Amsterdam University of Applied Sciences

PROFESSIONAL ASSIGNMENT PROJECT

EUROPEAN SCHOOL OF PHYSIOTHERAPY

SEMESTER 7

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TOPIC: THE EFFECTIVENESS OF BLENDED LEARNING VERSUS TRADITIONAL LEARNING IN HEALTHCARE STUDENTS AND ITS IMPLICATIONS FOR THE IMPLEMENTATION IN THE PHYSIOTUTORS WEBSITE

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CREATING TOMORROW

Preface

The professional assignment project (PAP) takes place during the 7th semester of the curriculum of the European School of Physiotherapy (ESP). The aim of the PAP is to work out a question that is relevant to the profession of physiotherapy and to guarantee its practical application. With the successful completion of the PAP, students show proficiency on the professional KNGF role “The physiotherapist as a developer” as well as the role of “The physiotherapist as a manager”. (Koninklijk Nederlands Genootschap voor Fysiotherapie (KNGF) 2006)

The following review plus the justification of our website based on the findings from the review constitutes our professional assignment project.

The client for our project is Jan-Jaap Voigt (MSc. Physiotherapy), representing the European School of Physiotherapy (ESP).

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Prologue

How it all started

During our own studies at the European School of Physiotherapy (ESP), we had to absorb a great amount of content from practical lessons and try to remember the information in a short amount of time.

Unfortunately, most of what we have covered got lost after (or even worse, before) the completion of the exam, however, this content is very crucial and will continue to be relevant during later semesters and internships. Eventually, students will have to hit the books again – mostly Magee (Magee 2014) in case of ESP students – to look up a special test in order to assess the patient's complaints. The existing problem is that the book often only contains a written description about the test or, at best, one or two illustrations.

In our opinion, practical knowledge and skills need to be taught in a more visual way – either in person or with the help of videos. As such, we decided to become tutors for the subject 'Physiotherapeutic Assessment 1' when we were in our second year at the ESP in order to teach practical skills to the new students as well as refresh our own memories regarding our own skills. However, in live sessions content is not explained more than a couple of times until it is time to move on to the next topic. While we could retain most of the content of the 'Physiotherapeutic Assessment 1' classes by repeating it in the role as tutors, most of our 1st year students were struggling with the exact same issues previously mentioned.

Vision

So why not use videos in order to look up a special test on YouTube? This is exactly what we did ourselves. Prior to beginning our YouTube channel, we ran into several issues while searching for practical videos on the Internet. Sometimes useful and of high quality videos can be found, but there are also videos of unacceptable video and sound quality, videos containing lousy content, or videos that would only perform the test in 20 seconds without any explanation.

How credible is the content of a YouTube channel that has only posted one or two videos about physiotherapy?

How trustworthy is the content of a channel that has been last updated more than one year ago?

How useful is a special test when one can't be sure what signs or symptoms one are looking for? What is a positive or negative test and what are its statistical values?

These are a handful of problems we encountered ourselves, which led us to the idea to start Physiotutors. While it started out as a small platform to sum up the content that we covered

during our tutor classes, our goal became to solve the challenges mentioned above. Our vision is to create high-quality videos regarding content and presentation, whilst providing our students with a platform of physiotherapeutic assessment videos that can guarantee them consistency. Therefore, we are always trying to include the latest scientific research in our videos, as well as offer enough background information to our students without overloading them at the same time.

Physiotutors as our PAP

With a growing number of videos and steady improvement of our audiovisual and content quality, our channel has now reached more than 2.100 subscribers and more than 110.000 views on YouTube. We then thought that what proved to be a successful concept in practice should also potentially be combinable with our PAP at the ESP. Therefore, our suggestion to the school was to use our website www.physiotutors.com as our product and create the so-called ESP-Zone, which should be an e-learning environment for the subject 'Physiotherapeutic Assessment 1'. In addition to giving 1st year students of the ESP the ability to review the content of their face-to-face classes, this online module should stimulate them to "connect the dots" with other subjects and to improve their clinical reasoning process. This should be achieved with the help of different instructional design elements that prove to be valuable according to the literature. Additionally, individual leaning and personality types should be taken into account in order for the 1st year students to achieve maximal acquisition of knowledge, skills and satisfaction.

However, while the product had already taken on concrete forms, the question still remained regarding whether such a blended learning approach between an e-learning environment and face-to-face classes would be beneficial for our target group. Furthermore, which learning and personality types can profit from such an approach, and which elements does an e-learning environment have to contain to accommodate these different types?

The answers to these questions will be given by this thesis that follows below.

The effect of a blended learning approach vs. traditional learning regarding skills and knowledge gains in health professions

Introduction

Internet usage is still growing worldwide with more than 3 billion users connected in 2015. This equals a penetration of more than 40% of the world population, with the Netherlands placing sixth between Norway and Denmark with a penetration of 96,08% (Real Time Statistics Project 2015).

While growing, it has permeated all areas of life, including education in the medical field. As methods of teaching clinical reasoning to students in the medical field continue to evolve, the need to develop and refine methodical approaches is ongoing (Turner et al. 2006).

One approach is to establish an online learning environment that can potentially be enriched with multimedia features.

While Chumley-Jones et al. (2002) titled their review with the question “Web-based learning: Sound Educational Method or Hype?” in 2002, little doubt now remains about the fact that e-learning in the medical field was not only a hype as it is more prevalent than ever(Ruiz et al. 2006).

Stewart et al. (2013) add that, especially nowadays, blended learning is extensively used in medical education.

While Chumley-Jones et al. (2002) could not define web-based learning’s unique educational contribution at that point in time, more evidence for its benefits kept emerging.

Advantages of e-learning

A few years later, Potomkova et al. (2006) mentioned the advantages of e-learning in their literature review such as accessibility, ease of use, freedom of navigation, high quality medical images and the possibility of repeated practice. These are several of the reasons why medical students preferred web tutorials over traditional lecture based classes.

In addition to the abovementioned advantages, Stewart et al. (2013) contributes that, a blended learning approach adds standardization of content, learner autonomy and cost-efficiency.

From a financial point of view, a web-based training (WBT) can be beneficial over a session with a standardized patient according to the randomized-controlled trial (RCT) of Turner et al.

(2010). The set-up costs of a standardized patient and a WBT were comparable, but the ongoing costs of a WBT were lower, suggesting that web-based teaching may be a viable strategy. On top of that, Maloney et al. (2012) proved that a web-based learning environment was clearly more cost-effective for the education provider when compared to face-to-face teaching.
While Wutoh et al. (2004) could prove that internet-based medical education programs are just as effective as traditional formats when it comes to changes in participant knowledge, they still questioned if this knowledge could also be transferred into practice.

In an extensive review of George et al. (2014) including 95 different studies on e -learning in the field of health professions, online e-learning showed to be equivalent and possibly superior to traditional learning, not only when it comes to knowledge gains, but also regarding skill acquisition.
The same authors found no significant differences in students´ attitudes or satisfaction, which are important aspects when it comes to the usage rate of a web-based program.

Barriers of e-learning

On the contrary, a few drawbacks have commonly been described in the literature regarding e-learning. Technical issues, student isolation and the missing interaction in a regular classroom are mentioned by (Grimes 2002).
Childs et al. (2005a) conducted a literature review in order to identify barriers of effective e-learning for health professionals and students, in which the author also proposed possible solutions to these barriers.
The main barriers that have been identified in this review were: requirement for change, costs, poorly designed packages, inadequate technology, lack of skills, need for a component of face-to-face teaching, time intensive nature of e-learning and computer anxiety.
It seems that many of these barriers must have changed over time supposedly due to technological advances and the fact that the use of computers and of the Internet has become normal (Real Time Statistics Project 2015).
Nowadays, it is hard to imagine that technical problems, like slow Internet connections, are a problem anymore in the Western World with average download speeds of 15,2 mbps measured in the Netherlands in 2015 (Statista GmbH 12/2015).
This being said, Macznik et al. (2015) report minimal evidence of barriers for the use of online technologies. At the same time, they still advise to address the identified issues to enhance adherence to the use of online technologies in health professionals' education.

So while technical issues, computer anxiety, costs, inadequate technology and lack of skills should hardly be a complication anymore, the question still remains regarding how student isolation and lack of interaction can be compensated for.
According to the authors, blended learning, the combination of traditional classroom teaching and e-learning, can be an approach to combine the advantages of both worlds.

Definition of the problem

It has been proven that e-learning can be as effective as and possibly superior to traditional methods in health professions (George et al. 2014). Moreover, McCutcheon et al. (2015) suspected that blended learning might even be more suitable for health care education because it combines the need of hands-on-skills-based training on a practical level with self-directed learning.
However, there is lack of evidence in the literature to support this hypothesis.
While Macznik et al. (2015) and George et al. (2014) proved that e-learning was as effective as traditional learning and possibly superior in the field of physiotherapy and in the medical field in general, no such a contemporary review has been carried out for blended learning yet.
Both of the mentioned authors included RCTs, which compared blended learning to traditional face-to-face methods, but the focus of these two reviews was solely on e-learning vs. traditional learning regarding skills and knowledge.
Therefore, this thesis will focus on the main research question; to examine if healthcare students are able to perform better when they use a blended learning approach in comparison to traditional face-to-face teaching regarding their skills or knowledge.
Furthermore, it will be discussed which learning and personality types can benefit the most from e-learning and how instructional design should be implemented in a digital learning environment to accommodate these different types.
The answers to the abovementioned research questions will form the foundation for the product and will influence which elements are used on the website www.physiotutors.com and within the ESP-Zone on the Physiotutors website in particular.

Methods

Eligibility criteria

Only peer-reviewed journal articles that research the effectiveness regarding knowledge and skill acquisition of blended learning versus traditional education in different health professions were included in this review.

Our definition of blended learning was a combination of traditional face-to-face classes given by a teacher plus additional learning material that was provided to the students online, which could have either been a website, educational videos or a specially designed e-learning environment or module.

Articles had to either measure skill, knowledge or both as their research outcome while outcome measures such as satisfaction or attitude were not searched for in particular.

Respective trials had to be conducted in the field of physiotherapy, medicine, nursing or occupational therapy.

Furthermore, only research articles following an RCT design, published in 2010 or after were included in the review. The decision to include only RCTs from the last five years was made in order to take the rapidly changing technical possibilities into account that have a great influence on the quality of an e-learning environment.

Language used in the RCTs had to be English or German.

Articles were excluded if: the e-learning part of the blended learning approach contained computer-assisted learning that was accessible offline, or if the e-learning part described games or virtual reality. The latter two were excluded because their complexity goes far beyond that of a website enhanced by multimedia and their implementation is more difficult to realize.

Search strategy

The main question to be researched was: “Are healthcare students able to perform better with a blended learning approach in comparison with a traditional face-to-face teaching regarding their skills or knowledge”?

To obtain maximal data and to reduce bias, a systematic search was conducted in order to identify relevant articles.

The search itself took place on 11th December 2015 using following databases:

CINHAL, MEDLINE, ERIC. Additionally, Google Scholar was used to obtain access to articles that were unobtainable through the aforementioned databases.

The keywords from table 3 were combined with the Boolean operators “OR” within columns, and “AND” between columns.

These keywords had to either be contained in the title or abstract.

In both searches, we filtered for RCTs on MEDLINE and CINAHL, as well as for journal articles on ERIC, where filtering for RCTs is unfortunately not possible.

Population	**Intervention**	**Outcome**	**Context**
-Student* -Pupil*	-e-learning - elearning -web-based -web based -video-based - video based -online -digital - blended - adjunctive	-grade* -performance* - effectiveness - efficiency - knowledge - skill* - GPA - clinical reasoning	- Physiotherap* - physical therap* - medic* - Nurs* - Occupational therap* -Health*

Table 1: Key words used in the search for the main question

The concrete search strings, which were used on EBSCOhost research databases for CINAHL, MEDLINE and ERIC, are presented in the following table:

TI (student* OR pupil*) AND TI (e-learning OR elearning OR web-based OR web based OR video-based OR video based OR online OR digital OR blended OR adjunctive) AND TI (grade* OR performance* OR effectiveness OR efficiency OR skill* OR knowledge OR GPA OR clinical reasoning) AND TI (physiotherap* OR physical therap* OR medic* OR nurs* OR occupational therap* OR health*)
AB (student* OR pupil*) AND AB (e-learning OR elearning OR web-based OR web based OR video-based OR video based OR online OR digital OR blended OR adjunctive) AND AB (grade* OR performance* OR effectiveness OR efficiency OR skill* OR knowledge OR GPA OR clinical reasoning) AND AB (physiotherap* OR physical therap* OR medic* OR nurs* OR occupational therap* OR health*)

Table 2: Concrete search strings for MEDLINE, CINAHL and ERIC databases

Furthermore, the authors made use of literature obtained through references from the articles that were found following the outlined search strategy.

Selection of studies

The process of study selection is outlined in figure 1.

All duplicates were removed with the help of the bibliographic software RefWorks.

Afterwards, the records were screened for title and abstract regarding their eligibility.

At last, the remaining articles were full-text screened and analyzed.

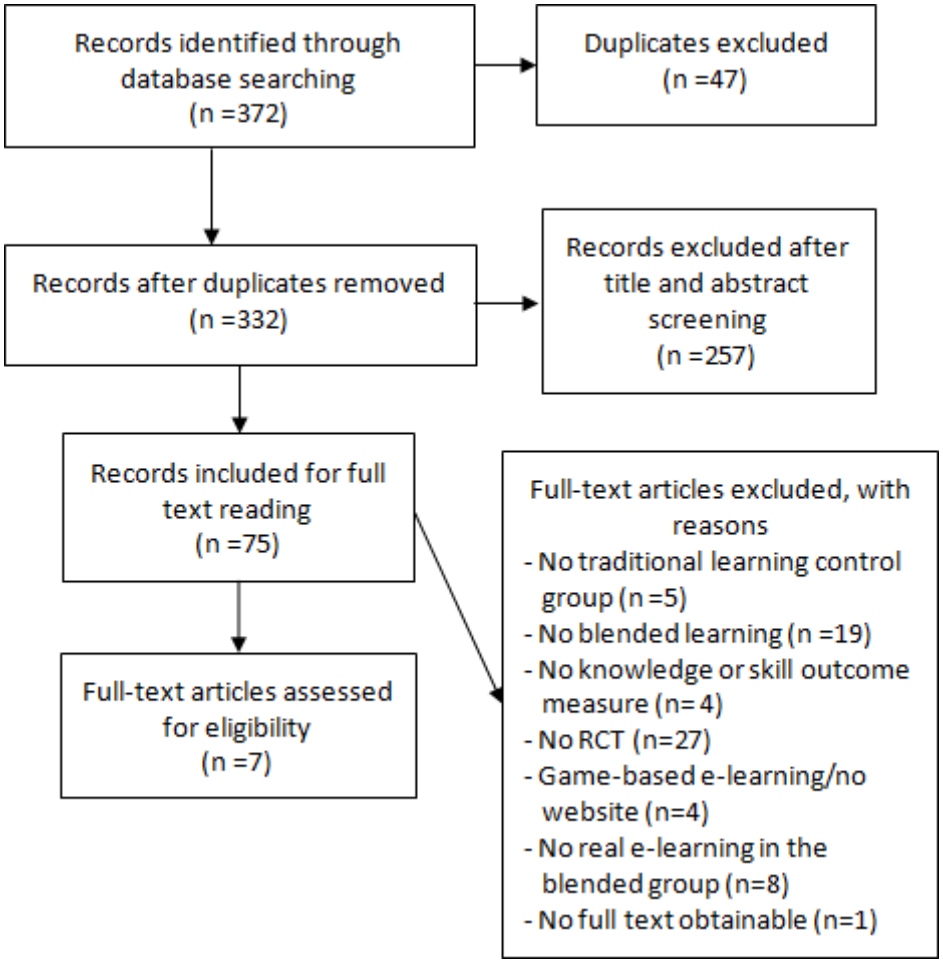

Figure 1: Search outcomes and flow of the studies

Assessment of risk of bias

The selected articles were read and analyzed by the authors for the level of evidence and graded on the PEDro scale. The PEDro scale was used as a qualifying standard (de Morton 2009) to compare articles as no specific scale exists to assess risk of bias in educational studies. The number of 'Yes' answers to each of the eleven items on the PEDro scale are summed and listed in Appendix I. The authors decided to exclude articles with a number of 5 and below in order to avoid high risk of bias.

Results

Search results

The results of the search and the flow and number of studies screened are presented in Figure 1. After the title and abstract search, a total number of 372 records were retrieved. After the removal of duplicates, the authors were left with 332 articles that were screened for title and abstract as well as for publication type.

Of the 75 studies, which were eligible for full text reading, five articles were excluded because they either did not have a control group or their control group was no traditional face-to-face cohort. Furthermore, 19 articles did not use a blended learning approach as their intervention group, four articles did not measure knowledge or skill performance as their outcome measure, 27 articles did not choose for an RCT design and four articles wrote about game-based e-learning. Another eight articles were excluded as their e-learning part in the blended intervention group was not real e-learning according to the authors' definition, but computer-assisted offline learning. At last, one article was not obtainable in full text and was therefore discarded.

Therefore, after screening, a total number of seven articles met the inclusion criteria for this review and were accepted for final analysis.

Study characteristics

All of the included articles were published in the English language, but they were originally conducted in five different countries (two in Spain, two in Australia, Brazil, Canada and Thailand). According to our inclusion criteria, all of the articles used the design of an RCT.

In a combination of each article, a total number of 405 participants were investigated, with 16 being the smallest sample size (Silva et al. 2012) and 112 as the biggest sample size (Gagnon et al. 2013).

Out of seven studies, three were conducted in the field of physiotherapy with second year students (Arroyo-Morales et al. 2012), undergraduate students (Cantarero-Villanueva et al. 2012) and fourth year undergraduate students (Silva et al. 2012).

Another two studies were executed with nursing students in their first undergraduate year (Gagnon et al. 2013) and during their midwifery practicum II (Gerdprasert et al. 2011). The two studies conducted in the medical field had second year students as their sample population (Hibbert et al. 2013) and undergraduate students following their eight week pediatric rotation (Stewart et al. 2013).

All studies investigated the effectiveness of blended learning versus face-to-face teaching as the control group. Hibbert et al. (2013) hereby focused on revision with the help of videos in comparison with traditional methods.

The other six articles provided the students in their intervention group a web-based learning environment on top of traditional classroom lectures. Two articles solely had knowledge as their main outcome measure, three articles focused only on skills, while the remaining two articles measured both, knowledge and skill outcomes in their research.

Quality of articles

The quality of the studies ranged from six to eight on the PEDro checklist, which means that no articles were excluded due to the agreed cut-off point of below six. While six to eight positive items on the list do not seem high, it has to be mentioned that due to the nature of the intervention, it was not possible to blind the subjects. Therefore, a realistic maximum that could have been achieved is ten points on the scale.

Results of individual studies

Study	Discipline	Know-ledge	Skills	No. of parti-cipants	Characteristics	PEDRO score	Field
Arroyo-Morales (2012)	Physiotherapy	ND	B	46	IG: 5h classes + 20h website CG: 5h Classes + 20h documents and books	7	Palpation + ultrasound
Cantarera-Villanueva (2012)	Physiotherapy		B	44	IG: 6h classes + 20h website CG: 6h classes + 20h documents and books	8	Palpation + ultrasound
da Silva (2012)	Physiotherapy	B		16	IG: classes + website CG: classes + conventional written material	6	Bronchial hygiene
Gagnon (2013)	Nursing	ND		112	IG: 5 classroom session + 11 interactive modules CG: 13 classroom sessions	6	Nursing research
Gerdprasert (2011)	Nursing	B	B	84	IG: traditional teaching + suppl. web-based learning CG: traditional teaching	6	Intrapartum nursing care
Hibbert (2013)	Medicine		B	22	IG: classes + video-learning CG: classes + revision as usual	6	Clinical endicrinology
Stewart (2013)	Medicine		B	81	IG: standard teaching + online learning module CG: standard teaching	8	Newborn examination
B = Blended learning siginificantly better, ND = No significant difference between groups, IG = Intervention group, CG = Control group							

Table 3: Overview of the results of the individual studies

An overview of the results of the individual studies can be seen in table 3 above.

When it comes to knowledge, two studies proved that the knowledge gains in the blended learning group were significantly greater than in the traditional group (da Silva et al. 2012, Gerdprasert et al. (2011), while another two studies could not detect a difference in knowledge outcomes between the intervention and the control group (Arroyo-Morales et al. 2012, Gagnon et al. 2013). In two of the studies, both groups attended the same live classes

together and were then given two different options to prepare for the exam: a website with the course content for the intervention group and written material for the control group (Arroyo-Morales et al. 2012, da Silva et al. (2012). One study had an unequal amount of live classes with five face-to-face classes for the intervention group and thirteen classes for the control group, while the intervention group was given eleven interactive modules in addition to the traditional classes (Gagnon et al. 2013).

Unfortunately, only little attention was given to the monitoring of the total study time spent in the respective groups. Arroyo-Morales et al. (2012) mention five hours of presence classes and 20 hours of non-presential study time during a three week period for both cohorts, although the actual time students spent studying was not monitored. The RCT by Cantarero-Villanueva et al. (2012) had a similar approach with just one hour of live classes, but the other characteristics were exactly the same with the exception of two instead of three weeks of study time. The article by da Silva et al. (2012) only accounted for a two week study period without giving further details. Furthermore, Gagnon et al. (2013) did not state any length or time that was spent on live classes or the e-learning module. Unfortunately, the only study that really monitored access time to the website was Gerdprasert et al. (2011), who mentioned an average access time of 5.10 ± 2.76h, but did not control for the time students spent studying in the control group. Hibbert et al. (2013) at least measured the number of accesses to their videos (1-3 times), with each ranging in duration from 33-48 minutes. They also assessed the time that students claimed to practice with real or surrogate patients, which accounted for 33-48 minutes as well, but a broad range was found from 0-14 minutes until more than three hours. However, no separate study time per group was mentioned. Both groups in this study had two tutorials per week for four to six weeks and one single live lecture before. Their OSCE exam took place two weeks after the randomization. At last, the study of Stewart et al. (2012) solely mentions that their RCT took place during an eight week pediatric rotation, but the author did not take any study time in the respective groups into account.

In order to examine knowledge outcomes, two articles (Arroyo-Morales et al. 2012, da Silva et al. 2012) used multiple choice questions (MCQ) with 20 questions each, while Gerdprasert et al. (2011) measured knowledge with 15 scenario questions in a conceptual knowledge test. Gagnon et al. (2013) conducted two exams, one at mid-term and at the end of their intervention, but did not mention further details about the form or items of knowledge examination.

For skills assessment, three RCTs (Arroyo-Morales et al. 2012, Cantarera-Villanueva et al. 2012, Hibbert et al. 2013) used objective structured clinical examinations (OSCE). The other two authors used a performance skill checklist with fifteen items (Gerdprasert et al. 2011)

and 40 items respectively (Stewart et al. 2013). In all cases, assessors that were experienced in the respective subject graded the skills performances.

An interesting finding in the RCT of Gagnon et al. (2013) is that less motivated students performed significantly better in the blended approach compared with the traditional approach. Additionally, students with a high self-directed learning readiness (SDLR) at baseline significantly improved their SDLR in the intervention group compared with the control group. Conversely, students with a low and medium SDLR score significantly improved their SDLR more than the traditional face-to-face classes.

With regard to skills as the main outcome measure, all five RCTs found a significantly higher skill performance in the blended group in comparison with the traditional group. (Arroyo-Morales et al. 2012, Cantarera-Villanueva et al. 2012, Gerdprasert et al. 2011, Hibbert et al. 2013 and Stewart et al. 2013).

While one study found greater improvement of skills in the intervention group, they noted that students from this group also needed significantly less time to palpate anatomical structures, but more time to acquire the ultrasound image of the respective anatomical structure (Arroyo-Morales et al. 2012) compared to the traditional learning group. Another study mentioned that students of the blended learning approach group had significantly lower levels of ignorance-related stress during their internship in intrapartum nursing care in comparison with the control group (Gerdprasert et al. 2011).

Three articles (Arroyo-Morales et al. 2012, Cantarera-Villanueva et al. 2012, Stewart et al. 2013) mention that students in the intervention group were highly satisfied with the e-learning module. Two articles state that there was no difference in satisfaction between the intervention and the control group (Cantarera-Villanueva et al. 2012, Gagnon et al. 2013).

Gerdprasert et al. (2011) assessed the students' perception of the web-based module for usefulness, web design and online strategy and found an outcome of 91.1 out of 100, which is very high according to the author.

Discussion

This review is one of the first to exclusively examine the effects of blended learning versus traditional classroom teaching regarding knowledge and skills acquisition in the field of health care. It fills the gap for the latest evidence regarding blended leaning in healthcare that has emerged after the first review on this topic by Rowe et al. (2012) who have examined all articles up until the year 2010. However, no overlap between our review and Rowe et al. (2012) exists. This is due to the fact that the only two articles that were included in Rowe et al. (2012) from 2010 did not have an RCT design and were thus not eligible for our review.

Our review included a total of seven RCTs with two articles solely measuring knowledge gains, three articles that had skill level as their outcome measure and two articles that combined both.

The overall quality of articles that we included was moderate with proper randomization and low attrition in all RCTs and a PEDro rating of at least six. However, high risk of bias still remains due to the fact that three articles did not compare knowledge or skill level for differences at baseline (Gagnon et al. 2013, Hibbert et al. 2013, Stewart et al. 2012) and another three articles did not mention any blinding of the assessors (Arroyo-Morales et al. 2012, da Silva et al. 2012, Gerdprasert et al. 2011). Only Stewart et al. (2013) managed to also blind the teachers to student participation and group allocation. While the risk of bias in the evaluation of an MCQ is still low with an assessor that is not blinded, blinding is especially important when assessors are grading skills performance. This is due to the fact that examination with the help of checklists or OSCEs is highly subjective and the lack of blinding can lead to distorted interpretation.

Another point worth mentioning is that the article of Gagnon et al. (2013) did not mention any details about the in-class exams that were taken for knowledge assessment, which leaves room for interpretation. Moreover, Gerdprasert et al. (2011) did not choose for multiple choice questions, but for a conceptual knowledge test, whose outcome is dependent on the assessors' subjective grading. In order to prevent subjective bias, they conducted a pilot study with 30 fourth year nursing students and estimated the reliability with 0.85.

In order to assess skill performance, three articles (Arroyo-Morales et al. 2012, Cantarera-Villanueva et al. 2012, Hibbert et al. 2013) used OSCEs, which is common practice in different health professions (Ross et al. 1988). The advantage of this method is that students rotate through different stations with different tasks and different examiners, as well as real or simulated patients. In this way, stations can be standardized and enable fairer assessment in comparison with the classical examination, where a student is assigned to only one examiner. This traditional way of skills assessment was used in the RCTs, done by Stewart et al. (2013) with a checklist with 40 different items, as well as in the RCT by Gerdprasert et al. (2011) with fifteen different items. In addition to the drawback of the form of examination, the latter RCT relied on an assessor that was also not blinded to the cohort, which comprises the quality of outcome measurements severely.

Regarding knowledge gains, 50% of the analyzed RCTs (2/4) reported higher knowledge gains in the blended group in comparison with the traditional cohort. The other 50% stated that no significant difference was found between intervention and control group.

In the research of Gagnon et al. (2013) this might be due to the fact that the blended group had only five live classes while the control group received thirteen sessions. So in this case, the e-learning part had to partially replace face-to-face classes, which at least resulted in the

same outcomes regarding acquired knowledge. Taking this outcome into consideration, one might argue that it could be advisable for educational institutions to replace some of their classes with e-learning modules. This, in turn, would enable the institution to save financial and logistic resources for teachers and rooms and is in line with the findings of Maloney et al. (2012). They concluded that a web-based educational approach is clearly more efficient from the perspective of the education provider and that a lower number of enrollments are necessary to reach a program's break-even point.

Outcomes are homogenous when skill acquisition as the main outcome measure was observed: all of the studies (5/5) stated that the blended learning group had better skills performance than their face-to-face only counterpart.

An interesting finding of Gerdprasert et al. (2011) is that students in the intervention group experienced less ignorance-related stress during their clinical internship at the intrapartum nursing care. In fact, students in the blended group scored significantly lower on the stress questionnaire in comparison with the control group in the category 'ignorance-related stress'. This category assessed questions like "I know how to conduct normal labour, so I am not stressed" or "I have enough knowledge that I can pass this course, so I am not stressed" for example. This result could lead to the assumption that a blended leaning approach is not only beneficial during exam preparation during school periods. In addition, this result especially leads to the ability to revise study material in order to prepare for clinical experiences, which can support healthcare students in their self-efficacy and, therefore, lead to stress-relief.

Overall, although two studies were not able to detect a difference regarding knowledge outcomes, our findings suggest that blended learning is superior in comparison with traditional teaching for knowledge gains and especially skill acquisition.

Our findings point in the same direction as earlier reviews in the field of e-learning, which could observe that online technology enhances practical skill performance and knowledge acquisition in the field of physiotherapy (Macznik et al. 2015) and that online e-learning is at least equivalent and possibly superior to traditional learning (George et al. 2014).

Rowe et al. (2012), who conducted the first review solely on blended learning, came to the conclusion that online learning for clinical skills is no less effective than the traditional approach. One could argue that the latest developments in e-learning seem to have improved online learning to the extent that blended learning even turns out to be superior to face-to-face classes.

The participants in the included studies came out of the fields of physiotherapy, medicine and nursing. Therefore, the results of this review can be generalized to the respective disciplines. Furthermore, all of the RCTs' populations were undergraduate students and three out of

seven articles focused on physiotherapy students. Therefore, we strongly believe that our findings are transferable to students of the European School of Physiotherapy.

A question that still remains is if the e-learning part of the blended learning approach led to significantly better results or if this effect can be explained by the greater amount of time students invested on studying in general. Essentially, only Gerdprasert et al. (2011) monitored access time of the e-learning module and found a positive correlation (r = .88) between access time and performance skills scores. This finding might suggest that additional time spent with the study material led to better outcomes, rather than the e-learning module itself. However, this scenario is also realistic in our opinion, as students could be increasingly motivated by an additional e-learning opportunity, which might be more appealing to them than the traditional options they are used to.

Interestingly, students with low motivation in the research done by Gagnon et al. (2013) were the ones that benefited more from the blended learning opportunity than their control group counterpart. So, if this effect cannot be explained by a higher effectiveness of the e-learning part, then maybe it was the result of a longer study time of students with a low motivation, because they were stimulated to accomplish more.

Although the video group needed less than a third of the study time to achieve the same results, this is an area which has to be researched more closely due to the fact that is has been found that learning with the help of videos in comparison with textbooks had the same outcome (Steedman et al. 2012).

Our study has several strengths: the review is based on a thorough search of literature and all included studies were RCTs. Furthermore, only articles from 2010 or after were eligible, which ensured that our findings are contemporary and up to date in a field that is highly influenced by the rapid change of technological opportunities, especially regarding mobile devices. At last, this review combines findings from three different professions within the area of health care as well as from five different countries, which were both developed and developing countries. Therefore, it provides information on the effectiveness of blended learning in these respective settings.

On the other hand, the review had a few limitations. Due to time and resource constraints, only one author assessed included RCTs for their risk of bias. In addition, the authors could have been biased due to the fact that our product part of our PAP is an educational website that had been created prior to the execution of this review.

Learning and personality types and e-learning

With the exception of the article by Gagnon et al. (2013), no RCT took into account that different learning and personality types could have an influence on how well individual

students perform and how they perceive the e-learning environment of the blended learning approach. Therefore, a literature search was conducted by the authors in order to identify articles, which show how different learning and personality types should be accommodated in an e-learning environment. The search strategy can be found in Appendix II.

It has been found that teaching methods tailored to students' style of learning definitely improve their understanding, performance and retrieval of the subject when learning physiology (Anbarasi et al. 2015).

While the traditional teaching approach is a teacher-centered passive method, e-learning is shifting this approach towards an active self-directed learning approach (Ruiz et al. 2006).

Therefore, it is not surprising that e-learning especially empowers independent and self-directed learners (Sit et al. 2005) and that those self-directed learners are more successful in online education (Grimes 2002).

This is also shown as one of the results of Gagnon et al. (2013) who pointed out that learners with a high self-directed learning readiness (SDLR) could significantly raise their SDLR score with blended learning than the face-to-face control group. However, learners with a low or medium SDLR improved more in a face-to-face environment than with the blended approach. In the same RCT, the author could show that students with a low degree of motivation were able to perform significantly better regarding knowledge than those in the face-to-face only group. Like mentioned earlier, one could speculate if the reason for low motivation was due to the fact that the traditional classroom approach failed to motivate these students in the past.

One model to categorize different learning styles is the the VARK Learning Style Inventory. It distinguishes four different types: the visual (V), the auditory (A), the read/write (R) and the kinesthetic type (K). According to the research of Reynolds (2005), no specific learning style according to the VARK model had a significantly better outcome in neither online, nor face-to-face group. Furthermore, Jordanov (2001) described that students display a different learning style while using the internet in comparison with their usual learning style. Additionally, Muir (2001) confirms this finding as she states that online learning styles are always adaptable, while this is not the case for traditional learning styles.

While Wu et al. (2014) found no correlation between different learning styles and online course satisfaction; he still recommends to include as much variance as possible into the e-learning course in order to account for learning style differences.

One supposedly obvious barrier to e-learning, which has been mentioned in the introduction, is the lack of ICT knowledge. In the article of Wan et al. (2008), the authors confirm that students with prior experience in information seeking and communication via ICT (which they summarize under the topic virtual competence) allowed e-learners to learn effectively and feel satisfied with their experience.

Bishop-Clark et al. (2007) examined the effects of personality types according to the Myers Briggs Type Indicator (MBTI) and found that personality preference has little influence on web-based learning performance, but it does have an impact on satisfaction. In opposition what one might expect, the authors found that extroverts participate more in online courses than introverts. This finding was confirmed by (Daughenbaugh et al. 2002), who stated that e-learning appeals more to extroverts than to introverts. However, extroverts had a more difficult time relating to others. The same was true for the 'feeler type' of the model, who felt isolated. Sensing/Thinking types especially enjoy an online environment, because they are mainly interested in facts that can be collected and verified by their senses and they like to make their decisions in a linear step-by-step process (Bishop-Clark et al. 2007).

This observation has also been described by other articles in which sensory students demonstrated a higher level of online participation and intuitive types presented lower online participation. Higher participation, in turn, led to better performance (Huang et al. 2012).

Conclusion

In summary, our review found that blended learning is superior to traditional classroom lectures regarding knowledge and, especially, skill gains in the field of health professions. Although satisfaction was high in the blended groups, it seems that the e-learning part of the blended learning approach is not equally well received by different learning and personality types. In order to maximize the performance as well as student satisfaction, these different types have to be accounted for during the implementation of a blended learning environment.

Eventually, it appears that blended learning could be an interesting solution for educational institutions not only regarding the performance and satisfaction of their students, but possibly also from an economical point of view.

Stewart et al. (2013) has argued that the strength of the evidence is such that medical education research no longer to needs to ask 'if 'we should be using blended learning but rather 'when' and 'how' it should be used. The 'how' has especially not been sufficiently answered in the different articles that were included in our review. Therefore, we will elaborate on the components of a blended learning tool and their application in our product in the following part.

Physiotutors and ESP zone - a multimedia e-learning environment based on the latest findings from instructional design and learning/personality types

Introduction

Knowing now that e-learning has merit in healthcare education, we investigated which components should be included in setting up a successful e-learning tool from an instructional design point-of-view. The findings would later serve as the basis for building a custom blended-learning tool for students of the ESP. It is integrated into the Physiotutors website (www.physiotutors.com) and can be accessed under www.physiotutors.com/esp-zone.

In this part, we will briefly describe our target group, show how the needs, wishes and characteristics of this target group have been accounted for with the help of feedback surveys and how we can ensure that students with less virtual competence receive guidance. Additionally, the manner in which different learning and personality types have been accommodated in the e-learning module with the help of certain elements will be explained. The diverse ESP student population will be able to maximally benefit from these measures. Eventually, all of these measures are considered to achieve the best possible knowledge and skill gains as well as user satisfaction.

Finally, we recommend different scenarios to encourage high usage of the e-learning module and to give a perspective on the intended brand development of Physiotutors.

Target group

Our target group is first year students at the ESP who usually are completely new to the subject of 'Physiotherapeutic Assessment 1' and to the Dutch education system in general. Therefore, their prior skills before they start our course are low. Some students possess different knowledge or skills from their previous education that may serve as useful during their ESP career. 1 Also, it may very well be that the level of ICT skills varies amongst the students. Furthermore, important knowledge to better understand the background of the skills being taught in 'Physiotherapeutic Assessment 1' is mediated in the subjects 'Anatomy 1', 'Clinical Reasoning 1' and 'Case Study 1' amongst others. The more knowledge first year

students are able to obtain from these classes that are given in the very beginning of their education, the easier it will be for them to follow our course.

Traditionally, a class at the ESP comprises around 80 students in total from all over the world. When we started at the ESP, our class included students from over 20 different countries. This is one of the most striking characteristics of the ESP. Therefore, different learning cultures are accompanied by different language abilities of the students, even though the ESP sets a minimum English proficiency level. Furthermore, the age range in the program is quite broad and usually ranges from around 17-40. There are students who just graduated high school, while others already own a bachelor's or even master's degree or have been working on a job for years.

Despite all those differences, all students have one thing in common: they left their country to study at the ESP in Amsterdam, which shows that ESP students' motivation is usually above average. The ESP curriculum is an intensive program which requires the student to have a high level of independency and organization of their study career. In turn, these characteristics render ESP students predestinated for a learning approach that demands a high level of self-directed learning.

Instructional Design

In the e-learning part of a blended approach, instructional design should be taken into account in order to comply with the pedagogical guidelines. A well-designed e-learning module, containing good academic content and exercises, is motivating and its outcomes are as good as that of traditional lectures (Reime et al. 2008).

Prior to setting up content for an e-learning tool there should be some sort of needs-assessment that allows the designer to focus on the specific wishes of the learner, who will later make use of it (Childs et al. 2005b, Cook et al. 2006, Levac et al. 2015, Palloff et al. 2007).

Navigation

Learners that do not possess a high level of virtual competence should be given an introduction to the unfamiliar e-learning environment in order to ensure that they know where to find information and how to best use the online module. When a learner first gets in contact with the e-learning tool they should be welcomed and the tool should outline exactly what is contained in the learning module. The screen should be visually appealing with minimum text to avoid overwhelming the learner during the first contact with the site (Elkins

et al. 2015). Additionally, the website should be well designed so that navigation feels intuitive for the learner. The site should be built with clear sections with enough spacing between elements. All elements should be labeled and the font should be legible with text in size 10-12 to avoid confusion (Childs et al. 2005b, Elkins et al. 2015, Foreman et al. 2005, Rosen 2009). The site should use loose linear navigation. By doing so, the content will be aligned with the curriculum and, therefore, will enable self-pacing of the learning process. The learner will select what to learn and when to learn it (Childs et al. 2005b, Foreman et al. 2005, Palloff et al. 2007), which contributes to the element of individualization. The learner should not feel pressured to use the learning tool, but should have the option to use it at his or her convenience. After all, the tool should aim to help them and is not meant to cause additional stress (Allen 2007).

Learning objectives

The learner should know what each module contains and learning objectives should be set to clearly state the learning goals of the module. The literature seems to agree upon utilizing *Bloom's Taxonomy* when setting up learning objectives (Allen 2007, Brouwer et al. 2013, Foreman et al. 2005, Foster et al. 2014, Horton 2012, Masters et al. 2008).
If the learner is able to judge their proficiency prior to starting a module, the module may be skipped.

Feedback

The literature seems to contain an obvious consensus on the fact that feedback mechanisms are an essential part of e-learning. These mechanisms should follow a two-way stream where feedback from the tool to the learner is crucial to evaluate, reward and stimulate the learning process and feedback from the learner to the designer helps to improve the e-learning experience (Afifi et al. 2014, Clark et al. 2008, Cook 2006, Cook et al. 2010, Lewis et al. 2014).

Collaboration

Feedback should not just be a sequence of in- and output, but it should also facilitate learning amongst and from the learners. The literature evidently states that the e-learning tool should enable the learner to communicate and collaborate with other learners through means of sharing information, asking questions, posting assignments or working together on a task. Additionally, necessary resources should be provided by the tool (Brouwer et al.

2013, Childs et al. 2005b, Elkins et al. 2015, Horton 2012, Levac et al. 2015, Lewis et al. 2014, Liebowitz et al. 2011, Moule 2007, Palloff et al. 2007, Reeves et al. 2008, Rosen 2009, Rosenberg 2006).
Collaborative tools are especially useful in ill-defined problems that do not have a single right answer (Clark et al. 2008).

Assessment

As the ultimate goal of any e-learning tool is to increase proficiency in a subject, the e-learning tool should provide means for assessment. The assessments may range from short periodical questions over summative exams using several forms of questions (e.g. Multiple choice, fill-the-blanks) to case studies assessing judgment skills of more complex situations. Assessments make the e-learning tool more interactive; they reinforce necessary information, evaluate the learning process, motivate the learner to pay attention and may certify knowledge. It is crucial that the e-learning tool gives immediate feedback to test results free of judgment with detailed explanations guiding the learner in evaluating their performance (Afifi et al. 2014, Allen 2007, Cook 2006, Cook et al. 2010, Elkins et al. 2015, Horton 2012, Rosen 2009).

Multimedia

In e-learning, multimedia can and should be used as a pathway for knowledge transmission. Through the use of media, different learning styles can be targeted (Levac et al. 2015) and the content becomes more interactive, which, in turn, engages the learner (Allen 2007, Clark et al. 2008, Cook et al. 2010, Elkins et al. 2015, Foster et al. 2014 ,Lewis et al. 2014, Moridani 2007, Masters et al. 2008, Romanov et al. 2007).
Media, such as video, is especially valuable for demonstrative purposes of a mechanical application but needs an “offline” scenario to discuss and practice it (Elkins et al. 2015). Furthermore, the length of videos should not exceed 2-4 minutes, as this time frame seems to be the average attention span of a viewer (Rosen 2009).
Overall, the designer should strategically employ media and aim for the highest quality possible (Foreman et al. 2005, Haskin 2013, Lewis et al. 2014, Sandars et al. 2010).

Other

One crucial factor for the satisfaction of e-learning students is that learning and personality types are taken into account. Therefore, the instructional design of a website should be able

to provide several personality types with options to increase their satisfaction and performance.

Moreover, students should be assessed according to their ability to learn self-directed as literature suggests that students with a higher self-directed learning readiness benefit more from e-learning and vice versa. Additionally, students with a low SDLR should at least receive notice that online learning might not be suitable for them.

Lastly, the e-learning environment should also be customizable for smartphones and tablets. Hibbert et al. (2013) point out the advantages of flexible on-demand learning with the use of smartphones and tablets, which gives students the possibility of 'beside access'. This is, nowadays, especially important as 83% most of the students possess a smartphone with Internet connection according to the Bundesverband Digitale Wirtschaft (Lopez 2014).

Theoretical content of the website

The theoretical physiotherapeutic content for the videos in the learning environment was mandated by the course manual of the subject 'Physiotherapeutic Assessment 1' by the European School of Physiotherapy (Major et al. 2015-2016).

The backbone for the execution of techniques and special tests in the videos, as well as additional information that was included in the website to create an improved learning experience was based on the book 'Orthopedic Assessment' (Magee 2014).

In order to ensure high-quality content and to avoid discrepancies, both authors followed the courses of two different first-year classes in the subject 'Physiotherapeutic Assessment 1' at the European School of Physiotherapy.

When in doubt, the authors discussed the content with the teacher, Francesca Bosello, and in the last instance with the client and head of the skills line at the ESP, Jan-Jaap Voigt.

Website Sitemap

The whole content of the website is alphabetically shown in the sitemap below:

- About Us
  - About Andreas
  - About Kai
- Assessment
  - Ankle Assessment
    - Achilles Tendon
    - Ankle fracture

We previously stated that according to Bundesverband Digitale Wirtschaft (Lopez 2014), 83% of students possess a smartphone with Internet connection. Furthermore, Rosen (2009) recommend making e-learning available on multiple devices (e.g. PC, Mac, Smartphone, Tablet). Our analytics show that around 34% of our total views on YouTube (September 2015 – January 2016) came from mobile devices like smartphones and tablets (Figure 2). For the same timeframe, 24% of all hits on physiotutors.com came from mobile devices (Figure 2). Therefore, we made sure that the website is responsive, which means that it adjusts itself to various screen sizes and can be easily viewed from any device and in any browser. Figure 3 shows the responsiveness of the website when viewed on a computer and smartphone respectively.

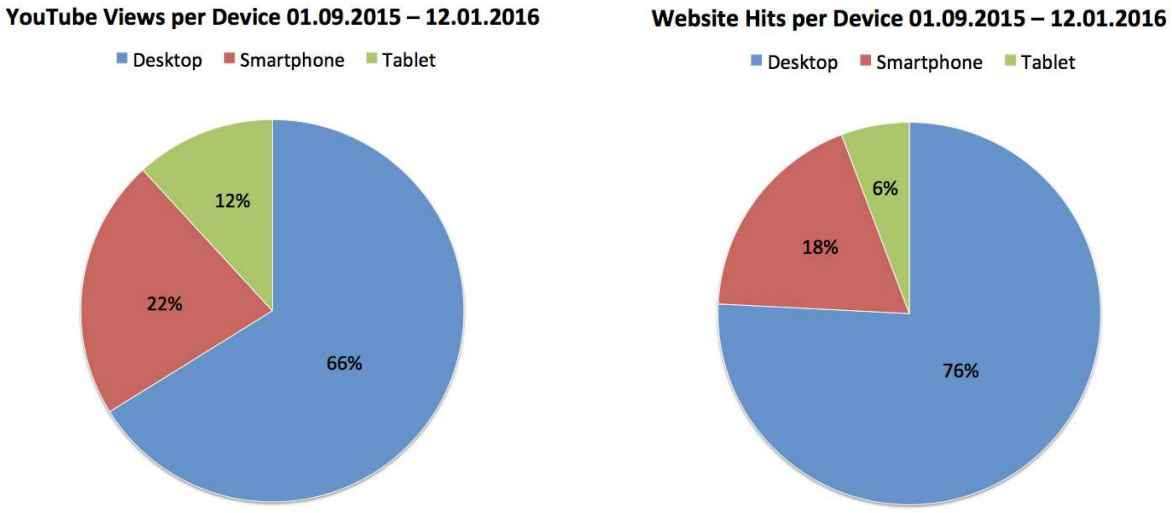

Figure 2: Device Analytics for YouTube Channel and Website

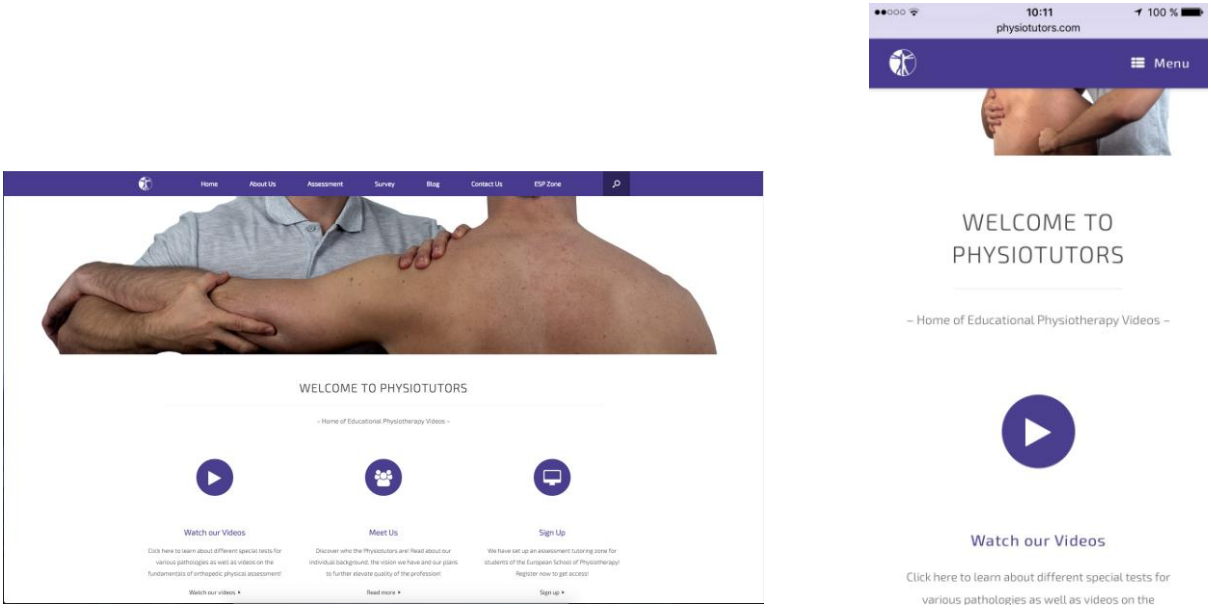

Figure 3: Website viewed in Google Chrome on Mac OSX & on Safari for Apple iOS

ESP-Zone

In the following paragraph, we will outline how we have put the findings on instructional design, learning and personality types into practice in the ESP-Zone.

Glossary:

Interface: The space where interaction between the user and website occurs

Thumbnail: Reduced size versions of pictures or videos to help organize and recognize them

Hyperlink/Hypertext: Clickable text that redirects the user to a different page

Plug-in: a piece of software, which enhances another software application and usually can be run independently

Synchronous communication: instantaneous electronically mediated communication between two or more participants (e.g. chat, video-conference)

Asynchronous communication: Electronically mediated communication in that the participants do not communicate concurrently (e.g. email, forum)

To access the ESP-Zone, the learner navigates to www.physiotutors.com/esp-zone and logs in with a previously created and verified account.

Once logged in, the learner finds a short description of the module contents as well as a video tour explaining how to use the website. Furthermore, buttons to logout, to view the user profile and to get redirected to a forum are provided. All elements are labeled to avoid confusion (Elkins et al. 2015). Figure 4 shows the welcome screen and its components. Before the learner starts with the module, he or she can perform a self-assessment by clicking on the button on the bottom left. The importance of such a self-assessment for different learning types has been described already. The self-directed learner-rating (SDLR) questionnaire has been adapted from Williamson (2007) and it tries to make sure that the learner becomes

aware of his or her ability to work with the ESP-Zone. Once the questionnaire is completed by the learner, he or she receives a recommendation to what extent the ESP-Zone might benefit them.

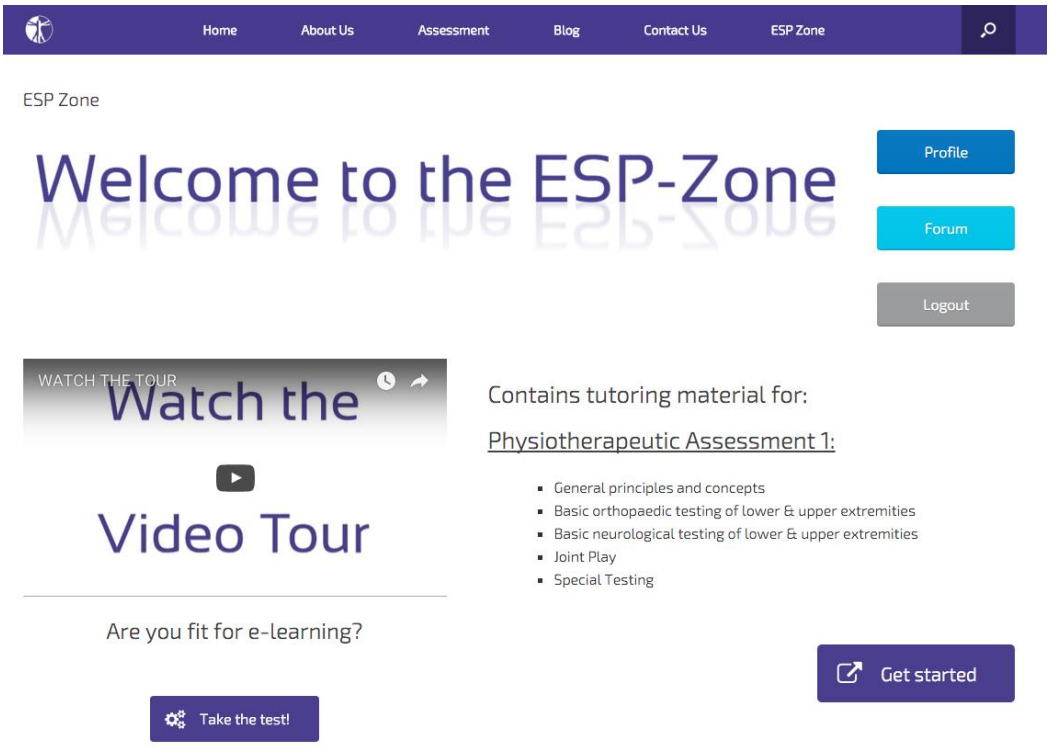

Figure 4: Components of welcome screen

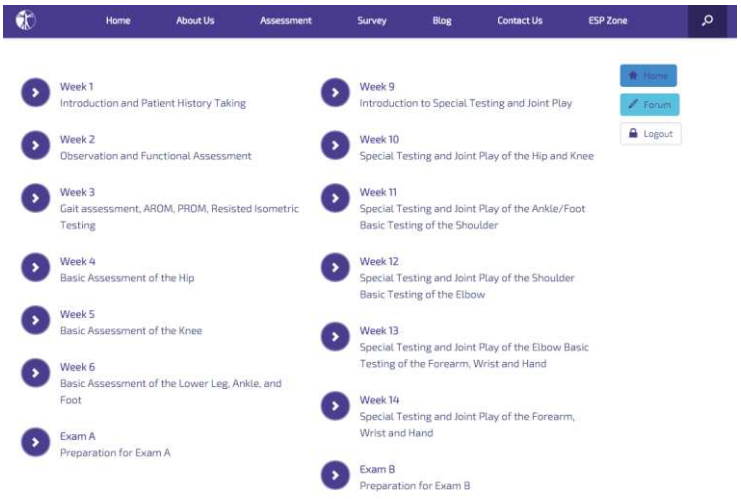

Figure 5: Overview of module weeks

Once the learner selects the module by clicking on the 'Get started' button on the bottom right of the page, a list of the weekly modules pops up (Figure 5). The learner has the ability to choose any item to start learning. There are no restrictions as to which content may be viewed or not. Furthermore, buttons taking the learner to the homepage, forum, or logout are displayed and are individually labeled and color-coded. This allows for clear navigation throughout the e-learning environment.

If the learner clicks on one of the hyperlinks representing each week of the course calendar, the actual learning interface appears (Figure 6).

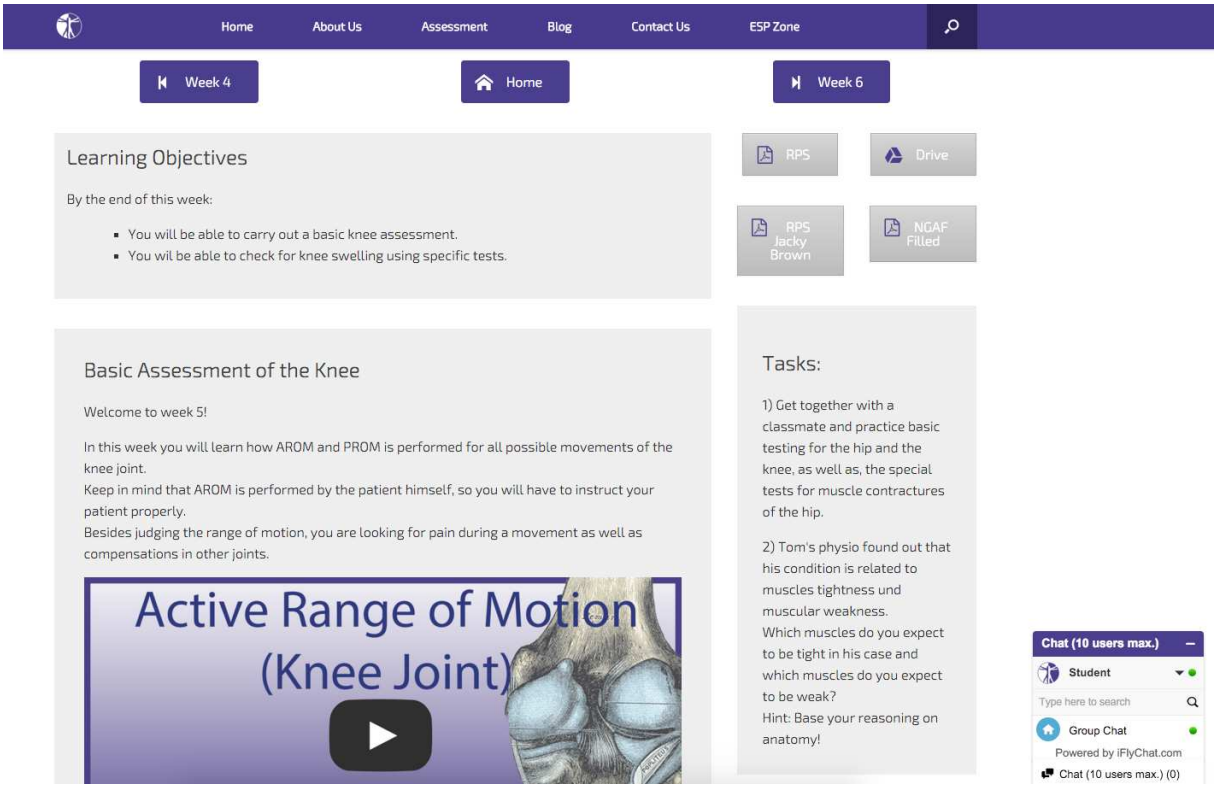

Figure 6: Learner Interface

On the top of the screen, the user finds the navigation bar. The buttons allow for navigation between weeks in a linear manner and are clearly labeled with both symbols and text. The learner can move between consecutive weekly sections or go back to the module overview (Figure 5) to choose a specific section. The sensing/thinking personality type might find this especially useful.

Below, the learner finds the main content split up in two columns. The left column comprises the learning objectives and main content of each week, while the right column contains resources and assignments.

As the main goal of the learning tool is to teach a practical skill, multimedia content in the form of videos is emphasized. The HD-videos have an average length of 2-3 minutes and can be viewed by clicking the thumbnail. In the videos, practical skills, such as basic assessments and special tests, are demonstrated. Visual and auditory learners will most likely appreciate the multimedia content as they can observe a demonstration. The read/write type learner can still read about the background of the testing modalities and the videos always feature annotations to clarify what is being shown.

We provide the learner with a multitude of collaborative tools within the ESP-Zone that should facilitate learning by making it more interactive and social. For example, the learner can upload his or her work into a dedicated Google® Drive folder to share it with every other learner. The Google® Drive folder can also be used to work on assignments simultaneously using Google's shared authoring tools.

The learner can also use the dedicated chat for synchronous communication and file sharing among logged-in users (Figure 6 bottom right). There is an option to start a private chat or enter the group chat to talk to all online users at the same time.

Additionally, a forum with multiple threads has been implemented into the ESP-Zone (Figure 7). The forum is meant to enable asynchronous communication and allows learners to access and read up on information whenever they so desire. Furthermore, the forum serves as a means for feedback to the designer. We have created a thread dedicated to technical support, as well as a thread where the learner can discuss the content and give comments for further improvement. By using several means of communication, we want to prevent the feeling of isolation that may be elicited in some personality types. Furthermore, a combination of asynchronous and synchronous means of communication allows both extrovert and introvert learners to participate in knowledge exchange. While the extrovert might take a more active role in a chat, the introvert can use the forum as a more slow-paced source of information exchange. Read/write type learners will also appreciate the text based information in the chat and/or forum.

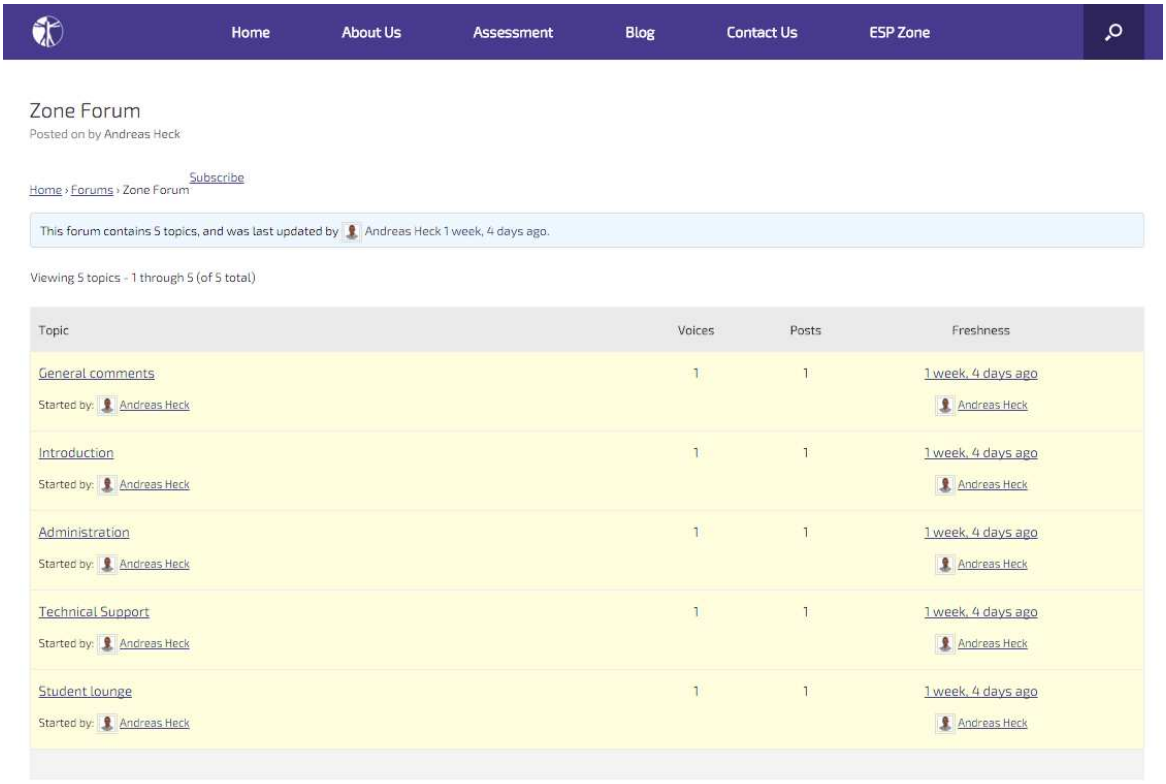

Figure 7: Thread overview of user forum

As for assessment methods, the ESP-Zone includes case studies that usually span over multiple module weeks and should allow the learner to apply the knowledge to a real world scenario and make the learning process more personal. The tasks section (Figure 8) includes assignments for the module, as well as, assignments to prepare for the following one. These preparation assignments usually are of an explorative nature to make the learning process more interactive. Furthermore, there is always a practical assignment to encourage the learner to practice the skill with a partner. While case studies will mainly encourage the read/write type to apply the knowledge, the kinesthetic type will appreciate the practical tasks.

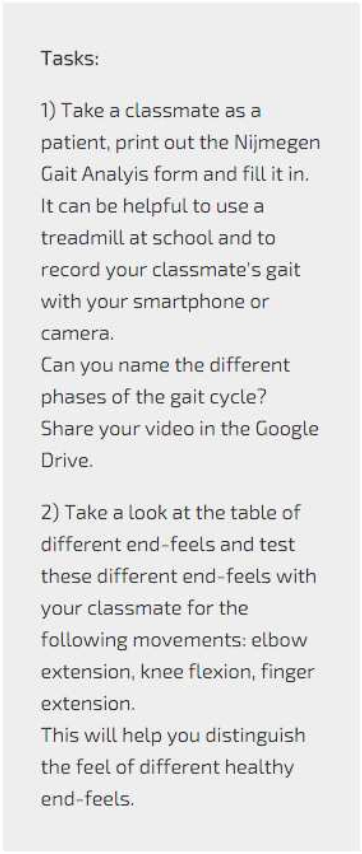

Figure 8:Tasks section

There are two exam preparation modules that summarize the content necessary for the practical exams and offer self-assessment opportunities to the learner. The learner will find a multiple-choice quiz comprised of 20 questions on the content of the previous modules. The quiz may be taken once, without a time limit. When the learner submits the answers, an automated email containing the results is sent out and if scored sufficiently (75% correct), the learner receives a certificate. This motivates the learner to focus on the content and the immediate feedback allows the learner to assess areas of knowledge that need improvement.

Furthermore, there is always a video dealing with an exam situation. For example, in one video the instructors demonstrate an exam and include common subtle mistakes that are made by students. The learner is asked to observe and note down any mistakes found, which will be revealed later in the video. Secondly, there is an interactive video, which can be used by two learners simultaneously to practice their skill in preparation for the exam. The instructor takes the role of the examiner and asks several questions to the learner. He or she is prompted to pause the video after each question and then demonstrate the necessary skill on a partner. When the video is resumed, the instructor links to possible solutions the learner may explore by clicking on elements in the video.

Discussion

The ESP-Zone, being the e-learning tool, has been integrated into an existing WordPress Website (www.physiotutors.com). We purposefully opted for a custom solution versus the commercially available tools such as Blackboard or WebCT due to financial reasons. We

thought and still believe that we can achieve comparable results with the features of a WordPress website including several plug-ins that it has to offer. To continuously take the users desires and views into account in the creation of the ESP-Zone, a survey has been periodically sent out to the users who have evaluated the overall appeal of the website as well as the specific contents of the e-learning tool (Figure 9, 10 & 11). This allowed us to create a product that respects the opinions of and satisfies different personality types. The evaluations show that from the start, the overall website design appealed to the users who rated its quality fairly high (Figure 9). Improvements were made to the layout of certain website elements to allow for better navigation, which can explain the higher rating in the second evaluation round. The first evaluation round mainly concerned the bare framework and look and feel of the website and was directed to a broad audience. At the time, most of the content had not been implemented yet. During the second evaluation round, we specifically addressed first year students of the ESP to take a close look at the contents of the website and ESP-Zone as the website was almost complete, which could explain the increase in the points for searching, quality of audiovisual content and navigation.

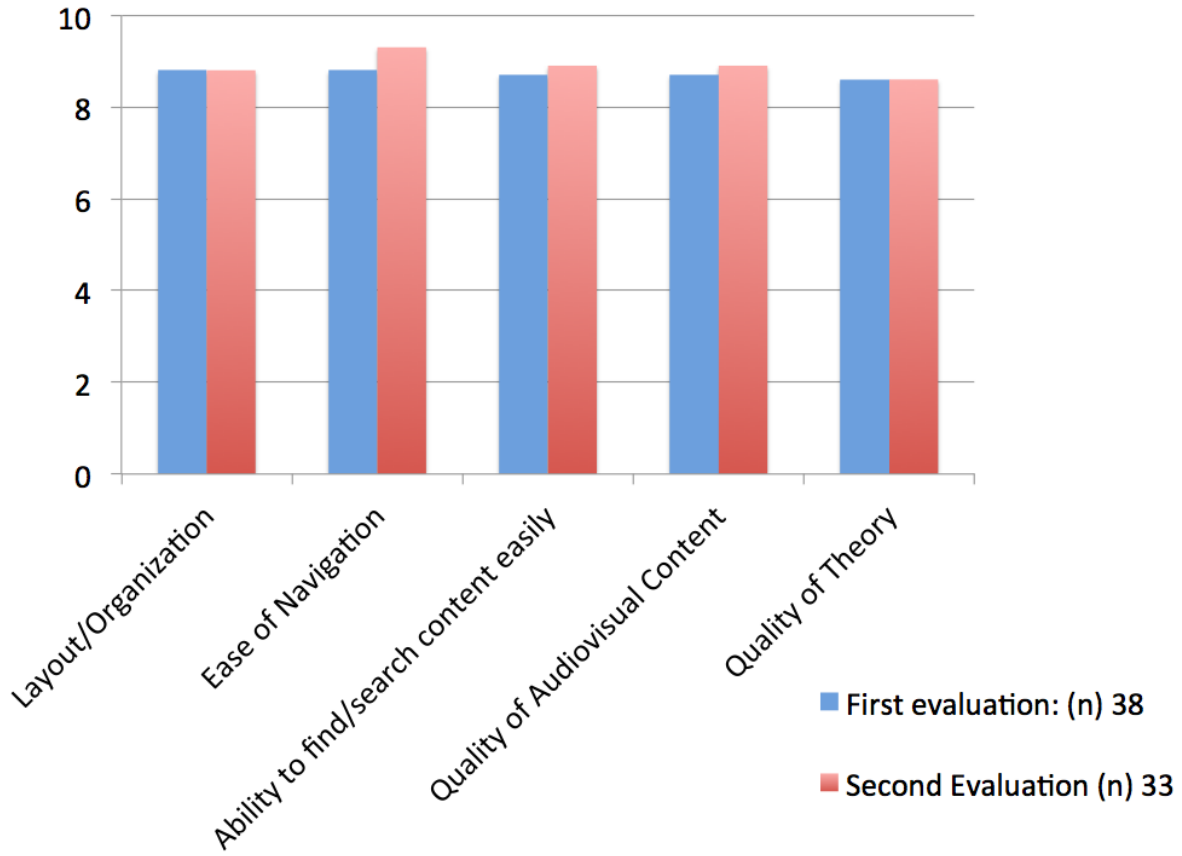

Figure 9: General evaluation of www.physiotutors.com on a likert-scale from 0(bad) to 10 (excellent)

Furthermore, we asked for specific feedback on how the users perceive the ESP-Zone content. The users seem to appreciate and value the e-learning tool (Figure 10 & 11).

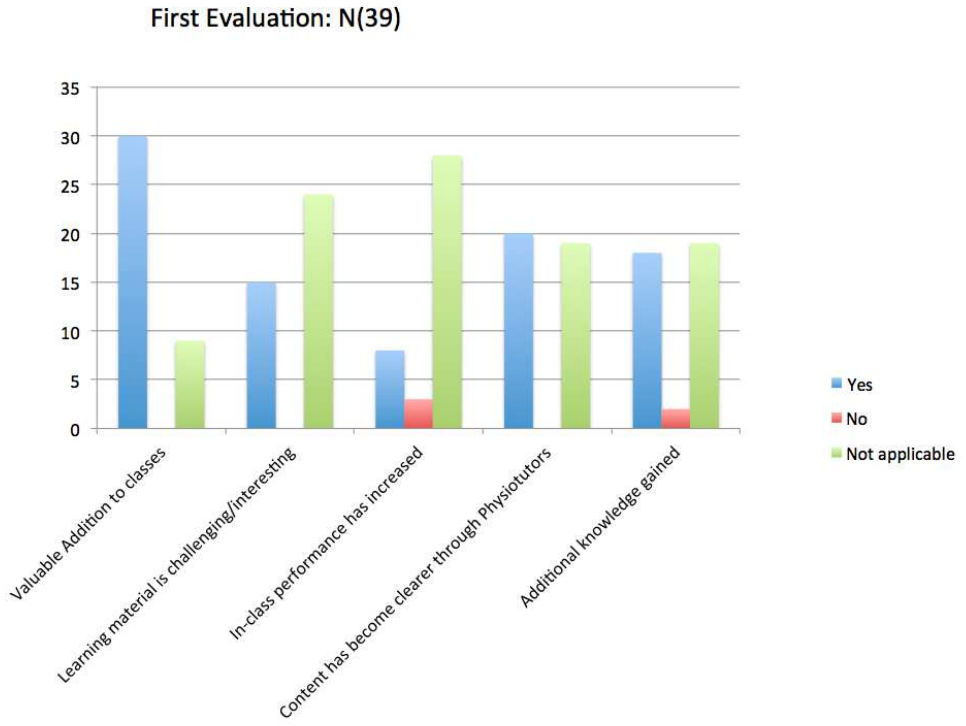

Figure 10: Results of first evaluation for contents of the ESP-Zone

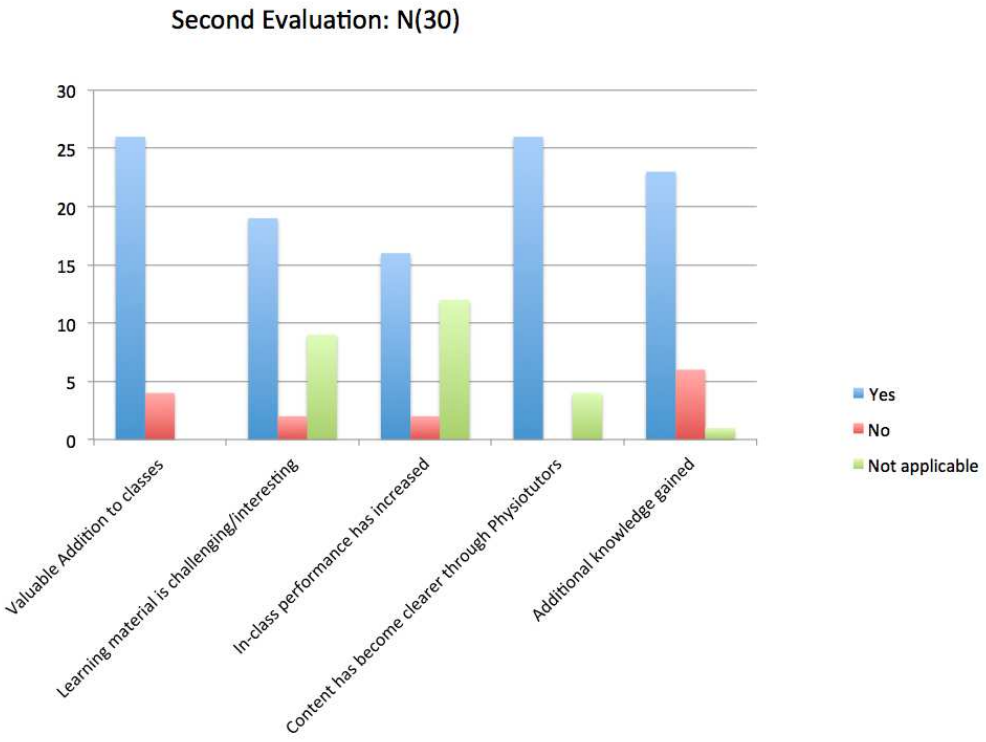

Figure 11: Results of second evaluation for contents of the ESP-Zone

The shift from “not applicable” to “yes” can be attributed to the fact that at the time of the first evaluation, the first-year students were in their first week of class at the ESP and could not really evaluate their increase in knowledge or skill. Most of the “yes” answers in the first evaluation came from students of upper years.

The user comments we have received through our survey support the decisions made:

„Looks great, good job Kai and Andy! I am sure first year students will use it just as much as the Magee if not more!“

“Great job, the website is smooth and well designed, I'm really looking forward to see it grow and become more complete. The videos quality is great, well edited, its looks reliable and professional.“

„You manage to make what we go through in class so much clearer, thank you!“

Nonetheless, we have to acknowledge the fact that despite motivating the users, user feedback was fairly low considering the total number of 76 registered accounts.

Usually, students who set up a website for a PAP opt for free solutions. WordPress’ free services or Google Sites have been used many times in the past (Chon et al. 2012, Masiero et al. 2013). These solutions come with drawbacks as the website name usually includes the provider’s name. For example, if a free website is registered with WordPress the domain or website address is displayed as: examplewebsite.wordpress.com
Furthermore, these sites are barely noticed by search engines (Google) and functionality for someone who is not a web-developer is limited as it is not possible to use third-party plug-ins. As it has become evident in the introduction that the project Physiotutors goes well beyond the creation of this PAP, the authors have bought the domain Physiotutors.com to avoid the previously mentioned limitations. Due to the costs of both the domain and server, ads are displayed on select pages throughout the website. Even though the ads are displayed predominantly on the very top and bottom of the page, they have been perceived as distracting by some users. Nonetheless, the authors will keep the ads to partially cover costs of the website. Lastly, all pages that are concerned with the ESP-Zone are completely Ad-free.
We had to make other drawbacks due to financial reasons. The chat for example allows a maximum of 10 people to be online at the same time if no license is bought. However, we believe it sufficiently adds to the functionality of the ESP-Zone – at least for now.

The possibility to further enhance functionality through investments shall be kept in mind for future developments.

Lastly, Cook (2012) mentioned that the use of passwords for access restriction could impede the use of an e-learning tool. Nonetheless, we opted for password protection to ensure the content would only be available to students of the European School of Physiotherapy (ESP). We felt this was necessary to provide an exclusive product to our client.

Recommendations to increase usage

The goal of each PAP is to deliver a product that is put to use in practice. In our case, we deliver a blended learning tool to the ESP. One can imagine that students might disregard additional learning resources in the intense ESP program. Therefore, we have come up with several possibilities to increase usage. First and foremost, we advise teachers to promote signing-up to the ESP-Zone during the first week with their new students. A trial by Mahnken et al. (2011) states that in order for an e-learning tool to be used, extrinsic motivation from the teachers is required. The authors showed that students, for whom participation in an e-learning supplement was mandatory, performed better in formative post-course assessments. The group that was free to choose whether or not to make use of the extra learning opportunity performed worse in the same post-course assessment. This could be of particular interest for the teaching staff at the ESP. If usage of the ESP-Zone was mandatory and participation was tracked by e.g. quiz results or assignment submission to Google® Drive, fewer people might need to retake their exam.
Furthermore, we envisioned a couple of incentives for students to use the ESP-Zone. Students could get (partial) elective credits or a minimal grade boost (+0,5) if they could prove they did the assignments in the ESP-Zone (e.g. provide certificates for quizzes).

Scenario Recommendations

With the PAP, the product is handed over to our client Jan-Jaap Voigt at the European School of Physiotherapy. The rules for a PAP state that an online product has to be available for at least 7 years. In the following paragraphs, we will outline a couple of scenarios of future developments that would render our product future-proof.

Online tutoring

The ESP already established a peer-tutoring system, where second year students tutor and assist first year students once a week to answer question or practice skills.
We were also tutors in our second year and we realized that, at times, it was difficult to arrange a time and place that suited the majority of first-year students.
Therefore, we think a possible scenario could be that second-year students also take the role of the online tutor within the ESP-Zone alongside the weekly meetings with the students. They could offer assistance in the chat to answer questions directly, moderate a thread within the forum, or check assignments that are uploaded to the Google Drive repository. This would allow first-year-students to have even more guidance in their learning process. At the moment, we try to assist the students as much as possible but this should be handed over to other students down the road.

Extension of hospital environment (semester 2) into the ESP zone

For the moment, the ESP-Zone covers the content of physiotherapeutic assessment in the first semester. A possible future scenario would be to add the second semester content. This might be done by the authors independently or could be the topic for a future PAP. The setup of the ESP-Zone allows others to contribute to its expansion. A second possibility would be to disassociate the ESP-Zone from Physiotutors.com to have it as a stand-alone website that the client can work with in future projects.

Randomized Controlled Trial

This idea has already been discussed with our client, as we had planned to do an early evaluation of first year students' performance in exam A. We would have liked to check how students with an active ESP-Zone account performed compared to students without an account. This idea fell through, but we regard a randomized controlled trial as a great opportunity for a future PAP. A random group of students would get access to the ESP-Zone while the other will simply follow classes. The user activity would be logged within the website and exam results would be compared between the two groups. A randomized controlled trial could then possibly confirm the findings of our review.

Vision Physiotutors

Next to the possible future developments of the ESP-Zone, we also have private plans to expand our project: Physiotutors.

During the writing of this PAP project, the YouTube channel www.youtube.com/physiotutors has reached more than 2.300 subscribers and more than 120.000 views, with a promising growth rate. Our YouTube analytics show a monthly 10-20% increase in subscribers, viewing time, and view count. Just this past quarter we have had an increase of 200%-250% in channel growth. We are currently present on other social media platforms like Twitter, Instagram and Facebook, where we are about to reach the 800 likes mark. Our website www.physiotutors.com is a registered domain, which functions as our central hub, where visitors can get to know us, follow our activity on all social media platforms, and watch our videos.

At the moment, the only monetary source is Google AdSense, which is activated on most of the 140 videos that have been filmed, as well as advertisement that is displayed on our website. This yields a low double-digit amount of money per month that is used to cover our current regular expenses and to pay off investments that have been made so far.

While our videos have immensely advanced over the course of the last two years regarding visual and auditory quality and content, limited time to produce enough content has been the main limiting factor until now.

Therefore, our marketing activities were minimal and included a collaboration with Nils Oudhuis, a Dutch physiotherapist who is famous for his Facebook page “Trust me, I’m a physiotherapist” with more than 50.000 followers, as well as a visit to the Medica in Düsseldorf, Germany, one of the biggest medical exhibitions in the field of health care in the world.

Our vision is to establish our YouTube channel as the leading channel on Physiotherapy education in order to help students from all around the world and to elevate the level of physiotherapy as a profession. This goal is hard to measure with factual data as our competitors are changing and growing as well, but at the moment the largest competitor (physicaltherapyvideo) has around 40.000 subscribers and 9+ million views.

At the same time, we are occupying a niche due to the fact that our focus is mainly directed towards physiotherapy students and the subject assessment, while other channels address physiotherapy in a broader sense.

Content-wise, we would like to head into several directions: our main topic will remain physiotherapeutic assessment of the most common musculoskeletal pathologies as well as basic assessment, however, we are also planning to provide videos for the treatment of these pathologies. Another opportunity that we are currently considering is to start covering

applied anatomy and how to palpate different structures in the human body. Due to the fact that we are both planning to do our masters in manual therapy, our content will surely cover a lot of content that will be taught to us in the near future.

A YouTube channel is highly dependent on its audience. So, while producing high quality videos with high quality content is our backbone, we are planning to profoundly improve our marketing. We are in touch with an expert on YouTube marketing in Germany, and an important topic is search engine optimization for which we are planning to collaborate with Aviv Hidrian, a physiotherapist, former ESP student and SEO expert.

Following the advice of our YouTube marketing expert contact, we will try to either join a professional YouTube network or form our own network with other channels that operate in the field of physiotherapy and healthcare in general. In simple words, these networks help each other to gain a bigger audience by recommending other channels in the network to their current audience. Another step that is in the planning is to apply for Google Ad Grants, which is a version of AdWords that is designed for non-profit organizations. As a participant, one is granted an amount of 10.000$ per month in the form of free AdWords advertising.

Finally, our long-term goal financially is to benefit from Physiotutors in a way that one could potentially live from the generated earnings. While our project is still young, there are several options that we can imagine at the moment:

One option is to offer a ‘members only’ area on our webpage where we provide information that is not accessible to the standard user on YouTube, which could be in a form of an e-learning environment similar to that of the ESP zone.

A second option is to start with affiliate marketing, which could be implemented in the form of reviews of different physiotherapeutic products in our videos. As soon as viewers buy a recommended item via an affiliate link on our channel or from our website, we are granted a certain percentage of the sales value of this item.

YouTube channels with a bigger audience also benefit from product placement. So, a third option is to earn money by placing certain products from a certain brand in our videos and getting paid for it by that particular company (for example by using a treatment table from Enraf Nonius etc.).

Lastly, we are considering offering private lessons in the form of live sessions for students that struggle with the subject of physiotherapeutic assessment. This could take place in the form of online counseling via Skype or a similar platform.

Appendix I: PEDro Rating Single Scale Items

PEDro Scale Items	**Arroyo-Morales**	**Cantarero-Villanueva**	**da Silva**	**Gagnon**	**Gerdprasert**	**Hibbert**	**Stewart**
1. Eligibility criteria specified	Yes	Yes	No	No	No	No	Yes
2. Random subject allocation	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3. Allocation concealed	No	No	No	No	No	No	No
4. Groups similar at baseline	Yes	Yes	Yes	No	Yes	No	No
5. Subjects blinded	No	No	No	No	No	No	No
6. Test administrators blinded	No	No	No	No	No	No	Yes
7. Assessors blinded	No	Yes	No	Yes	No	Yes	Yes
8. Measurement of at least 1 outcome was obtained from more than 85% of subjects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
9. Treatment or control as allocated	Yes	Yes	Yes	Yes	Yes	Yes	Yes
10. Results of between-group statistical comparisons reported for at least 1 key outcome	Yes	Yes	Yes	Yes	Yes	Yes	Yes
11. Study provides both point measures and measures of variability for at least 1 key outcome	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Score	**7**	**8**	**6**	**6**	**6**	**6**	**8**

Appendix II: Search strategy learning and personality types and e-learning

Eligibility criteria

All articles that draw a connection between learning or personality type and influence on knowledge, skills, satisfaction or attitude in e-learning or blended learning programs were included.

Research was neither limited on a certain publication date nor on a particular article type.

Search strategy

The question to be researched was: "How does learning or personality type influence performance of students in blended learning or e-learning regarding knowledge, skills or satisfaction"?

This search was conducted on 12th December 2015 using following databases:

CINHAL, MEDLINE, ERIC. Google Scholar was used in addition to obtain access to articles that were unobtainable through the before-mentioned databases.

The keywords from table 4 were combined with the Boolean operators "OR" within columns, and "AND" between columns.

The search was conducted twice: Once with the key words in the title and the second time with the key words having to be contained in the title/abstract.

Population	**Intervention**	**Outcome**	**Variable**
-Student* -Pupil*	-e-learning - elearning -web-based -web based -video-based - video based -online -digital - blended - adjunctive	-grade* -performance* - effectiveness - efficiency - knowledge - skill* - GPA - clinical reasoning	- Learning type* - learning style* - Personality type*

Table 4: Key words learning/personality type search

The concrete search strings which were used in EBSCOhost research databases for CINAHL, MEDLINE and ERIC are presented in the following table:

TI (student* OR pupil*) AND TI (e-learning OR elearning OR web-based OR web based OR video-based OR video based OR online OR digital OR blended OR adjunctive) AND TI (grade* OR performance* OR effectiveness OR efficiency OR skill* OR knowledge OR GPA OR clinical reasoning OR satisfaction OR attitude*) AND TI (learning type* OR personality type*)
AB (student* OR pupil*) AND AB (e-learning OR elearning OR web-based OR web based OR video-based OR video based OR online OR digital OR blended OR adjunctive) AND AB (grade* OR performance* OR effectiveness OR efficiency OR skill* OR knowledge OR GPA OR clinical reasoning OR satisfaction OR attitude*) AND AB (learning type* OR personality type*)

Table 5: Search string for MEDLINE, CINAHL and ERIC databases

Furthermore, the authors made use of literature obtained through references from the articles that were found following the outlined search strategy as well as from references from articles which were found while answering the main research question.

Appendix III: Search strategy instructional design

Eligibility criteria

Literature that describes instructional design in e-learning and that is ideally set in health professions. Research was limited to publications from 2005 or later. The rationale behind this measure was that YouTube went public in 2005 and as our product heavily relies on their services, we wanted to make sure that sources were aware of its existence.

Search strategy

The question to be researched was: "Which instructional design elements have to be included in an e-learning environment"?
This search was conducted on 12th December 2015 using following databases:
CINHAL, MEDLINE, ERIC. Google Scholar was used in addition to obtain access to articles that were unobtainable through the before-mentioned databases. After consulting the librarian at our university, we included "books 24x7" as another resource for educational literature.

The search in MEDLINE, CINAHL, and ERIC included the following search string:

instructional design AND (e-learning OR elearning OR web-based OR web based OR internet learning OR online OR internet OR digital OR blended OR adjunctive) AND (physiotherap* OR physicaltherap* Or medic* OR nurs* OR health*)

Table 6:Search string for MEDLINE, CINAHL, ERIC.

e-learning [Title]

Table 7: Search in Books 24x7

Furthermore, the authors made use of literature obtained through references from the articles that were found following the outlined search strategy as well as from references from articles which were found while answering the main research question.

The process of study selection is outlined in figure 10.
All duplicates were removed with the help of the bibliographic software RefWorks.
Afterwards, the records were screened for title and abstract regarding their eligibility. Books were included upon review of the table of contents.
Lastly, the remaining sources were full-text screened and analyzed.

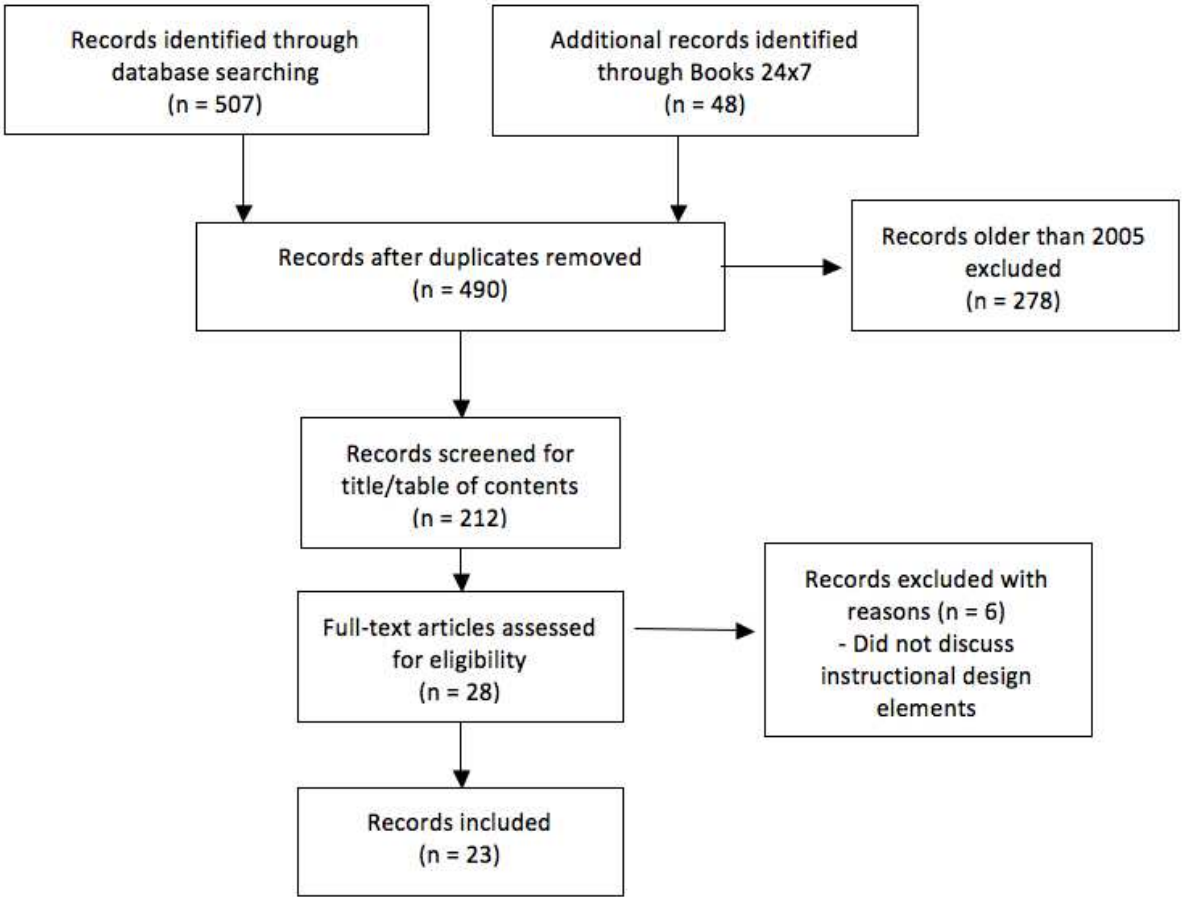

Figure 12: Search PRISMA

Appendix IV: Technology Index

Website:

Both the website domain www.physiotutors.com and a server were acquired through Hostgator (www.hostgator.com). The latest version, v. 4.4 as of writing this description, of the online publishing tool WordPress (www.wordpress.com) was installed and used to build the website. Within WordPress, a handful of third-party plugins were used to enhance functionality of the website:

- Advanced recent posts (v.0.6.14)
- All In One SEO Pack (v.2.2.7.5)
- BackUpWordPress (v.3.3.4)
- bbPress (v.2.5.8)
- Black Studio TinyMCE Widget (v.2.2.8)
- Contact Form 7 (v.4.3.1)
- Favicon by RealFaviconGenerator (v.1.3.1)
- Google XML Sitemaps (v.4.0.8)
- iFlyChat (v.3.0.5)
- Latest Posts (v.1.2)
- Meta Slider (v.3.3.6)
- Page Builder by SiteOrigin (v.2.2.2)
- Quiz and Survey Master (v.4.6.4)
- SiteOrigin Widgets Bundle (v.1.5.4)
- WP User Avatar (v.2.0.4)
- WP Video Lightbox (v.1.7.7)
- WP-Members (v.3.0.8)
- WR Contact Form (v.1.1.11)
- WR Pagebuilder (2.5.3)
- YouTube Channel (v.3.0.9)

Filming Equipment

Below, the reader will find a detailed list of all the equipment that was used to produce video content. The videos were later uploaded to the Physiotutors YouTube Channel (www.youtube.com/Physiotutors) and embedded into the website.

- **Camera**:
  - Canon XF100 Professional Broadcast Camcorder + Transcend 64GB Compact Flash Memory Card 144x
- **Monitor**:
  - 7” Lilliput HD Monitor
- **Lights:**
  - 4x Wallimex Daylight Lamp 250W + Wallimex Softbox
  - Yongnuo YN-300 LED Light

- **Sound:**
  - Røde Filmmaker Wireless Kit + Røde Broadcast Lavalier Microphone
  - Samson CO1 Studio Condenser + Focusrite Scarlett 2i2 Interface
- **Editing:**
  - Apple Macbook Pro MC723LL/A 2,3GhZ
  - Samsung 830Pro 512GB SSD Scratch Drive for raw video files
  - Transcend TS-RDF8K Multicard Reader
  - Elgato thunderbolt dock
  - Apple Final Cut Pro X

References

Afifi MK, Alamri SS. Effective Principles in Designing E-Course in Light of Learning Theories. Turkish Online Journal of Distance Education 2014;15(1):128-142.

Allen MW. Designing Successful e-Learning: Forget What You Know about Instructional Design and Do Something Interesting, Michael Allen's e-Learning Library. US: John Wiley & Sons; 2007.

Anbarasi M, Rajkumar G, Krishnakumar S, Rajendran P, Venkatesan R, Dinesh T, et al. Learning style-based teaching harvests a superior comprehension of respiratory physiology. Adv.Physiol.Educ. 2015;39(3):214-217.

Arroyo-Morales M, Cantarero-Villanueva I, Fernández-Lao C, Guirao-Piñeyro M, Castro-Martín E, Díaz-Rodríguez L. A blended learning approach to palpation and ultrasound imaging skills through supplementation of traditional classroom teaching with an e-learning package. MANUAL THER 2012;17(5):474-478 5p.

Bishop-Clark C, Dietz-Uhler B, Fisher A. The Effects of Personality Type on Web-Based Distance Learning. J.Educ.Technol.Syst. 2007;35(4):491-506.

Bolla P, Tervahauta M. GetPTsmart. [. Last updated 2012; Last accessed 08/2015] Available at: http://getptsmart.com.

Brouwer N, Dekker P, Pol Jvd. e-Learning Cookbook TPACK in Professional Development in Higher Education. 2013;1:6-128.

Cantarero-Villanueva I, Fernandez-Lao C, Galiano-Castillo N, Castro-Martin E, Diaz-Rodriguez L, Arroyo-Morales M. Evaluation of e-learning as an adjunctive method for the acquisition of skills in bony landmark palpation and muscular ultrasound examination in the lumbopelvic region: a controlled study. J.Manipulative Physiol.Ther. 2012;35(9):727-734.

Childs S, Blenkinsopp E, Hall A, Walton G. Effective e-learning for health professionals and students--barriers and their solutions. A systematic review of the literature--findings from the HeXL project. Health.Info Libr.J. 2005a;22 Suppl 2:20-32.

Childs S, Blenkinsopp E, Hall A, Walton G. Effective e-learning for health professionals and students-barriers and their solutions. A systematic review of the literature-findings from the HeXL project. Health Information & Libraries Journal 2005b;22:20-32 13p.

Chon L, Tait D. Manual Mobilization - Jointplay techniques in assessment and therapy for upper and lower extremeties. Amsterdam[. Last updated 2012; Last accessed 08/2015] Available at: https://arthrokinematics.wordpress.com.

Chumley-Jones HS, Dobbie A, Alford CL. Web-based learning: sound educational method or hype? A review of the evaluation literature. Acad.Med. 2002;77(10 Suppl):S86-93.

Clark RC, Mayer RE. E-learning and the Science of Instruction : Proven Guidelines for Consumers and Designers of Multimedia Learning. San Francisco, CA: John Wiley and Sons, Inc; 2008.

Cook DA, Levinson AJ, Garside S, Dupras DM, Erwin PJ, Montori VM. Instructional design variations in internet-based learning for health professions education: a systematic review and meta-analysis. Academic medicine : journal of the Association of American Medical Colleges 2010;85(5):909-922.

Cook DA. Where are we with Web-based learning in medical education? Med.Teach. 2006;28(7):594-598.

Cook DA, Thompson WG, Thomas KG, Thomas MR, Pankratz VS. Impact of self-assessment questions and learning styles in Web-based learning: a randomized, controlled, crossover trial. Academic medicine : journal of the Association of American Medical Colleges 2006;81(3):231-238.

Daughenbaugh R, Ensminger D, Frederick L, Surry D. Does Personality Type Effect Online versus In-Class Course Satisfaction?. 2002.

de Morton NA. The PEDro scale is a valid measure of the methodological quality of clinical trials: a demographic study. Aust.J.Physiother. 2009;55(2):129-133.

Elkins D, Pinder D. E-Learning Fundamentals. : Association for Talent Development; 2015.

Foreman KB, Morton DA, Musolino GM, Albertine KH. Design and utility of a web-based computer-assisted instructional tool for neuroanatomy self-study and review for physical and occupational therapy graduate students. Anatomical record.Part B, New anatomist 2005;285(1):26-31.

Foster MJ, Shurtz S, Pepper C. Evaluation of best practices in the design of online evidence-based practice instructional modules. Journal of the Medical Library Association : JMLA 2014;102(1):31-40.

Gagnon M, Gagnon J, Desmartis M, Njoya M. The Impact of Blended Teaching on Knowledge, Satisfaction, and Self-Directed Learning in Nursing Undergraduates: A Randomized, Controlled Trial. NURS EDUC PERSPECT 2013;34(6):377-382 6p.

George PP, Papachristou N, Belisario JM, Wang W, Wark PA, Cotic Z, et al. Online eLearning for undergraduates in health professions: A systematic review of the impact on knowledge, skills, attitudes and satisfaction. J.Glob.Health. 2014;4(1):010406.

Gerdprasert S, Pruksacheva T, Panijpan B, Ruenwongsa P. An interactive Web-based learning unit to facilitate and improve intrapartum nursing care of nursing students. Nurse Educ.Today 2011;31(5):531-535 5p.

Grimes EB. Student perceptions of an online dental terminology course. J.Dent.Educ. 2002;66(1):100-107.

Haskin S. Using Video in E-Learning. : Association for Talent Development; 2013.

Hibbert EJ, Lambert T, Carter JN, Learoyd DL, Twigg S, Clarke S. A randomized controlled pilot trial comparing the impact of access to clinical endocrinology video demonstrations with access to usual revision resources on medical student performance of clinical endocrinology skills. BMC Med.Educ. 2013;13:135-6920-13-135.

Horton W. E-learning by design: 2nd edition. 1st ed. San Francisco: Pfeiffer; 2012.

Huang EY, Lin SW, Huang TK. What Type of Learning Style Leads to Online Participation in the Mixed-Mode E-Learning Environment? A Study of Software Usage Instruction. Comput.Educ. 2012;58(1):338-349.

Jordanov WL. An Examination of the Relationship between Learning Style and Technology Use. 2001.

Koninklijk Nederlands Genootschap voor Fysiotherapie (KNGF). The professional profile of the physical therapist. 2006.

Levac D, Glegg SM, Camden C, Rivard LM, Missiuna C. Best practice recommendations for the development, implementation, and evaluation of online knowledge translation resources in rehabilitation. Phys.Ther. 2015;95(4):648-662.

Lewis KO, Cidon MJ, Seto TL, Chen H, Mahan JD. Leveraging e-learning in medical education. Current problems in pediatric and adolescent health care 2014;44(6):150-163.

Liebowitz J, Frank M. Knowledge management and e-learning. 1st ed. Boca Raton: Auerbach Publications; 2011.

Lopez C. Faszination Mobile - Verbreitung, Nutzungsmuster und Trends. 2014BVDW - Wir sind das Netz 2014.

Macznik AK, Ribeiro DC, Baxter GD. Online technology use in physiotherapy teaching and learning: a systematic review of effectiveness and users' perceptions. BMC Med.Educ. 2015;15:160-015-0429-8.

Magee DJ. Orthopedic physical assessment. : Elsevier Health Sciences; 2014.

Major M, Ranzijn P, Thomas S, Bosello F. Course Manual Assessment 1 - Lower extremeties, upper extremeties, semester 1. 2015-2016Hogeschool van Amsterdam, European School of Physiotherapy 2015-2016.

Maloney S, Haas R, Keating JL, Molloy E, Jolly B, Sims J, et al. Breakeven, cost benefit, cost effectiveness, and willingness to pay for web-based versus face-to-face education delivery for health professionals. J.Med.Internet Res. 2012;14(2):e47.

Masiero S, Phillipart J, Vanderzwaag S. Lumbar Spine Assessment - Explanations and clinical reasoning on the assessment of the lumbar spine. Amsterdam[. Last updated 2013; Last accessed 08/2015]Available at: https://lumbarspineassessment.wordpress.com/.

Masters K, Ellaway R. e-Learning in medical education Guide 32 Part 2: Technology, management and design. Med.Teach. 2008;30(5):474-489.

McCutcheon K, Lohan M, Traynor M, Martin D. A systematic review evaluating the impact of online or blended learning vs. face-to-face learning of clinical skills in undergraduate nurse education. J.Adv.Nurs. 2015;71(2):255-270.

Moridani M. Asynchronous video streaming vs. synchronous videoconferencing for teaching a pharmacogenetic pharmacotherapy course. Am.J.Pharm.Educ. 2007;71(1):16.

Moule P. Challenging the Five-Stage Model for E-Learning: A New Approach. ALT-J: Research in Learning Technology 2007;15(1):37-50.

Muir DJ. Adapting Online Education to Different Learning Styles. 2001.

Palloff RM, Pratt K. Building Online Learning Communities : Effective Strategies for the Virtual Classroom. San Francisco, CA: Jossey-Bass; 2007.

Potomkova J, Mihal V, Cihalik C. Web-based instruction and its impact on the learning activity of medical students: a review. Biomed.Pap.Med.Fac.Univ.Palacky Olomouc Czech.Repub. 2006;150(2):357-361.

Real Time Statistics Project. http://www.internetlivestats.com/. [. Last updated 2015; Last accessed 12/2015]Available at: http://www.internetlivestats.com/.

Reeves PM, Reeves TC. Design considerations for online learning in health and social work education. Learning in Health & Social Care 2008;7(1):46-58 13p.

Reime MH, Harris A, Aksnes J, Mikkelsen J. The most successful method in teaching nursing students infection control - E-learning or lecture? Nurse Educ.Today 2008;28(7):798-806.

Reynolds D. Learning Styles of Online Students vs.Onground Students 2005.

Romanov K, Nevgi A. Do medical students watch video clips in eLearning and do these facilitate learning? Med.Teach. 2007;29(5):484-488.

Rosen A. E-Learning 2.0: Proven practices and emerging technologies to achieve real results. 1st ed. New York: AMACOM; 2009.

Rosenberg M. Beyond E-Learning: Approaches and Technologies to Enhance Organizational Knowledge, Learning, and Performance. 1st ed. San Francisco: Pfeiffer; 2006.

Ross M, Carroll G, Knight J, Chamberlain M, Fothergill-Bourbonnais F, Linton J. Using the OSCE to measure clinical skills performance in nursing. J.Adv.Nurs. 1988;13(1):45-56.

Rowe M, Frantz J, Bozalek V. The role of blended learning in the clinical education of healthcare students: a systematic review. Med.Teach. 2012;34(4):e216-21.

Ruiz JG, Mintzer MJ, Leipzig RM. The impact of e-learning in medical education. Academic medicine 2006;81(3):207-212.

Sandars J, Lafferty N. Twelve Tips on usability testing to develop effective e-learning in medical education. Med.Teach. 2010;32(12):956-960 5p.

Silva CCBMd, Toledo SLP, Silveira PSP, Carvalho CRF. Evaluation of a multimedia online tool for teaching bronchial hygiene to physical therapy students. Rev Bras Fisioter 2012;16(1):68-73.

Sit JW, Chung JW, Chow MC, Wong TK. Experiences of online learning: students' perspective. Nurse Educ.Today 2005;25(2):140-147.

Statista GmbH. Statista - The statistics portal. Hamburg, Germany[. Last updated 12/2015; Last accessed 12/2015]Available at: http://www.statista.com/statistics/204952/average-internet-connection-speed-by-country/.

Steedman M, Abouammoh M, Sharma S. Multimedia learning tools for teaching undergraduate ophthalmology: results of a randomized clinical study. Can.J.Ophthalmol. 2012;47(1):66-71.

Stewart A, Inglis G, Jardine L, Koorts P, Davies MW. A randomised controlled trial of blended learning to improve the newborn examination skills of medical students. Arch.Dis.Child.Fetal Neonatal Ed. 2013;98(2):F141-4.

Turner MK, Simon SR, Facemyer KC, Newhall LM, Veach TL. Web-based learning versus standardized patients for teaching clinical diagnosis: a randomized, controlled, crossover trial. Teach.Learn.Med. 2006;18(3):208-214.

Wu DC. Learning Styles and Satisfaction in Distance Education. Turkish Online Journal of Distance Education 2014;15(4):112-129.

Wutoh R, Boren SA, Balas EA. eLearning: a review of Internet-based continuing medical education. J.Contin.Educ.Health Prof. 2004;24(1):20-30.

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