

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/279058488>

The effect of Wiley PLUS Web-Based Homework system on student performance in the Chemical Engineering Extended Curriculum Program: Introductory Physics course

Conference Paper · June 2015

CITATIONS

2

READS

151

2 authors:



Moses Basitere

Cape Peninsula University of Technology

45 PUBLICATIONS 81 CITATIONS

[SEE PROFILE](#)



Eunice Ivala

Cape Peninsula University of Technology

61 PUBLICATIONS 351 CITATIONS

[SEE PROFILE](#)

Some of the authors of this publication are also working on these related projects:



Avocado oil Extraction [View project](#)



SlaughterHouse Bidelipidation [View project](#)

The Effects of *Wiley PLUS* Web-Based Homework System on Student Performance in the Chemical Engineering Extended Curriculum Program: Introductory Physics Course

Moses Basitere and Eunice Ndeto Ivala

Cape Peninsula University of Technology, Cape Town, South Africa

Basiterem@cput.ac.za

Ivalae@cput.ac.za

Abstract: The importance of providing students with feedback on their learning is well documented. However, providing feedback to individual students is often impossible and time consuming. To address the need for a more efficient and effective approach to giving individualized feedback to students, a *Wiley PLUS* web-based homework (WBH) system that provides automated grading to individual students was piloted in a physics class for this study. Thus, this paper presents results on the effects of the use of *Wiley PLUS* web-based automated grading homework system in a first year introductory Engineering Physics course. The study investigated how the *Wiley PLUS* web-based homework system impacted on the students' paper based tutorial mock test, mid-term-test and Final Integrated Summative Assessment (FISA) performance. The study was informed by *Laurillard's* educational media conversational framework for teaching and learning supporting the 'interactive activity' learning process using Web-based homework as an adaptive medium. Both quantitative and qualitative methods of collecting data were used in this study. A comparison between students' performance on the *Wiley PLUS* online web-based homework, paper based written tutorial mock test, mid-term test and FISA was done to evaluate if there was a correlation in students' performances. Additionally, during the final class of the semester, Chemical Engineering Extended Curriculum Program students who enrolled for the introductory Physics course responded to a survey and participated in focus group interviews to gauge their perceptions and experiences on the use of the *Wiley PLUS* web-based system. Quantitative data was analysed using descriptive statistics and inferential statistics, while qualitative data was analysed using an inductive strategy. Results indicated that the *Wiley PLUS* WBH system enhanced students' learning and collaboration among learners. There was a strong positive correlation between students' WBH marks and marks students' obtained in the tutorial mock test, mid-term test and the FISA.

Keywords: automated grading, descriptive statistics, online assessment, inferential statistics, web-based homework, *Wiley PLUS*

1. Introduction

The inclusion of technology in the classroom has revolutionised the education environment and impacted the way students learn and access educational materials. The use of web-based homework (WBH) online systems has rapidly been growing in the educational sector, especially in the developed countries (Bonham *et al.* 2003). As a result, this has led to the development of software packages, which allow students to complete homework assignments online.

A hundred thousand students in the United States of America (USA) submit their homework for computerized grading over the Internet while attending real classrooms (Bonham *et al.* 2003). This practice is reported to be growing in courses such as mathematics, chemistry and accounting (Jones 2008).

The importance of homework assessment, feedback on the assessment and its impact on academic performance has been recognised by college researchers in the area of Mathematics, Physics and Science related courses (Bonham *et al.* 2003). However, providing individualised instant feedback to students is nearly impossible and time consuming. Hence, there is a need for designing ways of providing instant feedback to students. Computerised online systems that provide students with homework assignments and instantly mark and provide individualised feedback, is one way of providing instant feedback to students. Furthermore, the online system also provides other benefits such as placing the students' grades in an electronic format, measuring learning accurately, promoting student centred learning and also monitoring at-risk students on the course (Jones 2008).

To date, little research has been conducted in South African institutions of higher learning on the role of web-based homework systems especially in the area of Mathematics and Physics courses that are deemed to be difficult for first year engineering students. Hence, this study used *Laurillard's* educational media conversational framework to evaluate if the *Wiley PLUS* web-based homework (WBH) system supported the feedback-

reflection-adaptation phase of the learning process in an introductory Physics course. The researchers were guided by the following objective:

To evaluate the impact of *Wiley PLUS* web-based online system as an adaptive medium for promoting learning through experiential tasks such as Web-based Homework (WBH) and assignments. The study specifically answered some research questions adapted from a similar study done by Jones *et al.* (2008) from California State University on an introductory accounting course using *Wiley PLUS* web-based system. These questions were:

- If homework is not collected and graded, would students spend less time practicing course concepts?
- Do students prefer paper-based homework with no individual feedback to web-based homework with individual feedback?
- Where do students access the web to complete online assignments?
- Do students believe technical issues with computers, the web, or the WBH systems affect their course performance?
- Do students perceive automated homework grading as a form of course interactivity?
- How many hours per week do students spend on web-based exercises?
- Do students believe web-based homework enhances learning?
- What is the ideal number of attempts students should be allowed before assignment submission?
- Are exercise hints and links to electronic and online animation helpful in clarifying what is required?
- Is there a correlation in student performance on WBH compared to the paper based tutorial mock test, mid-term averaged test and FISA?

2. Literature

Homework is an important component in the physics and mathematics courses as these courses place more emphasis on the ability to solve problems (Bonham *et al.* 2003). Courses such as mathematics (Hauk *et al.* 2005), physics (Bonham *et al.* 2003), chemistry (Frailich *et al.* 2007) and Accounting (Bryant *et al.* 2000; Jones 2008) are reported in literature increasingly in the use of the web-based homework online system. For example, the use of the computerised homework online system in physics courses has been reported in literature to have its roots in the Programme Logic For Automatic Teaching operation (PLATO) system in the 1960's (Bonham *et al.* 2003).

2.1 Web-based homework system

In the literature, web-based homework has been used for formative assessment 1) to provide feedback for the teacher to modify learning activities and experience, 2) to identify and remediate individual student deficiency; 3) to improve student learning and build student confidence and 4) to improve students' metacognitive awareness of how they learn (Bonham *et al.* 2001; Bonham *et al.* 2003; Jang 2009). The main goal for which many universities use web-based homework is to provide instant individualised feedback to students, which is often time consuming in paper-based homework and beyond the resources available in the universities (Tang *et al.* 2002; Bonham *et al.* 2003; Demirci 2007; Jones 2008). With the lack of experienced tutors and teaching assistants, many universities around the world are abandoning time intensive approaches of collecting and grading paper based homework (Mestre *et al.* 2002). There are several studies comparing the impact of WBH to paper-based homework (PBH) reported in the literature. For instance, Bonham *et al.* (2003) reported on a college physics study that there was no statistical difference in exam score between students who used Web Assign WBH and those using PBH system. These results were also in agreement with results obtained in a study conducted in 19 college-algebra classes (Mestre *et al.* 2002; Hauk *et al.* 2005) using the Web Work online system. However, (Mestre *et al.* 2002; Hauk *et al.* 2005) and Bonham *et al.* (2003) were in agreement that WBH was as effective as PBH. A study conducted by Jones (2008) on an introductory accounting course for students majoring in business using commercial web application *Wiley PLUS* to automate grading of multi-part accounting exercises, showed that the web-based homework system enhanced learning but did not increase student course interaction. Furthermore, the study found that immediate feedback and allowing for multiple attempts encourage students to practice with the course material.

Furthermore, a study conducted by (Mestre *et al.* 2002) using Online Web-based learning (OWL) at a large U.S. public university found that offering WBH led to an improved overall exam performance in a physics course. Students who used OWL to submit assignments for grading scored significantly higher in examinations as compared to those who submitted PBH. The mean difference between WBH and PBH was found to be about one-third typical exam standard deviation. The results were in agreement with results from a study by (Tang *et al.* 2002) using Web Assign on a college physics and calculus courses. The study findings showed that using Web Assign to deliver and grade WBH increased the level of interaction with faculty peers, increased time spent on course work and students' collaboration outside the classroom and enabled faculty to provide instant individualised student feedback on homework assignments.

In this study, Wiley PLUS WBH was used to provide, submit, and grade the exercise and to monitor at-risk students on each weekly homework assignment. Students were given 96 hours to submit the web-based homework assignment, which was based on the sections of the chapter being taught in the classroom. Students' performance marks on the WBH were compared to students' marks on the paper based tutorial mock test, mid-term test and FISA. When working with Wiley PLUS, students received individual feedback on the completed portions of the physics exercise each time they clicked the <Submit Answer> button. After one attempt of the homework assignments, students received a publisher-provided hint in questions to which they had given a wrong answer. On the second attempt, all parts of the exercise were graded and the scores were recorded on the grade book. Students were given the option to view the solution. Students may also view an online grade book in Wiley Plus to see the total score for the web-portion of the assignment along with class averages. Student e-mails and a closed Facebook group were used for all course communication.

3. Theoretical framework

This study was informed by Laurillard's conversational framework for teaching and learning (Laurillard, 1996, 2002). The theory advocates that teaching and learning is a dialogic activity in which learners attempt to reconstruct teacher's mental model of the course content (Laurillard 2013) as shown in Figure 1 below. This framework is composed of five media forms, which are, (a) narrative, (b) interactive, (c) communicative, (d) adaptive, and (e) productive. Each media form supports different types of learning experience. Narrative media tell or show the learner something (e.g. text, image). Interactive media respond in a limited way to what the learner does (e.g. search engines, multiple choice tests, and simple models). Communicative media facilitate exchanges between people (e.g. email, discussion forums). Adaptive media are changed by what the user does (e.g. some simulations, virtual worlds) and supports: (a) experimenting, (b) practicing, and (c) clarifying internal relations. Automated grading of homework assignments such as WBH is a form of adaptive media which facilitates interaction by helping students move from initial conceptual understanding to experiential knowledge that closely approximates the teacher's mental model of the course material (Jones, 2008).

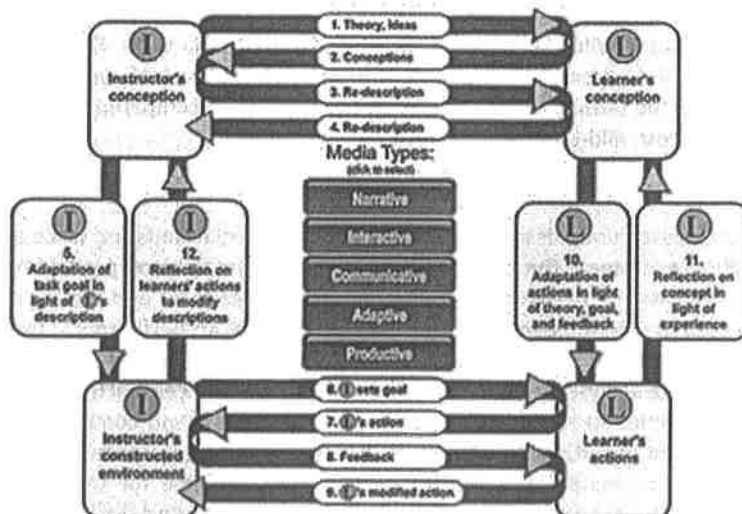


Figure 1: Laurillard educational media framework (Laurillard 2013)

The learning process in this framework is supposed to support an iterative exchange between teacher and students, which occurs at two distinct levels. The first level is referred to as "discursive activities," whereby the

teacher presents the conceptual knowledge, idea, principle, and theory to be learned. Then learners are supposed to engage with the course content through dialogue, asking questions and receiving responses from the teacher. Through this dialogue between the teacher and the learners, the teacher clarifies or elaborates on the course material. The second level is the "interactive or experiential activities", whereby the learner puts the theory into practice, application and action through experiential tasks such as homework exercises, laboratory experiments, or even field trips. The teacher continuously monitors the learners' experiential progression and provides feedback, which enables learners to improve their understanding of the course material (Laurillard 1997, 2013). Learners at the same time are expected to reflect on their experiential learning and "adapt" their actions, as a way of blending the theory and practice. The model argues that interaction is central to "deep" learning (Laurillard 2013).

4. Context of the study

The study was conducted in the 2014 academic year at the Department of Chemical Engineering at a University of Technology in South Africa. The participants of the study were first year Extended Curriculum Program (ECP) Chemical Engineering National Diploma (ND) students. The ECP program has been designed to support students who are enrolled in Chemical Engineering program with ≤ 50 percent pass rate in high school (matric) Mathematics and Physical Sciences.. To ensure that the ECP students succeed in their studies, the students take half a workload compared to mainstream students (Mainstream students are those whose matric marks are above 50 percent and who take six subjects per semester). As part of providing learning support to these students, the lecturer responsible for teaching Physics with support from the department and John Wiley & Sons Publisher piloted the *Wiley PLUS* online system to provide online homework assignments with an aim of ensuring that students receive immediate rich feedback. The online system not only provided online assignments but also video, animation, PowerPoint presentations and a prescribed e-book, which were beneficial to both the teacher and the students.

5. Methodology

Both quantitative and qualitative methods of collecting data were used in this study in order to ensure triangulation of data and to enhance the significance of the findings by integrating different ways of knowing (Caracelli *et al.* 1997).

6. Context and participants

The study was carried out at the Faculty of Engineering, Department of Chemical Engineering at a University of Technology in South Africa. The participants of the study were 34 out of 47 students who were enrolled for ECP Chemical Engineering in 2014 and working towards a national diploma.

7. Data collection

The study was conducted using Wiley Plus homework platform from John Wiley & Sons Publisher. A survey, followed by focus group interviews with students on their perceptions of web-based homework, was administered at the end of the term. Students' marks on the WBH were compared to students' marks on the paper-based tutorial mock test, mid-term test and FISA.

8. Data analysis

Quantitative data was analysed using descriptive statistics and inferential statistics, while qualitative data was analysed using an inductive strategy. The inferential statistics used the Pearson product moment correlation coefficient (PPMC) to evaluate the strength of the correlation between WBH and tutorial mock test, mid-test and FISA. A t-test was used to determine the significance of the correlation coefficients of the WBH as compared to tutorial mock test, mid-test and FISA. Focus group interview data was recorded on tape and transcribed verbatim. The interviews were analysed focusing on the identification of conceptual themes and issues emerging from the data, using techniques such as clustering, and making contrast and comparisons (Huberman *et al.* 1994). The participant consent to participate in the study was sought and the purpose of the study was explained to the students. Interview transcripts and student scripts were available for the students to scrutinise. Anonymity and confidentiality were adhered to as promised to the students and the Faculty of Engineering gave ethical clearance before the project was implemented.

9. Findings and discussion

The survey results showed that 73% (34 out of 46) of ECP students responded to the survey and participated in the focus group interviews. Fifty-six (56%) percent (N=19) of the students were female. Eighteen percent (18%) of the respondents were between the age of 17 and 18 years, 59% between 19 and 20 years and 24% between ages 20 and 25 years. Twenty-four (24%) percent of the respondents achieved high school Physical Science marks at level 3 (40-49%), 65% achieved at level 4 (50-59%) and 12% achieved at level 5 (60-69%). The rest of the findings are presented by using questions, which guided this study.

Research Question 1: If homework is not collected and graded, would students spend less time practicing course concepts?

Over eighty (80%) percent of learners (53%-strongly agree; 35% agree) indicated that they spent less time practicing course concepts when homework was not collected and graded. This was confirmed during student focus group interviews;

STUDENT A: ...I actually think that some of the questions on Wiley should be for marks because what we're actually seen like when we first used Wiley PLUS, Mr Moses said that the first two tests are not for marks. And if you actually check on that, not a lot of people attempted it. But when he started saying okay, guys, these are for marks, that's when you could see that people are on the IT centre. They are doing the questions and all that. So I think in a way it should also be for marks, ja. [sic]

The above findings support (Jones 2008) and (Tang *et al.* 2002) findings in which 71% of accounting students and 58% of physics and calculus students respectively claimed they would study less, if homework was not collected and graded. Additionally, the results can be interpreted as students' endorsement of the web-based homework assignment (Tang *et al.*, 2002) as it motivated students to study and practice course concept.

Research Question 2: Do students prefer paper-based homework with no individual feedback to web-based homework with individual feedback?

Over 60% (50% disagree; 15% strongly disagree) of learners indicated that they did not prefer paper-based homework with no feedback, 15% percent pointed out that they preferred paper-based homework with no individual feedback compared to web-based homework with feedback and 21% neither agreed nor disagreed. These results confirm (Jones 2008) findings, in which over 70% of accounting students overwhelmingly preferred WBH with individual feedback as compared to paper-based homework with no feedback. *Wiley PLUS* web based online system allowed students more than one attempt for each online homework assignment submission, which students saw as an advantage over paper-based homework. Also the instant feedback provided after each attempt was said to be an advantage of WBH compared to PBH.

Research Question 3: Where do students access the web to complete online assignments?

Fifty-nine percent (59%) of the students reported that they completed their homework assignment at home, 16% accessed it using a cellphone, 41% using their laptops and 41% used the university Information Technology (IT) centre computers to complete homework assignments. These results contrast with Jones's (2008) findings in which 84.1% of accounting students completed their homework at home and 12.2% completed their assignments at university. Although students receive free Internet data to use at this university, university Internet is slow at times, which makes it difficult for students to access online assessments. Hence, students who use their cellphone and laptop at home have to pay for their own data to access the web outside university campus.

Some of the students indicated that they couldn't afford Internet data to access *Wiley PLUS* at home as indicated in the quote below and as a result they used the printed version of the *Wiley Plus* text book from the library to read and prepare for the assignment at home and complete the online assignment at the university as free data was provided for each student to use on campus.

STUDENT B:...The disadvantage of this is that at home, I don't have Internet at home and therefore the Wiley PLUS was a problem for me and that's why I took the book out and the book was also

wow. So I prefer if you can give the Wiley book to some of the students who don't have Internet at home. [sic]

Research Question 4: Do students believe technical issues with computers, the web, or the WBH systems affect their course performance?

Fifty-five percent (55%) of the students (26%-strongly agree; 29%-agree) reported that technical difficulties with computers, the web or web-based homework affected their course performance, with 26% neither agreeing nor disagreeing. A little less than 20% (18%) disagreed that web based and technical difficulties were a concern. Students also elaborated on this during the focus group interviews by indicating that the Internet was slow at the university. However, these only happen for a short period of time when students were still getting used to the introduction of the web-based homework system as indicated by the students below;

STUDENT C:... *What I didn't like about Wiley plus at first it was a bit problematic. I don't know if you guys all remember the Internet problems and stuff. But then as time goes by it was just easy and nice.*[sic]

This finding is in contrast with findings from Jones's (2008) study, whereby most of the students (67.5%) reported that technical difficulties did not affect their course performance; with 19.3% neither agreeing nor disagreeing, and 13% indicated that technical difficulties with web-based homework were a concern.

Research Question 5: Do students perceive automated homework grading as a form of course interactivity?

Over sixty percent (60%) of the students (24%-strongly agree and 41%-agree) perceived that WBH promoted course interaction and peer learning (student collaboration), and 35% of the students neither agreed nor disagreed. The promotion of peer learning was also reported during the focus group interviews:

STUDENT D:...*If you still don't understand we could discuss amongst ourselves. It actually promoted a lot of group work because we would go to IT centre and then try to get these things done, get your answers and ask other people.*

As the Wiley PLUS web-based online platform is an adaptive medium, which has the capability to change its state due to user response as defined in Laurillard's Conversational framework, there was no student-teacher interaction but student collaboration and computer student interaction did occur. Computer-student interaction by nature is interactive but does not promote teacher-student interaction (Jones 2008). Computer-student interaction was beneficial as students received more exercises with instant individual feedback, multiple attempts, access to video and animation from the web-based online system as indicated in the following quote:

STUDENT E: ...*it helped with video thing, everything. I think we got more work in Wiley, than we could in class because we would get feedback right there and there and then you know that I'm wrong here.* [sic]

Research Question 6: How many hours per week do students spend on web-based exercises?

Most students (56%) spend 2-4 hours per week completing web-based homework and other Wiley PLUS activities such as reading the e-book, watching videos and animations, while 29% of students spend 0-2 hours and 9% spend between 4-6 hours.

STUDENT F:... *Okay, ja it helped me with my marks because sometimes I would spend like four hours in Wiley sometimes like – let me say most of the time when I'm at IT Centre then I'd be like, let me just open Wiley and do some questions or read. Wiley, I have the book as well. So sometimes I do not need to go to the IT Centre, I would just stay in my room and then do some questions and then read.*

Students also indicated that they used Wiley PLUS online system to catch up with the work if they missed a class:

STUDENT G:...*Like some of the topics that we did example, like I think it was Heat Transfer, I was not in class that time and then I sat down with my Wiley PLUS e-book in my room and then I studied. And then I found it easy...*[sic]

The above results support Jones's (2008) findings in an accounting course, which indicated that 49.4% of the students spent between 2-4 hours per week completing web-based homework, which was over and above time spent on any paper-based homework required for the class.

Research Question 7: Do students believe web-based homework enhances learning?

Over 75% (32% strongly agree; 44%-agree) of students reported that *Wiley PLUS* web-based homework enhanced their learning of the physics course content. Only 9% of student disagreed, while 15% neither agreed nor disagreed. The survey results corroborated with Jones's (2008) findings, which showed that 71.1% of the accounting students reported that using *Wiley PLUS* enhanced their learning of the course content. Additionally, Tan *et al.* (2002) reported similar findings (over 64% agreed) in a calculus and a physics course using Web Assign online system. The researchers in this study are in agreement with Jones (2008) in suggesting that irrespective of which online system is used, online homework based systems seem to be perceived to enhance learning of the course material.

Research Question 8: What is the ideal number of attempts students should be allowed before assignment submission?

Students were asked to indicate the number of exercise attempts they preferred before submitting Web based homework for final grading. The results showed two opposing views among students, with 53% of students preferring 1-2 attempts and 47% preferring 2-3 attempts. The students who indicated 1-2 attempts felt that too many attempts encouraged a trial and error approach on the homework completion, while those who advocated for more than one attempt indicated that it helped them to learn and also try different ways of solving problems:

STUDENT I:The reason why we have more than one attempt is because we need to learn, you can't just do it once and get the answer. You have to try different ways of getting that answer. So I don't think that they have to reduce the number of attempts.

However, the idea of multiple attempts was said to have also promoted cheating collaboration among students on completion of assignments especially multiple choice type questions. In this regard, students sat in groups of three and each made a choice until one got the correct answer on the first attempt. Those students who got the wrong answer on their first attempt could use their second chance to answer the question based on their peers' correct answer:

STUDENT J:... Because if you sit as she said, three, then if I click A, and she clicks B, she clicks C then the second time we're going to click D, then obviously D's the right answer.

The above results may explain why some of the students performed lower than 50% in the paper-based tutorial mock test, while in the *Wiley PLUS* web-based homework assignment system they scored higher marks (see figure 1). It seems that students' marks on the *Wiley PLUS* assignments did not lead to better student performance on the paper-based tutorial mock and mid-test as 37% of students' overall scores were above 50% on *Wiley PLUS*, but less than 50% on paper-based tests with no multiple attempt. These results may also be attributed to students' cheating collaboration and many indicate that some of the students did not understand the purpose of web-based homework as a formative assessment.

Research Question 9: Are exercise hints and links to electronic and online animation helpful in clarifying what is required?

Over 90% (50%-strongly agree; 47% agree) of the students indicated that *Wiley PLUS* online exercise hints were helpful in giving students clues of how to solve a problem and hence enabled them to understand concepts. The usefulness of hints was also confirmed during students' focus group interview;

STUDENT H:... Like for me, ma'am, I liked it very much in the sense that it provided more time to actually do the questions and then if you went wrong it gives you a hint on how to tackle it. Then if you went wrong the second time then, maybe it pops the answer so that you can read how the answer should be done...

These results are contrary to what Jones (2008) in a study using *Wiley PLUS* WBH in an accounting course found when only 43.3% of the students found hints provided by the *Wiley PLUS* system to be helpful, while 25.3% of students neither agreed nor disagreed and 31.4% did not agree on the value of hints to be useful. Students also appreciated the availability of hyperlinks to other media texts such as video, animations and electronic e-book version provided by the author.

STUDENT I:... What I liked about the Wiley Plus it's the thing, the videos and the hints like after reading you study, you do some questions and then if the questions, they are not clear, like some

times you do not understand the questions clearly. So we view the thing – the clips, we watch the videos and then they explain how it's done and stuff like that and then after that if still you don't understand still, they give you a hint and then you do it and then you get it correct. [sic]

The provision of hyperlinks to other texts also resulted in students taking full control of their learning, independent learning, and it promoted a learner-centred approach to learning.

Research Question 10: Is there a correlation in student performance on WBH compared to the paper based tutorial mock test, mid-term averaged test and FISA?

A series of paired sample t-tests was done to compare the average marks students scored on the *Wiley PLUS* WBH with the marks obtained in the tutorial mock test, mid-test and FISA. The first paired sample analysis was run to determine if there was a correlation between the WBH and paper-based tutorial mock test. Findings indicated that a significant strong positive correlation existed between the WBH and paper-based Tutorial test with a correlation coefficient ($r=0.5068$) and t-test value of 3,9436 at a critical value of 2,014 ($\alpha=0,05$), suggesting that students who scored high on the WBH tended to score high on the paper-based tutorial test. Likewise students who perform low on WBH also tended to perform low on the paper-based tutorial mock test (see figure 2). Figure 2 below clearly shows that 52% of the students with high scores of ($\geq 50\%$) in WBH scored high ($\geq 50\%$) on paper-based tutorial mock test. Likewise, 11% of the students with low score on WBH ($\leq 50\%$) scored low on paper-based tutorial mock test.

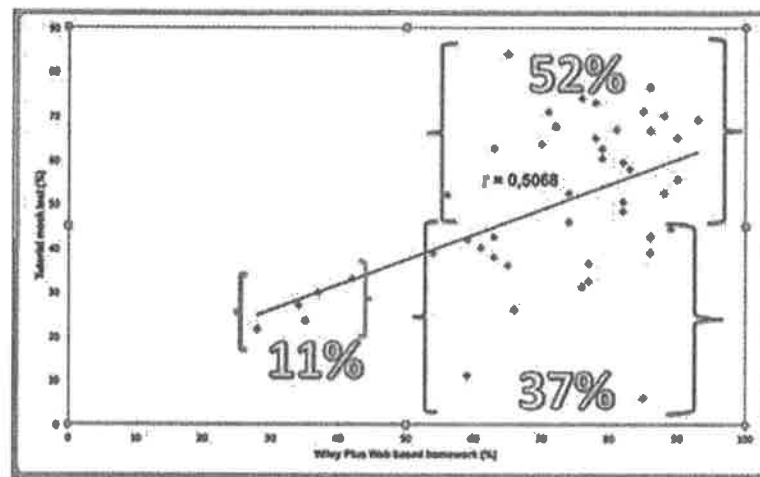


Figure 2: Correlation between *Wiley PLUS* marks compared with paper-based tutorial mock test

Only 37% of the students who scored high on *Wiley PLUS* scored low on the tutorial mock test. This may be due to students' cheating collaboration as indicated in Research Question 6. Additionally, the mean score on WBH was also high at 70% compared to 49% on the tutorial mock test.

The second paired-sample analysis was run to determine if a correlation existed between WBH and Mid-term test. Results showed that a positive correlation existed between the WBH and mid-test marks, with a correlation coefficient of $r=0.4805$ (see figure 3) and t-test value of 3,6753, with a critical value 2,014 ($\alpha=0,05$). These results showed that students who scored high on WBH also score high on mid-test, while students who scored low on the WBH also scored low on the mid-term test (see figure 2). Figure 3 illustrates that 52% of students with high score on WBH performed well on the mid-term test, while 37% of the students who scored high on *Wiley PLUS* WBH did not score high in the mid-term test. Although the results showed a coincidence of the same percentage (52%) and (37%) score as in the first paired sample analysis, the percentages do not represent the same group of students as in the first paired analysis but a mix, as some of the students who scored 50% and above on the paper-based mock test scored lower than 50% on the mid-test. The mean (70%) score for WBH was still high compared to the mid-term test, which was 48%.

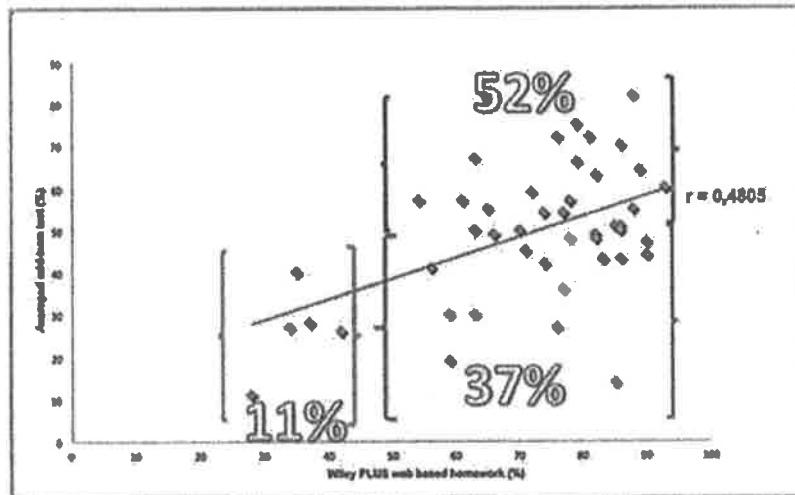


Figure 3: Correlation between *Wiley PLUS* marks compared with averaged mid-term tests

The third paired-sample analysis was run to determine if a correlation existed between WBH and FISA marks (FISA covers all sections in Physics 1 and it is done at the end of the semester). The results indicated a significant positive correlation between WBH and FISA marks, with a correlation coefficient $r=0,6532$ (see figure 4) and t-test value of 4,9948 at a critical value of 2,014 ($\alpha=0,05$). These results suggests that students who scored 50% and above on WBH had a higher chance of scoring 50% and above on the FISA. The FISA mean score was 52%, which was slightly higher, compared to paper-based tutorial mock test and mid-term test.

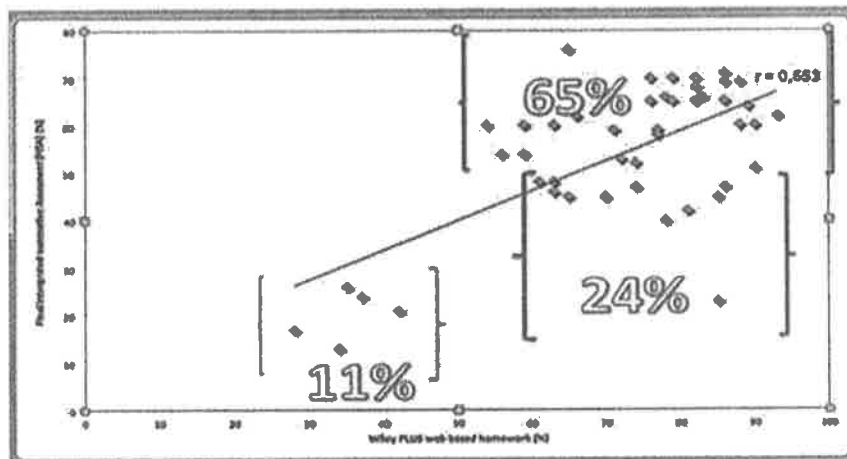


Figure 4: Correlation between *Wiley PLUS* marks compared with Final Integrated Summative Assessment (FISA)

Figure 4 indicates that 65% of the students who scored 50% and above on WBH also scored 50% and above on the FISA. The same 11% of the students who had low scores on the paper-based mock test and the mid-term test also obtained low scores on the FISA. The results also showed that the 20% of students who scored high scores on WBH consistently obtained higher scores in the paper-based tutorial mock test, mid-term test and the FISA.

10. Conclusions and recommendations

The *Wiley PLUS* web-based online system was used in this study as an adaptive medium, supporting what Laurillard's describe as "interactive activity". The finding of the study showed that there was a strong positive correlation between WBH marks compared to paper-based tutorial mock test, mid-term test and the FISA. Furthermore students indicated that they preferred web-based homework with individualised feedback compared to ungraded paper-based homework as it enhanced their learning. There was overwhelming agreement amongst the students that if homework was not collected and graded, they would spend less time practising course concepts. Additionally, results showed that some students cheated in their engagement with the online homework by practising what the researchers in this study call and define as cheating collaboratively, which perhaps hindered their understanding of the course contents. To solve this problem, the researchers are

of the opinion that randomised questions and also reduced mark allocation if students get the answer on their second attempt before submitting the homework may be a suitable solution. Furthermore, the instructor should explain clearly to the students the purpose of the online-based homework (which is for formative assessment) so as to ensure that students use the resource to enhance the understanding of the course contents instead of just doing it for marks.

References

- Bonham, S., Beichner, R. and Deardorff, D., (2001). "Online homework: Does it make a difference?". *The Physics Teacher*, Vol. 39, No. 5, 293-296.
- Bonham, S.W., Deardorff, D.L. and Beichner, R.J., (2003). "Comparison of student performance using web and paper-based homework in college-level physics". *Journal of Research in Science Teaching*, Vol. 40, No. 10, 1050-1071.
- Bryant, S.M. and Hunton, J.E., (2000). "The use of technology in the delivery of instruction: Implications for accounting educators and education researchers". *Issues in Accounting Education*, Vol. 15, No. 1, 129-162.
- Caracelli, V.J. and Greene, J.C., (1997). "Crafting mixed-method evaluation designs". *New directions for evaluation*, Vol. 1997, No. 74, 19-32.
- Demirci, N., (2007). "University Students' Perceptions of Web-Based vs. Paper-Based Homework in a General Physics Course". *Online Submission*, Vol. 3, No. 1, 29-34.
- Frailich, M., Kesner, M. and Hofstein, A., (2007). "The influence of web-based chemistry learning on students' perceptions, attitudes, and achievements". *Research in Science & Technological Education*, Vol. 25, No. 2, 179-197.
- Hauk, S. and Segalla, A., (2005). "Student perceptions of the web-based homework program WeBWorK in moderate enrollment college algebra classes". *Journal of Computers in Mathematics and Science Teaching*, Vol. 24, No. 3, 229-253.
- Huberman, A.M. and Miles, M.B., (1994). "Data management and analysis methods". Vol., No.
- Jang, S.-J., (2009). "Exploration of secondary students' creativity by integrating web-based technology into an innovative science curriculum". *Computers & Education*, Vol. 52, No. 1, 247-255.
- Jones, C.G., (2008). "Student perceptions of the impact of web-based homework on course interaction and learning in introductory accounting". *Issues in Information Systems*, Vol. 9, No. 223-232.
- Laurillard, D., (1997). "Learning formal representations through multimedia". *The experience of learning*, Vol. 2, No.
- Laurillard, D. (2013). "Rethinking university teaching: A conversational framework for the effective use of learning technologies". Routledge.
- Mestre, J., Hart, D.M., Rath, K.A. and Dufresne, R., (2002). "The effect of web-based homework on test performance in large enrollment introductory physics courses". *Journal of Computers in Mathematics and Science Teaching*, Vol. 21, No. 3, 229-251.
- Tang, G. and Titus, A. (2002). "Increasing student time on task in calculus and general physics courses through WebAssign", ASEE Annual Conference & Exposition.