

***An exploration of the factors that contribute to learning
satisfaction of first year anatomy and physiology students***

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Abstract

Lecturers have reverted to using a 'blended' approach when teaching anatomy and physiology. The students' response to how this contributes to their learning satisfaction was investigated using a self-administered questionnaire. The questionnaire consisted of close- and open-ended questions which were based on three determinants of learning satisfaction being perceived course learnability, learning community support and perceived learning effectiveness. Regarding course learnability the students responded positively on the questions regarding the relevance of the subject for their future careers. Students however identified a number of distractions that prevented them from paying full attention to their studies. As far as learning community support was concerned, the respondents indicated that they were more comfortable asking a peer for support if they were unsure of concepts than approaching the lecturing staff. Most of the students study in their second language and this was identified as a stumbling block for success. There was a difference in opinion among the students regarding the use of technology for teaching and learning of anatomy and physiology. From the students' perceptions regarding learning effectiveness it became clear that students' expectations of the anatomy and physiology was unrealistic, they did not expect the module to be so comprehensive. Many of the students were also 'grade oriented' rather than 'learning oriented' as they indicated that they were more concerned about results than 'owning' the content of the module. Asking students to evaluate aspects of the teaching and learning process have provided valuable information to improve future offerings of anatomy and physiology.

Key words

Course learnability; learning support; learning effectiveness

Introduction

The pass rate at institutions for Higher Education is a matter of concern. A poor pass and graduation rate does not only have economic implications for the institution, but also has implications for the learners and the country. Graduates earn more than high school leavers and will be paying more tax and they are usually less dependent on the state's health care and pension system (19).

Traditionally, education has not been driven so much by technology as by other factors such as ideology, cultural and religious heritage, and other socio-political factors. However, over the past decade enormous challenges have arisen because of changing student demographics, demands on providers of education and rapid development in technology (1, 4).

To keep in pace with these changes the lecturing staff of the physiology department design and use blended learning interventions to help students master the content. These interventions include lectures, tutorials - both paper-based and computer-assisted, practical sessions in the laboratory also using computer-assisted equipment, and computer-based animations and simulations. Structured discussions are used during these interventions to encourage the students to use the 'language of physiology' and to engage with the content.

A blended learning environment combines the advantages of face-to-face and technology-assisted learning (TAL) to promote learning satisfaction. An added advantage of a blended learning environment is that different modes of instruction support the different types of knowledge acquisition which support different learning styles (13).

Learning satisfaction nurtures motivation to study and if the lecturing staff incorporate these interventions using the blended teaching and learning approach, it could have a positive effect on pass rates and retention of students. According to Hu (12) the

determinants of learning satisfaction are learning effectiveness, perceived course learnability and learning community support (Figure 1).

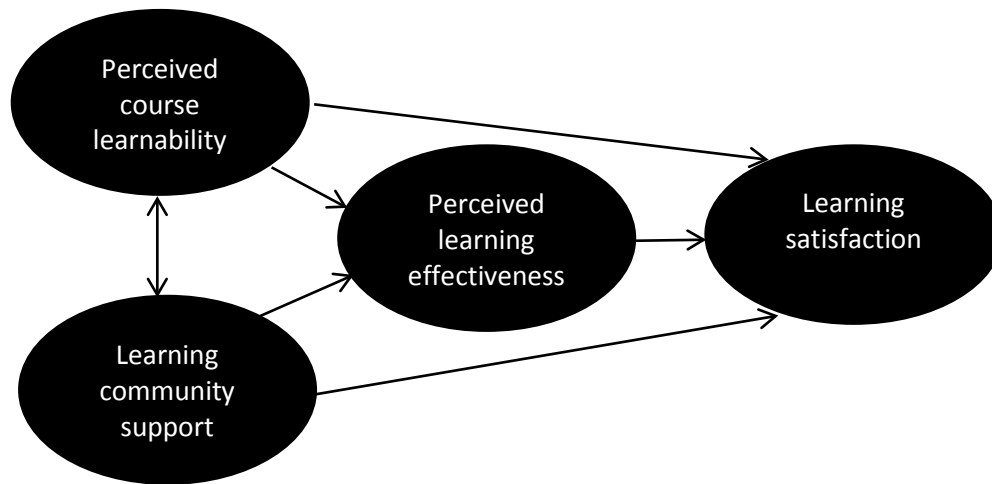


Fig. 1 Determinants of learning satisfaction (12)

The aim of this article is to indicate which aspects of a blended learning approach contribute to learning satisfaction. This information was obtained by asking students to respond to questions related to each of the determinants of learning satisfaction.

Background on determinants of learning satisfaction

Perceived course learnability

A perception of course learnability is required to motivate students to persist with their learning. The complex theme of motivation has been described extensively by Keller (14). According to Keller the five principles of motivation are:

- **Curiosity:** which is aroused due to a perceived gap in current knowledge and helps to gain and maintain attention (14);
- **Relevance:** when learners perceive information to be relevant to their own goal for learning, they will be motivated to ensure that they understand the concept. Teaching students abstract theory alone can be demotivating as they find it difficult to relate the

theory to their discipline. This is especially true for 'building block' subjects such as physiology that students do during their first years of study (14,15);

- **Success:** motivation is promoted when learners are confident that they can succeed in mastering a learning task (14);
- **Extrinsic and intrinsic motivators:** Learning satisfaction helps to maintain continued motivation. This requires a balance between extrinsic and intrinsic motivators (14);
- **Self-regulation strategies** protect the intentions to learn when distracted and obstacles interfere with persistence. Distractors could be emotional (lack in confidence, low motivation, lack of interest, nervousness or anxiousness), physical (problems with eyesight, hearing, health or mobility), psychological (fear of failure, low self-esteem, deflated ego, feeling of alienation) or sociological (unable to work in groups, difficulty to bond with others, problems to 'connect' with lecturer or an unfamiliar environment) (7).

The students' perception of the learnability of a course is affected by their learning style. Differences in students learning style underscores the importance of the physiology lecturer to be aware of needs of students; which in turn calls for a suitable delivery medium for the learning content (11, 12).

Learning style refers to the characteristic behavior of an individual student and serves as a relatively stable indicator of how information is perceived (visual, auditory, or kinesthetic) (9), as well as which cognitive style the student prefers when interacting with information within the learning environment (8, 17).

The different learning domains, cognitive, affective, psychomotor and conative, gives a guideline to what the students need to be able to learn. The cognitive domain relates to the ability to think and to mental skills, while the affective domain is about emotions and feelings, especially related to values. The psychomotor domain is concerned with the mastery of physical skills (behavior), while the conative domain focuses on striving to perform at the highest level, that is having the will, desire, drive, level of effort, mental energy, intention,

striving, and self-determination to learn. The higher education graduate of the 21st century needs the opportunity to develop expertise across all four domains (22).

Learning community support

Vygotsky (1978) claimed that only properly organized learning results in mental development and sets a variety of developmental processes into motion (28). This raises the question: how are teaching, learning and development related?

The *sociocultural framework* that was inspired by Lev Vygotsky claims that the development of the mind is a result of constant interactions with the social world. This included interactions between the environment in which students grow up, and the academic environment in which they have to study (28).

Anna Stetsenko's expanded on the heuristic ideas in Vygotsky's theory which linked learning to development. She linked the three concepts of the Vygotskian framework which are the role of *social interaction* as the main source of mental processes, *cultural tools* as mediating components of psychological functioning and the *zone of proximal development* as the main portal through which development proceeds, saying that these three are interconnected by activity (26).

Cognitive function is the result of *social interaction* as learning takes place within a social environment. This interaction in a blended learning environment consists of activities in the classroom and laboratories and could happen during lectures, tutorials, structured discussions and practical sessions. Learning also takes place through collaboration with other students and using social media to communicate. The direction of the cognitive development due to mutual complementary role of the learner and 'facilitator' is inseparable of their social environment and is seen as an inter-psychological process (27).

The second concept, *cultural tools*, refers to the artificial means that enable individuals to master learning. Learners need to master physiological tools in order to develop specific

skills to become competent practitioners. In a blended learning environment these tools include attending lectures, where concepts are explained; participating in discussions with peers, to ensure understanding and clarify misconceptions; to use the prescribed textbook and other resources to reinforce understanding; to use computer-assisted materials such as animations and simulations to visualize physiological processes; to participate in practical sessions using models, wet specimens and laboratory equipment to help conceptualize physiological processes. The character and quality of these cultural tools are direct determinants of the particular features and the quality of the mental activity of the learner. Once these devices have been acquired they can be used to create new functional psychological systems that operate according to new rules and develop according to new laws. Vygotsky distinguished between the effect of everyday and scientific 'tools' that lead to two different types of developmental outcomes. Everyday concepts are acquired in an unstructured and fragmented manner from interactions with people and is subject to chance and often difficult to trace. Scientific concepts are learned in specially organized and structured interactions aiming to introduce learners to scientifically sound definitions of diverse phenomena. The qualities of the cultural tools induce and shape the direction of the development. If learners are faced with fragmented phenomena and poorly generalized ways of dealing with them they end up learning by memorizing unrelated facts (26). Efficient cultural tools are learning materials that take efficient cultural practices into account that express the essence of the phenomena studied, and provide templates of action and contexts where the actions can be applied. Providing appropriate cultural tools is characterized by high levels of mastery and transfer of knowledge by learners and retorts the important question 'how the teaching and learning of specific cultural tools impact on the development of the learner' (25).

The most common understanding of the third concept, the *zone of proximal development*, is that in collaboration with a more experienced person the learner is able to solve problems on a more advanced level than when acting alone. The quantity as well as

the quality of the scaffolding plays a role in this collaborative process. The experienced person structures and models an appropriate solution to a problem, engaging the learner in this solution. Gal'perin postulated that there are three stages of transformation through which mental processing has to go progressing from physical action to audible verbalization and then to 'internal speech' and other mental operations. This support is guided by the current ability of the learner to solve the problem and is adjusted as the learner manages the solution. The quality of the support which could be in the form of modeling, contingency managing, feedback, instructing, questioning and cognitive structuring plays a role in the cognitive development of the learner (25, 26).

Thus the full heuristic potential of the three concepts, as described by Vygotsky, can be uncovered by exploring the internal links among the concepts in a way that exposes the grounding dynamics of human development without compartmentalizing them into separate processes. The link between these three concepts involves the *transformation of activity* where the learner makes progress under the guidance of the more experienced person, who as a representative of the culture of the local community (the community of physiologists), provides the learner with new cultural tools (physiological concepts and processes) (23). The cultural tools are first introduced on an external, interpersonal level through shared interactions (activities) between the learner and the expert for the learner to acquire them. The expert reveals the meaning and function of the new cultural tools as well as how to operate with the aid of the tools. The learner gradually internalizes the meaning and function of the cultural tools and this constitutes the learners advanced cognitive functioning. "By virtue of mastering new cognitive tools in which essential characteristics of cultural practices are embodied in a schematized and abbreviated form" (p.248) the learner is able to progress to a new stage of development to independently perform more complex tasks (26).

Perceived Learning effectiveness

According to Heath (10) learning effectiveness in medical education is improved when the principles of the Cognitive Flexibility Theory as described by Feltovich, Spiro and Coulson in 1989 are applied. These principles warn that oversimplification of complex concepts should be avoided; that students should be exposed to multiple examples of a concept and that they should be provided with multiple representations of the content (blended approach); that knowledge is context-dependent and that knowledge construction and not transmission should be emphasized. This approach also enhances knowledge transfer.

Within a constructivist learning environment the learning effectiveness of the conceptual phase is often best supported by face-to-face instruction to assist with the construction of appropriate schemata (16). The enriched intellectual stimulation supported by interactive computer-assisted presentations of scenarios found in animations and simulations support more advanced learning activities. The flexibility of branching and immediate feedback is a further advantage of TAL to support each student according to their personal needs (20).

Learning effectiveness can be measured objectively by means of assessment of learning outcomes. Graduates of the 21st century are expected to have skills that focus on higher order outcomes and need to be aligned with the meta-outcomes that cut across the four learning domains. This can be done by assessing student's ability to access and use information, to communicate using multiple media, to demonstrate understanding accompanied by reflection, to apply rules and procedures to structured and unstructured problems, to be creative, to think critically, to make sound judgement, to solve problems, to exhibit intellectual curiosity, to proactively seek extended knowledge of the discipline, and to exhibit ethical behaviour.

Student engagement can be improved by increasing staff engagement with students, engaging students in active, collaborative learning activities, setting high academic

standards and providing continuous timely feedback on activities. The quality of student learning is directly but not exclusively related to the quality of teaching, thus learning effectiveness can be improved by improving teaching through setting clear goals and objectives and indicating how they will be assessed explicitly. Students should also be shown how to assess their own learning (13, 22).

Learning satisfaction

The determinants of learning satisfaction are considered as the interaction between perceived course learnability, perceived community support and perceived learning effectiveness (12).

Factors that contribute to learning are quality of the teaching and interpersonal interactions. Good teaching requires a balanced work load at the right level and that clear goals are set out as to what is expected of the learner for assignments and assessments (30). Active learning with regular feedback from the expert (teacher/tutor) and peers serves as reinforcement to ensure that transfer of learning takes place (29). These factors help to establish a productive learning environment (18, 30).

Factors that play a role in satisfaction are the students' interest in the subject and their eagerness to understand it. Their attitude towards learning activities is affected by their personal characteristics and this is especially true for group activities (18).

The role of the diverse learning opportunities in a blended learning environment can add to learning satisfaction. These opportunities are often more creative than traditional learning and improve motivation and achievements (18). Learning satisfaction is increased when the learners experiences that the learning meets their own needs and self-imposed goals to accomplish their own desires and values (5).

Improved learning satisfaction leads to decreased attrition, increased enrollment and motivation and a productive learning environment (30).

Methods

The methodology for this study included both quantitative and qualitative procedures. This mixed methods study consisted of a survey with both close- and open-ended questions (28). (Appendix A)

Ethical approval and protocol authorization was obtained from the Faculty of Health Sciences Higher Degrees committee and Senate of the University of Johannesburg.

Seventy six of a possible 230 first-year students (mean age 19.5 ± 1.4 yr.) who were registered for Anatomy and Physiology 1¹ for Biomedical Technology, Chiropractic, Homoeopathy or Podiatry and Physiology 1 for Emergency Medical Care (EMC) in the Faculty of Health Sciences at the University of Johannesburg, South Africa (2012) volunteered to participate in the study. The students were assured that the responses will be treated with confidentiality and that their identity will not be revealed. The students gave their written consent to participate in the study after which they completed the questionnaire.

The students completed the self-administered questionnaire that consisted of two sections:

The first section was to acquire demographic information of the students - which module they were registered for, the cultural group they belong to, their age in years and their gender. (Although they had to disclose their cultural group, age and gender this information will not be reported in this article).

¹ Anatomy and Physiology 1 is an introductory module for all Health Sciences students at UJ. All the body systems are address during theoretical and practical sessions. The prescribe textbook for this module is 'Fundamentals of Anatomy and Physiology by Frederic H. Martini, Judi L. Nath and Edwin F Bartholomew' Benjamin Cummings Publishing

The second section was the learning satisfaction survey with both closed (yes/no) and open ended questions and consisted of three parts: the first to determine their learning expectations, the second to determine their perceptions of learning support and the third to determine their perceptions of the learnability of the physiology module that they were registered for (12).

Results and Discussion

Demographic of participants

The students who volunteered to participate were registered in the following programs:

Homoeopathy (H) – 4; Chiropractic (C) – 9; Podiatry (P) – 8 and Emergency Medical Care (E) – 11. For data analysis these students (HCPE) were grouped together as they attend the same class. There were 44 Biomedical Technology students who participated, they cover the same content as the other group but have a separate offering.

Quantifying learning satisfaction

The questionnaire was based on the determinants for learning satisfaction and the role that each of these play in learning is discussed with the results of this study.

The response to questions to determine specific aspects of the learnability of the module perceived by the students is illustrated in Figure 2 and the following discussion.

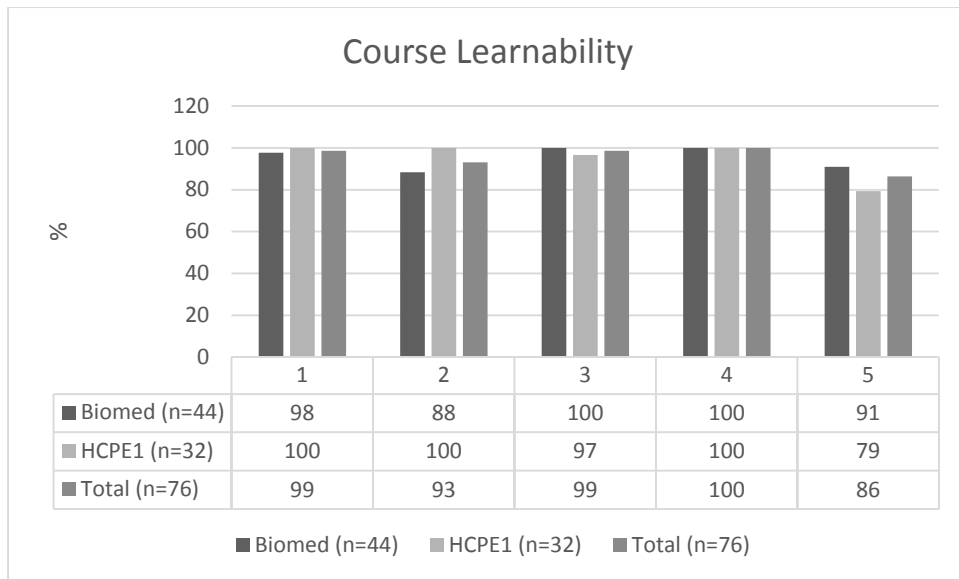


Fig. 2: Response to questions regarding course learnability

The students' response to the questions related to course learnability:

- 1 Do you find it interesting to learn more about the functioning of the human body?

Most students (99%) indicated that they found it interesting.

- 2 Do you think anatomy and physiology is relevant to prepare you for your career?

All the HCPE students and 88% of the Biomedical technology students could see the relevance of the module for their future careers.

- 3 Do you think you have what it takes to be a good (program they were registered for was indicated here) _____ and (4) are you prepared to give your best to get there?

Most of the students (99%) were confident that they were capable of being a good professional in their chosen career and that they were prepared to work for it.

- 5 Do you enjoy studying?

86% of the students were enjoying their studies.

The response to questions to determine specific aspects regarding learning community support of the students is illustrated in Figure 3 and the following discussion.

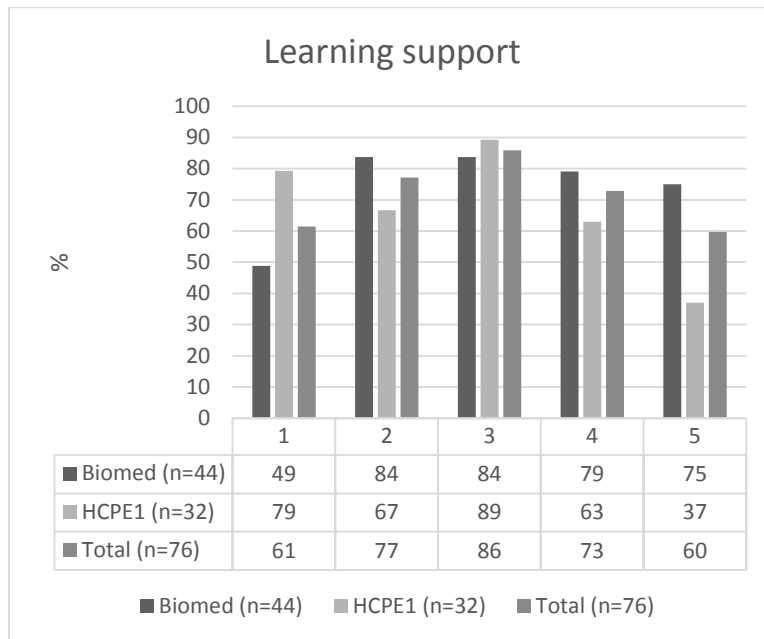


Fig. 3: Response to questions regarding learning support

The students' response to the questions related to learning community support:

- 1 Do you prefer lectures or discussions to learn **new** content? (The percentage of students preferring lectures is captured in Figure 3.)

There was a difference in the preference of the two groups of students, with the Biomedical Technology students preferring discussions while the HCPE group was more comfortable with lectures.

- 2 Do you find that you understand the content better if you discuss it with a friend?

The preference in the previous question was confirmed when 84% of the Biomedical Technology students indicated that they understand better if they discuss the work with a peer compared to 67% of the HCPE group.

Did you find the practicals where you had to use the PowerLabs²:

3. Interesting? And 4. Helpful to understand the concepts that were discussed in class?

² PowerLab - Lab Tutor Experiments: Human Physiology (2012). ADInstruments Pty Ltd.

86% of the students found the practicals interesting while 73% found it helpful to understand theoretical concepts.

5. Would you like more and different types of technology to be used for teaching and learning?

While 75% of the Biomedical Technology students would like more technology incorporated in the module, only 37% of the HCPE group thought it was necessary.

The response to questions to determine specific aspects of learning effectiveness of the students is illustrated in Figure 4 and the following discussion.

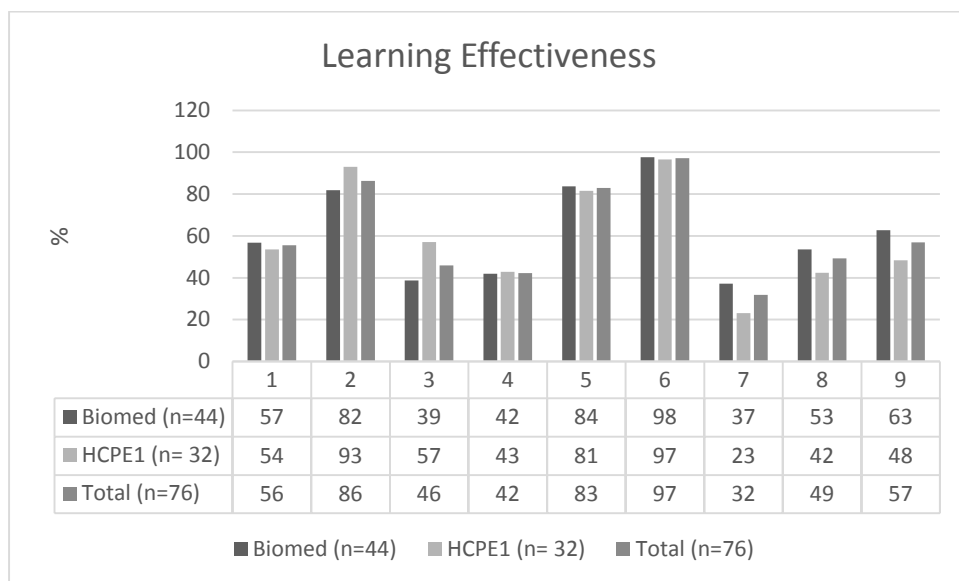


Fig. 4: Response to questions regarding learning effectiveness

The students' response to the questions related to learning effectiveness:

- 1 Do you feel that what is expected for anatomy and physiology is more than what you thought it would be when you came to study?

56% of the students entered the programmes not expecting the level of Anatomy and Physiology that is expected of them.

- 2 Do you find it easy to **relate topics** that you covered in previous chapters (or other subjects) to understand new work?

86 % of the students indicated that they were able to relate new content to previous chapters of anatomy and physiology as well as supporting subjects.

- 3 Did you make use of the CD that accompanies your textbook or any other computer-based material to study?

Only 46 % of the students made use of the CD with interactive tutorials that accompany the prescribed textbook.

Do you make sure that you **understand** the work covered during a lecture before moving on to study the next section by:

- 4 asking the lecturer if you do not understand?

Only 42% of the students consult the lecturer if they have trouble understanding concepts.

- 5 asking one of your friends if you are not sure?

A large percentage of the students (83%) ask their peers if they are not sure of concepts.

- 6 consulting your textbook if you are not sure?

Most students (97%) consult the textbook to clarify uncertainties.

- 7 visiting the library to read up more? Or

Only 32 % of the students do make use of the library.

- 8 doing an internet search to find out more?

49% of students do internet searches to help them to clarify content.

- 9 Do you feel your marks are a true reflection of **the effort you put into studying**?

Only 57% of the students thought their effort was reflected in the marks they obtained.

Qualifying learning satisfaction

Students' written responses to the questionnaire for each of the determinants of learning satisfaction were analyzed using principles of content analysis. In vivo coding was used to

identify the concepts in the core categories to establish trends (24, 29). The analysis was done using Atlas.ti³.

The results are presented according to the themes identified for each of the determinants for learning satisfaction. Figure 5 illustrates the themes according to which the open-ended questions are discussed.

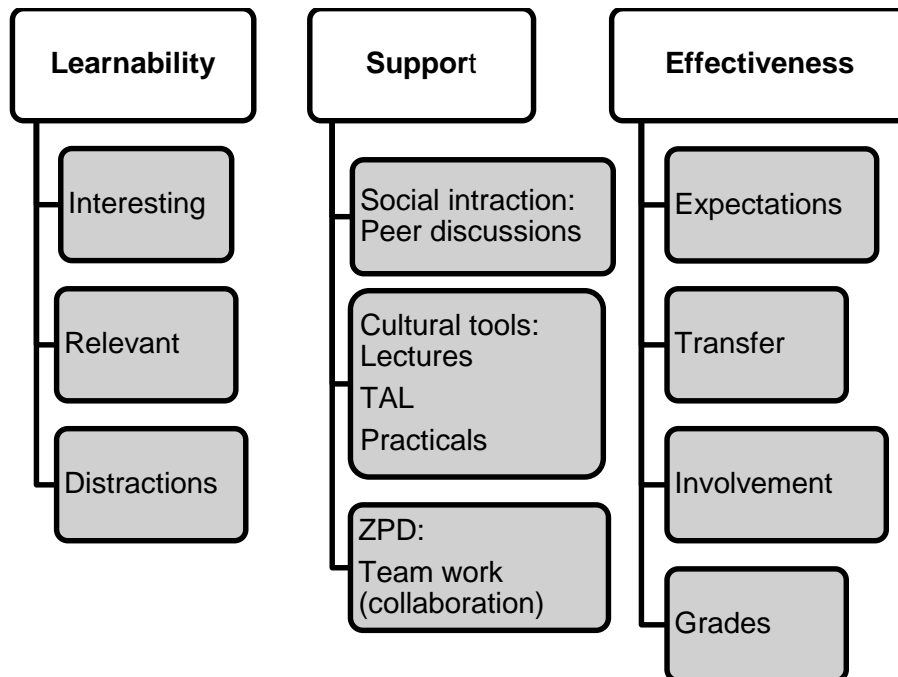


Fig. 5: Themes identified for learning satisfaction

Perceived course learnability

Interesting: A perception of course learnability is required to motivate students to persist with their learning (14). Ninety nine percent of the students were curious to find out more about the functioning of the human body and indicated that they found it interesting to learn about the functioning of the body. 'I, myself am a fully functional 'human body' so it AMAZES me to learn about what is happening in me every minute, second and hour of the day. I love A&P.' (P.9). This kind of enthusiasm which is aroused when students are interested in what

³ Atlas.ti Qualitative data analysis Version 6.2.28 ATLAS.ti GmbH, Berlin

they are learning is a strong motivator towards learning effectiveness and learning satisfaction.

Relevant: Ninety nine percent of the students realized that Anatomy and Physiology is relevant for their future careers. 'I am a medical student who is one day going to qualify to be a great chiropractic doctor, therefore what I learn in A&P will be the basis of my diagnoses, treatment and symptoms when working with patients' (P. 9). 'Even though podiatrist work mostly with feet they are still part of (a very important part of) the human body. Everything is so interconnected and synchronized. The A&P of the full body is very relevant' (P. 21). All the students indicated that they are prepared to give their best to reach their goal. If students are aware of the relevance of the subject for their future career they are more likely to experience learning satisfaction (15).

Distractions: Although the students indicated that they were very committed to their studies they identified several distractions preventing them from paying full attention to their studies. The problems were study related (procrastination, disorganized, demotivated, short concentration span and laziness); personal (stress, fatigue, worries, headaches and uncertainty); social (cell phone, social networks, friends, sport, computer games, music and the TV); living conditions (family, chores, noise, quietness and roommate). 'Well with me I stay with my parents. I have to clean, cook, do dishes, study and have a social life, which really gets me busy and stressed. But now I can manage it all' (P. 55). Other problems that were mentioned are financial problems, transport problems, part time job and being hungry. 'I have financial problems, sometimes it's difficult for me to concentrate with an empty stomach' (P. 8). These distractions are similar to those identified by Dawson (7) who classified distractions related to emotional, physical, psychological or sociological problems.

Learning community support

The key to supporting students to achieve success in physiology lies in identifying the relationship between the factors that contribute to teaching, learning and the level of mental

development of the students. Vygotsky linked these concepts when he described the role of social interaction, the use of cultural tools and the zone of proximal development (ZPD) (28).

Social interaction:

The development of the mind is a result of constant interactions within the social world which includes the interactions the students experience in the environment in which they grew up as well as the academic environment in which they study (2, 27). In the academic environment it is not only the interaction with the lecturing staff, but also the interaction with their peers that stimulate mental development. Although 82% of the students indicated that they ask their peers for help when they do not understand the work, as supported by this remark 'I prefer to discuss the unknown work with a friend to help grasp concepts' (P.16), only 43% stated that they feel at liberty to ask the lecturer if they need to clarify their understanding of a concept signposted by remarks such as 'I seldom ask my lecture during lecture periods because I feel extremely nervous I am not used to asking questions during class' (P.19). Considering the students' background (many of them come from rural areas to study in the city) and that more than 50% of the students are not first language English speakers, lecturing staff should go out of their way to encourage students during class to consult with them and be approachable during informal discussions which should put students at ease to ask when they need help.

Cultural tools:

Lectures: In a blended learning environment the students need to be exposed to a variety of 'tools' to master the physiology content. The different modes of instruction support different types of knowledge acquisition (13). Students are first exposed to new content during face-to-face lectures where PowerPoint presentations are used. Interactivity during the lectures helps to improve the understanding and retention of information. Most students (78%) indicated that they find that **peer discussions** of difficult concepts during class helped them. 'I like discussion because me too I'm involved I have my own opinion especially when

we debate I get a better understanding' (P.34) and 'A friend explain it in more simplified way and it is easier to remember and understand what a friend said' (P.58).

TAL: Students had the option to use the **animated tutorials** on the CD that accompanies their textbook on their own. Only 46% of the students used these animations to study. Those who did found it helped them 'I used it for the nervous system before writing the test and it makes things better and they explain most of the things very well' (P.8) and 'It helps giving me a visual demonstration of the processes that occur in the work we study and I remember things better like that' (P.63). The students who did not use the material reported that they either did not have access to a computer or that their computer was not suitable to run the programs. 'Do not have facilities to accommodate that but would love to as I have seen its preview and it's understandable' (P.36).

Practicals: The purpose of doing practicals is to help students see applications of the concepts they learnt about in class. They used the PowerLab⁴ systems during the practical sessions. The practicals are designed in such a way that students need to share their results and answers to questions between groups. According to Magoldo (3) the students' preferred style of interaction change as they develop. During the early stages college students tend to be dualists. They expect clear indications of what is expected. This is the stage of the absolute knower. This is followed by the stage of the transitional knower when students use absolutist strategies and realize their capacity for interpretation. They can be encouraged to experiment, but ultimately they want assurance that they are close to being correct. The next stage is that of the independent knower when students realize that knowledge is open to many interpretations. They are aware of the need for a personal approach to interpreting information, theories and experiences. They finally reach the stage of the contextual knower when they become comfortable judging how their knowledge base and skills might apply to a

⁴ PowerLab: Lab Tutor Experiments: Human Physiology (2012). ADInstruments Pty Ltd.

situation. They can connect concepts to applied settings. These findings were supported during the practicals. Most of the students (86%) did not mind sharing information with the other groups and 57% indicated that they put in more effort as their peers depended on their results and explanations. Students need to be made aware of the importance of being able to interpret their findings in the light of existing theories and models to be able to apply it in 'real world' situations. They also need to learn to critically evaluate results and to trust their peers learn to work as part of a team.

ZPD: The amount of scaffolding provided by a more experienced person that learners need to solve problems on a more advanced level than when acting alone, is what is referred to by the zone of proximal development (ZPD) (25, 26). Students indicated that support from both the lecturer and peers helped them to gain a more advanced understanding of physiology. While they found that the lectures provided the schemata to structure the content their peers played an important role in elaborating on the understanding the work as illustrated by the following examples: 'Many times I'm sure I understand something 100%, but when **discussing** it, there are always new things I pick up that I didn't previously know' (P.29). 'I get to interact with the topic and obtain a different view of it from my friend and this enables me to visualize it more clearly' (P.38). 'Studying alone I tend to leave other things behind but as I begin **discussing** with my friend it helps me recognize the mistakes I made and help me to understand more' (P.40). 'A friend will ask you questions and you will be able to help each other think out of the box' (P.61).

Perceived learning effectiveness

Expectations: Learning can be considered as being effective when it meets the students' expectations of what they need to know for the career of their choice. Students entering tertiary education need to be made aware of how Anatomy and Physiology will enable them to understand their clinical subjects during their senior years as well as help them with diagnosing pathologies in their practice once they qualify. Fifty six percent of the

students' responded that the work load for Anatomy and Physiology was more than what they expected it to be when they registered for the module. 'I definitely didn't think that we would study these subjects so deep as we are doing, it would be nice if someone can tell us why so much work have to be done' (P.5). 'After Term Test 2 I reali[z]ed the importance of knowing everything in detail. I also learned that you have to be specific when 'telling stories' in a paper' (P.63).

Transfer: It was surprising to see that 86% of the students feel that they find it easy to transfer knowledge between the different sections of the work as well as between subjects. Comments like 'I have learnt that in order to really understand the key concepts of A&P you have to integrate the various chapters/ bodily processes rather than to learn it in isolation. A&P is like a box that must be built into a whole in order to make use of it' (P.9) and 'I find it exciting to find links and realizations from one chapter to another' (P.3) illustrates their realization of the importance of transfer of knowledge. Students also showed that they appreciate that it is important to understand one section before moving on to the next. 'If I understand everything in the previous chapter and I can still remember the information I can connect it with the chapters. I'm doing now (but if I forget or didn't understand I can't relate). It makes it easier and interesting so I understand it' (P.33). The students were also able to relate between different subjects. 'I find that aspects covered in anatomy and physiology and EMC 1 [Emergency Medical Care 1] are mutually supportive' (P4) 'Work I studied in other subjects relates quite nicely to what we do in A&P i.e. in microbiology we discussed similar physiological processes while in Podmed [Podiatric Medicine] we discuss similar anatomical structures' (P.33). 'There are topics that are related to pathophysiology and immunology that makes it easier to understand the modules' (P.58). However, there were students who had difficulty to link concepts between sections of the same subject. 'It is hard for me to connect previous chapter to new work. I'm used to studying section by section but not putting them together' (P.22) and 'Sometimes it is hard to remember what I have done previously,

depending on how much I understand' (P.32). The problem identified by the students who struggle with transfer appears to be linked to their study method.

Involvement: According to Heath (10) learning effectiveness in medical education is improved if students are exposed to multiple examples of a concept and provided with multiple representations of the content (blended approach). Within a constructivist learning environment the learning effectiveness of the conceptual phase is often best supported by face-to-face instruction to assist with the construction of appropriate schemata (21). 'The physiology offered this term was good, the lecturer involved us as a class, by making us discuss some of the topics in class, and she explained the concepts and terms in an appropriate manner that I understand' (P.66). Eighty six percent of the students thought that the practicals were interesting and 73% reported that it helped them to understand the theoretical concepts discussed during lectures. 'The glucose practical was that one could literally see the effects, which is nice to see, so practicals that one can see literally what's happening will be very helpful and interesting' (P.7). The enriched intellectual stimulation supported by interactive computer-assisted presentations of scenarios used during animations and case studies can be used to support more advanced learning activities. 'I prefer animations to simplify and explain difficult concepts e.g. brain, sensory and motor pathways etc.' (P.11). 'The more we are able to participate the better we are able to understand as we will be learning activity' (P.62). These remarks by the students emphasize the role of blended learning activities for Anatomy and Physiology.

Grades: Students find it difficult to realize that they need to understand the anatomy and physiology to be able to apply it in subjects such as pathology and diagnostics. Their main objective is just to get good grades; they are grade oriented (only 57% of the students indicated that they feel that their marks are a true reflection of the effort they put into studying) rather than learning oriented. 'Instead of 'owning' the material, I simply studied for tests' (P.4). Eison (1979) (3) identified style in terms of students' attitudes toward grading and learning. His work was based on the idea that students fall into two categories: *learning*

oriented students (LO) who see the classroom as a place to find ideas and information that is important to them; and *grade oriented* students (GO) who see the classroom as a place where they will be tested and graded to obtain a qualification. Eison compared learning styles of adult students (aged 32-67), young adults (aged 23-31) to those of traditional-age students (aged 17-22). The adult groups scored higher on learning orientation. The younger students were more inclined to have test anxiety (3). 'So yes I think stress, time management and not having enough time to enjoy the work in class did lead to many of us failing the paper' (P.29). The preferences of teaching method for the groups were also different. The younger students prefer short frequent quizzes drawn from clearly specified study areas; graded assignments; and extra-credit activities. 'What may have improved the outcomes in our case is the inclusion of mini mock tests. (P.4) '... it could help to provide tutorials on cycles and steps of concepts ...' (P.14). Adults on the other hand are less concerned with the testing policy, enjoy less structured, un-graded learning opportunities, and are not so concerned about their final course grade. The learning styles of the younger group were characterized by lower levels of interest in the course, higher levels of competitiveness, and decreased interest in assuming responsibility for getting the most out of the class. 'I only studied for tests, which made it a bit difficult to grab everything' (P.50). There is a big difference between the age groups in their interest and willingness to participate in class activities. The fact that younger students are more instrumental (engage in activity for the sake of the payoff), "The mechanisms that the lecturer used e.g. explaining to friends what I understand helped me a lot' (P.32), if handled in a sensitive way, can lead to an increased sense of competence which can move to a more developmental orientation with respect for themselves and their education 'Every day after class I would consolidate that is go over things we did in class and make sure I fully understand them for I can move on to a new chapter. I'd write out summaries of mechanisms I needed to know, make sure I could write it in my own words' (P.51).

Perceived learning satisfaction

To attain learning satisfaction students need to perceive the physiological concepts and processes as interesting and relevant for their future career. Students need to identify and overcome the distractions which stand between them and learning satisfaction and ultimately success.

The support of the learning community in the form of social interaction between students and with the lecturing staff plays an integral role in establishing learning satisfaction. Students identified discussions as a vital part of their learning. The structured discussions during lectures and practicals as well as informal discussions in their own study groups helped them to develop a deeper understanding of the physiological concepts and processes.

To fully attain learning satisfactions students need to perceive the learning to meet their expectations of what is required to be a successful practitioner once they qualify. They need to be able to transfer the knowledge between subjects and within the same subject to form a 'big picture' of how physiology is related to their clinical subjects and career of choice. The outcome of learning is improved if they are actively involved in the learning process.

If the factors involved in perceived learnability, support and effectiveness are identified and managed properly they will lead to perceived learning satisfaction and ultimately success.

Conclusion

Students that find that the learning environment satisfies their needs to become a successful professional are motivated to go the extra mile. This requires the factors that contribute to learning satisfaction to be in place.

The learnability of physiology is improved when students' perceptual and cognitive differences are entertained by using a blended teaching approach. The varied methodologies helps to make the content interesting which motivates students to study.

Social community support of students at Institutions of Higher Education has become challenging as students with different cultural backgrounds enter. Sensitivity regarding social interactions, the use of cultural tools in teaching and the challenge to help students reach goals beyond their 'comfort zone' is vital in the current learning environment.

The effectiveness of the offering can be assessed using different assessment methods. It is important to evaluate the effectiveness of the offering too. Asking the students to evaluate aspects of the teaching and learning process have proven to provide valuable information on what is assisting them in their learning and what not.

Taking note of the factors that contribute to learning satisfaction can enhance the learning experience which will help with improving the pass rate and student retention. More students graduating will have a positive impact on the economy of the country.

Limitations and suggestions for future studies

This study was conducted at a specific time at one South African institution, it would be interesting to do a longitudinal study at different institutions to see the difference over time and to compare perceptions at different institutions.

The outcome of this study can be used to improve the questionnaire and for future studies include more students from different modules at different institutions.

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Author contribution

Author contributions: S.E. conception and design of research; S.E. performed experiments; S.E. analyzed data; S.E. interpreted results of experiments; S.E. prepared figures; S.E. drafted manuscript; S.E. edited and revised manuscript; S.E. approved final version of manuscript.

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Figure captions

Fig. 1 Determinants of learning satisfaction

Fig. 2: Response to questions regarding course learnability

Fig. 3: Response to questions regarding learning support

Fig. 4: Response to questions regarding learning effectiveness

Fig. 5: Themes identified for learning satisfaction

APPENDIX A

DEMOGRAPHIC INFORMATION

1. Please specify the programme that you are registered for:

1.1. Chiropractic	
1.2. Emergency medical care	
1.3. Homoeopathy	
1.4. Podiatry	
1.5. Biomedical technology	

LEARNING SATISFACTION SURVEY

Please read each statement or question carefully and respond with **your honest opinion**.

1 Learning expectations

1.1. Do you feel that what is expected for anatomy and physiology is more than what you thought it would be when you came to study?

Yes _____ No _____

Please explain

1.2. Do you find it easy to relate concepts that you covered in previous chapters (or other subjects) to understand new work?

Yes _____ No _____

Please explain

1.3. Did you make use of the CD that accompanies your textbook or any other computer-based material to study?

Yes _____ No _____

Please explain

1.4. Do you make sure that you **understand** the work covered during a lecture before moving on to study the next section by:

1.4.1. Asking the lecturer if you do not understand Yes ___ No _____

1.4.2. Asking one of your friends if you are not sure Yes ___ No _____

1.4.3. Consulting your textbook if you are not sure Yes ___ No _____

1.4.4. Visiting the library to read up more Yes ___ No _____

1.4.5. Doing an internet search to find out more Yes ___ No _____

Please elaborate on the above responses (for 1.4)

1.5. Do you feel your marks for term 2 is a true reflection of **the effort you put into studying**?

Yes _____ No _____

Please elaborate on your study method (mention things like - if you worked throughout the term or did you only study for tests; did you make summaries or just read from the textbook)

2 Learning support

2.1 Do you prefer lectures or discussions to learn **new** content?

Lectures _____

Discussions _____

2.2 Do you find that you understand the content better if you discuss it with a friend?

Yes _____

No _____

Please explain

2.3 Did you find the practicals where you had to use the PowerLabs:

• Interesting Yes _____ No _____

• Useful to understand the concepts discussed in class Yes _____ No _____

2.4 During the practical when you tested the glucose levels for different intakes:

• Did you feel comfortable getting answers to questions from the other groups?
Yes _____ No _____

• Did you mind sharing information with the other groups? Yes _____ No _____

• Did you put extra effort into answering questions because you felt that your peers depended on you? Yes _____ No _____

2.5 Would you like more technology to be used for teaching and learning?

Yes _____ No _____

Please provide some suggestions

3 Course learnability

3.1 Do you find it interesting to learn more about the functioning of the human body?

Yes _____ No _____

Elaborate by giving an example of something that fascinated you.

3.2 Do you think anatomy and physiology is relevant to prepare you for your career?

Yes _____ No _____

Why or why not?

3.3 Do you think you have what it takes to be a good

Chiropractor/Homeopath/Podiatrist/EMC/Biomedical Technologist (cross out the careers that do not apply to you)?

Yes _____ No _____

and are you prepared to give your best to get there?

Yes _____ No _____

3.4 Do you enjoy studying?

Yes _____ No _____

3.5 What distracts you from studying?

3.6 How did you feel about the Physiology offering during term 2?

Please provide suggestions of changes that could improve it.

Thank you for your participation. S Eagleton

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