding the time needed to complete a single smear review. The average time needed for a student to complete a smear evaluation limits the total microscope time and number of unique smear exposures during scheduled classes.

PROBLEM 2

Variation in smears and evaluations create a challenge for instructor feedback

Traditional grading of students' smear evaluations uses an acceptable range for normalized white blood cell (WBC) counts and an acceptable degree of difference for red blood cell (RBC) morphology grades. Target count ranges and morphology grades are instructor established from a single smear randomly selected from a set of smears that were prepared from a single sourced sample. Likewise, students evaluate a single randomly selected smear from a patient set.

It is very unlikely two or more students will evaluate the exact same areas of a smear. Slight variations in smear preparations compounded with variation of instructor and student smear evaluation areas increases variation in counts and morphology grades. These variations create a challenge when providing instructor feedback to individual student smear evaluation performance.

SOLUTION

CellaVision® Proficiency Software (CPS) was incorporated into the WBC and RBC course modules. The CPS virtual smear assignments provided students additional practice with cell classifications and morphology grading. Utilization of CPS feedback allowed for focused discussion during smear review sessions.

RESULTS

Smears selected from a database that represented various normal and abnormal RBC and WBC morphologies were assigned in CPS. A total of 52 were incorporated in the RBC and WBC course modules, and they were assigned as required to complete. More smears were assigned as optional to complete, for students wanting extra practice.

Course Module	Microscope	CPS
RBC	18	30+
WBC	23	22+
Totals	41	52+

CPS provided students and instructor high resolution RBC and WBC feedback for each smear. Feedback included an overall summary of agreements (Figure 1), degrees of difference for RBC morphology grading (Figure 2), overall WBC agreements per classification class (Figure 3), and individual WBC cell classifications among participants (Figure 4).

Figure 1: Summary of results

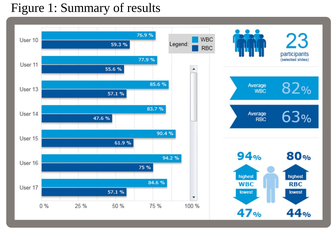


Figure 2: RBC characterization

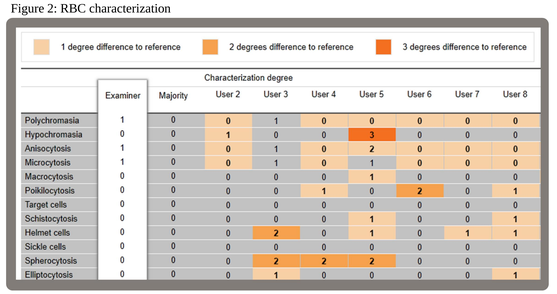


Figure 3: WBC classes

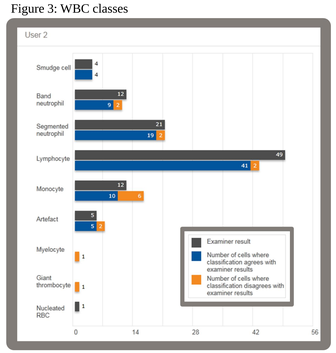
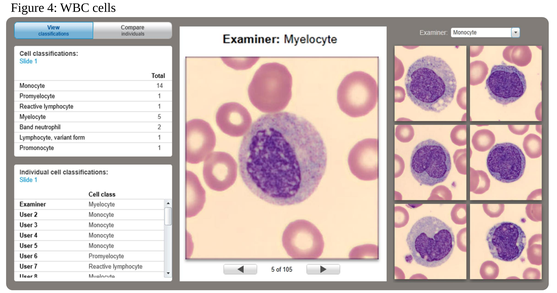


Figure 4: WBC cells



REFLECTIONS

CPS allowed incorporation of virtual smear evaluation training while not requiring students' presence in the laboratory. This advantage allowed students to gain more experience in identifying and differentiating cell morphologies. The disadvantage was the additional time commitment required for students to complete the virtual smears. A future consideration is to only assign RBC morphologies in CPS for the RBC course module and vice versa for WBC classifications.

CPS offered an abundance of feedback for students and instructor. Students could review RBC and WBC results in comparison with the instructor, with the majority of peer participants, and with individual peer participants. This feedback advantage gave each student an idea of how far away their classifications were from the instructor and peers, and it identified where their questions to the instructor should be focused. The advantage for the instructor was similar; the instructor could quickly view the majority classifications to help narrow morphologies of discussion during follow up review sessions.

CPS's amount of feedback can be a disadvantage. Variable subjectivity among students' morphology perceptions were naturally present, leading to each student undoubtedly producing results that disagreed with the instructor's evaluation. For example, CPS marked disagreement when a student selected band neutrophil when compared to the instructor's segmented neutrophil classification. An argument can be made, for a student at this level, that CPS's marked disagreement added minimal value to the lesson. A future consideration is for the instructor to further investigate CPS's feedback results to better distinguish the difference between an overall satisfactory agreement versus an overall unsatisfactory agreement.

CPS offers data export options for the summary of overall agreements, RBC characterization, and WBC classes. These files can be imported to data analysis software that would allow the instructor to culminate the data and develop different agreement evaluation schemes. Continuous review of the culminated data would allow the instructor to identify class and individual trends as the RBC and WBC course modules progress.

RESOURCE

CellaVision® (n.d). CellaVision® Proficiency Software (Version 2.3.0 build 36). cellavision-proficiency-software.com (Internet Explorer access only)

SUPPLEMENTAL

Poster Title

Author Names

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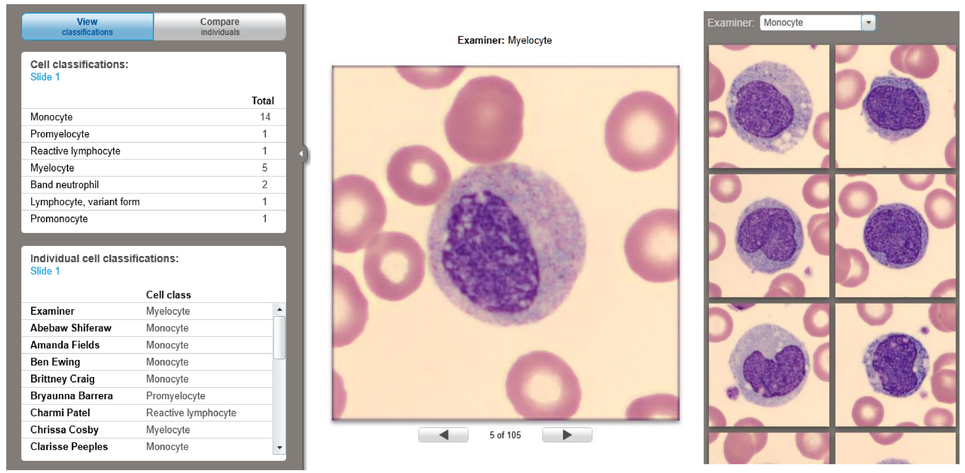

View classifications | Compare individuals

Cell classifications:
Slide 1

	Total
Monocyte	14
Promyelocyte	1
Reactive lymphocyte	1
Myelocyte	5
Band neutrophil	2
Lymphocyte, variant form	1
Promonocyte	1

Individual cell classifications:
Slide 1

	Cell class
Examiner	Myelocyte
Abebaw Shiferaw	Monocyte
Amanda Fields	Monocyte
Ben Ewing	Monocyte
Brittney Craig	Monocyte
Bryaunna Barrera	Promyelocyte
Charmi Patel	Reactive lymphocyte
Chrissa Cosby	Myelocyte
Clarisse Peeples	Monocyte

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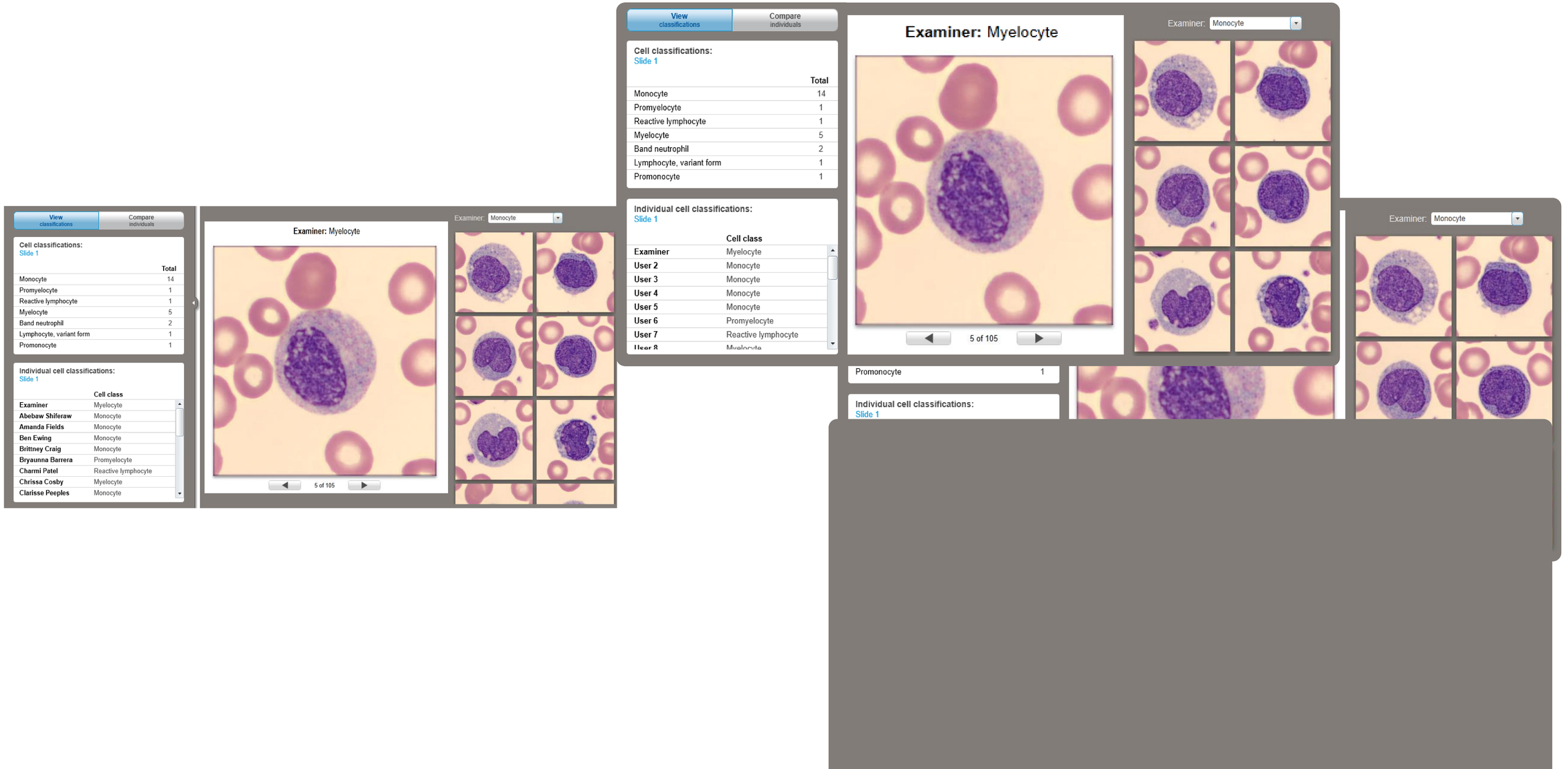

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1 degree difference to reference 2 degrees difference to reference 3 degrees difference to reference

Characterization degree

	Examiner	Majority	User 2	User 3	User 4	U			
Polychromasia	1	0	0	1	0				
Hypochromasia	0	0	1	0	0				
Anisocytosis	1	0	0	1	0				
Microcytosis	1	0	0	1	0				
Macrocytosis	0	0	0	0	0				
Poikilocytosis	0	0	0	0	1				
Target cells	0	0	0	0	0				
Schistocytosis	0	0	0	0	0				
Helmet cells	0	0	0	2	0				
Sickle cells	0	0	0	0	0				
Spherocytosis	0	0	0	2	2				
Elliptocytosis	0	0	0	1	0				
Ovalocytosis	0	0	0	0	0				
Teardrop cells	0	0	0	1	0				
Stomatocytosis	0	0	0	0	0				
Acanthocytosis	0	0	0	0	0	1	2	0	0
Echinocytosis	0	1	0	2	0	1	2	1	2
Howell-Jolly	0	0	0	2	0	0	0	1	0
Pappenheimer	0	0	0	0	0	1	0	0	0
Basophilic stippling	0	0	0	0	0	0	0	0	0
Parasites	0	0	0	0	0	0	0	0	0
RBC Morph	0	0	0	0	0	0	0	0	0
Folded RBCs	0	0	0	0	0	0	0	0	0
RBC Agglutinates	0	0	0	0	0	0	0	0	0
Rouleaux	0	0	0	1	2	0	0	0	0
Smudge Cell	0	0	0	0	0	0	0	0	0

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Characterization degree

	Examiner	Majority	User 2	User 3	User 4	User 5	User 6	User 7	User 8
Polychromasia	1	0	0	1	0	0	0	0	0
Hypochromasia	0	0	1	0	0	3	0	0	0
Anisocytosis	1	0	0	1	0	2	0	0	0
Microcytosis	1	0	0	1	0	1	0	0	0
Macrocytosis	0	0	0	0	0	1	0	0	0
Poikilocytosis	0	0	0	0	1	0	2	0	1
Target cells	0	0	0	0	0	0	0	0	0
Schistocytosis	0	0	0	0	0	1	0	0	1
Helmet cells	0	0	0	2	0	1	0	1	1
Sickle cells	0	0	0	0	0	0	0	0	0
Spherocytosis	0	0	0	2	2	2	0	0	0
Elliptocytosis	0	0	0	1	0	0	0	0	1

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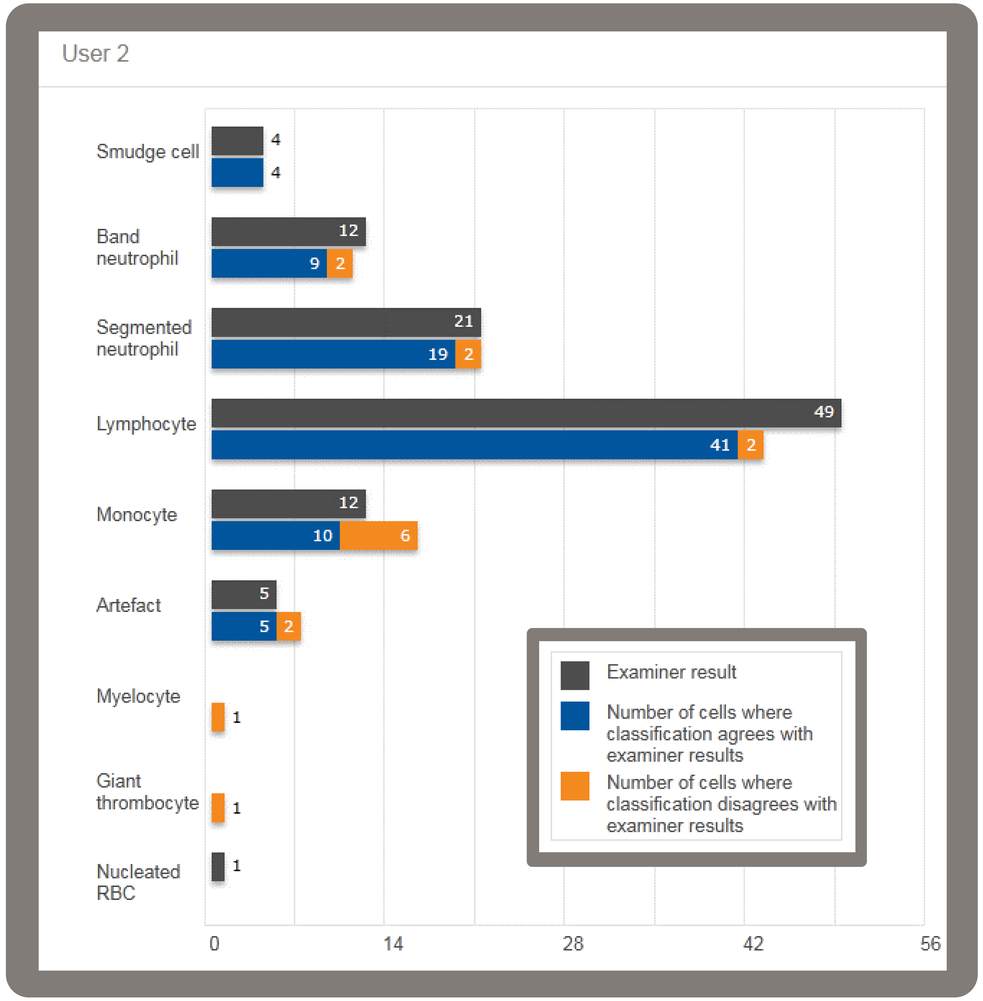

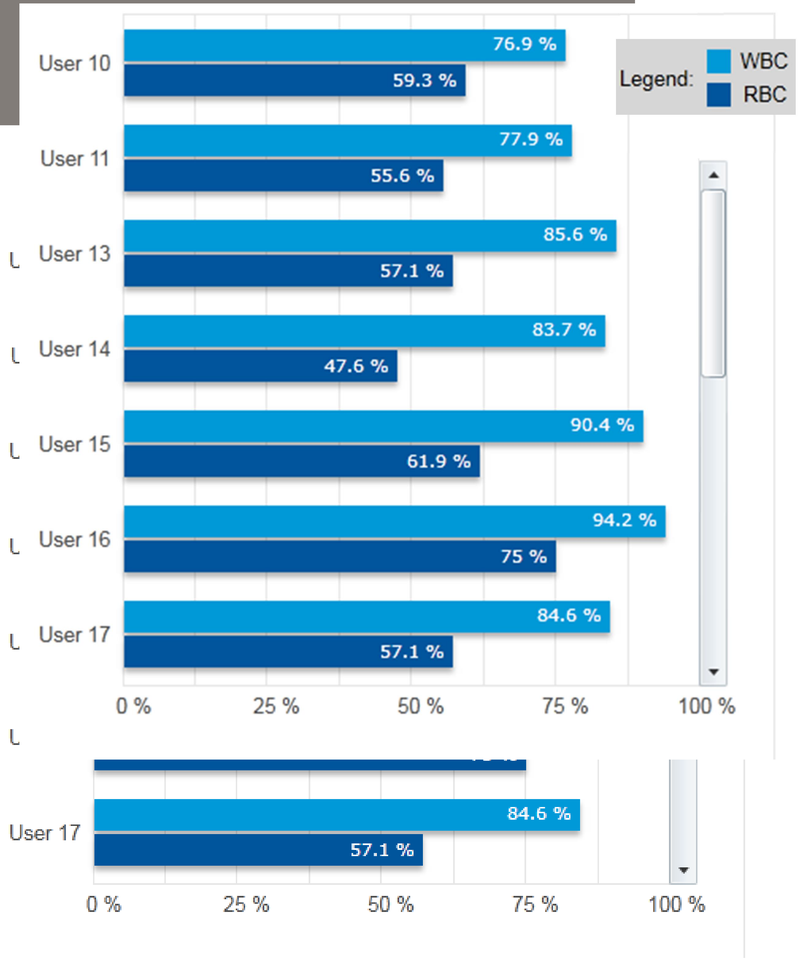

23
participants
(selected slides)

Average WBC 82%

Average RBC 63%

94%
highest
WBC
lowest

80%
highest
RBC
lowest

47%
highest
WBC
lowest

44%
highest
RBC
lowest

47%

44%

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