*J. Afr. Ass. Physiol. Sci. 2 (2): 78-86 (2014)*

Journal of African Association of Physiological Sciences
*Official Publication of the African Association of Physiological Sciences*
*http://www.jaaps.aapsnet.org*

*Physiology Education*

# Assessment of Practical Research-Based Activity Program as a Tool for Teaching Medical Physiology to Undergraduates

Suzy F. Ewida
*Physiology Department, Faculty of Medicine, Menoufia University, Egypt*

**Keywords:**
*Practical Research, Physiology, Teaching, Undergraduates*

**ABSTRACT**
**Background:** Practical work is an essential component of science teaching and learning. Medicine is an applied science, interpreting evidence and applying it to real life, so the practical researchï based activity program (PRBAP) may be considered as a good way for learning at medical schools; **Methods:** The traditional activity programs which were used by our physiology department for years became non-interesting ways for gaining new skills so constructing a PRBAP was of considerable importance. PRABP was evaluated by student feedbacks on designed Likert scale with five items for student enjoyment assessment and six items for developed key skills and by calculating the mean score of students' grades and the number of first year students finished their physiology course; **Results:** In this study, the twenty students that participated in PRBAP showed a positive response to nearly most items on Likert scale, $P < 0.001$ for all five items of enjoyment assessment when compared to non-PRBAP students. Also PRBAP students showed significant difference in group working and communication skills, Individual study skills**,** Practical skills, and time management when compared to non-PRBAP students. PRBAP students showed significant difference in the number who finished their first year physiology course compared to the non-PRBAP students of the same academic year, however no significant difference in the mean score of grades. **Conclusion:** PRBAP appears to be a good way for generating motivation for learning and also to demonstrate the relevance of physiology among students.



## .INTRODUCTION

Teaching knowledge as sets of facts to be stored and retrieved to answer anticipated test questions is hardly a form of learning and certainly not effective for long term retention (Trottier, 1999). Teaching and learning techniques have recently changed from its formal lecture-based teaching and activities to become more student-centered. These changes are due to the fact that intrinsic motivation has the most positive impact on student performance (Williams and Deci 1998). It is now documented that students can learn more effectively when actively involved in the learning process (Bonwell and Eison, 1991 & Sivan et al., 2000).

The number of undergraduates reporting research experiences has increased at all types of college and universities (Hu et al., 2007). The Council on Undergraduate Research (CUR) defines research as ñan inquiry or investigation, conducted by an undergraduate student that makes an original intellectual or creative contribution to the disciplineò (Council on Undergraduate Research, 2014).

While various teaching methods can be used, practical work has a key role in the teaching of evidence provided that the type of practical work is selected carefully with a clear purpose in mind (Gott and Doggan**,** 1996).

ó Practical workô is defined as any teaching and learning activity which involves at some point the students in observing or manipulating real objects and

Address for correspondence:
Email *suzy_fayez@yahoo.com*

materials (Abraham and Miller, 2008). Practical work is an essential component of science teaching and learning (Miller, 2004). The House of Commons Science and Technology Committee, for example, declared that: practical work, including fieldwork, is a vital part of science education. It helps students to develop their understanding of science, appreciate that science is based on evidence and acquire hands-on skills that are essential if students are to progress in science. Students should be given the opportunity to do exciting and varied experimental and investigative work (House of Commons Science and Technology Committee, 2002).

The practical research approach is one way in which such active learning strategies can be implemented in our institutions. It is important to bear in mind the significant differences between research scientists exploring the boundaries of the known and students trying to come to terms with already accepted knowledge. In the context of teaching scientific knowledge, practical research work is best seen as *a practice* and not as *discovery* (Nuffield Foundation, 2014).

Medicine is an applied science, interpreting evidence and applying it to real life by using clinical reasoning skills and experience (Abraham *et al., 2004*), so the practicalï based research is important for medical students, to demonstrate the relevance of physiology teaching among students by integrating clinical experience with teaching to generate enthusiasm and motivation for learning.

***Participants and methods***

This study was conducted at the department of Physiology, Faculty of medicine, Menoufia University. The undergraduate medical program at Menoufia University, Faculty of medicine, is a six-year academic program. The students are taught preclinical subjects in the ýrst three years. The ýrst two year subjects include Anatomy, Physiology, Biochemistry, and histology. The ýrst-year physiology curriculum contains; general physiology, blood, nerve and muscle, autonomic nervous system, cardiovascular, respiratory and gastrointestinal physiology.

***Study design:***

The students participated in this study were (448) Students attending their first academic year in 2013-2014. Twenty students choose to participate in the practical research-based activity program (PRBAP) and the remaining students (n=428) participated in the non practical research-based activity programs (non-PRBAP). They were divided into two groups as follows; I) PRBAP students II) non-PRBAP students

At the end of the program twenty students were randomly selected from each group to answer the designed questionnaire of Likert scale.

Students' final results were used to calculate the mean score of students' grades and the number of first year students finished their physiology course the sample size of group II students increased to include all the non-PRBAP students (n=428).

***The traditional non-PRBAP activities:***

Non-PRBAP traditional activities in our physiology department includes review researches that involve *gathering information* about a required topic from different sources such as; internet, medical books, journals etc., and writing a review article about this topic or present it in oral presentation or poster.

***The practical research-based activity program (PRBAP)***

Students participated in this program on their request. They were further divided into three working groups, each group guided for selection of a practical topic from their curriculum to work on, and then they left freely to distribute the work burden. All students were continually guided and followed up throughout the determined period till completion of the program.

***Constructions of PRBAP***

About 12 hours (1 h\w) were needed for teaching research techniques and for following up students work and guiding them.

- Teaching the students how to construct a research, title, aim, introduction, materials and methods, results, and discussion
- Lectures about collecting information from different sources, how to select the reliable source and how to keep the reference and formatting them properly
- Practical sessions required to make the student capable of using their selected practical tool.
- Putting a plan for the materials and methods required, the form of information collected as raw data, and inclusion and exclusion criteria.
- Teaching the students how to make some statistics for their collected results.
- Teaching the students how to represent their data in the form of tables and figures in simplified forms.
- Explain how to discuss their results and write good explanations.

***Examples of the topics included***

Example 1: Arterial blood pressure in manual workers versus office workers in different age groups

Example 2: Cold stress test as a tool for prediction of hypertension in chronic renal patients versus chronic chest patients

Example 3: Cold stress test for prediction of hypertension in females from different age groups.

***Designed questionnaire of Likert scale:***

These scales use ýxed choice response formats and are designed to measure attitudes or opinions (Likert, 1932 & Rattray and Jones 2005). At the end of the program, feedbacks on designed eleven items of the Likert scale, ranging from Strongly Agree to Strongly Disagree, were collected from the students. Five items for Enjoyment Assessment and six items to assess Developing Key Skills as shown in table 1, beside a free area for expressing what they liked or didn't like about their physiology activity.

Based on the item, the respondent will choose a number from 1 to 5 using the criteria below: 1) strongly agree. 2) Somewhat agree. 3) neutral/no opinion. 4) Somewhat disagree. 5) Strongly disagree.

**Table 1**: Designed Likert scale for Enjoyment and Developed Key Skills Assessment

| | |
|---|---|
| **Enjoyment assessment:** | |
| Item 1 | I didn't know what I should have learnt from the physiology activity I just completed. |
| Item 2 | I like doing physiology activity. |
| Item 3 | In the physiology activity I just completed I learnt something useful. |
| Item 4 | I wish all physiology activities were just like the one I completed. |
| Item 5 | The physiology activity I just completed is too hard. |
| **Develop Key Skills Assessment:** | |
| Item 1 | Item 1- The physiology activity I just finished added an experience of group working skills and communication skills (Group working and communication skills). |
| Item 2 | Encouraged me to carry out independent research outside the lecture (Individual study skills**)**. |
| Item 3 | Encouraged me to utilize a number of different sources, i.e. Internet, library, laboratory results and contacting experts (Information gathering and analysis**)**. |
| Item 4 | I enjoyed the hands-on approach I have done in my activity and learned a new practical skill (Practical skills**)**. |
| Item 5 | I had meetings with academic staff to ensure progress during the activity rather than all the work being left to the last week (Time management**)**. |
| Item 6 | I presented my work in a variety of formats, oral presentations, articles, posters and reports (Presentation skills). |

***The total score of physiology grades:***

The total final score of physiology grades for first year students include; attendance of practical sessions, four end courses assessments, activity program, final practical assessments, end year oral assessments and end year recall assessment, which were conducted by all our staff members.

The total score of grades is 250 degree and the pass mark is 150.

Also the number of students attended the final exams and succeeded to finish their first year physiology course were used to compare both groups.

**Table 2: PRBAP Students' feedback on Likert scale:**

| Items | Strongly agree | Somewhat agree | Neutral\no opinion | Somewhat disagree | Strongly disagree |
|---|---|---|---|---|---|
| **Enjoyment assessment:** | | | | | |
| 1. I didn't know what I should have learnt from the physiology activity I just completed. | 0 | 0 | 1 | 7 | 12 |
| **2.** I like doing physiology activity. | 14 | 5 | 1 | 0 | 0 |
| **3.** In the physiology activity I just completed I learnt something useful. | 17 | 1 | 0 | 0 | 2 |
| 4. I wish all physiology activities were just like the one I completed. | 9 | 8 | 2 | 0 | 1 |
| 5. The physiology activity I just completed is too hard. | 5 | 12 | 3 | 0 | 0 |
| **Develop key skills:** | | | | | |
| 1**. Group working** and communication skills | 14 | 5 | 0 | 1 | 0 |
| 2. **Individual study skills** | 7 | 10 | 2 | 1 | 0 |
| 3. **Information gathering and analysis** | 9 | 10 | 0 | 0 | 1 |
| 4. **Practical skills.** | 15 | 4 | 0 | 0 | 1 |
| 5. **Time management** | 11 | 7 | 0 | 1 | 1 |
| 6. Presentation skills | 1 | 8 | 7 | 3 | 1 |

PRBAP, Practical research-based activity program. Total number = 20 students

***Statistical analysis***

Data were expressed as mean ± standard error (X±SE). The data were analyzed statistically using student t-test for comparison between two independent group means and chi square test ($x^2$-test) to study the association between two variables and comparison between two independent groups in terms of categorized data.

$P<0.05$ was considered statistically significant and $p< 0.01$ or 0.001 is highly significant.

**RESULTS**

In this study, Students shared in the practical research-based activity program (n = 20) showed a positive response to nearly most items of Likert scale. The numbers of students choose from agreement to disagreement on Likert scale represented in table 2.

***Enjoyment assessment results***

This study showed the effect of using practical research as a base of physiology activity program on student enjoyment recorded by Likert scale when compared to students used the non-practical research-based activity program. Students who performed the PRBAP had a more positive enjoyment assessment of physiology activities. There were significant ($p<0.001$) effect of using PRBAP on the mean student response to all 5 items Likert items of enjoyment assessment (4.55 ± 0.14, 1.35 ±0.13, 1.45 ± 0.28, 1.8 ±0.23 & 1.9 ± 0.14) when compared to the corresponding responses of students using non-PRBAP (2.45 ±0.31, 3.1 ± 0.3, 3 ±0.33, 3.7 ± 0.33 & 3.05 ± 0.28) respectively (figure 1).

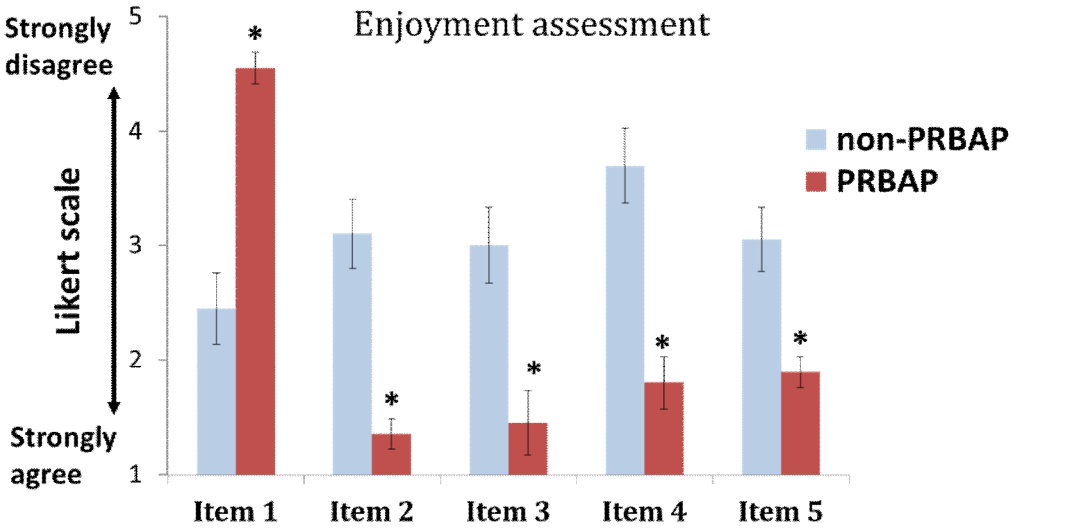


**Fig. 1:**
Students response on a Likert scale (Mean± SE) for each item of the enjoyment of physiology activity either; non-PRBAP (non-practical research-based activity program) or PRBAP (practical research-based activity program) groups. On the Likert scale a response of 1 meant the student strongly agreed with a statement while a response of 5 meant the student strongly disagreed
* indicates p-value < 0.001.

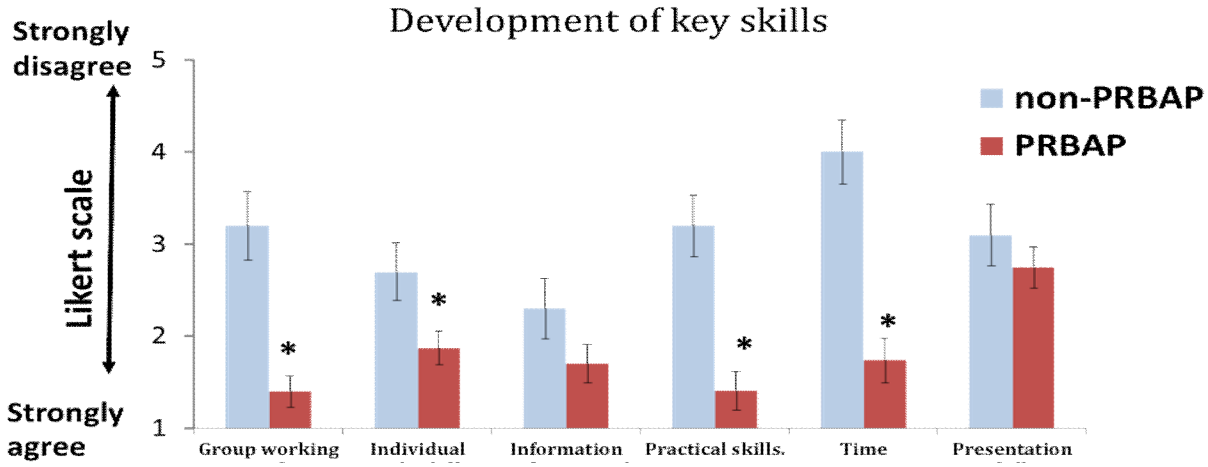


**Fig. 2**: Students response on Likert scale (Mean± SE) for each item of the developed key skills in physiology activity either; non-PRBAP (non-practical research-based activity program) or PRBAP (practical research-based activity program). On the Likert scale a response of 1 meant the student strongly agreed with a statement while a response of 5 meant the student strongly disagreed.
* indicates p-value < 0.05.

***The mean score of students' grades at the end of first year physiology course academic year 2013-2014***

Scores are expressed as mean grades obtained from the sum of grades during the entire physiology course (total 250). The mean grades (Mean± SE) of PRBAP students (n=20) was (193.2±5.2) which was insignificant (t= 1.297& P= 0.195) compared to the rest of non-PRBAP students who attended the final exam (n= 387) whose mean grades was (184 ± 1.6) (figure 3).

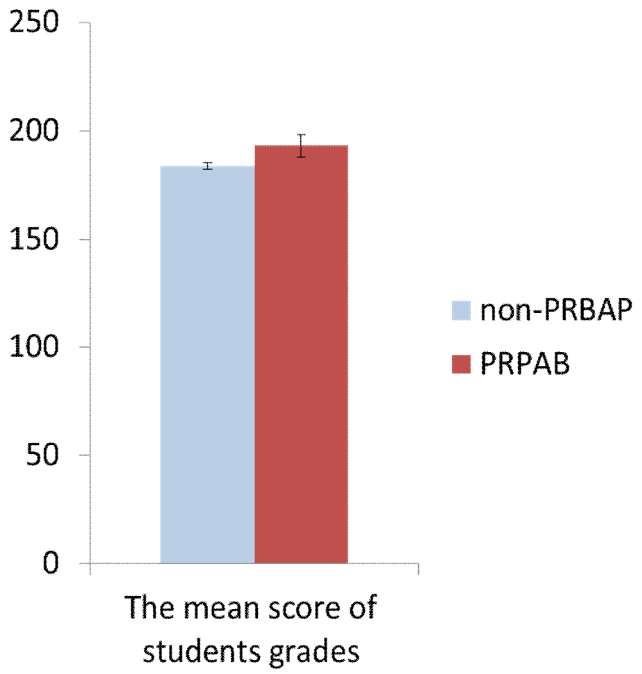


**Fig.3:** The mean score of students' grades of practical research-based activity program (PRBAP) and of non-PRBAP.

***The number of students who finished the first year physiology course at the academic year 2013-2014***

The total number of first year students was (448 students); (42) students failed to get the pass-marks and (41) students didn't attend the final end year exam, the total number of students who didn't finish the first year physiology course was (83) students. Table 3 shows that as regard finishing the first year physiology course for PRBAP and non-PRBAP students there was a significant difference ($p<0.05$).

**DISCUSSION**

Students attending our medical college are students with the highest scores in the final secondary school exam all over the country. They come to our college with big dreams of becoming great doctors helping people. Their big dream is one day they may become like our inspiring Professor Sir Magdy Yacoub, who is the most famous cardiac surgeon in Egypt and all-over the world. But unfortunately most of their dreams are destroyed from the first year under the heaviness and the dullness of the academic subjects with rarity of clinical senses. So I tried to change that by integrating the physiology with some clinical researches dealing with humans ï within accepted limits- to regain students' interest in physiology studying.

Changing the activity associated with the physiology course for some students from non-PRBAP to PRBAP significantly improved their interest and enjoyment in studying physiology as shown from the significant difference in all 5 items recorded from Likert scale about enjoyment. There is also evidence that students find practical work relatively useful and enjoyable as compared with other science teaching and learning activities (Cerini et al., 2003).

PRBAP students liked the physiology activity program and wished that all physiology activities were just like the PRBAP. This was obvious also from their comment as some of them mentioned that they were very happy when they entered the hospital, met the patients and measured their blood pressure, even the relatives who came for visits asked the students to measure their blood pressure too, this gave the students a good feeling of being somewhat like clinicians and restored some of the dreams which they came to the college with.

PRBAP students liked the physiology activity program and wished that all physiology activities were just like the PRBAP. This was obvious also from their comment as some of them mentioned that they were very happy when they entered the hospital, met the patients and measured their blood pressure, even the relatives who came for visits asked the students to measure their blood pressure too, this gave the students a good feeling of being somewhat like clinicians and restored some of the dreams which they came to the college with.

PRBAP students significantly mentioned that their activity was too hard compared to non-PRBAP students, this is because they didn't have a previous experience to do or learn about research methodology, analyze the data or writ a research, and also they hardly found the time for their practical research, also some of them were new in dealing with technology as using different computer programs and internet. Working in a team for students who didn't know each other were a challenge too. However this didn't prevent them from enjoying their activity and accepting the hardiness of it as intrinsic motivation, reflects the highest degree of self-determination (Ryan and Deci, 2002)

Also their enjoyment comes from their feeling that this activity is important and useful. They significantly agreed that they knew what they should have learnt from it and they confirmed that they learnt something useful and gained lots of skills, for that they accepted the hardness and difficulties of the program.

Students of PRBAP showed statistically developed skills compared to non-PRBAP as they gained group working and communication skills because field work increase communication among members of the group. The variations of students experience add to each other and they can capitalize on one anotherôs resources and skills (Chiu, 2008).

PRBAP significantly increased individual study skills compared to non-PRBAP as increasing their motivation increased the student abilities, this was in agreement with Rodenbaugh and colleagues who stated that students are naturally curious with powerful intrinsic motives to challenge and test their knowledge. Specifically, as students learn, they acquire new knowledge and are eager to practice and test their abilities (Rodenbaugh et al., 2014).

Most Practitioners would agree that good- quality practical work can engage students, help them to develop important skills, help them to understand the process of scientific investigation, and develop their understanding of concepts (Woodley, 2009).

Transforming the practical work to full practical based-research gives the student insight into scientific research methods and gives them experience to develop their scientific attitudes. That is why PRBAP students significantly encouraged carrying out independent research outside of the lecture which is considered development in their individual study skills.

PRBAP significantly increased students' practical skills not only by repeating the experiments they used in their practical research but also by collecting data and analyzing them which is considered the base of research skills.

Time management significantly improved with PRBAP compared to non-PRBAP because increased motivation of students and enjoyments prevented the delay of work which is usually associated with other students' studying tasks and duties.

Unfortunately not all PRPAP students found the time to present their researches because they started in their research late in this academic year, they take long time as it was a new experience for them and also the plenty of end courses exams for all subjects delayed them.

The mean score of students' grades at the end of first year physiology course were insignificant in PRBAP students compared to the non- PRBAP students, this may be explained by the distribution of the grades in our department where the higher grades depend on the recall and oral exams compared to the practical exam. Also traditional measures fail to assess significant learning outcomes; a test might be valid for one purpose but inappropriate for other purposes (Dietel et al 1991). Also homogenous cross-section enrolled in both groups cannot be guaranteed. It is entirely possible that the demographics and mental capabilities of the two groups may be different (Latif, 2014).

The number of PRBAP students that finished the first year physiology course was significantly different from non PRBAP students for since all of them finished their physiology course with no one absent from the final recall exam or had not got the pass marks. The practical research program made the student more self-confident and had more courage facing the exam. Nagda and colleagues found that working on research with a faculty member contributed to student persistence at the University (Nagda et al., 1998). Being involved in a research project as an undergraduate is associated with various desirable effects such as persistence, graduate school study, and future career choice **(**Pascarella and Terenzini, 2005**).**

**Table 3:** The number of students finished the first year physiology course at the academic year 2013-2014

| **Items** | **Students finished their course (n=365)** | **Students didn't finish their course (n=83)** | **$X^2$-test** | **P value** |
|---|---|---|---|---|
| **PRBAP students (n=20)** | 20 | 0 | 4.7605 | 0.029 |
| **Non PRBAP students (n=428)** | 345 | 83 | | |

PRBAP, Practical research-based activity program

P value <0.05 significant

**Conclusion**

Non-PRBAP which was used by our physiology department for years became an old and non-interesting way for gaining new skills. Medicine is an applied science, interpreting evidence and applying it to real life, So PRBAP may be considered as a good way for learning. PRBAP is important to generate motivation for learning and to demonstrate the relevance of physiology among students by integrating clinical experience within their activity

**ACKNOWLEDGEMENTS**

I would like to thank the students who accepted to participate in this work specially the practical research group for their hard work; Ebtesam Abd El-Fatah, Ahmad El-Batahgy, Esraa El-Magraby, Esraa Hagr, Asmaa El-Shayeb, Asmaa Qinawe, Alaa Tolba, Amira A. Omar, Amira Roshde, Aya El-Fekki, Eman Salah, Enas El-Shaal, Gehad El-Shekh, Dalia Khodier, Dina El-Dosoki, Rania Mabrouk, Reem El-Shereif, Sarra Abd El-Razik, Nihal Kandeel, Eman Hagr.

**REFERENCES**

Abraham I, Miller R (2008). Does Practical Work Really Work? A study of the effectiveness of practical work as a teaching and learning method in school science**.** *International Journal of Science Education* **30(14, 17):**1945ï 1969.

Abraham RR, Upadhya S, Torke S, Ramnarayan K (2004). Clinically oriented physiology teaching: strategy for developing critical-thinking skills in undergraduate medical students. *Adv Physiol Educ* **28(1-4):**102-4.

Bonwell C, Eison J (1991). *Active Learning: Creating Excitement in the Classroom AEHE ERIC Higher Education Report No. 1* Washington, D.C.: Jossey-Bass ISBN 1 878380-08-7.

Cerini, B, Murray I, Reiss M (2003). Student review of the science curriculum. Major findings. London: [online] Planet Science/Institute of Education University of London/Science Museum. http://www.planet-science.com/sciteach/review. [May 20, 2014]

Chiu MM (2008). Flowing toward correct contributions during groups' mathematics problem solving: A statistical discourse analysis. *Journal of the Learning Sciences* **17 (3):** 415ï 463.

Council on Undergraduate Research (CUR) (2014). About the Council on Undergraduate Research [online]. www.cur.org/about.html [22 August 2014]

Dietel RJ, Herman JL, Knuth RA (1991). *What does research say about assessment?* [Online]. Available: http://www.ncrel.org/sdrs/areas/stw_esys/4assess.htm [June 2014].

Gott R, Doggan S (1996). Practical work: its role in the understanding of evidence in science. *International Journal of Science Education* **18 (7):**791-809.

House of Commons Science and Technology Committee (2002), Science Education from 14 to 19 [online]. http://www.publications.parliament.uk/pa/cm200102/cmselect/cmsctech/508/50813.htm [2014].

Hu S, Kuh GD, Gayles JG (2007). Engaging undergraduate students in research activities: Are research universities doing a better job? *Innovative Higher Education* **32:** 167-177.

Latif R (2014). Impact of case-based lectures on students' performance in vascular physiology module. *Advances in Physiology Education.* **38 (3):** 268-272.

Likert R (1932). A Technique for the Measurement of Attitudes. *Archives of Psychology*. **140:** 1ï 55.

Miller R (2004). The Role of Practical work in teaching and learning of Science [online] National Academy of Sciences, Washington, DC, file:///C:/Users/Mesc/Downloads/Documents/Robin_Millar_Final_Paper_2.pdf [ June 2014].

Nagda BA, Gregerman SR, Jonides J, Hippel W, Lerner JS (1998). Undergraduate student faculty research partnerships affect student retention. *Review of Higher Education* **22:**55ï 72.

Nuffield Foundation (2014). About Teaching and learning using practical work. www.nuffieldfoundation.org [12 March 2014]

Pascarella ET, Terenzini PT (2005). How college affects students: *A third decade of research*. San Francisco, CA: Jossey-Bass

Rattray J, Jones CM (2005). Essential elements of questionnaire design and development .*Journal of Clinical Nursing* **16:** 234ï 243.

Rodenbaugh HR, Lujan HL, Rodenbaugh DW, DiCarlo SE (2014). Having fun and accepting challenges are natural instincts: jigsaw puzzles to challenge students and test their abilities while having fun! *Adv Physiol Educ* **38:**185-186,

Ryan RM, Deci EL (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *Am Psychol* **55:** 68ï 78.

Sivan A, Wong Leung R, Woon C and Kember D (2000). An Implementation of Active Learning and its Effect on the Quality of Student Learning Innovations. *Education and Training International* **37** (4): pp381-389.

Trottier RW (1999). A peer assisted learning system (PALS) approach to learning basic sciences. A model

developed in basic medical pharmacology instruction. *Med Teacher* **21:** 43ï 47.

Williams GC, Deci EL (1998). The importance of supporting autonomy in medical education. *Ann Int Med* **129:** 303ï 308.

Woodley E (2009). Practical work in school science ï why is it important? *School science review* **91**(335)**:** 49-51.