Current Journal of Library and Information Sciences
Volume.7, Number 2; April-June, 2022;
ISSN: 2836-9300 | Impact Factor: 6.61
https://zapjournals.com/Journals/index.php/cjlis
Published By: Zendo Academic Publishing

ANALYZING VIRTUAL CHAT EFFECTIVENESS: A COMPARATIVE STUDY OF LIBRARY PROFESSIONALS AND UNDERGRADUATE EMPLOYEES

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Article Info

Keywords: Virtual Reference Chat, Library Service, Employee Types, Patron Interaction, Service Efficac

Abstract

Over the past few decades, library patrons have been engaging with libraries through virtual means, with some services dating back to the late 1980s. As technology has continued to advance, the utilization and monitoring of virtual reference chat services have become more streamlined, offering increased convenience for both library staff and patrons. These technological enhancements have also enabled libraries to gather and analyze quantitative statistics and qualitative data from these chat interactions. Moreover, the staffing models for chat services have evolved, with a transition from relying solely on professional librarians as chat respondents to including paraprofessional staff, graduate students, and undergraduate students.

In this context, this paper seeks to address a critical question regarding the effectiveness of different employee types (non-student and student) in responding to virtual reference chats. For the purposes of this study, "non-student" employees encompass professional librarians and paraprofessional library staff, while "students" refer to undergraduate student employees. Graduate students are not considered in this classification, as they are typically not part of the reference desk staffing. While some assessment has been conducted regarding the ability of students to handle virtual reference chats, there exists a clear need for further research that compares the efficacy of different employee types. This research aims to ensure the delivery of high-quality service to library patrons engaging with virtual reference chat services.

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1-Introduction

Patrons have had the ability to contact libraries virtually for decades with some services dating back to the late 1980s (Lee, 2004). As technology improved, the ease of implementing and monitoring virtual reference chat (hereafter "chat") has increased. As such, using library chat has become simpler and more convenient for library employees and patrons alike. In addition, these improvements have provided a greater ability for libraries to gather and analyze quantitative statistics and qualitative information about chats. As chat services have evolved, so have their staffing models with some staffing models moving from relying on professional librarians as the sole chat respondents to including more paraprofessional staff, graduate students, and undergraduate students (Fuller & Dryden, 2015; Keyes & Dworak, 2017). These various staffing models have led us to a question about the ability of each employee type (non-student and student) to answer chats. For the purpose of this paper, we define "non-student" employees as professional librarians and paraprofessional library staff, while "students" are defined as undergraduate student employees; we do not typically employ graduate students at our reference desks so they are excluded from our definition. While some assessment has been conducted regarding students' ability to answer virtual reference chats (Bodemer, 2014; Lux & Rich, 2016; Keyes & Dworak, 2017), there is a need for more research comparing the efficacy of employee types to ensure high-level service to patrons.

The Harold B. Lee Library (HBLL) at Brigham Young University is the largest religious university library in the United States (ALA, 2012), serving over 30,000 full time students and roughly 5,000 full time faculty and staff. In an effort to serve these patrons better, the HBLL implemented its first chat system in the early 2000s using a commercial product, Convey Systems. At that time, chat was staffed solely by professional librarians but the Convey software was very cumbersome for both the patron (requiring an install on their computer) and the librarians (difficult monitoring and answering; e.g. having to choose whether to "browse share"). We discontinued use of Convey Systems in 2007 and took two years to explore a variety of free options including Plugoo, MeeboMe, and AIM.

After this exploration and testing a variety of other commercial products, the HBLL transitioned to using LibraryH3lp (http://libraryh3lp.com) in 2009. This change resulted in a volume increase from 1,062 chats in 2008 to 7,087 chats in 2009.Library patrons initiate the majority of chats (74%) from the library home page, answered by students at the general helpdesk. Otherwise, patrons access the chat through subject guides or through one of the many library databases. While employees at the general helpdesk answer the majority of questions, some questions are either asked directly to other subject helpdesks or transferred to those subject queues.

When we first implemented LibraryH3lp, non-student employees were scheduled for time blocks throughout the week (9:00 a.m. to 6:00 p.m.) to be the first responders to incoming chats; times outside of the 9:00 to 6:00 pm window relied on students as the first responders, as non-student employees weren't typically around. Overtime, discussions with student and non-student employees who have answered chats led us to realize that students could likely handle the majority of questions asked on chat. Therefore, we have gradually transitioned to having student employees as the first contact. We conducted this study in an effort to support or counter the decision to rely completely on student employees as the first responders to the chats. While other researchers have investigated the ability of student employees to *support* professional librarians in answering reference questions, including chat, we investigate the possibility of students being the primary contact for chat questions and the quality of those interactions.

LibraryH3lp functions using queues, with each queue assigned to a different service point of the library (e.g. Learning Commons, Humanities, Science, etc.). Individual user accounts are then assigned to one or more queues that they can monitor for incoming chats. Added functionality includes the ability to transfer chats between queues

or individuals. Separate queues for each reference desk also contribute to success. While students at all desks have a degree of familiarity with other service areas, instances arise when another subject-specific reference desk may better answer a chat. Having separate queues allows our students to seamlessly transfer a chat to another queue where the patron can receive the best service possible. Similarly, the queues allow students to transfer the chats to non-student employees, thus permitting our professional staff to provide higher-level reference help when needed. In total, 392 of the chat interactions resulted in a transfer to another queue. In addition, multiple students monitor each queue at the same time, which ensures coverage of the service. Supervisors may also monitor the queues and review student responses as necessary. The monitoring of chat motivates students to be on their best behavior and provide quality responses for our patrons. Students often take pride in answering the chat and become library ambassadors who often unofficially advertise the library's services to classmates and friends.

For years we hoped to conduct some sort of comprehensive qualitative assessment of our chat service, but the large number of chats received over the years (sometimes over 600 chats per month) made the project seem daunting. However, after exploring various assessment methods, we determined that assessing one year of chat transcripts would not only be possible but would provide the insight and assessment needed to evaluate and improve our service. As such, a professional librarian, a paraprofessional staff employee, and student employee conducted the research using 4,475 chat transcripts from the 2016 calendar year. In conducting this research, we sought to explore the accuracy and completeness of library employees' responses to chat questions by coding the chat transcripts. Of particular interest was to explore a comparison of responses by student employees and non-student employees. For example, is one group more accurate or complete than the other, or are the responders equally effective in answering chat? When starting the project, we hypothesized that student employees would be just as effective as non-student employees in answering the chats. In addition, with the expectation of supporting a chat reference service and the ever-increasing demand on professionals' time, is there evidence to support having chat questions primarily answered by student employees to alleviate the time demands on professionals?

2-Literature Review

2.1-Staffing Virtual Reference

Historically, academic libraries insisted that reference questions be addressed/answered by full-time librarians and/or staff (Ward & Phetteplace, 2012); meaning, employees with extensive library education or experience. However, in recent years this dynamic has shifted to training undergraduate and graduate students to take a primary role in triaging questions asked in libraries, including staffing the virtual reference presence (Faix, Bates, Hartman, Hughes, Schacher, Elliott & Woods, 2010; Ward & Phetteplace, 2012; Lux & Rich, 2016). Various studies demonstrate that student effectiveness is on par with non-student employees when answering reference questions (Bodemer, 2014; Lux & Rich, 2016; Keyes & Dworak, 2017).

Many libraries utilize paraprofessionals to answer virtual reference (Ryan, 2008; Mungin, 2017). For example, at the University of Illinois, librarians tracked their usage statistics to determine peak virtual reference times; during these peak times, professional librarians staff the service, otherwise, paraprofessional staff perform this task (Ward & Phetteplace, 2012). Similarly, the University of Arizona, found that paraprofessionals could successfully answer reference desk questions 89% of the time thus allowing professional librarians to focus on issues requiring their advanced education and experience (Ryan, 2008).

Other studies find that undergraduate student employees, when trained correctly, can be nearly as or just as effective in answering chats as professional librarians (Bodemer, 2014, Lux & Rich, 2016; Keyes & Dworak, 2017). Some benefits of undergraduate students staffing chat reference include reduced spending on wages due to undergraduates' lower pay rates; added work time for professional librarians to focus on other librarian duties;

and an improved librarian morale due to librarians passing on their professional values to undergraduates (Faix et al., 2010).However, some researchers find that successful undergraduates require more extensive training (Ward & Phetteplace, 2012; Keyes &Dworak, 2017). Nevertheless, Keyes & Dworak (2017) find that while undergraduate students could use more training on the referral process, signing off at the end of a chats, and in providing sources in their responses, they exceeded professional librarians and library staff in greeting patrons and in maintaining a courteous tone and digital presence. Many libraries utilize graduate students in answering their chat reference services (Ward, 2004; Faix et al., 2010; Ward & Phetteplace, 2012; Fuller & Dryden, 2015). While these studies mention the use of graduate student employees, we were unable to find information on graduate students' abilities to answer questions using these services.

2.2-Analyzing Chat Reference

Previous studies used a variety of categories for coding when analyzing chat reference services. Some of the more popular codes used by other researchers include the type of question the patron asked, the accuracy of the response to the patron, and customer service skills utilized such as greeting the patron, response time, and providing sources for the information provided (Fuller & Dryden, 2015; Baumgart, Carrillo & Schmidli, 2016). In addition, Mungin (2017) coded for affiliation of the user, the status of the person answering the question, and behaviors of both the user and responder. Lux and Rich (2016) also coded for responder type. However, many other studies lack codes for responder type thus demonstrating a need for more research coding for this. In addition to other codes, Keyes and Dworak (2017) coded for the difficulty of the query. Ruppel and Vecchione (2012) coded for user satisfaction of the service as well as their likelihood to use the service in the future.

To ensure accuracy in coding, some researchers took precautions when analyzing their services. For example, Fuller and Dryden (2015) first coded the same 100 test questions independently then compared their results and discussed any discrepancies. This helped determine inter-coder reliability and a systematic conventions for coding transcripts with common discrepancies as determined by the 100 test questions. Baumgart, Carrillo and Schmidli(2016) conducted an hour-long of group training for those coding the transcripts. In addition, they created a screencast tutorial for coders to become familiar with the software and coding process. To ensure inter-coder reliability, each transcript was coded twice, once by one of four graduate students and once by one of the principal investigators.

To code and analyze libraries' chat reference services, researchers used a variety of assessment tools. Mugin(2017) used Dedoose while Fuller and Dryden (2015) utilized NVivo, a coding software that uses qualitative and mixed-method tools. Baumgart, Carrillo and Schmidli (2016) utilized the statistical analysis software program, R. Radford and Connaway (2013) used QW software for their analysis. Both Lee (2004) and Keyes and Dworak (2017) successfully conducted the analysis using Excel Spreadsheets. Others did not specify the software or tools utilized to conduct their analysis. Given the variety of methods used to code data, we realized that the selected method depended on the hypothesis and the desired statistical output of the researchers.

The number of chat transcripts analyzed varied by researcher. Mungin (2017) coded chat transcripts from August 2009 to June 2014, a rather in-depth approach. Keyes and Dworak (2017) analyzed 3,700 transcripts from May 2014 through September 2016. Baumgart, Carrillo and Schmidli (2016) looked at one week's worth of chat transcripts, reviewing 403 chat transcripts. Lux and Rich (2016) selected 150 transcripts conducted by undergraduate student employees and 150 transcripts conducted by librarians; the researchers then coded each transcript individually before comparing their results to reconcile differences. Instead of using chat transcripts,

Ruppel and Vecchione (2012) administered a survey to a class immediately after the members of the class utilized their chat service.

When conducting their analysis, Radford and Connaway (2013) randomly selected 850 transcripts from July 2004 to October 2006. Fuller and Dryden (2015) chose to examine one year of chat transcripts, over 3,000, for their research. Ryan, Daugherty, and Mauldin (2006) also examined one year's worth but had considerably fewer transcripts (349). Lee (2004) chose 119 days' worth of transcripts, though it is not clear why he chose this length of time. This diversity in sample sizes suggests that the number of transcripts chosen to evaluate is not as important as getting a large enough sample size to draw accurate conclusions.

3-Methodology

Embarking on such a large-scale project required extensive planning up front. Below we describe the steps taken during the planning phase of the research.

3.1-Download and anonymize the data

To get the data in a format that was usable for this project, we reached out to LibraryH3lp who gave us a file containing all the transcript data from the 2016 calendar year. The download of this file included complete information about the time of the chat, chat transfers, the responder/employee type, and more. We then imported this file into an Excel spreadsheet in preparation for analysis and coding. Next, we imported the spreadsheet into Microsoft Access, which we used to create a form to use in coding the data (see Image 1).Though we found that most transcripts were already anonymous, to comply with the Institutional Review Board, and to protect patron and employee privacy, we anonymized the data in the transcripts prior to importing into MS Access. This was simplified by the software, LibraryH3lp, which assigns patrons a unique number as their identifier. In addition, the employee answering the student is simply labeled "Librarian" in the transcript. Except in the case of an SMS interaction, when the cell phone number served as the patron ID, the personal information we needed to anonymize was recorded only if the patron or employee chose to use identifying information within the chat to facilitate the interaction (e.g. an email address for follow up). Even in these cases, much of the personal information we were able to remove programmatically, including cell phone numbers. Where this was not possible, we eliminated the person's identifying information manually. The library assessment team completed this process of de-identifying the chats, thus keeping all the data anonymous for the researchers.

3.2-Select software for coding and analysis

After exploring a few analysis software programs, including nVivo, Open Refine and Dedoose, we decided instead to build a MS Access database to perform the coding and analysis. We chose to use MS Access because it permitted us to build our own coding system using its "Form" function (see Appendix A to see a blank form). Similarly, the learning curve for the coders to use MS Access was not as steep as it was for the other software systems, which allowed us to start our coding at a quicker pace. After coding the data in MS Access, we exported the coded data to an MS Excel spreadsheet where the analysis occurred. This allowed researchers to easily view findings and examine different codes with greater speed.

3.3-Determine analysis codes

In reviewing the literature, we discovered a myriad of ways that the data could be coded. To test our hypothesis (comparing accuracy and completeness between student and not-student employees) we decided to code each individual chat transcript for who responded to the question (a student or non-student) and the accuracy and completeness of the answer given. In addition, we coded for a variety of other criteria to get a clearer picture of how patrons use chat at BYU. After meeting and discussing the possibilities several times, we agreed to code for 25 criteria (see Appendix C for a complete list and description of each criterion).The two criteria we focused on

primarily were *Perceived incomplete*(Was the patron given all the requested information as perceived by the coders?) and *Perceived inaccurate*(Was the information given by the employee accurate, as perceived by the coders?).The purpose of this focus was to determine the effectiveness of students as the primary contact for patrons. For years, the HBLL helpdesks have been staffed solely by students, suggesting their ability to do the same virtually via chat.

3.4-Code the Data

Meeting as a team throughout the process was crucial in helping us come to a consensus on the definition and use of each code. For qualitative research of this type, it is important for each researcher to define the criteria in the same way to avoid discrepancies. In order to mitigate any differences between researchers, two of the researchers, the undergraduate student employee and the paraprofessional staff member, coded all the chats separately.

The professional librarian then compared the two analyses and reconciled any differences. In this way, we reviewed each transcript three times for consistency. At the beginning of the process, we met occasionally to refine the criteria and come to a better agreement on how to code, especially when we noted a consistent discrepancy. After a while of coding, the meetings became less necessary because coding became increasingly consistent. To code the data, we viewed each chat transcript and applied codes according to the code criteria (see Image 1). For example, if the transcript started with the employee saying “Hello” the researcher would select the code “Greeting”. If an interaction transpired in the transcript that seemed important but did not apply to any of the codes, researchers left notes in a comment box. These comments helped researchers clarify codes. Though there were many pre-filled, noneditable fields (see Image 1, grayed out in the form) we used them as references to clarify some of the coding we did. For example, if a transaction had a lengthy “Total time” we attempted to determine the cause. It might be that the chat was transferred without a timely response, or perhaps the transaction indeed lasted that long.

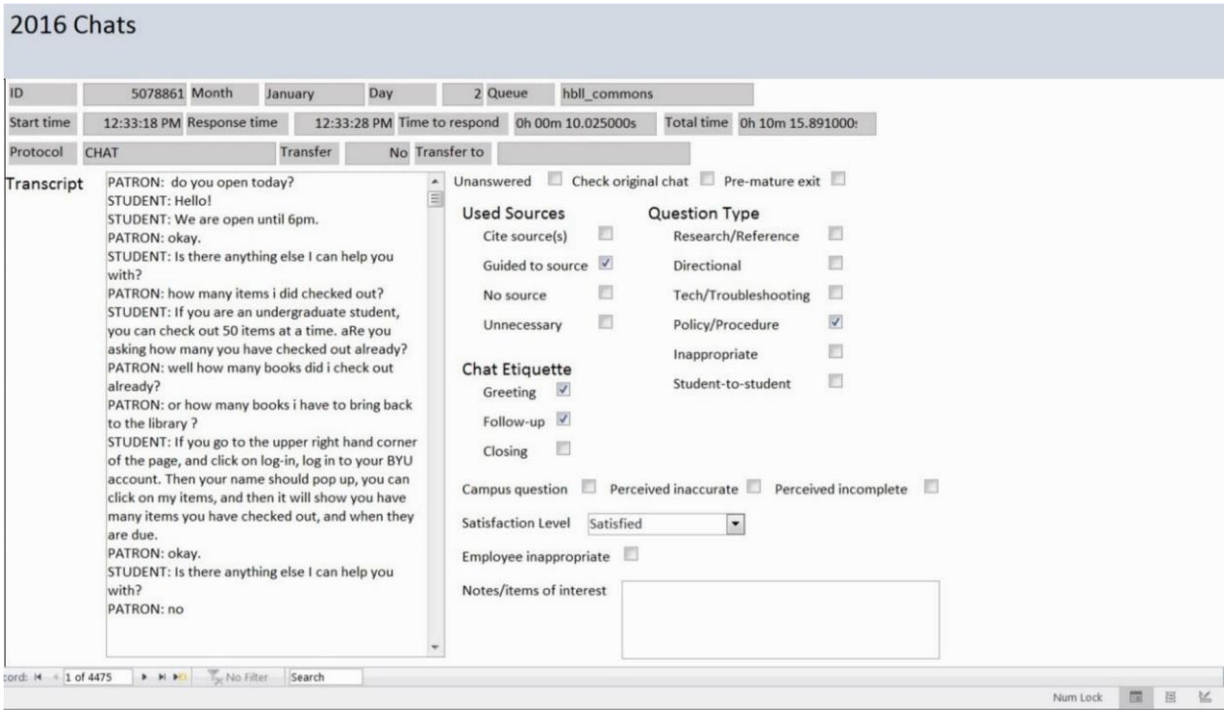


Image 1--Transcript Coding Form

4-Results

4.1-Summary

Students at the reference desks primarily answer chat questions, while non-students typically receive chat questions by receiving a transfer or they happen to be staffing the service. It is no surprise, therefore, that of the questions that were answered, students answered 95% while non-students only answered 5% (see Image 2). Note that the total is only 4,055 because this represents only those chats that were answered; there were 8.7% of questions that went unanswered, which suggests the need for more training.

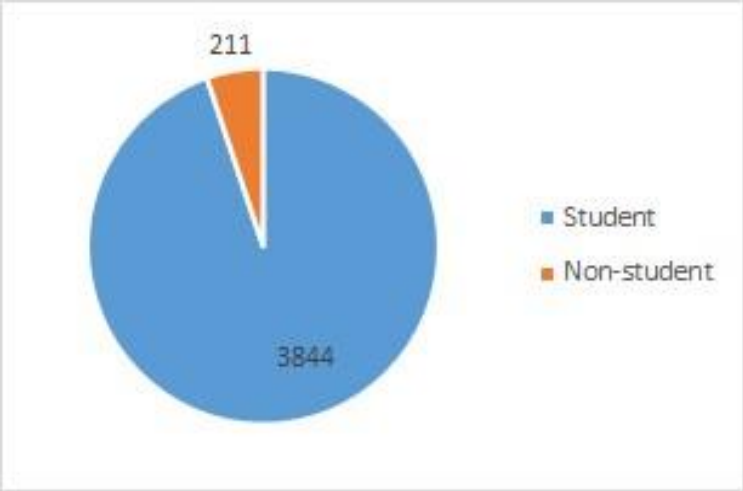


Image 2--Number of student and non-student chat transcripts

While the primary purpose of this research was to compare the effectiveness of answering chat questions between student and non-student employees, we also wanted to explore the occurrences of unanswered questions. We discovered that of the 4,475 chats only 8.7% were unanswered. This percentage may seem small, but it represents 388 interactions where the patron expected a response but did not receive one. It was important to track the number of unanswered questions so we could reduce that number in the future by discovering the cause. In doing so, we discovered a variety of reasons that questions go unanswered. One of the primary reasons is when employees forgot to logout of the computer during the weekly campus devotional when all service points are closed, or at the end of the day; 20.6% of unanswered chats occurred for these reasons. However, 79.4% of those unanswered chats occurred during regular staffed hours and the reason they went unanswered cannot be determined by analyzing the data.

Question Type	Total	Percentage
Research/reference	2936	65.6%
Policy/procedure	124	20.4%
Tech/troubleshooting	397	8.9%
Directional	314	2.8%

Table 1--Number of questions by type

Recording the question type (see Table 1) showed us that patrons use the service to fill various information needs and, on occasion, patrons ask multiple questions during a single interaction (238). It is important to note that the majority of questions asked using chat were coded as research/reference (65.6%). We were surprised that policy/procedure questions were next (20.4%) and we think this is because many of the questions that we received

were regarding the hours that the library is open. Tech/troubleshooting questions were third (8.9%) followed by directional, which is the question type asked the least (2.8%).We tracked the time it took to answer each chat as well as the duration of each chat interaction. We found that on average, the chats were answered after a 91 second wait. This average includes chats with the longest wait times occasionally reaching or exceeding one hour. However, only 123 transactions took more than 10 minutes to respond to the initial patron request. When we remove these 123 transactions, the average time to answer was 79 seconds. The average duration of a chat interaction was 13 minutes 46 seconds. While occasionally they lasted over one hour, 91.75% lasted less than 30 minutes (see Table 2). For chats that lasted longer than 30 minutes, one must be cautious of the instances where the chat was completed but not immediately closed by the responder thus extending the recorded chat length. It is also important to note that this does not include the unanswered transactions. Considering this, while non-students did not answer a large percentage of the overall questions, what they did answer represents about 2740 minutes or over 45 hours. Removing this responsibility from non-student employees would result in a significant cost savings or cost reallocation for the library.

Transaction time	**Total / Percent**	**Student Total / Percent**	**Non-student Total / Percent**
Less than 1 minute	263/6.7%	250/6.7%	13/6.5%
1-5 minute	1606/40.9%	1517/40.6%	89/44.7%
6-10 minutes	818/20.8%	775/20.8%	43/21.6%
11-29 minutes	937/23.8%	888/23.8%	49/24.6%
30+	307/7.8%	303/8.1%	5/2.5%

Table 2--Number and percentage of transaction times

Another significant concern in the anonymous online world of chat is how employees interact with the patrons (appropriately or inappropriately). In an effort to improve the service to patrons, we coded each transaction for appropriateness as well. Table 3 shows that very few interactions were considered inappropriate (.04%). Indeed, we are very happy with the low number, though there is always room to improve.

4.2-Student vs. Non-student Comparisons

The primary purpose of this project was to compare student and non-student responses to chat questions. In particular, we wanted to know if students were as complete and/or accurate as non-students were. As shown in Table 3, students are slightly less complete or accurate than non-students, though the difference is minimal. This suggests that students are, for the most part, as effective as non-students in answering chat questions. However, a further training emphasis on accuracy and completeness could help improve those measures of effectiveness.

Evaluation Criteria	**Student Total**	**Students**	**Non-student total**	**Non-students**
Perceived incomplete	217	5.7%	11	5.2%
Perceived inaccurate	138	3.6%	6	2.8%
Chat etiquette--Greeting	2903	75.5%	148	70.1%
Chat etiquette--Follow-up	582	15.1%	50	23.7%

Chat etiquette--Closing	1785	46.4%	112	53.1%
Source use--Cited source	1394	36.3%	99	46.9%
Source use--Guided to source	661	17.2%	39	18.5%
Source use--No source	275	7.2%	11	5.2%
Source use--Unnecessary	1580	41.1%	68	32.2%
Employee Inappropriate	2	.04%	0	0.0%

Table 3--Evaluation criteria total and percentage comparison

In addition, we explored the effectiveness of students and non-students using the technology (chat and information sources) for the benefit of the patrons. Table 3 shows that while the students are better at greeting new chat patrons, the non-students are better at following up on questions and providing a closing statement, though there is still much room for improvement. Non-students are also better at providing sources, such as a link or call number, for the questions asked in chat.

An important functionality of the chat software is the ability to transfer questions to a more appropriate desk or service to answer the question. This is an important comparison we explored by analyzing the transcripts. Surprisingly, we found that no chat interactions were transferred from students to non-students, though non-students did answer some transferred questions. This is likely because transcripts are typically transferred to a queue instead of to an individual, regardless of question type. As show in Image 3 students are more likely to transfer "Research/Reference" questions and slightly more likely to transfer "Policy/Procedure" questions than they are other types, but again, these were transferred to subject desk queues, not to non-students. This suggests that students know when the question requires more specialized knowledge or experience. Though transcripts were never transferred to non-students, one statistic that the transcripts cannot tell us is how often the student called or sought out a nonstudent to find an answer to a question The following transcript is not only an example of this situation but is also an example of excellent service.

PATRON:*I have a question...*

STUDENT: *hello.*

STUDENT: *How can I help you?*

PATRON: *HI, there used to be a BYU Case Method Wiki for information literacy case problems..but all of the links to it are broken. doyou know where it has moved to?*

STUDENT: *That's a good question. Let me look into that for you.*

PATRON:*[Librarian] used to maintain it*

STUDENT:*I do know that we have a page called library instruction. Is this what you were looking for or something else.*

http://sites.lib.byu.edu/instruction/ **PATRON:** *no, not this...*

PATRON: *like this: ttps://sites.lib.byu.edu/casewiki/index.php/About_the_Library_Instruction_Case_Wiki.*

STUDENT: *okay. Let me contact [the librarian]and see what he knows.*

PATRON: *ok..*

STUDENT:*I just got off the phone with [the librarian] and he didn't realize that the website/links were broken. He is working on getting a team to fix it right away.*

PATRON: *ok..great. i'll just keep checking*
STUDENT: *is there anything else I can do for you?*
PATRON: *nope, that should do it for now. :)* **STUDENT:** *Okay. Have a nice day!*
PATRON: *thanks!*

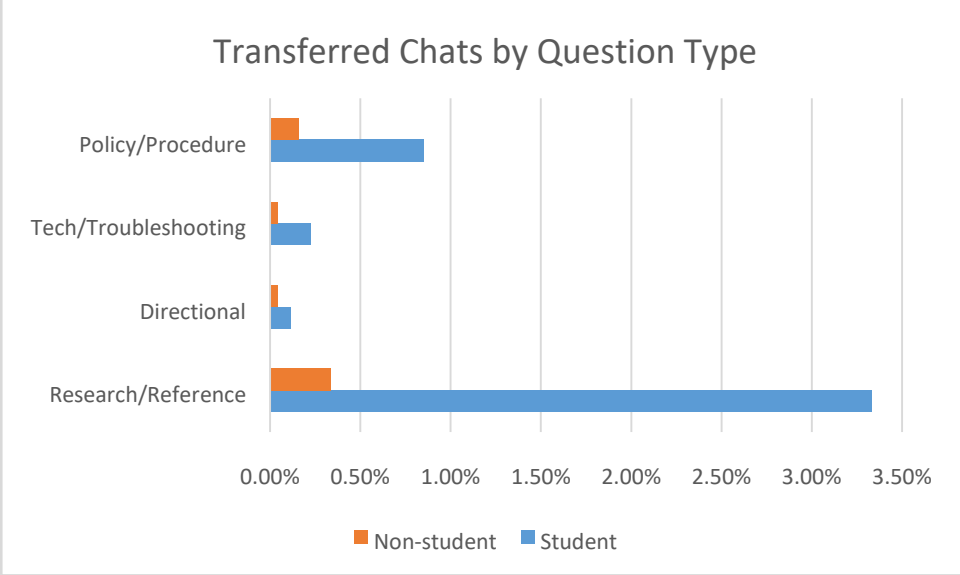


Image 3--Transferred Chats by Question Type

Image 4 shows the comparison of "Perceived Inaccurate" and "Perceive Incomplete" questions. This comparison shows that while non-students are slightly better at answering correctly, the difference is not very high.

An example of inaccuracy is shown in the following chat transcript. This example also shows how the library employee did not understand the policy for Group Study Rooms, as stated clearly on the reservation site.

09:28 **Patron:** *Hi - Is it okay for only one person to reserve and utilize a study room, or is there a minimum quantity of people allowed?* 09:28 **Librarian:** *hi* 09:28 **Librarian:** *That is fine*
09:28**Patron:** *Great - thanks!*

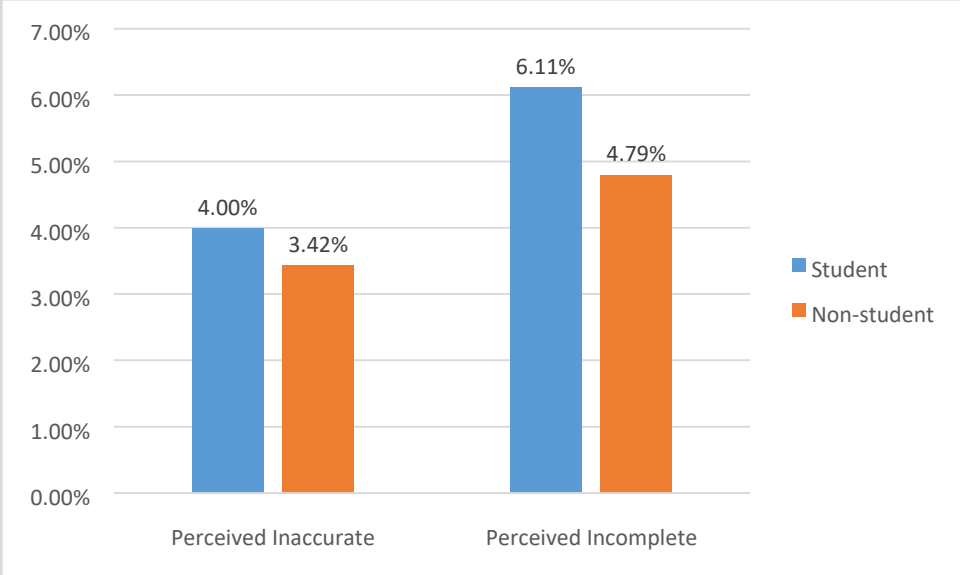


Image 4--Perceived Inaccurate & Perceived Incomplete

In addition, here is an example of a chat that was "Perceived Incomplete". While the answer does include some pertinent information, it would have been better to include a link to the "Religion" subject guide or forward it to the religion helpdesk. While much of the information presented is accurate, the patron did not get a complete answer.

14:22PM **Patron:** *Hi*
14:23PM **Student:** *Is there are database you would recommend for specific information on different religions?*
14:24PM **Student:** *Ebsco probably has something helpful for you: http://dbs.lib.byu.edu/religion-ebsco* 14:24PM **Patron:** *Great thanks!*

5-Discussion

We believe the student employees' ability to effectively answer chat questions can be largely attributed to the regular and consistent student employee training provided in every department of the library. Students and their supervisors convene each week for one hour of student training on a variety of library topics. While chat is not the sole focus of these weekly meetings, the topics covered (e.g. reference skills, customer service, technology) often contribute to student understanding of the library, its resources and how to effectively answer questions using that information. As such, the training helps the students become more qualified and knowledgeable when answering chat. In addition, each department conducts these trainings, guided by standards agreed upon in a library-wide Reference Coordinating Committee. This coordination facilitates consistency throughout the library, which likewise contributes to student success in answering chat questions. The department-specific training also allows supervisors to provide subject specific training that is often needed when answering reference questions. We suggest a practice of a librarywide chat training program to encourage even greater consistency throughout the library.

We have identified other contributors that may lead to student success in answering chat. For example, the library offers a searchable "Frequently Asked Questions" website (https://lib.byu.edu/faq/) that acts as a quick reference guide where student employees (and others) can search for quick answers. The depth and search ability of the site allow students to become quickly informed about almost any topic in the library. This is an especially helpful tool for student employees who are new to the job and gaining familiarity with the library.

While the results suggest undergraduate student employees are capable of answering chat at nearly the same level as non-student employees, the wage implications of doing so should be considered. The wage of the students at the Learning Commons reference desk starts at $9.55 per hour. This pay rate is far below what academic librarians get paid (national average of $66,650/year or $32.04/hour) to answer the same service (Bureau of Labor Statistics, 2018b). Paraprofessional staff also earn substantially higher wages than students do, at an average of $14.33 per hour (Bureau of Labor Statistics, 2018a). While utilizing undergraduates to answer chat reference is certainly more cost effective, one must consider the ethical implications of paying lower wages to student employees for the same level of work. On the other hand, allowing students to answer these often-basic questions, and transferring the more in-depth ones, allows non-students to focus on more administrative or professional responsibilities.

In addition to the statistical findings, we recorded several observations that add depth to our research. While the non-student employees performed better regarding chat etiquette, we found that, like Keyes and Dworak (2017), the student employees had a better virtual presence. In analyzing the chat transcripts, we observed that student employees are more familiar with online chatting protocols than non-student employees are. Likewise, the patrons using the service are typically informal in their conversations and seem to prefer the person answering the chat to utilize the same casualness. On occasion, the non-student employees exhibited awkward chat protocol like saying

nothing but "OK" which can be off-putting for patrons. Unlike the student employees, there is no formal training for non-students regarding online interactions and how to answer chat. While the non-students may receive instruction on how to use the LibraryH3lp software, they receive little to no training for chat norms and responding techniques. We recommend an increased and formalized training on chat lingo and norms for non-student employees, which may improve their responses.

We also noticed that response time to an incoming chat took more time, on average, for chat interactions initiated after 5:00 PM or on the weekends. Similarly, we observed a drop in response completeness during these times. There may be several reasons that contribute to these findings. During these times, student employees are fully responsible for the chat service, as non-students are typically out of the library. A lack of supervision from nonstudent employees may contribute to this drop of service level. Another possibility is that demand for the chat service decreases during these times. While 55.44% of the hours offered lie outside of the traditional Monday through Friday, 8:00 AM to 5:00 PM window, only 26.68% of all our chats occur during this time. This indicates a slower service window, which allows students to give attention to other duties and tasks, possibly distracting them from monitoring chat. In the future, we should address additional training for monitoring chat in the evenings and weekends.

Despite the time required for such a comprehensive analysis of 4475 chats for a complete calendar year, the results turned out to be well worth the effort. Without an entire year's worth of data, we would not have had a large enough sample of non-student responses to chat questions, as we found that only 4.7% of the chats were answered by non-student employees. However, now that we have a baseline with such a complete set of data, we can perform future studies with just a sampling of chats.

6-Limitations and Future Directions

Some limitations to our study include unequal sample size for non-student and student chat transcripts, researchers' inabilities to reconcile differences together, and comparing only two employee types instead of all the possibilities (i.e. student employees, graduate student employees, staff, professional librarian). When determining to look at an entire years' worth of chat transcripts, we did not realize the large number of chats being answered by our students, especially in comparison to non-students. Ideally, we would have had as many non-student transcripts to analyze as we had student transcripts for a more balanced comparison. Nevertheless, we find that despite the smaller number of non-student transcripts, the student transcripts themselves support our hypothesis that students are capable of answering chats effectively.

For a more accurate analysis of the chats, we would have preferred to reconcile any differences between the researchers' codes as a team. However, due to scheduling conflicts and the amount of time required to code 4475 transcripts, we settled for having the third researcher reconcile any differences between the first two coders. Because of early agreements and regular communications, many of the two coded records were identical, requiring little reconciliation unnecessary. When there was a discrepancy, we relied on the third researcher to determine the most appropriate codes. While having each researcher participate in reconciliation would have been preferred, we are satisfied with the results and the fact that three separate researchers analyzed each chat.

As mentioned in the literature review, while many libraries utilize graduate student employees in answering chat, we found little research conducted on graduate students' abilities to answer chat. The HBLL does not typically employ graduate students to work at the reference desks, which limited us for this type of research. In the future, we would like to examine graduate students at other libraries or potentially hire them within our own library for research purposes. Similarly, when coding the transcripts, we did not differentiate between professional librarians

and paraprofessional library staff. A more complete study could separate each of the non-student employees into their own group to gain further insight to each employee group's performance. For example, are paraprofessionals as adept at answering chat questions as students and professional librarians?

Future studies could also include a survey of patron experience which, when combined with this data, would achieve a more complete view of the experience from both sides of the system. Another potential addition to this research could be an employee survey to attempt to expose the issues we were unable to find in this study. We also plan to use the existing data to inform trainings within the library. We plan to separate the data by queue and provide a report for each reference desk. This can be used as a training opportunity to help prepare new employees and to improve weekly student training.

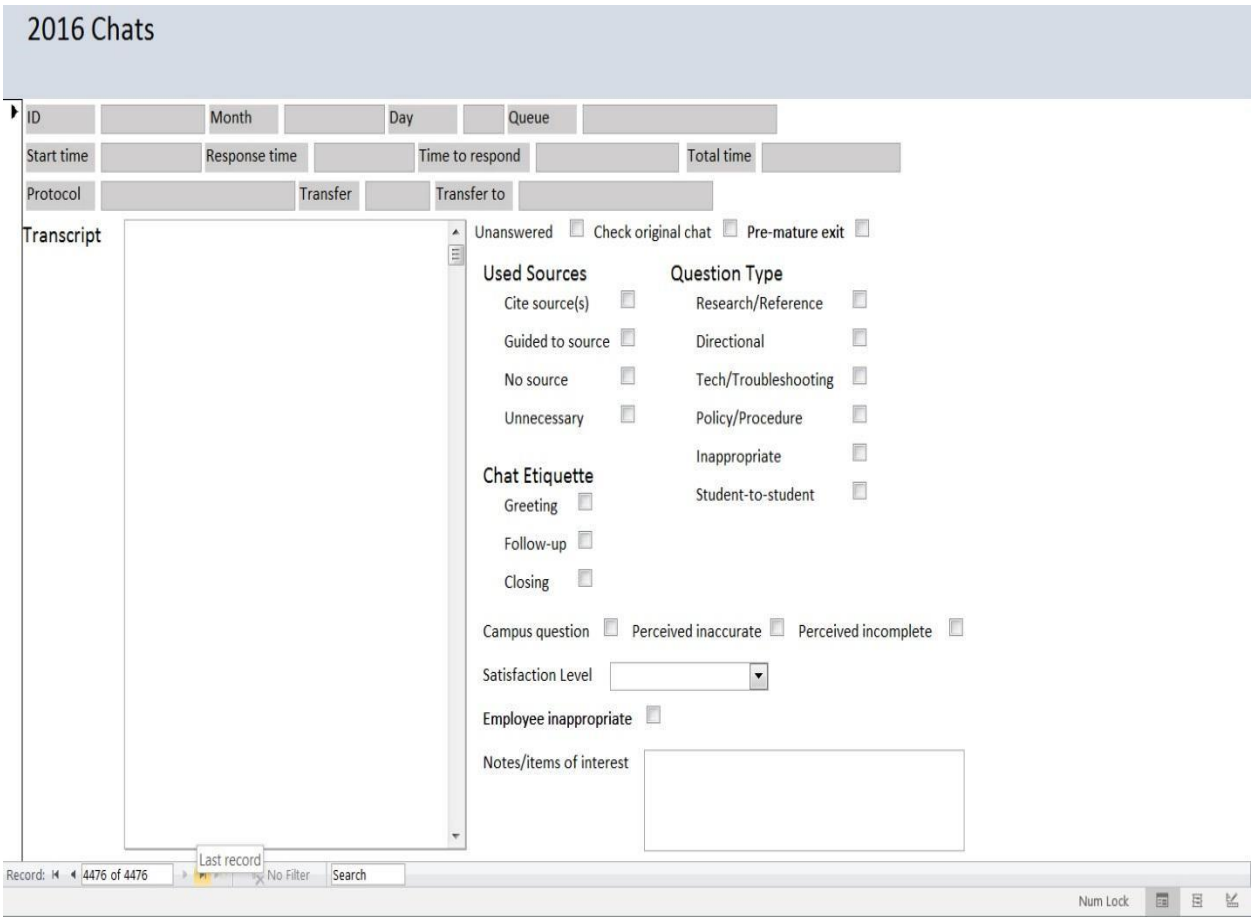
7-Conclusion

In this research, we aimed to determine if undergraduate student employees could be as accurate and complete in answering chat as non-student employees. We hypothesized that student employees would be just as effective. In analyzing 4475 chats from the 2016 calendar year, we found that students are complete in answering chats nearly as often as non-students, with non-students answering completely only 0.5% more often. Likewise, students were only inaccurate 0.8% more often than non-students were. With a difference less than 1% in accuracy and completeness, students are in fact as effective as non-students are. We also noted that students are currently more capable at understanding and using the technology used by patrons when interacting via chat. While both students and non-students perform well overall, both could improve by receiving more training. For example, students can benefit from more training on logging out of chat during off hours and non-students can benefit from training on chat protocols and lingo.

In addition to the findings regarding accuracy and completeness, we discovered several other interesting results including reasons for chats going unanswered, the types of questions the library answered most often (research/reference, 65.6%), and the duration of each chat, with most taking 1 to 5 minutes (40.7%). We were also able to make additional comparisons between students and non-student employees regarding chat etiquette and source use. While these areas were not the focus of our study, they helped contribute to our understanding of how different employee types provide service via chat. Students' abilities to answer chat is likely attributable to high-quality training received prior to their answering chats and the regular weekly training that takes place thereafter. Using student employees to answer chat questions grants them more opportunities to learn about the library, which in turn makes them more effective advocates for the library. It also benefits the library by reducing costs associated with staffing chat and by providing non-students more time to focus on higher-level work.

This research can be helpful for libraries considering the use of student employees in answering chat. In the future, others can use this research to inform similar studies regarding the ability of various employee types (e.g. graduate students or paraprofessional staff) to answer chat questions.

Appendix A--Blank MS Access Coding form



Appendix B--Pre-filled Downloaded fields

List of information automatically gathered from the chats

- *ID*
- *Month*
- *Day*
- *Queue*
- *Start time*
- *Response time*
- *Time to respond*
- *Total time*
- *Protocol*
- *Transfer*
- *Transfer to*
- *Transcript*

Appendix C--Code definitions

- *Unanswered*: This indicated that the library employee failed to acknowledge a question and it went unanswered. At first, we thought the total was higher than it was, but the reasons, which will be explained later in this document, helped us to understand this number.
- *Check original chat*: If there was something that we needed to review later we marked this box to help us know which chat we needed to look at in more detail by going to the original transcript to clarify a question.

- *Premature exit*: Occasionally, a patron would begin a chat but disconnect before the employee had a chance to respond.
- *Used Sources*: This section was to help us determine when a question was asked if the employee, if necessary, used the correct source and if the source was given to the patron or if the patron was guided to the source (teach a man to fish). How do non-students compare to students?
  - *Cite sources*: Was the source of information cited for the patron? This could be an exact citation or a link to a source. Phone numbers and call numbers were also considered citations.
  - *Guided to source*: Was the patron shown how to find the information he/she sought? For example, was the patron given step by step instructions to get to a particular source.
  - *No source*: No source was shared, though one should have been. o *Unnecessary*: No source was necessary, usually because the question did not require anything other than general reference knowledge. An example of this type of question is, "What time does the library close?"

 Question type: This section of criterion was important to help determine the type of questions received by chat, as opposed to in-person and email questions.

  - *Research/reference* questions are those asked with the intent to find information for a research or other project. The answers typically require some small research on the part of the library employee.
  - *Directional* questions refer to those asking for the location of something. Due to the virtual nature of this interaction type, these are rarely asked.
  - *Tech/troubleshooting* questions are often asked about printing or a technology problem. For example, relating to issues with the Interlibrary Loan system or when the OPAC is not working.
  - *Policy/procedure* questions often related to the manner in which the library performs its functions or activities allowed in the library.
  - *Inappropriate* questions happen rarely and refer to questions or comments patrons make in the system.
  - *Student-to-student* are those interactions that happen from one student employee to another. Usually these happen when a change in shifts occurs or when communications need to happen between reference desks.

 Chat etiquette: This section is an overall assessment of if the employee treated the patron with the same respect that is expected from an in-person interaction. We also wanted to know if there was a difference between student and non-student employees, especially related to the perceived generational gap.

  - *Greeting*: Was the patron greeted upon initiation of the chat? A simple "Hello" or "Hi" sufficed. o *Follow-up*: Was the patron asked if there was anything else,he/she needed help with or was a clarification question asked?
  - *Closing*: Did the employee thank the patron for contacting the library or told to "Have a good day"?
- *Campus question*: Occasionally (insert %) questions that pertain to the campus as a whole are asked. For the most part, the employees are able to answer these types of questions, either by knowing the answer or finding it for the patron. Because the library is in the center of campus and provides services during early and late hours, these types of questions are often asked, which is why we determined to code for this.
- *Perceived incomplete*: Was the patron given all the necessary information as perceived by the coders?
- *Perceived inaccurate*: Was the information accurate, according to the coders?
- *Satisfaction level*: The default for this selection was "Satisfied". Emotion is much harder to determine over chat than in person, so we only coded it otherwise if there was something in the transcript that indicated either excellence or dissatisfaction. (examples?)
- *Above and beyond*: This indicates that the library employee answered more than the basic question, or the patron was overly grateful.

- *Satisfied*: This is the default selection if neither of the other two applies
- *Dissatisfied/frustrated*: On occasion a patron is frustrated of dissatisfied with the interaction. The reason was often something out of the control of the employee or due to a slow response.
- *Notes/items of interest*: This field was intended for us to put in any comments that would help us as we analyzed the chats. Unfortunately, we did not use this as effectively as we could have.

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