

# Virtual physiological laboratories: The impact of team work as a new learning tool



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## Introduction

Although the use of virtual laboratories in medical education has been shown to improve learning (1), laboratories in general have not been consistent in educational objectives and their pedagogical values have been difficult to assess. From a comparative review of hands-on versus simulated laboratories, Ma and Nickerson (2) proposed a framework of educational goals for laboratory learning. It encompasses three major facets:

- 1) Conceptual understanding: to assist students in understanding key concepts taught in the classroom
- 2) Design skills : to assist students in their ability to design, investigate, and understand the nature of science thereby increasing their ability to problem-solving
- 3) Social skills: where team behaviors are enhanced through communication, team interaction, problem-solving, and leadership skills.

The project aims at addressing those three goals by developing virtual laboratories to be done in groups from a class of Human Anatomy and Physiology, ANP 1505 (French classes).

Virtual laboratories have already been incorporated in that course and they were favorably perceived by the majority of the students (3).

The labs were designed as assignments to be done individually, however, thereby precluding the added value of team work.

Furthermore, they were based on the simulation program "web-Human" which offers a user-friendly environment but which is limited in terms of controllable and measurable variables. The present project also aims at developing entirely new laboratory protocols from the more powerful and versatile simulation program QCP, *Quantitative Circulatory Physiology* (4).

### Objectives

1. To assess the feasibility of using the simulation program QCP as a virtual lab environment.
2. To design laboratory protocols that promote team work in order to encourage students to discuss their own experimental observations, assumptions and conclusions among themselves.
3. To compare the interest and performance of the students with students from previous years.

## Development of virtual labs and team work

**+ Mode d'emploi**  
**Aperçu initial du logiciel**

**LISTE DES PARAMÈTRES ET VARIABLES DU LOGICIEL QCP**

**Paramètres modifiables**

1. **Température ambiante (°F ou °C) :** Ambient Temperature  
→ Ambient Temperature → Ajustez la température (entre -34.4 et +54.4 °C)
2. **Posture :** Restrainer : Pour déterminer une position constante  
→ Suggester : Permet une position qui peut changer selon la situation (par ex. si le sujet s'effondre)  
Exercice : Exercice  
→ Type : Exercice Bike → Level  
→ Treadmill → Run/Walk → Speed
3. **Hémorragie (ml) :** Arterial Hemorrhage  
→ Blood Volume → Arterial Hemorrhage → Switch ⊕ On  
→ Ajustez le volume total de sang perdu (en mL) et la durée du saignement (TimeSpan, en minutes)
4. **Transfusion (mL) :** Blood Transfusion  
→ Transfusion → Transfusion Controls → Switch ⊕ On  
→ Ajustez le volume total de sang transfusé (en mL), la durée (TimeSpan, en minutes), de même que l'hémocritie du sang transfusé (Hematocrit)
5. **Injection intraveineuse de diverses hormones :** Hormone Infusion  
→ Infusion Pumps → Choisissez une hormone → Switch ⊕ On  
→ Ajustez la quantité à injecter de façon continue (quantité par minute). L'injection continuera aussi longtemps que la commande « Switch » sera à

### Step 1: Development of a user guide

**B) Tom fait une longue marche de 2 heures**

Pour reproduire cette situation, il faut d'abord refaire le protocole précédent: un Go de 10 minutes en position allongée, suivi d'un Go de 30 minutes en position debout. Pour faire marcher Tom pendant 2 heures (à une vitesse de 3 km/h):

- « Treadmill » dans la colonne « Type »
- « Walk » → Ajustez la vitesse (Speed) à 2 MPH (= 3 km/h)
- Go de 2 heures (2 x 1 hr). L'heure finale devrait être 2:40 AM.

**Résultats:**  
Le débit cardiaque (DC) de Tom a plus que doublé durant sa marche, passant de 5,3 L/min au début à presque 11L/min après 2 heures. Sa pression artérielle moyenne a aussi augmenté, mais de façon moins importante, passant de 90 à 117 mm Hg, soit une augmentation de 30%.

**Question:**  
Expliquez les changements du débit cardiaque et de la pression artérielle durant la marche.

**Questions à discuter**

**A) Tom passe de la position allongée à la position debout**  
Expliquez les phénomènes qui ont entraîné le changement de la fréquence cardiaque en position debout.  
Votre explication doit nécessairement contenir les éléments homéostatiques suivants:

- Quelle est la variable à contrôler ? Quel(s) est(sont) le(s) stimulus ?
- Quels sont les centres de régulation ?
- Quels sont les récepteurs ? Quels sont les effecteurs ?

À noter: toutes les variables devront être montrées graphiquement.

**B) Tom fait une longue marche de 2 heures**  
Expliquez les phénomènes qui ont entraîné les changements du débit cardiaque et de la pression artérielle. Répondez spécifiquement aux questions suivantes:

- i) Quels phénomènes ont permis l'augmentation du débit cardiaque ?
- ii) Pourquoi est-ce que la pression artérielle n'a pas augmenté autant que le débit cardiaque ?

Pour chacune des questions présentez les graphiques des changements des variables qui appuient vos affirmations.

**C) Variation des débits sanguins durant la marche:**  
Mesurez et expliquez chacun des changements des débits sanguins:

- Débit sanguin dans les muscles
- Débit sanguin dans la peau
- Débit sanguin coronarien
- Débit sanguin dans les intestins

### Step 2: Development of a lab manual

**Consignes à suivre pour la remise des rapports de laboratoire virtuel**

- 1) **Le rapport individuel:**
  - Cliquez sur « Équipe \_\_\_ » sous l'onglet « Mes groupes » dans Blackboard.
  - Cliquez sur « Blogue de groupe ».
  - Cliquez sur « Créer une entrée de blogue »:
  - « Titre » : Inscrivez « Labo 1 »
  - « Texte » : Inscrivez votre nom et autre information pertinente si désiré.
  - « Joindre un fichier » : affichez votre rapport
- 2) **Le rapport de l'équipe:**

Une fois les rapports individuels affichés, les membres du groupe doivent déterminer les meilleures réponses pour chacune des questions et désigner une personne responsable de colliger les réponses choisies et de les imprimer. Voici la démarche à suivre:

  - ✓ Désignez un volontaire qui sera responsable de produire le document final.
  - ✓ Soumettez votre évaluation dans le blogue de groupe sous forme d'un message. Exemple:  
Salut l'équipe! Voici mon opinion:  
Question 1: Je suis tout à fait d'accord avec les réponses de Julie et Julien pour mesurer les produits de dégradation du glycogène. On peut choisir l'une ou l'autre de leur réponse.  
Question 2: Je pense que Marie a trouvé la bonne façon de mesurer l'activité parasymphatique. Bravo!
  - ✓ À partir de ces commentaires, la personne responsable devra faire le rapport final, le soumettre au groupe pour approbation, et imprimer la version finale.

### Step 3: Setting up team work

### Questionnaire ANP1505 Winter 2015 Based on Dennison and El-Masi,(5)

1. The labs enhance my understanding of the key concepts taught in the classroom.
2. The labs enhance my problem-solving and critical thinking skills through the construction of different scenarios of human physiological processes.
3. The labs are designed to facilitate teamwork among students.
4. The labs are beneficial and contribute to my overall professional development.
5. Overall, the lab requirements are reasonable and achievable.
6. Overall, I was satisfied with the labs.

### Step 4: Elaboration of a survey

## Methodology

This research involved the creation of virtual laboratories targeting the metabolic, cardiovascular and respiratory systems, to be accomplished in groups. This entirely new approach should encourage students to get a more in-depth understanding of the theory taught in class.

### Method and approach

- i) The research was done with the class "Anatomie et physiologie humaines I" (ANP1505C), session W2015. This class had 98 students.
- ii) The virtual laboratories were constructed from the simulation program QCP, *Quantitative Circulatory Physiology*, QCP (4). It is the first year that this program has been used in one of our ANP courses.
- iii) The teams were formed at random via the Blackboard Learn platform of the University of Ottawa. There were 22 groups of 4 and 2 groups of 5.
- iv) Students will had a week to individually submit a lab. By the next class, the students within a the same group had to discuss their answers via a forum found on Blackboard Learn. The students then had until the next class to choose the best answer, or re-write an answer together. The group must submit a new laboratory report on behalf of all members.
- v) Two labs reports were planned for the session.

## Results

The results have not yet been collected. The benefits of group work in physiology labs will be collected once both labs are completed.

- 1) **Surveys:** Students will be invited to answer a paper-based survey at the end of the session in order to evaluate their interest and the knowledge gained regarding the group work.
- 2) **Analysis of evaluations:** The students exams, which include theory seen in the labs, will be analyzed and compared with students fits of group work in physiology from previous years, who submitted lab reports individually.

## Conclusion

### Future considerations

The data from both the surveys and the analysis of the evaluation will facilitate an analysis of the impact of group work on the potential long-term retention of knowledge gained through the laboratories in comparison to individual work. In addition, we will be able to determine the interaction that the students had amongst each other.

## References

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