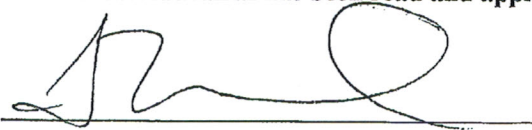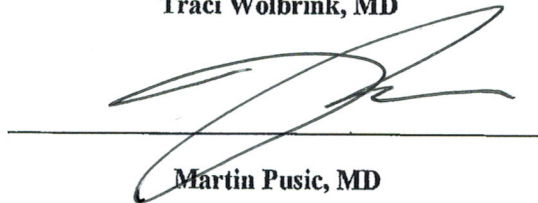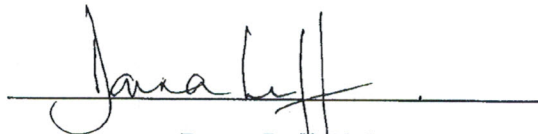This Thesis, The Ancillary Learning Resources Used by Medical Students for Self-Directed Learning, presented by Phinda Njisane, and Submitted to the Faculty of The Harvard Medical School in Partial Fulfillment of the Requirements for the Master of Medical Sciences in Medical Education has been read and approved by:

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THE ANCILLARY LEARNING RESOURCES USED BY MEDICAL STUDENTS FOR

SELF-DIRECTED LEARNING

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A Thesis Submitted to the Faculty of

The Harvard Medical School

in Partial Fulfillment of the Requirements

for the Degree of Master of Medical Sciences in Medical Education

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The Ancillary Learning Resources Used by Medical Students for Self-Directed Learning

Abstract

The Internet is an important source of medical information. It not only increases the scope of available medical resources, but also provides opportunities that support self-directed learning and the individual learning preferences of medical students. This study identifies the common online learning resources used by medical students and their perceptions regarding the use of online resources for learning.

This study was conducted at a South African medical school which offers a six-year medical degree program. A mixed methods study design was used. The study consists of two phases, an initial qualitative phase that used focus group discussions, and a subsequent quantitative phase that used an online survey. The focus group discussions informed the design of the survey. This survey was distributed to medical students in years three to six.

A total of 19 medical students participated in the focus group discussions. The focus group discussions highlighted that online resources provided students with flexibility regarding how information could be acquired and also facilitated the learning process. However, there were concerns regarding credibility, depth and contextual relevance of some online resources. From 201 survey responses, 83% of respondents used online resources as often or more often than university-provided materials. The most popular resources were YouTube (91%), UpToDate (86%) and Medscape (75%), of which UpToDate and YouTube were found to be more useful than textbooks ($p < .001$). Students used these resources to establish a basic conceptual understanding of a clinical topic (79%). Using these was also considered time efficient (73%).

Online resources complement student learning. However, there are concerns regarding resource credibility, depth and contextual relevance. Medical schools should consider advising students on the rational and effective use of these online resources and should consider assisting in the development of information seeking and management so that students can successfully meet their learning goals.

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Chapter 1: Background

The practice of medicine requires the continuous acquisition and mastery of rapidly expanding and evolving knowledge and skills (Ding, Babenko, Koppula, Oswald, & White, 2019; Monroe, 2016). To develop lifelong learning, medical students need to learn to self-direct and manage their learning (Monroe, 2016; Zhang, Peterson, & Ozolins, 2011). Therefore, the practice of self-directed learning (SDL) is a priority in medical education (Monroe, 2016; Zhang et al., 2011). SDL is the process by which learners recognise their learning needs, set their own learning goals and objectives, identify appropriate learning materials and resources, regulate learning, and evaluate and apply learning (Kim, Olfman, Ryan, & Eryilmaz, 2014; Miflin, Campbell, & Price, 2000; Wilcox, 1996).

The formal university curriculum provides the knowledge base on which supporting resources build (O'Carroll, Westby, Dooley, & Gordon, 2015). Educators and curriculum developers may recommend, provide and assist in identifying these resources. However, as students advance in their training to the clerkship setting, the role of the teacher shifts from supplier of information and learning materials to demonstrator of clinical practice (Miflin et al., 2000). Therefore, particularly during clinical clerkships, there is a general expectation that students self-direct their learning and exercise information seeking by identifying supplementary learning materials, resources and activities that adequately address their learning objectives and needs (Miflin et al., 2000).

1.1 Online resources

The Internet has become a valuable medical information resource (Hughes, Joshi, Lemonde, & Wareham, 2009). Before the expansion of online resources, medical students would have largely depended on resources such as textbooks and lecture notes for learning (Judd & Elliott, 2017). The Internet enables distance learning, and flexible and learner-centred approaches to teaching and learning (Ellaway & Masters, 2008). The online resources

used in medical education to access medical information include and are not limited to:

UpToDate, Medscape, DynaMed, PubMed, general web searches, YouTube, wikis, podcasts,

blogs, Twitter and Facebook (Boruff & Storie, 2014; Hughes et al., 2009; Judd & Elliott,

2017; Mallin et al., 2014; O'Carroll et al., 2015; Rapp et al., 2016; Sterling, Leung, Wright,

& Bishop, 2017; White, Sharma, & Boora, 2011).

      The goal of this study was to understand the contemporary medical student's use of

online resources. This study identifies the online resources that are commonly used by

medical students, the role of these resources, and the students' perceptions regarding the use

of these.

Chapter 2: Methods

This was a mixed methods study conducted between October 2018 and February 2019 at the University of Cape Town's (UCT) Faculty of Health Sciences in South Africa. UCT offers a six-year Bachelor of Medicine and Bachelor of Surgery (MBChB) degree program.

This study was carried out in two phases. First, the qualitative data collected from focus group discussions was used to develop an online survey which formed the basis of the second phase where a survey was made available to year three to six medical students. This cohort of students was chosen as a greater degree of self-directed learning was expected during clinical clerkships.

This research was approved by the Harvard Longwood Medical Area Institutional Review Board and the UCT Human Research Ethics Committee.

2.1 Phase 1: Qualitative data collection and analysis

Focus groups. Students were invited to participate in semi-structured focus group discussions, see Appendix A for the interview guide. A separate focus group was held for each class cohort. The learning environments, teaching and learning strategies, and SDL resources were discussed. The qualitative data was initially analysed using content analysis to inform the survey development, further described below. Additionally, a thematic analysis was conducted to determine students' perceptions of electronic resource use for SDL.

2.2 Survey development

The survey developed is comprised of the following sections: (i) demographics, (ii) SDL resources, (iii) learning preferences, and (iv) student perceptions (Appendix C). Its design was informed by the focus group discussions and the literature reviewed. Examples of resources that fell within a resource category were included for clarity regarding how these were categorised. For example, clinical handbooks were categorised as textbook resources, the example of Life in the Fast Lane was provided for blogs, and Osmosis, Geeky Medics

and others as YouTube resources. Resource usefulness and frequency of use were rated using five-point Likert scales. Usefulness was rated using the following scale where 1 = not useful, 2 = slightly useful, 3 = moderately useful, 4 = very useful and 5 = extremely useful. While, frequency of use was rated using this scale: 1 = very rarely (once a month or less), 2 = rarely (more than once a month), 3 = occasionally (weekly), 4 = frequently (more than once a week), 5 = very frequently (daily or more). Additionally, a general inquiry regarding SDL was made. Respondents were asked to subjectively rate how orientated they were towards self-directed learning on a scale of one to ten (1 = not at all SDL orientated, 10 = extremely SDL orientated).

Pretesting. Pretesting of the survey involved assessment of face validity, cognitive interviews and a pilot of the survey with conveniently sampled medical interns. The main purpose was to assess the content relevance, language, and clarity of the survey items generated. The think-a-loud technique, verbal probing technique or both were used to determine whether respondents understood the questions and answer choices in the way intended by the researchers (Artino, La Rochelle, Dezee, & Gehlbach, 2014). A pilot survey was then distributed to medical interns to ensure that the online survey was working correctly, and that useful data was being collected.

2.3 Phase 2: Quantitative data collection and analysis

All UCT year three to six MBChB students were invited to complete the finalised online survey. Students were recruited via email, pamphlets and announcements. They could access the survey using an anonymous link or a quick response (QR) code.

Statistical analysis. Descriptive and comparative statistics were used. Depending on data distribution, means and standard deviations (SD) or medians and interquartile ranges (IQR) were used to describe continuous variables. Categorical data was described using frequency and or proportions. Likert scale item data was treated as ordinal and not as interval

data (Jamieson, 2004). Therefore, comparisons were made using the Wilcoxon signed rank test. Associations were determined by using the Chi-squared test of association or Fisher's exact test. To further analyse significant associations, simple logistic regression analysis was used. The alpha level was set at 0.05. The Bonferroni corrected alpha level was used to determine statistical significance to decrease the risk of type 1 error. STATA version MP 14 was used for statistical analysis (StataCorp, 2015).

Chapter 3: Results

3.1 Qualitative results from focus groups

A total of 19 students from year three (n = 5), four (n = 6), and five (n = 8)
participated in our focus group discussions. Most SDL resources students mentioned were
web-based and the decision was made to limit the scope of our quantitative inquiry to web-
based resources. This qualitative data was used to develop the survey, the results of which
can be found below.

The data was further analysed to determine what students' perceptions were regarding
the use of electronic learning resources for SDL. After categorising the students' perceptions
(see Appendix B) three themes were predominant: these resources facilitate the learning
process, provides students with flexibility and options, and student concerns.

These resources facilitate the learning process. Web-based resources used for
learning were viewed to be supplementary. They either helped to address deficiencies in
textbook resources or helped to consolidate learning that has occurred elsewhere. Video
based content was further described as "easier to absorb" (Focus group 2) in comparison to
notes and traditional text resources. These various online resources help students to orientate
themselves to the topic of interest, understand concepts, and process medical information,
particularly when the amount of information is perceived to be overwhelming in either
volume or content. By using these, students are enhancing their learning as the uptake of new
information – particularly from content laden and comprehensive sources – is facilitated. The
following quotes support the above statements:

> "Just from my experience whenever we are prescribed a textbook, usually I get so
> overwhelmed with the details. And I like summarising, but the thing is, I'll end up
> spending a whole weekend just summarising one topic when there are so many to
> actually go over. And so, I usually find myself just going onto YouTube and finding a

5-minute video or something just to get a broader idea of the bigger picture." (Focus group 1)

"I don't like reading textbooks. They are big, they are lots of words, some of them don't have pictures. It's just a lot. I love watching Osmosis videos. Cause I find that when they start a case, they don't really give us an overview of the case, they kind of just dive into all the detail. So, I normally watch a video that kind of explains: What is this thing? What is it about? What are the causes? Just basic stuff. And then I feel more confident to learn the materials on the slides because I have an idea of what is going on." (Focus group 3)

Provides students with flexibility and options. These online resources provide students with choice regarding how they would like to receive information and in which sequence. Students can choose which resource to use based on format, context and length. This may create a more personalised learning experience. As one student noted: "I like Medscape, I like how they break up everything on the side, so you can choose what you want to read, and in what order." (Focus group 1). The element of variety and choice also enables learners to manage their learning and to meet their changing learning needs. Furthermore, students have the freedom to choose the resources that appeal to their learning preference and are subjectively favourable. For some, these electronic resources present information in a more palatable and understandable format. As illustrated by the following quotes below.

"I think for me it will depend on the situation, if it is a topic I just want to rapidly know, I just go to Wikipedia and just get a general sense of what's happening. And then after that if it maybe does not explain it that well I will go onto a YouTube channel, read a text or something like that, further sort of embark on that." (Focus group 2)

"I think my choice is based on what I am wanting to know that for. Is it for an exam or just basic understanding? Or to understand something related to it. . . . But if it is a portfolio or case write up where I want to learn but also show the details of this, I'd think I would use a website or reading tools. But for my own understanding I think videos do work best." (Focus group 2)

Student concerns.

Lacking the detail needed for assessments. One way in which students evaluated the utility and depth of these resources was by determining whether these resources would help in answering assessment questions. Online resources, namely video-based resources, may have inadequately address the topic of interest in the detail required to sufficiently answer assessment questions. Therefore, students may feel that they have only gained a superficial or conceptual understanding of the subject. This reinforces the previous idea that these resources are largely supportive as they partially fulfil student learning needs. As a participant noted:

"I sometimes feel with videos, I have to question: am I going in enough detail for this topic? I feel like I still have to go back and read a lot more. Osmosis does it nicely but when I look through the past papers, I won't be able to answer those questions just through Osmosis. So, I definitely have to go read textbooks and stuff." (Focus group 3)

Out of context. Concerns regarding the clinical and geographical relevance of these resources were also expressed given that many of these resources are produced in countries with different disease burdens. As a participant stated:

"I suppose one of the key disadvantages is the South African context that we face there isn't really much in the way of quick access to resources that are South Africa specific, as we have a very different burden of disease. Whereas a lot of these videos

will leave TB [tuberculosis] and something lower down in their differential something

that is a lot more important for us." (Focus group 1)

Credibility. Students expressed the concern that these resources may not be equal in

quality or reliability. Therefore, students may feel the need to selectively choose their

resources. Certain resources, such as UpToDate and textbooks, appear to be trusted more

than others. When students identify discrepancies in information they may "just end up going

to UpToDate for the right answer" (Focus group 2).

3.2 Survey developed from focus group data and its pretesting

Using the qualitative data and literature reviewed, a survey was produced. Two

individuals in the medical education field provided commentary regarding the survey's face

validity. Five medical interns participated in the cognitive interviews and seven completed

the online pilot survey. This data was used to develop the final version of the survey, see

Appendix C.

3.3 Quantitative results from online survey

Two-hundred and sixteen recorded responses were received out of an 846 year three

to six student population i.e. 26% of the student population. Of these, 15 were excluded from

the analysis as the surveys were partial responses. Thus, 201 participant responses (63%

female; mean age = 22.77, SD = 1.99) were included. In 2018, 34% were in third year, 25%

in fourth year, 20% in fifth year, and 20% in sixth year. The mean self-directed learning

rating, a subjective measure of self-directed orientation, was 7.67 (SD = 2.07). Participants

were asked to select their top three out of six reasons provided for engaging in self-study. The

anticipation of an exam or assessments (76%), the desire to be a good doctor (65%), and to

improve or maintain an academic grade (41%) were shown to be the most popular reasons as

to why respondents engaged in learning outside of the classroom.

Online resources used for SDL. The survey revealed that all participants used at least one online resource for learning, of which, 97% used two or more. YouTube, UpToDate and Medscape were the most popular (Figure 1). Furthermore, of those that selected YouTube as a resource (n = 182, 91%), 5–10 minutes was considered the ideal video length (n = 93, 51%).
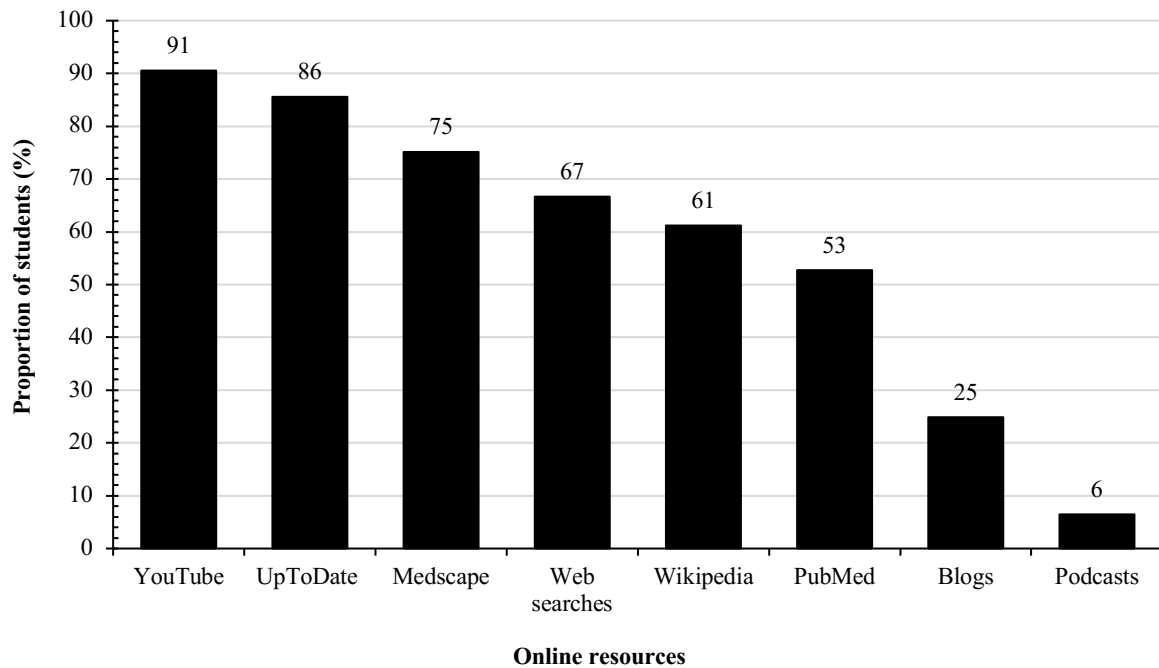
Figure 1. Online resources used by medical students for learning.

Fifty percent (n = 99) of respondents stated that they used these resources as often as university-provided resources. Thirty-three percent (n = 66) of respondents stated they use these more often and 18% (n = 35) stated they used these less often as university-provided materials. Therefore, 83% are using these as often or more often than university-provided materials. When asked to select their top three out of six reasons provided for using these resources, it was found that these assist with establishing a conceptual understanding of a clinical topic (79%) and their use is considered to be time efficient (73%). Additionally, these online resources appealed to their learning preferences (43%) and enabled them to learn at their own pace (43%).

Frequency of use and usefulness ratings. Web searches were the most frequently used resource with 52% of respondents reporting using web searches frequently or very frequently (Figure 2). UpToDate was considered the most useful among respondents with 65% of respondents rating it as very useful or extremely useful and was closely followed by YouTube (Figure 3).

YouTube, UpToDate, web searches and Wikipedia had significantly higher frequency of use ratings when compared to textbooks' ratings ($p < .001$), while PubMed's rating was significantly lower compared to textbooks' ($p < .001$), see Table 1. There was also evidence to show that YouTube's and UpToDate's usefulness ratings were significantly higher than textbooks' usefulness rating ($p < .001$), see Table 2.

There was no sufficient evidence to say that usefulness and frequency of use rating of each resource is associated with year of study, except for YouTube. It was found that the frequency of YouTube use is associated with year of study (df = 3, p = .004). Compared to year three students, year four (OR = 0.24, 95% CI: 0.11, 0.53; $p < .001$) and five (OR = 0.39, 95% CI: 0.17, 0.91; p = .03) students have lower odds of using YouTube frequently or very frequently. There is not enough evidence to say that the frequent or very frequent use of YouTube differs between year three and six students (OR = 0.49, 95% CI: 0.21, 1.13; p = .1).
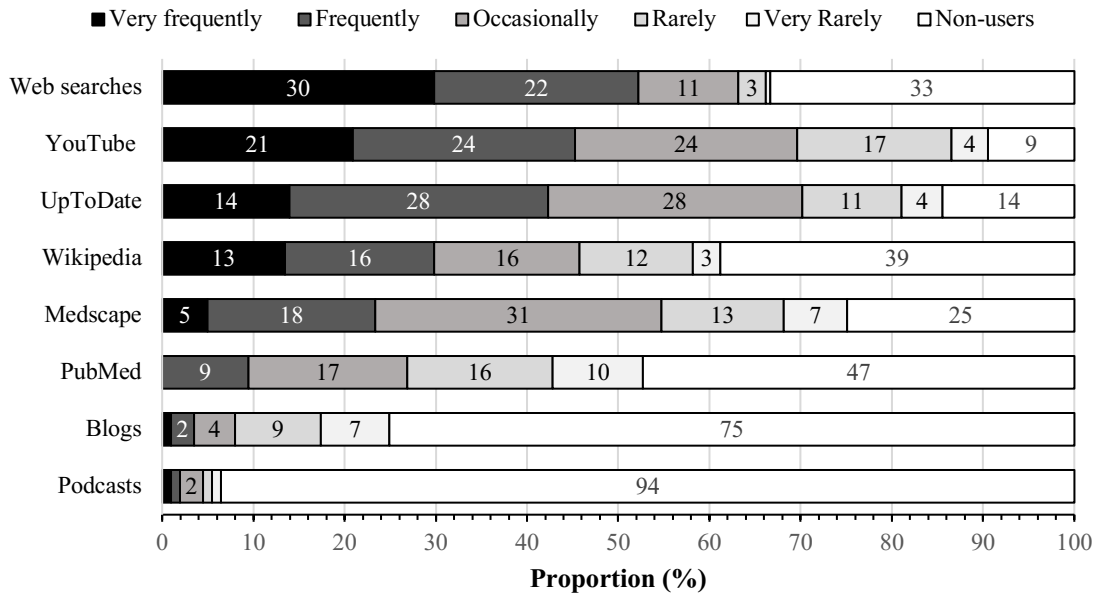
Figure 2. The distribution of frequency of use ratings for each online resource (n = 201).
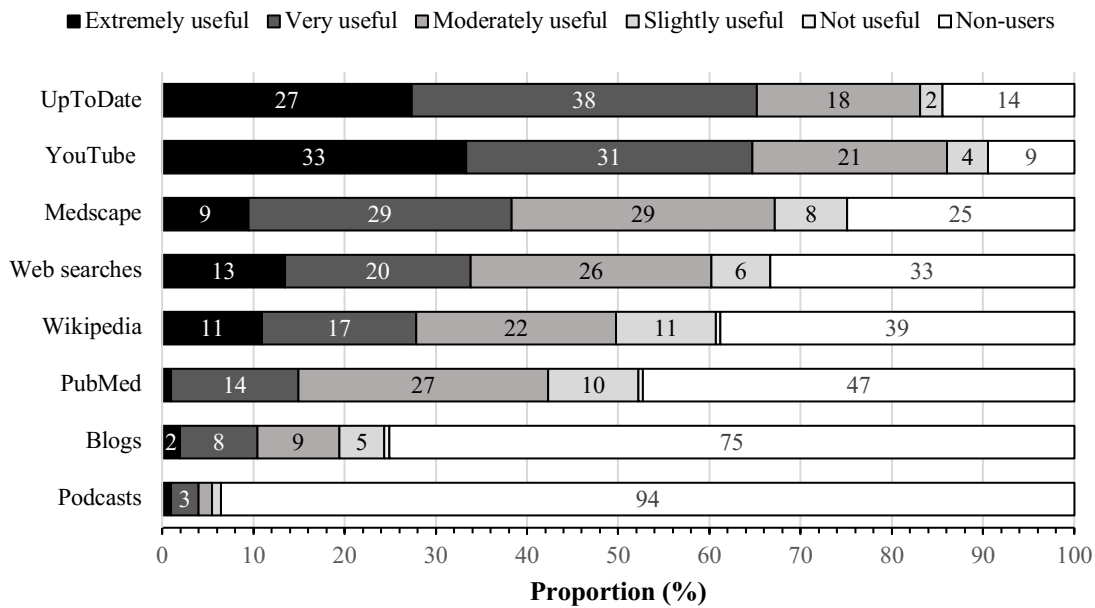

Figure 3. The distribution of usefulness ratings for each online resource (n = 201).

Table 1. *Comparison of each online resource's frequency of use rating to textbooks' frequency of use rating.*

Resource	n	Resource Median [IQR]	Textbooks Median [IQR][a]	z-score	p-value[*]
YouTube	182	3.5 [3 – 4]	3 [2 – 4]	-3.36	**<.001**
UpToDate	172	3 [3 – 4]	3 [2 – 4]	-3.38	**<.001**
Medscape	151	3 [2 – 4]	3 [2 – 4]	-0.77	.44
Web searches	134	4 [4 – 5]	3 [2 – 4]	-7.64	**<.001**
Wikipedia	123	3 [2 – 4]	3 [2 – 4]	-3.75	**<.001**
PubMed	106	3 [2 – 3]	3 [2 – 4]	3.32	**<.001**
Blogs	50	2 [1 – 3]	3 [2 – 4]	2.65	.01
Podcasts	13	3 [2 – 4]	3 [2 – 3]	-0.43	.67

Note. The frequency of use rating is based on a 5-point Likert scale ranging from 1 = very rarely (once a month or less) to 5 = very frequently (daily or more).

[a]All respondents were asked to rate the textbooks' frequency of use in order to make comparisons. The textbooks' median rating may differ as it is based on the textbooks' frequency of use ratings provided by the users of the resource it is being compared to.

[*]p <.006 is significant.

Table 2. *Comparison of each online resource's usefulness rating to textbooks' usefulness rating.*

Resource	n	Resource Median [IQR]	Textbooks Median [IQR][a]	z-score	p-value[*]
YouTube	182	4 [3 – 5]	3 [3 – 4]	-6.1	**<.001**
UpToDate	172	4 [4 – 5]	3 [3 – 4]	-7.29	**<.001**
Medscape	151	4 [3 – 4]	3 [3 – 4]	-1.65	.1
Web searches	134	4 [3 – 4]	3 [3 – 4]	-2.30	.02
Wikipedia	123	3 [3 – 4]	3 [3 – 4]	-1.17	.24
PubMed	106	3 [3 – 4]	3 [3 – 4]	2.6	.01
Blogs	50	3 [3 – 4]	3 [3 – 4]	0.05	.96
Podcasts	13	4 [3 – 4]	3 [2 – 4]	-0.71	.48

Note. The usefulness rating is based on a 5-point Likert scale. Usefulness ratings range from 1 = not useful to 5 = extremely useful.

[a]All respondents were asked to rate the textbooks' usefulness in order to make comparisons. The textbooks' median rating may differ as it is based on the textbooks' usefulness ratings provided by the users of the resource it is being compared to.

[*]p <.006 is significant.

Student preferences.

Resource format and access. Just more than half of the respondents preferred that their learning materials be on paper (n = 105, 52%). Twenty-nine percent (n = 59) preferred electronic resources and 18% (n = 37) had no preference. For those who had no preference or a preference for electronic resources, most participants used a laptop (72%) and less so mobile phones (11%), tablet devices (8%) and desktop computers (1%).

SDL resource qualities. Participants were limited to select their top three preferred qualities in an SDL resource out of the six provided. Multimedia, succinctness, portability and tests ranked the highest (Figure 4).
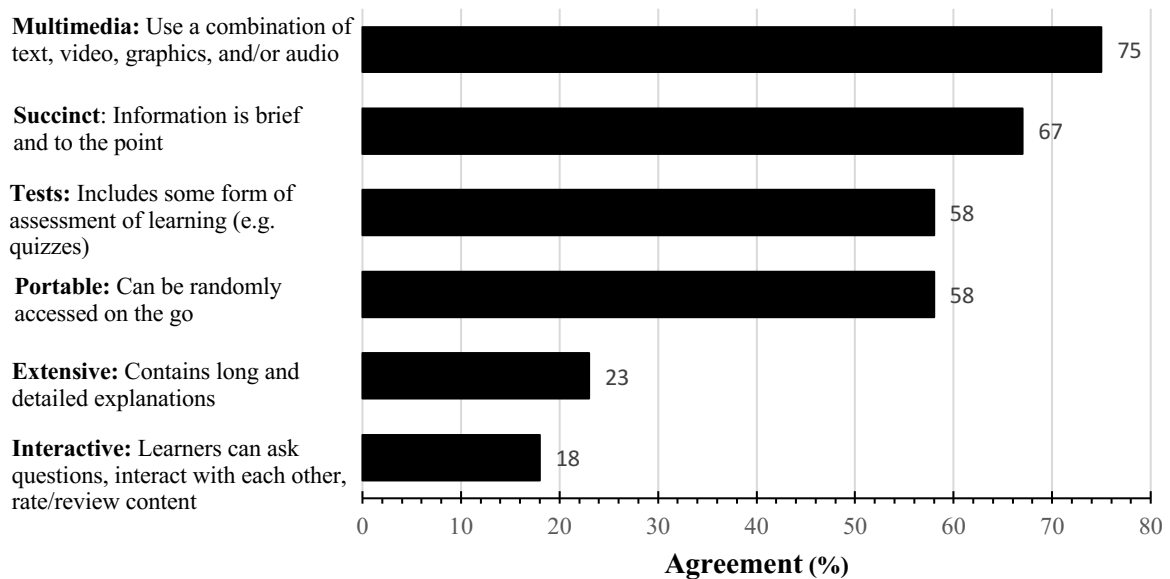

Figure 4. The preferred qualities in a learning resource.

Each participant was asked to select their top three, out of six, qualities that they would like in a self-directed learning resource.

Chapter 4: Discussion

This study shows that students generally rate themselves as being self-directed learning orientated and that they are engaged in the SDL process. They use a variety of web-based resources to get an overview and conceptual understanding of a topic. The most popular resources are YouTube, UpToDate and Medscape. The use of these for learning generally aligns with the features students preferred in a learning resource, namely multimedia elements, brevity and portability. However, many preferred paper sources.

The online environment provides students with flexibility regarding how they can acquire information, as most students used a combination of written (UpToDate and Medscape) and audio-visual (YouTube) content. Students are being taught in the context of a technology-rich environment (Rashid & Asghar, 2016) which has a growing educational potential. It is unsurprising, given the ubiquitous nature of the Internet and computer-based technologies, that such technologies are being used to address learning needs. Medical students are capitalising on these circumstances by using online resources to facilitate and supplement their learning. These findings are generally in keeping with the increasing trend of using non-traditional online educational tools for learning (Mallin et al., 2014; O'Carroll et al., 2015). Furthermore, proportionally more respondents were using these web-based resources as often or more often than university-provided learning materials. Unlike our findings, Judd and colleagues found that on average, first-year medical students accessed learning resources via the university learning platform more often than from external sources such as Google and Wikipedia (Judd & Elliott, 2017).

Learning involves acquiring new information, understanding it and potentially applying it (Taylor & Hamdy, 2013). Our findings show that students particularly favoured video-based resources to help make sense of content and to gain a conceptual understanding of a topic. Research has also shown that the use of multimedia enhances the learning process

(Rapp et al., 2016; Tackett et al., 2018). One study by Rowes and colleagues showed that, on average, residents who viewed a ninety-second fine needle aspiration (FNA) instructional YouTube video clip scored higher at a FNA objective structured assessment of technical skill (OSATS) station than those that did not (Rowse et al., 2014). A review conducted by Shariff and colleagues also suggested that multimedia use could effectively facilitate the development of surgical and cognitive skills (Shariff, Seretis, Lee, & Balasubramanian, 2016). Despite these benefits, students expressed concerns regarding the local relevance, depth and accuracy of these resources.

Some online resources may not meet the academic standard, however students may still elect to use these as they may prioritise convenience (Judd & Elliott, 2017; Judd & Kennedy, 2011). To address this, perhaps medical educators need to familiarise themselves with these online resources and the existing tools that have been developed to evaluate them. For example, the Academic Life in Emergency Medicine Approved Instructional Resources (ALiEM AIR) and METRIQ-8 are evaluation tools which may be used to assess the quality of blogs and podcasts (Thoma et al., 2018). Familiarity with online resources and these evaluation tools may enable educators to identify appropriate materials for their students. Students should also be advised on how best to identify high-quality learning materials for SDL.

4.1 Limitations

The survey provided respondents with examples of YouTube, blog and textbook resources for clarity regarding how resources were categorised. This may have influenced their response choices. The survey SDL measure was subjectively measured, therefore is subject to bias. However, in the context of this study, it is of value to be aware of how learners generally position themselves with regard to self-directed learning as one would expect SDL orientated leaners to be more engaged in information seeking. Furthermore, the

survey was accessible via anonymous link and a QR code, and participant responses were anonymous. Therefore, the researchers were unable to identify and exclude any double entries.

General statements about the use of these electronic resources were made. The most suitable context in which each resource could potentially be used was not addressed. The use of a learning resource may depend on the type of information required and the educational context (Cooper & Elnicki, 2011). Due to a low sample size of some items of the survey, there is a possibility of high type II error. The survey response rate was also low and study participants were volunteers and from a single site therefore the data obtained may not be generalisable to the entire UCT medical student population or other medical students within or beyond South Africa.

4.2 Conclusion

The Internet is important as it facilitates the process of self-directed learning in medical education. It enables access to an extensive range of resources, engages students and enables them to express their self-directedness by selecting information sources, managing, processing and appropriately using that information to meet their learning needs. The online resources identified support student learning. However, students may require guidance in their choice of resources as these resources vary in quality. Medical educators should consider advising students on how to select resources and assist in the development of information seeking and management.

Furthermore, the information gained from this study can be used by medical schools and educators to inform the development of teaching materials that are more responsive and relevant to students and their clinical contexts. It appears that concise resources that are easily accessible and make use of multimedia are preferred and are potentially of greater utility.

Further research could look at whether the use of these resources has any effect on academic achievement or clinical skills.

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Appendices

Appendix A: Interview guide

Introduction

Thank you for your willingness to participate in this study. My name is Phinda Njisane and I'm currently a Master of Medical Sciences in Medical Education student at Harvard Medical School. The general purpose of this focus group discussion is to determine what are the ancillary learning strategies or resources used by medical students, and how they contribute to the medical student's learning experience. This shouldn't take more than an hour and a half of your time.

I will be recording this session, but the content discussed here will be confidential. We will be using codes in place of your personal information to protect your identity, and the data collected will be kept in a secure and private location. I ask that all comments made during the focus group be kept confidential by refraining from discussing what has been said during this focus group outside of this meeting.

Do you have any questions before we start?

Transitioning into medical school or the clinical years of the medical school program

1. Can you tell me about your experience on entering the basic sciences/clinical years, having just completed your high school/pre-clinical years? (I'm particularly curious about your feelings, concerns and expectations).

2. What are your feelings about your current workload? (probe: assessments, learning materials, clinical expectations, experiences).

3. How are you using the current resources availed to you to prepare for your clinical assessments and responsibilities?
    a. Can you share a time when you felt that these resources had adequately helped you prepare?
    b. Can you tell me about a time when you felt ill-equipped and unprepared for your assessments or clinical duties?

Self-directed learning aids

4. How do you learn and what are your learning preferences? (Probe: Do you learn better when you: read, listen, visualize, problem solve, in lecture or at home?).

5. Can you name any ancillary learning resources and strategies you have used (or heard of) for self-directed learning? (try to elicit a complete list)

6. Which of these resources or activities have you personally engaged with and can you share your experiences?
    a. Why have you used these resources? (What characteristics or features do you look for when selecting your own learning resources and materials?)
    b. Of the methods you have used, which do you like the best? Why?
    c. How have these tools contributed to your learning and medical training?

7. What are the advantages for engaging in these activities? What are the disadvantages?

8. Is there anything else you would like for me to know so I can better understand the learning resources or strategies that you use?

Appendix B: Development of themes from codes and categories

This table shows the relationships between the codes, categories and themes.

	Codes and description	Categories	Themes
1	**Conceptual understanding:** Assists in orientating learners to the subject of interest	**Assists in the understanding and processing of information**	**These resources facilitate the learning process**
2	**Supplementary:** These resources help students consolidate learning that has occurred elsewhere.		
3	**Easy absorption:** Information is considered to be more easily understood or is presented in a better format.	**Facilitates the acquisition of knowledge**	
4	**Consistent framework:** There is a consistent or familiar format to the way in which the materials are presented.		
5	**Tests:** Used for self-assessment and to reinforce learning.		
6	**Preferred:** These resources appeal to the students' learning preferences.	**Personalised learning**	**Provides students with flexibility and options**
7	**Situational:** These resources can be accessed and used in different circumstances.		
8	**Time efficient:** These assist in maximising of time as students can receive information in a succinct format.	**Productivity**	
9	**Multitasking:** Allow learning (e.g. by listening) whilst also fulfilling other activities		
10	**Does not feel like studying**		
11	**Lacking detail:** May inadequately cover the subject of interest. Students may feel inadequately prepared for assessments.	**Student concerns**	
12	**Credibility:** Resources are not equally reliable.		
13	**Out of context:** Information provided may not be relevant to the students clinical or geographical context.		

Appendix C: Survey[1]

Consent Form

(consent form has been omitted)

A. SDL resources

Which of these *web-based* resources do you use for studying? (Select all those that apply)

- ☐   UpToDate
- ☐   Medscape
- ☐   General web searches
- ☐   YouTube (e.g. Osmosis, Geeky Medics, Dr Najeeb, Armando, Lecturio)
- ☐   Wikipedia
- ☐   PubMed
- ☐   Podcasts
- ☐   Blogs (e.g. Life in the Fast Lane)
- ☐   None of the above

Display This Question: If A. SDL resources used   Which of these web-based resources do you use for studying? (Select all... != None of the above

How often do you use these compared to university provided learning materials?
- o   More often than university-provided materials
- o   Less often than university-provided materials
- o   As often as university-provided materials

- -

Display This Question: If A. SDL resources used   Which of these web-based resources do you use for studying? (Select all... != None of the above

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[1] This is an edited version of the online survey. The original version was generated using Qualtrics software, versions November 2018 – February 2019.

Rate the following reasons as to why you use the aforementioned web-based SDL resources

	strongly disagree	disagree	neutral	agree	strongly agree
Using them is time efficient	○	○	○	○	○
They help establish a conceptual understanding of a clinical topic	○	○	○	○	○
They help meet my learning needs	○	○	○	○	○
They appeal to my learning preferences	○	○	○	○	○
They allow me to learn at my own pace	○	○	○	○	○
They help guide my learning	○	○	○	○	○

Display This Question: If A. SDL resources used   Which of these web-based resources do you use for studying? (Select all... != None of the above

Please select the TOP 3 of the above reasons for using these resources

- ☐ Using them is time efficient
- ☐ They help establish a conceptual understanding of a clinical topic
- ☐ They help meet my learning needs
- ☐ They appeal to my learning preferences
- ☐ They allow me to learn at my own pace
- ☐ They help guide my learning

Page Break

Textbooks (including clinical handbooks e.g. Oxford Handbooks)

On average, how often do you use Textbooks to learn?

- o   1 - Very rarely (once a month or less)
- o   2 - Rarely (more than once a month)
- o   3 - Occasionally (weekly)
- o   4 - Frequently (more than once a week)
- o   5 - Very frequently (daily or more)

When learning, how useful are textbooks?

- o   1 - Not useful
- o   2 - Slightly useful
- o   3 - Moderately useful
- o   4 - Very useful
- o   5 - Extremely useful

Display This Question: If A. SDL resources used   Which of these web-based resources do you use for studying? (Select all... = UpToDate

UpToDate

On average, how often do you use UpToDate to learn?

- o   1 - Very rarely (once a month or less)
- o   2 - Rarely (more than once a month)
- o   3 - Occasionally (weekly)
- o   4 - Frequently (more than once a week)
- o   5 - Very frequently (daily or more)

Display This Question: If A. SDL resources used   Which of these web-based resources do you use for studying? (Select all... = UpToDate

When learning, how useful is UpToDate?

- o   1 - Not useful
- o   2 - Slightly useful
- o   3 - Moderately useful
- o   4 - Very useful
- o   5 - Extremely useful

Medscape

On average, how often do you use Medscape to learn?

- o   1 - Very rarely (once a month or less)
- o   2 - Rarely (more than once a month)
- o   3 - Occasionally (weekly)
- o   4 - Frequently (more than once a week)
- o   5 - Very frequently (daily or more)

When learning, how useful is Medscape?

- o   1 - Not useful
- o   2 - Slightly useful
- o   3 - Moderately useful
- o   4 - Very useful
- o   5 - Extremely useful

General web searches

On average, how often do you use web searches to learn?

- o   1 - Very rarely (once a month or less)
- o   2 - Rarely (more than once a month)
- o   3 - Occasionally (weekly)
- o   4 - Frequently (more than once a week)
- o   5 - Very frequently (daily or more)

When learning, how useful are web searches?

- o   1 - Not useful
- o   2 - Slightly useful
- o   3 - Moderately useful
- o   4 - Very useful
- o   5 - Extremely useful

YouTube

On average, how often do you use YouTube to learn?

- o   1 - Very rarely (once a month or less)
- o   2 - Rarely (more than once a month)
- o   3 - Occasionally (weekly)
- o   4 - Frequently (more than once a week)
- o   5 - Very frequently (daily or more)

When learning, how useful are YouTube videos?

- o   1 - Not useful
- o   2 - Slightly useful
- o   3 - Moderately useful
- o   4 - Very useful
- o   5 - Extremely useful

Wikipedia

On average, how often do you use Wikipedia to learn?

- o   1 - Very rarely (once a month or less)
- o   2 - Rarely (more than once a month)
- o   3 - Occasionally (weekly)
- o   4 - Frequently (more than once a week)
- o   5 - Very frequently (daily or more)

Display This Question: If A. SDL resources used   Which of these web-based resources do you use for studying? (Select all... = Wikipedia

When learning, how useful is Wikipedia?

- o   1 - Not useful
- o   2 - Slightly useful
- o   3 - Moderately useful
- o   4 - Very useful
- o   5 - Extremely useful

Display This Question: If A. SDL resources used   Which of these web-based resources do you use for studying? (Select all... = PubMed

PubMed

On average, how often do you use PubMed to learn?

- o   1 - Very rarely (once a month or less)
- o   2 - Rarely (more than once a month)
- o   3 - Occasionally (weekly)
- o   4 - Frequently (more than once a week)
- o   5 - Very frequently (daily or more)

Display This Question: If A. SDL resources used   Which of these web-based resources do you use for studying? (Select all... = PubMed

When learning, how useful is PubMed?

- o   1 - Not useful
- o   2 - Slightly useful
- o   3 - Moderately useful
- o   4 - Very useful
- o   5 - Extremely useful

Podcasts

On average, how often do you use Podcasts to learn?

- o 1 - Very rarely (once a month or less)
- o 2 - Rarely (more than once a month)
- o 3 - Occasionally (weekly)
- o 4 - Frequently (more than once a week)
- o 5 - Very frequently (daily or more)

When learning, how useful are podcasts?

- o 1 - Not useful
- o 2 - Slightly useful
- o 3 - Moderately useful
- o 4 - Very useful
- o 5 - Extremely useful

Blogs

On average, how often do you use Blogs to learn?

- o 1 - Very rarely (once a month or less)
- o 2 - Rarely (more than once a month)
- o 3 - Occasionally (weekly)
- o 4 - Frequently (more than once a week)
- o 5 - Very frequently (daily or more)

When learning, how useful are blogs?

- o 1 - Not useful
- o 2 - Slightly useful
- o 3 - Moderately useful
- o 4 - Very useful
- o 5 - Extremely useful

What is the ideal length for an educational YouTube video?

- o Less than 5 minutes
- o 5 - 10 minutes
- o 11 - 15 minutes
- o 16 - 20 minutes
- o More than 20 minutes

End of Block: A. SDL resources

Start of Block: B: SDL Learning preferences

B: SDL Learning preferences

I prefer my study materials to be

- o On paper
- o Electronic
- o No preference

Which device do you most prefer to use to access learning materials?

- o   Desktop computer
- o   Laptop
- o   Mobile phone
- o   Tablet device
- o   No preference

When learning I prefer to...

- o   Learn on my own/independently
- o   Discuss learning materials with my peers in a group/pair setting
- o   Use a combination of the above

Select the TOP 3 QUALITIES you would like in an ideal SDL resource.

- ☐   Extensive: contains long and detailed explanations
- ☐   Succinct: information is brief and to the point
- ☐   Multimedia: utilises a combination of text, video, graphics and or audio
- ☐   Interactive: learners can ask questions, interact with each other, rate/review content
- ☐   Portable: can be randomly accessed on-the-go
- ☐   Tests: Include some form of assessment of learning (e.g. quizzes)

C: Student perceptions and academic life

Self-directed learning (SDL) orientated learners function autonomously. They set their own learning goals, initiate and regulate learning, and independently evaluate their learning efforts (Wilcox, 1996).
On a scale from 0 - 10 how self-directed learning orientated are you?

(0 = Not at all SDL orientated   10 = Extremely SDL orientated)

	0	1	2	3	4	5	6	7	8	9	10

Self directed learning orientation ()	

Generally, how stressful has the academic life at medical school been for you? Rate this on a scale from 0 to 10.

(0 = Not at all stressful   10 = Extremely stressful)

	0	1	2	3	4	5	6	7	8	9	10
Academic stress ()						●					

Select the TOP 3 REASONS that motivate you to study outside of the classroom?

- ☐ The anticipation of an exam/assessment
- ☐ My interest in the subject
- ☐ To avoid public humiliation of not knowing (e.g. in ward rounds, classrooms, tuts)
- ☐ The desire to meet my own learning goals and objectives
- ☐ To improve or maintain an academic grade
- ☐ The desire to be a good doctor

End of Block: C: Student perceptions and academic life

Start of Block: D. Demographics

D. Demographics

Year of Study in 2018
- o MBChB Year 3
- o MBChB Year 4
- o MBChB Year 5
- o MBChB Year 6

Sex
- o Male
- o Female
- o Intersex
- o Indeterminate

Age

_____