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ORIGINAL RESEARCH

Content Evaluation, Usage Profile, and Student Preferences Related to a Medical Student Wiki for Student-Authored Learning Resources (Carverpedia)

Nicholas Borcherding[1,2] · Matthew Rudolph[2] ·
Amy Tierney[2] · Reuben Vyn[3] · Darren Hoffmann[4]

Abstract We identified a lack of continuity in student-generated learning aids and the sharing of advice and resources between medical graduating classes. Carverpedia, built in the UIowa Wiki platform, is a novel collaboration between pre-clinical medical students and faculty to produce a centralized location for learning aids at the Carver College of Medicine. Carverpedia is designed to organize files and links in a centralized location accessible to all students. Previously, items were shared through various modalities (e.g., Facebook, email, etc.) without equal access for every student or well-developed archiving. After one academic year of use, there were 217 resources posted to the wiki site by 34 authors. Content posted on Carverpedia differed from Facebook content, with increased content summaries and active-learning. Site utilization, collected by Google Analytics, found 2979 sessions on Carverpedia and a total of 10,253 page views. Site usage and posting of resources was highly correlated with basic science exam schedule. This corresponded with the students surveyed on site usage, with the majority of students using Carverpedia for basic science courses, like Gross Anatomy and Foundations of Cellular Life. Of note, surveyed students found faculty-authored content, practice questions, content summaries, and active-learning resources the most useful of the resources posted. Overall, we found the Wiki format is effective as a means of creating an online community of support and collaboration for student-authored and faculty-authored learning resources.

Keywords Study material · Wiki · Student-authored · Student affairs · Self-regulated learning · Peer learning

Nicholas Borcherding, Matthew Rudolph and Amy Tierney contributed equally to this article

✉ Darren Hoffmann
    darren-hoffmann@uiowa.edu

1   Medical Science Training Program, The University of Iowa Carver College of Medicine, Iowa City, IA 52242, USA

2   Office of Student Affairs and Curriculum, The University of Iowa Carver College of Medicine, Iowa City, IA 52242, USA

3   Office of Teaching, Learning and Technology, The University of Iowa, Iowa City, IA 52242, USA

4   Department of Anatomy and Cell Biology, The University of Iowa Carver College of Medicine, 1-402 BSB, Iowa City, IA 52242, USA

Introduction

Constructivism is a highly influential learning theory which views the learner as the creator of their own understanding from the foundation of their own knowledge and experiences. This mental process leads to the building of new internal representations of course content by the learner [1–5]. During the learning process, these internal representations are often made external through the construction of actual written or drawn representations [6]. These can take many forms including outlines, drawings, charts, etc. In our medical school courses, we have observed for many years that during the learning process, students often create elaborate renderings of anatomical structures, flow charts for biochemical processes, compendiums of genetic diseases, drug classification schemas, and microbiological "bug lists" that rival published textbook resources in their comprehensiveness. Moreover, in synthesizing information from multiple lectures and other sources, these student-produced resources can exceed the quality of published texts in simplicity and clarity. Instructors can encourage students to

develop these materials since representing one's growing knowledge externally in a visible learning object can have many benefits in the learning process, including prompting learners to make new inferences [7] and providing a prompt to drive self-explanation [8].

After a student creates an educational resource for themselves, they often share these resources with their peers. These learning objects facilitate peer-to-peer communication building upon the social constructivist model [9]. Senior students who are tutoring junior students share their resources through whiteboard drawings or chalk talks. The antiquated "note service," wherein an appointed, often paid, student takes notes during class to distribute to their classmates, is a form of this crowd-sourcing of learning objects. Importantly, these activities are constructivist in that they often involve a step of "filtration" of instructor-delivered content through the point-of-view of the student who creates the visible learning object. This can result in diagrams or outlines that are simpler, more direct, and perhaps easier to understand by the novice learner.

Although there is no evidence in the medical education literature on this topic, we suspect that by viewing learning materials created by classmates, students discover new ways of representing their own knowledge. This may bring down students' barriers to constructivist learning methods by improving motivation and self-efficacy toward constructivist learning [10, 11]. For example, if a student believes they are not capable of creating their own learning objects, observing the examples of drawings or charts created by their peers may give the student the courage to put the pencil to the blank page.

Previously, students at the University of Iowa Carver College of Medicine developed groups on Facebook for each matriculating class. Students in each class use the class Facebook page to post-announcements related to school, share personal messages, and distribute their own student-authored learning resources. Similar usage of Facebook was described at a UK medical school where students used Facebook groups to ask for help from peers on curriculum content, prepare for exams, provide social support, plan and organize, and share/evaluate educational resources [12]. This has been an effective means of communicating within a class and sharing links and documents that appear to be intuitive for most students. However, learning materials posted to the Facebook group's pages often get lost as the pages have high turnover of posts and not all students use Facebook or choose to join the class Facebook groups. Thus, the Facebook method of sharing content does not effectively reach the whole class. Furthermore, materials posted to the site are essentially gone with each passing class, disallowing content-sharing across multiple classes. Lastly, only students participate in this forum, so faculty cannot contribute to or even review some of the shared content that may be useful to recommend or utilize in their courses informally.

Over the last 20 years, the use of crowdsourcing and collaboration to create and share information over the Internet has exploded, most notably through Wikipedia. Wikipedia is a collaborative website that makes use of the "wiki" format (a wiki is a website that allows collaborative modification of content through a web browser) to provide user-generated general reference material on almost any topic. While the veracity of material on Wikipedia is often a subject of critical debate [13–15], studies have shown that science articles on the crowd-reviewed Wikipedia have a high level of accuracy—near that of the scholar-reviewed Encyclopedia Britannica [16, 17]. Aside from this very well-known example of a Wiki, there are thousands of other Wikis in use by institutions, work groups, and classes as a means to do collaborative work over the web. In fact, there is at least one example (UMMedWiki, University of Minnesota) of medical school students using a Wiki to store over 1600 pages of lecture notes [18]. The University of Iowa uses the Confluence Wiki system, which is locally named "UIowa Wiki," and currently hosts over 1500 collaborative Wiki spaces for use by students, staff, and faculty.

In this study, we created a Wiki site (Carverpedia), hosted by the UIowa Wiki system, which allowed students in the UI Carver College of Medicine to share learning resources in a stable and secure online environment that was accessible by members of multiple classes and faculty over time. We hypothesized that if we "pre-seeded" the site with a variety of learning materials for courses in the first semester, new students would be driven to the site, understand its utility, and take over the development of new content on their own, such that the site would become robust and self-sustaining in 1 year. Over the course of the year, we tracked student usage of the site, posts, and content contributors and conducted a survey during the spring semester on student opinions about the site.

Methods

Curriculum Context

The University of Iowa Roy J. and Lucille A. Carver College of Medicine has a 4-year medical curriculum in which the first three semesters are focused more on basic science instruction and the subsequent five semesters are focused more on clinical instruction. Students in the Physician Assistant (PA) program also take all of their courses with the medical class for the first three semesters. The pre-clinical curriculum is integrated around themes of Mechanisms of Health and Disease, Clinical and Professional Skills, and Medicine and Society. The pre-clinical curriculum uses mixed instructional techniques but with a strong emphasis on lectures, particularly in the basic science courses. All lectures are recorded and broadcast online to enable flexibility in attendance. Exams in the

pre-clinical courses are developed in-house. In this study, all students in the medical and PA classes had access to the Carverpedia site starting at the beginning of their first year.

Website Development

The development team considered a number of options for the database (authors: medical students NB, MR, AT, and faculty advisor DH) and a consensus was obtained to use the University of Iowa (UIowa) Wiki platform to build the site given the local availability of technology support. An additional benefit of using the UIowa Wiki was that access to the site was password-protected and utilized only by authorized students, staff, and faculty at the University of Iowa Carver College of Medicine. Author RV, a Graduate Student Instructional Technology Assistant, was employed by the team to help build the website using Confluence wiki development tools by Atlassian (Sydney, Australia). The website was designed with ease of use and visual appeal in mind. The site's homepage outlines its purpose, links to each course organized by semester, and "what's new this week" highlighting newly added content. The left sidebar includes links to each semester and links to individual courses. Within each course page, content is subdivided based on resource type (practice questions, links to online resources, content summaries (e.g., restructured outlines, charts, etc.), active learning exercises (e.g., worksheets, fill-in-the-blank exercises, etc.), and faculty-authored content). Some of the resources were student-authored and some were curated by students from the web. See the Electronic Supplementary Materials for examples of pre-seeded resources from each category.

Pre-Release Content Development and Seeding of the Website

Before Carverpedia was opened to the student population, it was seeded with content created by the development team (medical students, authors MR, AT, NB; and faculty, author DH). The majority of this content was in the Year 1 Medical/Physician Assistant (M1/PA1) fall semester category, specifically in the Foundations of Cellular Life (Biochemistry/Cell Biology/Histology) and Gross Anatomy courses. The goal of "seeding" the site was to give first year students (Class of 2019) immediate utility for the site, as well as to provide examples of the types of resources students could add to facilitate the posting of new materials.

Recruitment/Publicity

Curriculum meetings were held with faculty in all curriculum areas to give faculty a preview of the website, answer questions, and solicit faculty feedback and involvement. The website was introduced to M1/PA1 (class of 2019, $n = 180$)

and M2/PA2 students (class of 2018, $n = 180$) at the beginning of the 2015 fall semester via e-mail and by directly demonstrating the site for M1/PA1 students during orientation week. All 360 students and 20 faculty/staff were given view/edit permission for the site. Although students in the M2/PA2 class were given access to the site, there were no pre-seeded materials posted to the site relevant to year 2 coursework, so we assumed that the majority of site traffic would come from the M1/PA1 class. A link to Carverpedia was also posted on the course management system (ICON), which houses links to course content and is utilized by all students.

Data Collection for Student Usage, Student Preferences, and Content Development

Data from the Class of 2018 Facebook group page during their M1/PA1 year (2014–2015) were collected by the authors by accounting the resources, dates of posting, and authors who post resources in the back-dated Facebook group page. This group served as a pre-intervention baseline for the level of content sharing and types of resources shared before Carverpedia was implemented.

Student usage data was obtained starting 1 month into the fall semester and throughout the remainder of the academic year via Google Analytics (Google, Mountain View, CA, USA). Data obtained from this source included the number of sessions (accesses to the site domain), page views per session (each page corresponded to one course, so multiple page views indicated accessing material for multiple courses), and time spent in the session. Other user data were also collected (bounce rate, web browser, geographic location) but are not reported here. The number of sessions and page views were also analyzed over time and compared against the exam schedule of the M1/PA1 class. For the purposes of this analysis, exams in the basic science courses were grouped together (Foundations of Cellular Life, Gross Anatomy, Mechanisms of Health and Disease I-IV) and exams in the clinical sciences were grouped together (Medicine and Society, Physical Exam and Patient Interview Skills).

Student's self-reported use and satisfaction was assessed with an online survey using Qualtrics software (Provo, UT, USA). The survey was e-mailed to M1/PA1 students in Spring 2016. At this point, the students had utilized Carverpedia for one semester (Fall 2015). The survey contained 12 questions and included multiple choice, rating scales, and free-response text answers (the full survey is provided in the Electronic Supplementary Materials). The questions aimed to establish if students used Carverpedia, the most and least helpful aspects of the site, and suggestions for improvement. A total of 50 students attempted the survey with a 10% dropout rate, giving a total of 45 students completing the survey (25% of the M1/PA1 class). At the end of the spring 2016 semester, all resources that were posted to the site were classified according

to resource type. The Confluence tools in the UIowa Wiki platform allowed administrative users to identify who posted each resource and when each resource was posted.

Results

Resource Profile on Class Facebook Page Prior to Carverpedia

Prior to Carverpedia, students primarily shared student-authored or student-curated learning resources through their class's Facebook group page. In 2014–2015, the M1/PA1 class posted a total of 60 resources to Facebook. Of these, most were links to online videos or other online resources, with 35 posts. The other major resource type was content summaries, with 24 posts. One student posted an active learning exercise, no students posted practice questions, and none of the resources posted were developed by faculty. In this cohort, there were a large number of student contributors (total of 34 individuals) each contributing one or two posts (ratio of resources/contributors was near 2:1). The breakdown of Facebook resources by resource type and contributors can be seen in Table 1.

Resource Profile after 1 Year

After 1 year of site activity, the site had 217 learning resources posted. Of these, 86 were added to the site by the site's developers (medical students NB, MR, AT, and faculty advisor DH) prior to release of the site, meaning that 131 resources were contributed during the academic year. Of the resources that were posted by site users, 112 were student-authored and 19 were faculty-authored. Students often contributed resources in more than one category. A total of 16 students contributed the student-authored resources that were posted during the year. This represented a ratio of resources/contributors of over 13:1. A total of four faculty members contributed faculty resources on Carverpedia. Faculty-contributed resources were primarily active-learning exercises and practice questions. Resource categories that were posted most frequently by student users were content summaries and active-learning exercises with 80 and 21 resources posted, respectively. The breakdown of Carverpedia resources by resource type and contributors can be seen in Table 2.

Cumulative Site Usage Statistics

At the end of the academic year, cumulative site statistics were obtained from Google Analytics. Over the fall and spring semester, there were a total of 2979 sessions, representing 1199 users (Table 3). Google Analytics tracked users as unique devices that accessed the website, not necessarily unique individuals. The website analysis tracked the first use of the website from a device and designated that as a new user. A device that returned to the site after the initial use was termed a returning user. Likewise, if the same device logged into the site again, this was designated as a returning user session. Given that a total of 380 individuals had access to the site, this indicates that each user used an average of four different devices to access the site over the course of the year. Of the total of 2979 sessions, there were 10,253 page views, with an average of 3.09 pages/session. The average duration of each session (time between login and closing the site) was 1 min and 35 s. Use of the site was different between the fall and spring semesters. From the fall to the spring semesters, page views increased from 4663 to 5590, despite a decrease in sessions from 1795 to 1184 (Table 3).

Usage Profile Over Time and Relationship to Academic Calendar

Site usage and resource posts were analyzed against the examination calendar of the M1/PA1 class to examine the relationship between exams and website use. Figure 1 displays the sessions for individual days along the fall (Fig. 1a) and spring (Fig. 1b) semesters. Usage was highly variable, but peaks in sessions were frequently associated with the exam calendar of major basic science courses in the M1/PA1 curriculum. Depositing of new materials was also linked to the academic calendar for basic science exams, with most materials being posted within a few days before an exam (Fig. 1a, b). No clear relationship was seen between either usage or resource postings during the Clinical and Professional Skills exam times (Fig. 1a, b). Average daily sessions decreased from fall to spring semester (22.4 sessions per day to 9.0 sessions per day), while resources posted by students, excluding the authors of this article, increased in the spring semester compared to the fall semester, 69 compared to 53, respectively (Fig. 1a, b).

Student Preferences on Carverpedia Resources

After the fall semester, M1/PA1 students were invited to complete a survey on preferences related to the site. Surveyed students utilized Carverpedia for basic science courses, with 96% of students responding they used the site for Medical Gross Anatomy (Fig. 2a). Additionally, 82.2 and 60% of surveyed students used Carverpedia for the basic science courses, Foundations of Cellular Life and Mechanism of Health and Disease I (MOHD I), respectively. In contrast, Clinical and Professional Skills I (CAPS I) and Medicine and Society I (MAS I) had 8.9 and 6.7% of students respond that they utilized Carverpedia for the respective class (Fig. 2a). For the individual class sites, students polled utilized faculty-authored material (91.1%) and active-learning (75.6%)

Table 1 The categories and quantity of materials that were produced by users of the M1/PA1 class Facebook page in the year prior to release of Carverpedia

Resource category	Fall semester courses		Spring semester courses		Annual totals	
	Resources	Contributors	Resources	Contributors	Resources	Contributors
Practice questions	0	0	0	0	0	0
Online videos/Web links	19	12	16	14	35	27
Content summaries	12	7	12	9	24	14
Active learning Exercises	1	1	0	0	1	1
Faculty-authored Content	0	0	0	0	0	0

resources the most; only 26.7% of students utilized videos and web links (Fig. 2b). Additionally, students were invited to write in specific examples of resources that were particularly helpful for them in a free-response item. Of the 45 students that completed the survey, 29 students provided specific resources and identified many individual resources that were helpful to them in their studies. Of note, 18 of the 29 students (62%) specifically commented on a series of faculty-authored supplemental worksheets. Another 7 of the 29 students (24.1%) commented on the usefulness of practice questions. Students were also invited to indicate which types of materials they would like to see more of in a free-response item. The most common responses were more practice questions (55.2%), active-learning worksheets (27.6%), faculty material or endorsements of student resources (17.2%), and content summaries (13.8%).

Student Preferences and Opinions on Site Functionality and Relationship to Facebook

Students surveyed reported a difference in the relative usefulness of the resources posted to Carverpedia. The majority of students, 84.4%, found faculty-authored material the most helpful (Fig. 3a). In addition, a lesser percent of students found practice questions (57.8%), summaries and alternative presentations (51.1%), and active learning material (44.4%) useful. The least useful material category for students was videos and web links at 4.4% (Fig. 3a). When asked to rate the level of helpfulness of Carverpedia, 44 students (97.8%) responded with very or somewhat helpful with 1 student (2.2%) who did not respond (Fig. 3b). Because students previously utilized Facebook as a means of sharing learning resources, we sought to determine if there were important differences between posting resources to Facebook vs. Carverpedia. On this topic, students had a wide variety of comments explaining their posting preferences. Thirteen of 31 students reported that Facebook was a less formal place to post and collaborate in making learning aids, with Carverpedia being a repository for more rigorously reviewed aids (student comment: "Carverpedia seems to be the archive for the more successful or helpful materials, while Facebook is a 'trial phase' to see if there is a positive student response"). Another common response (8 of 31 students responding) was that Facebook was easier to use compared to Carverpedia, with 4 of 31 students specifically mentioning Facebook has having better functionality with videos and other web links. Conversely, students believed that Carverpedia did contain a higher quality of resources as compared to Facebook (6 of 31), with a minority of students feeling otherwise, 1 of

Table 2 The categories and quantity of materials that were produced by the authors pre-release of the site compared to the total content posted by student and faculty contributors throughout the first year
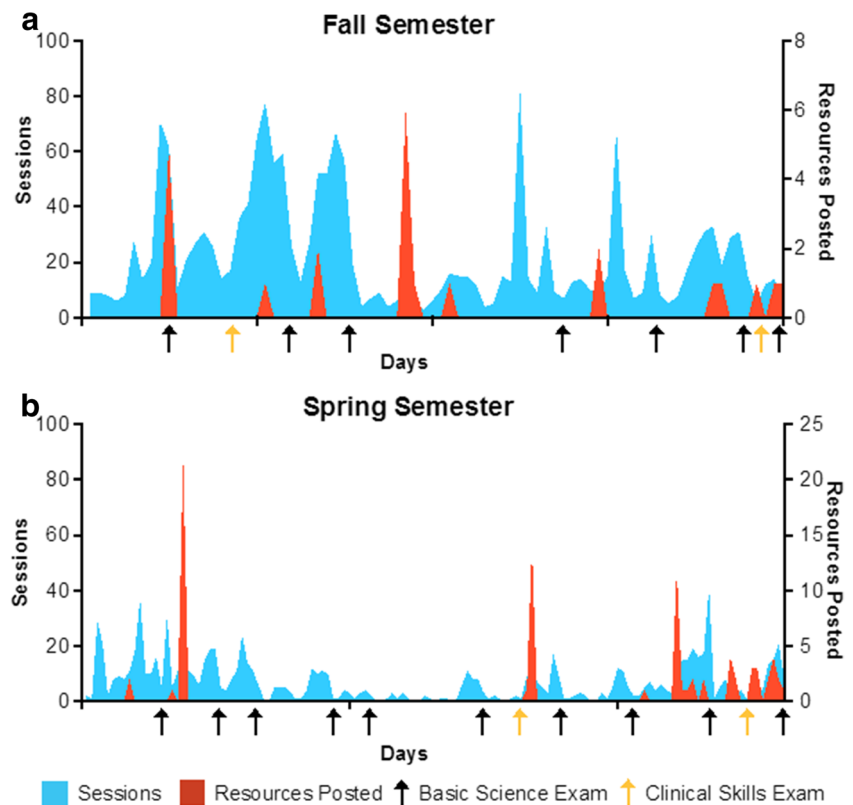
Resource category	Pre-release content (authored by site developers)				Post-release content (authored by site users)				Year 1 totals	
	Fall semester courses		Spring semester courses		Fall semester courses		Spring semester courses			
	Resources	Contributors	Resources	Contributors	Resources	Contributors	Resources	Contributors	Resources	Contributors
Practice questions	4	2	0	0	3	2	0	0	7	4
Online videos/Web links	47	3	0	0	8	6	0	0	55	9
Content summaries	19	3	0	0	16	7	64	3	99	11
Active learning exercises	6	3	0	0	3	2	18	1	27	6
Faculty-authored Content	10	1	0	0	19	3	0	0	29	4

Table 3 The user and session statistics on Carverpedia during the fall and spring semester and academic year

	Users	Sessions	Page views	Pages per session
Fall semester				
New users	681	681 (38%)	1825	2.68
Returning users	254	1114 (62%)	2838	2.55
Fall totals	724	1795	4663	2.60
Spring semester				
New users	386	386 (32.6%)	1923	4.98
Returning users	182	798 (67.4%)	3667	4.60
Spring totals	475	1184	5590	4.72
Academic year				
Year totals	1199	2979	10,253	3.09

31 felt there was no difference, 1 of 31 felt Facebook had higher quality material (student comment: "Carverpedia is more reliable content, but Facebook is easier to access"). One important crowd-sourcing function built into Facebook that is not available on Carverpedia is content voting (e.g., the "like" feature on Facebook). Students were asked how important content voting would be for use of Carverpedia; the majority of students rated content voting negatively, responding either "not important" (62.2%) or "content voting is a bad idea" (6.7%).

Discussion

The results of this study showed that a collaborative wiki functions well as a format for file-sharing and archival of student-authored learning aids produced during the academic year. Usage of the site was high throughout the year, with peaks in usage and resource posting corresponding to periods immediately preceding exams in basic science courses. Seeding the site with an array of example resources for the first semester was sufficient to drive production of new learning resources in the spring semester. Students perceived the materials available on the Carverpedia website to be helpful and preferred resources that were produced by students and faculty (summaries, practice questions, active learning exercises) as opposed to web links and online videos, which were the lowest rated resources.

The usage profile in terms of resources posted was considerably different than that of the class Facebook group page. On the class Facebook page, the majority of content included links to online videos or summaries of content from class. In the Carverpedia space, online videos were far less frequently posted than content summaries or active learning exercises, and they were rated the least useful type of resource on the site. In contrast, the number of active learning exercises that were contributed on Carverpedia was much higher than the number posted on the class Facebook page prior to opening the Carverpedia site. The tendency of students to post greater

Fig. 1 Sessions (*blue*) and materials that were posted (*red*) on Carverpedia across the fall (**a**) and spring (**b**) semesters, respectively. Exam dates are indicated by *arrows*; *black* indicates basic science exam, while *yellow* indicates clinical skills exam

Fig. 2 Survey results after the fall semester as a percentage of total students responded (*n* = 45). **a** Student responses for which courses they utilized on Carverpedia. **b** Student responses for which materials they utilized on Carverpedia
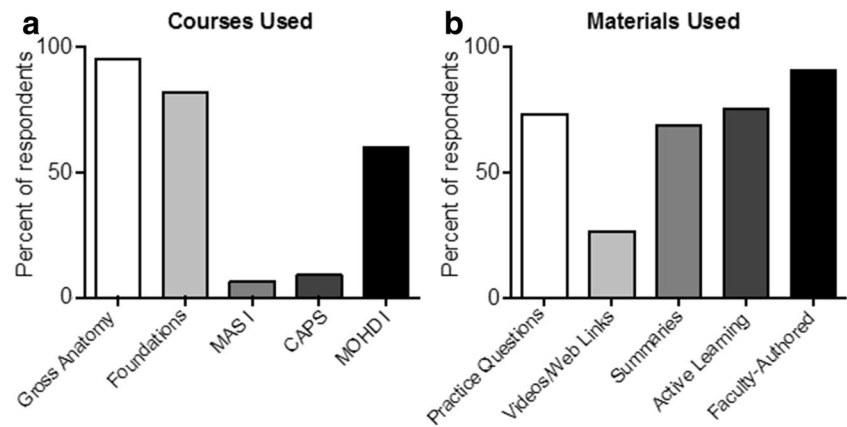
numbers of active learning exercises and content summaries on Carverpedia could have come from the pre-seeded content from the site developers. These examples may have created a reference point for students to create and share more engaged learning materials. On the other hand, students rarely posted videos on Carverpedia in spite of the fact that online videos were one of the largest groups of pre-seeded content posted by the site developers. This is in part explained by the survey results suggesting that online videos were the least helpful types of resources on the site. A more logistic-driven explanation is that it is easy to share online videos/links on Facebook by using the share buttons found on online articles/video links, whereas posting a video link to Carverpedia involves several design steps within the wiki editing tools. So it is possible that the video posts on Facebook represent a more casual sharing of resources, while posting resources on Carverpedia, which involves more than one click, calls for more thought or intention as to why the resource is useful.

The other major difference between student posts on Facebook versus Carverpedia was the number of contributors. The Carverpedia site had a relatively small number of contributors who contributed greater than six resources per student. It is possible that by having the Carverpedia website available, it encouraged a small group of highly motivated students to further develop their learning resources and create more of them. The majority of students in the class are primarily consumers on the Carverpedia website. This was also true on the class Facebook page, but to a lesser extent. Another possible explanation for the difference in numbers of posters may be technological facility with the Wiki tools. Certainly, some students indicated that Facebook was easier to use, but none indicated that the Wiki tools in Carverpedia were a major obstacle to participation. It should also be noted that the class Facebook page and Carverpedia are fundamentally different in that the Facebook group is students-only, whereas Carverpedia invites faculty to contribute. Several studies on student use of Facebook for academic purposes suggest that the hidden or secret nature of the Facebook group is a strength of the platform for enabling students to post freely without the scrutiny of their faculty instructors [12, 19, 20]. Indeed, the Facebook group at our College of Medicine continues to exist as a student-only space separate from Carverpedia, and the two web settings likely serve very different functions.

Student usage of this website was quite variable throughout the academic year with frequent peaks and troughs that reflected events in the academic calendar. The highest peaks in usage typically occurred over the 2–3 days prior to exams in the basic science courses. Peaks were not consistently seen prior to the clinical skills exams. This was expected given the high amount of resources related to basic science course content versus clinical science course content. The usage profile also differed between the fall and spring semesters overall. Overall, the numbers of sessions and users were diminished in the spring semester compared to the fall semester. However, the average session time, pages per session, and number of posted resources all increased in the spring semester. This finding suggests that student users spent more time on the site during the spring, presumably either looking for more resources or posting their own newly developed resources. The decline in number of users could be due to students who were initially curious about Carverpedia dropping off and no longer using the site in the spring. However, since this number reflects unique devices and not necessarily unique individuals, we cannot rule out the possibility that this downward shift simply reflects the same number of students using fewer devices to access the site. Another variable that could have impacted the traffic to Carverpedia is the M2/PA2 class entered the core clinical rotations in the spring semester, moving away from the classroom setting. Interestingly, a page has been provided on Carverpedia for resources related to clinical clerkships, but to date, no resources have been posted related to the clerkships.

An important consideration when evaluating the usage differences between fall and spring semesters is the fact that the site was pre-loaded with a variety of resources for the fall semester M1/PA1 courses, while no resources were pre-loaded for the spring semester courses. This led to a fall
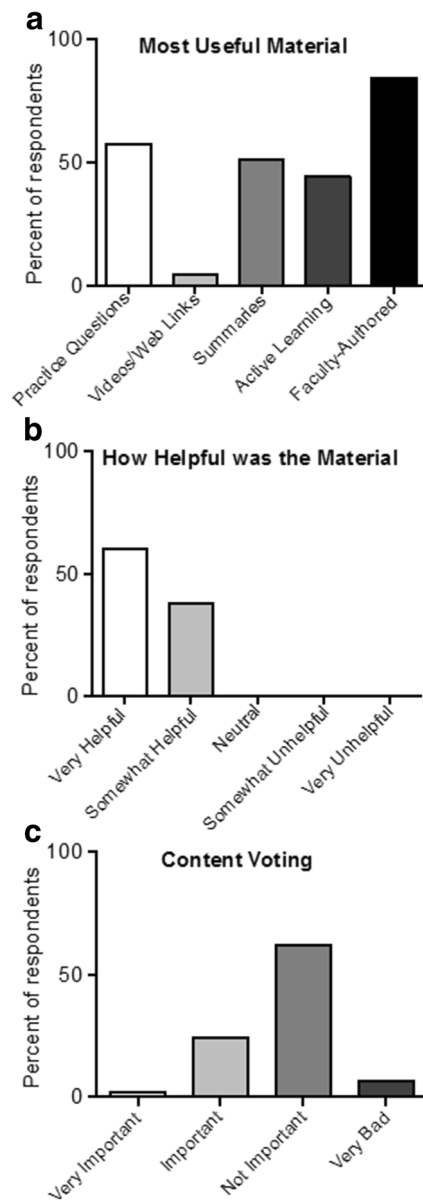
Fig. 3 Survey results after the fall semester as a percentage of total students responded (*n* = 45). **a** Student responses to which materials they found most useful on Carverpedia. **b** The results of student responses that asked them to rate the helpfulness of the material on Carverpedia. **c** The response of students when asked if the ability to vote on content (like, thumbs up/down) would be a helpful aspect to add to Carverpedia

semester with a greater number of site visitors but a smaller number of site contributors. In the spring semester, this trend was reversed. When there were no posted resources, students in the spring semester courses began posting their own resources, but site visits were less frequent overall. In the spring, students were able to navigate the site and post resources for the spring courses that were similar to the content posted for the fall semester courses. This suggests that pre-seeding the site with material for the fall courses was an effective way to both drive initial site visits and provide informal training for

students on what types of resources would be useful to post themselves. Indeed, the variety and depth of resources posted to Carverpedia outweighed that which was seen on the Facebook page in prior years, which supports the hypothesis that pre-seeded materials would provide a mechanism for modeling resource creation and reduce students' barriers to creating and sharing advanced constructivist learning materials with their classmates.

According to the survey results collected from students in this study, students prefer those resources that were authored by faculty. This suggests that students may have concerns about the accuracy of content authored by other students or the potential irrelevance of student-authored content to examinations, which reflect faculty's learning priorities. However, those student-generated resources that involved some re-organization of content and filtration through a student point of view (content summaries, practice questions, active learning exercises) were used almost as frequently as the faculty-authored content and were generally rated as useful resources. Compare these with links to videos on the web, which were the least frequently used resources and rated as the least useful. These resources, while reputable and well-produced, may have been underused and rated lower by students because they were not unique to our courses/curriculum and may have been perceived as less relevant. It is also possible that students viewed these resources as less valuable because they are inherently more passive than the types of activities and exercises in the other resource categories. Further, students may not feel that they need help finding video-based online resources through a curated site. In any case, future efforts toward developing materials for this type of site should focus on those resources that engage students with active learning pedagogies and not on curating links to online video resources.

In their responses to the survey, students also generally disagreed with implementing content voting (e.g., thumbs-up/thumbs-down) as a way to evaluate content on the site. Content voting served a purpose on the class Facebook pages as a way for students to see how many other classmates responded to a particular resource, so we had hoped to incorporate this function into the site design. However, it was not possible to incorporate content voting into the Carverpedia site as it was constructed, so we sought to determine if this would be an important add-on to incorporate as the site evolved. Interestingly, the majority of students felt that this would be either unimportant or a bad idea. Those who suggested it would be a bad idea indicated that students may be discouraged from contributing resources if their posts were being evaluated in this way.

Limitations

The interpretations of the research in this study have some limitations due to the context of the research itself. First,

since users can only be defined by Google Analytics tools as devices, there is no way to know exactly how many students in each class utilized Carverpedia, nor is it possible to confirm our assumption that the majority of site traffic came from the M1/PA1 class because of pre-seeded content. It is also impossible to track downloads or views of specific resources since activity within a page is untracked by Google Analytics, and the Confluence wiki tools are only designed to track posts and not views. This means that data on resource use and preference are based solely on self-reported data. Further, the survey was only completed by 25% of the student body. This could lead to over-estimation of impact or class-wide perception of value. While pre-seeding the site with content appeared to be an effective strategy, there was no control in this study where students used a non-seeded site to prove that this step was directly responsible for student use. Another limitation of this study is that it only addresses 1 year of implementation of the website. While there is sufficient data to demonstrate that the site has apparent value to current students, and the method of implementation was associated with the site becoming self-sustaining within a year, further questions remain which are not yet answerable until more time has passed. For example, it will be interesting to determine if the content produced in the spring semester by the class at-large will be enough to sustain higher viewership throughout the spring semester in the upcoming years. It will also be important to determine if the materials produced in the spring semester have the same perceived value as those produced by the development team prior to the launch of the site. Lastly, as a new class of first year students begins, it will be interesting to determine if student use of the site continues to increase as more and more resources are posted or if there is a saturation point that has already been reached.

Conclusions

The research shown here demonstrates that a wiki system is a suitable platform to support class-wide sharing of student-authored and faculty-authored learning materials. The presence of a wiki service on campus supported by the Office of Teaching, Learning and Technology enabled us to develop this site for a minimal investment and within a year, the site has become self-supporting. We believe that this site communicates to students a shared institutional value in constructivist learning methods and collaborative ingenuity in the learning process. The long-term impact of this platform remains to be seen, and important areas for continued research include differentiation of the resources that students share informally via Facebook vs. formally via the Wiki, assessment of the quality of resources posted by students, and observation of the

dynamics of site usage as the site grows and evolves. Future directions for the site include electing a group of students each year to curate high-yield content from the class Facebook page to add to the Carverpedia site, promote collaborations between students and faculty to develop more faculty-authored or faculty-endorsed content, and strategically build more content into the clinical clerkship pages and preparatory materials for the Step 1 and Step 2 USMLE board exams.

Compliance with Ethical Standards All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional review committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. No identifiable personal data were gathered from participants in this study. This study has been approved by The University of Iowa Institutional Review Board for human subjects research (2014, IRB no. 201403757). The authors have no conflicts of interest to disclose.

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