Designing Campus Learning Spaces

A Report on Students' Current and Future Needs

March 2010

LEARNING & SCHOLARLY TECHNOLOGIES
UNIVERSITY of WASHINGTON
UW Information Technology

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Acknowledgements:

The research project detailed in this report was undertaken at the behest of the Computing Services Replacement Space Work Group. This group was formed to plan for the closure of Mary Gates Hall Computing Resource Center (MGH CRC) and to develop plans for enhancements to other campus spaces to meet the needs currently being met by the MGH CRC. We would like to thank the Work Group members for their support of this project.

We offer special thanks to Richard Ells from UW Information Technology for taking several of the photographs featured in this report. We would also like to acknowledge the contributions of our excellent student staff, especially Jason Gordon for editing, Cathy Wu for formatting and visual design, and Nicole Wedvik and Galib Mirza for building the figures.

EXECUTIVE SUMMARY

Historically, the University of Washington (UW) has met students' computing needs by supporting general-access computing centers. Given the changing landscape of technology use and the high demands for campus spaces, Learning & Scholarly Technologies (LST), the unit within UW Information Technology responsible for managing these centers, is transitioning to a new model of computing support. This new model offers a hybrid of traditional general-access computing services *and* innovative solutions to better support students' use of laptops, netbooks, and other devices. In order to facilitate this transition and to meet the computing and studying needs of students at the UW, LST gathered survey and focus group data in autumn 2009 from over 3,250 students.

Our data show that students tend to use Mary Gates Hall Computing Resource Center (MGH CRC) for quiet, independent work and the Learning Commons in Odegaard Undergraduate Library (OUGL) for both independent and collaborative activities. However, the study did not focus exclusively on the two large computing centers managed by LST. We also found that laptop ownership among students is high: 93% of survey respondents reported owning a laptop and/or netbook, yet only 35% of this group frequently brought this equipment to campus. Data also show that students would like to see improvements to a variety of campus spaces to better support their computing and studying needs. Students emphasized the importance of (1) electrical outlets for charging laptops, (2) quiet areas to work without distraction, (3) evening access, and (4) comfortable furniture. In focus groups, students also described specific environmental features that best accommodated individual or group work.

This report provides valuable information for anyone involved in designing or managing any type of campus learning space, from student lounges and cafés to computer centers and libraries. Based on our findings, we make the following recommendations to the UW community: (1) continue to provide general-access computers and access to high-end software, (2) minimize obstacles to laptop use, (3) provide dedicated spaces for quiet, independent study, (4) establish or enhance spaces for collaborative work, (5) design mixed-use spaces thoughtfully so that students can readily assess which types of activities are encouraged in what areas, (6) increase access to printing, (7) consider aesthetics and comfort when designing student spaces, and (8) continue to involve students in all stages of the design process for new spaces.

Learning & Scholarly Technologies is transitioning to a new model of student computing support. This new model offers a hybrid of traditional general-access computing services *and* new solutions to better support students' use of laptops, netbooks, and other devices.

Students working in OUGL Learning Commons.

THE NEED FOR NEW CAMPUS COMPUTING SOLUTIONS

Colleges and universities around the globe are continuously assessing the best ways to meet students' computing and studying needs. For the past several years, there has been widespread debate in the educational technology community about the future of campus computing centers. Some institutions are moving away from traditional computing centers with rows of individual computers to more varied learning spaces, with flexible furniture and new use policies. At Emory University, for example, a traditional computing center was redesigned to provide both individual computer access and differently configured spaces and technologies to facilitate collaborative work. In addition, Emory provided comfortable furniture, did not discourage noise, and allowed food and beverages (Cattier). Other universities have implemented similar changes. At the University of Rochester, research on student needs resulted in a redesign of study and computing areas in the library to provide comfortable, colorful, and flexible work areas that could accommodate individual or group work (Carleson). At the University of Wisconsin, Milwaukee (UWM) minor changes were made to hours, staffing levels, and policies to allow more flexibility in the use of their computing centers. UWM also observed that their traditional computing centers continued to be in high demand (Shaefer).

At the UW, LST provides a combination of large campus computing centers (OUGL Learning Commons and MGH CRC) and distributed workstations ("Access+") in libraries across campus, all funded by the Student Technology Fee Committee. LST also supports student use of personally-owned laptops and computers through our Computer Vet service. This service provides free technical support to students, including assistance updating operating systems, establishing legal peer-to-peer file sharing, and installing anti-virus software. In addition, LST has worked with campus partners to provide environments that support laptop use. In 2009 we collaborated with UW Libraries to convert a computer classroom on the first floor of OUGL into a laptop and study alcove for students.

In June 2010 one of our two large general-access computing centers, MGH CRC, will close. Instead of moving this computing center to a new location, LST is working with campus partners to develop new solutions. While LST will continue to provide one large general-access computing center (OUGL Learning Commons) and numerous distributed Access+ workstations, we are also identifying a combination of new spaces and services on campus that will support students' use of their own hardware (laptops, netbooks, or other devices).

These impending changes provided a valuable opportunity for LST to gather information from students that would help us smoothly transition to a new service model. Specifically, we wanted to know how students were using laptops and other mobile devices on campus, how they were using existing computing centers, and what changes students desire going forward. To this end, LST conducted both an online survey and focus groups in autumn 2009. The information gathered provides a portrait of how students currently use UW-provided and personal computers while on campus, the obstacles they encounter when using these resources, and their current and future needs. In this report we present our findings and offer recommendations for meeting students' needs in new and existing student spaces.

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The closure of MGH CRC is just one of several major alterations to student spaces planned for the UW central campus over the next few years. Most significantly the Husky Union Building will close in July 2010 for a two-year renovation. Other large projects include the construction of a new advising center in MGH (in the space vacated by the CRC) and the development of a Research Commons in Allen Library. In addition, UW Libraries and various campus partners are currently envisioning possibilities for OUGL. While these changes will ultimately result in improved spaces and services for students, their short-term impact will be to decrease student space for studying and computing while improvements are underway. The latter pattern makes the efficient use of central campus spaces particularly important over the next few years. This report presents valuable information that can help members of the UW community provide spaces to meet students' studying and computing needs, whether as part of major renovation projects or through minor changes to enhance existing spaces. The information we provide will help the UW community make the most effective use of a variety of spaces where students work, whether those spaces are cafés and eateries, lounges and study alcoves, computing centers, libraries, building foyers, or other campus locations.

DATA COLLECTION AND ANALYSIS

The data analyzed for this report include survey data, comments and sketches collected during focus groups, and log data from LST's computing centers. Using an online survey method gave us the ability to collect information about students' computing and work needs from a large number of participants, allowing us to identify general patterns. The focus group protocol helped us learn about specific aspects of spaces that students liked or disliked, and allowed student participants to sketch their

Online Survey:
3,250 students responded

Focus Groups:
24 students participated

Usage Data:
28,353 unique users

ideal computing and work spaces in specific contexts. Finally, the computing centers usage data allowed us to look at actual patterns of use. These three sources of data were chosen to provide the most complete picture of students' current and future needs.

Student Technology Experience Survey

LST sent an email to all students of record at UW's main campus in Seattle asking them to take our Student Technology Experience Survey, a confidential online survey. We also posted signs advertising the survey in campus computing centers and other student spaces. Participants were offered a chance to win one of ten $25 gift certificates from the University Bookstore for taking the survey. Students' contact information for the drawing was not directly connected to survey results.

The survey included 37 questions and was divided into four sections. The first section, "Technology Use," asked participants if they owned a desktop computer, laptop computer, and/or netbook. It also included questions about their use of laptops and netbooks on campus. The second section, "Computing Centers," asked participants about their use of MGH CRC and OUGL Learning Commons. In the third section, "The future of public spaces at the UW," participants were asked to rate how difficult it was for them to find a space to do school work, and how important different features of public spaces (e.g., availability of printing) were for their computing and studying needs. The fourth and final section, "Demographics," asked for participants' class standing, department, and other general information.

The analysis sample was comprised of 3,250 students, of which 64% were undergraduates, 32% were graduates, and 4% "other." In addition to running descriptive statistics on the sections above, we conducted analyses comparing groups based on the frequency with which they brought their laptop to campus (never, rarely/sometimes, and most of the time/always) and class standing (undergraduate and graduate). Nine of the questions on the survey allowed students to write-in comments in response. We conducted a content analysis of this qualitative data.

Design Sessions

Survey participants who completed the separate entry for the drawing were asked if they would like to be contacted about participating in focus groups to help design new campus computing spaces. Based on their class standing, computing habits, and availability, we invited students from this sample and student staff working in LST computing centers to participate in focus groups. Students who completed the focus groups (except for LST student staff) were offered a $10 credit on their Husky cards as compensation for their time. A total of 24 students (16 from survey drawing sample; eight from LST) participated in four focus groups.

Photos provided both inspiration and reference points for discussion.

The focus groups were scheduled for ninety minutes and structured as a participatory design session. Participants were presented with four scenarios and asked to describe the ideal environment that would support completing the tasks associated with each scenario (e.g., completing a solo class project that will take several hours of focused work; coordinating a collaborative project among yourself and three classmates). If they did not spontaneously do so, participants were prompted to describe the kind of furniture, lighting, noise levels, and other similar features in their ideal environment, and what they carried with them or what was nearby. Photos representing a wide range of workstations, furniture configurations, lighting options, and partitions from a variety of institutions were mounted on the walls of the room in which the focus group was held; participants were encouraged to refer to these photos as they described the kinds of features that would or would not be included in their ideal environment. Participants were also given paper and pens to sketch their ideas.

Computing Centers Usage Data

On a quarterly basis, LST captures the total number of logins for both of our computing centers and for the Access+ workstations in libraries. To get a count of unique users, we also count how many different UW NetIDs are used to login to each center or workstation. We then analyze this data to determine the average number of logins or users per machine available, or per hour a facility is open. In this report, we share data from autumn 2009, when we recorded a total of 28,353 unique users across our various spaces and services.

MGH CRC: Students value the enclosed, quiet environment of the CRC, especially for individual work.

FINDINGS

Use of Campus Computing Centers

Before beginning our discussion of findings related to computing centers, we will first provide some context by offering a basic description of MGH CRC, OUGL Learning Commons, and Access+ workstations. MGH CRC is a 180-workstation computing center that provides students with access to high-end software (e.g., Adobe Creative Suite, video-editing software, SPSS, and others), technical support, and printing and plotting services. MGH CRC is centrally-located, with close proximity to advising, other student services, and classrooms. MGH CRC has an enclosed, quiet environment, with large work areas around each computer station and plentiful natural lighting. It is open Monday through Friday from 8:00 AM to 6:00 PM.

OUGL Learning Commons is an open-space 360-workstation computing center that, in addition to providing the same software and services as MGH CRC, is co-located with library resources. OUGL Learning Commons is a hub of student activity with a variety of work areas for students, including specialized technology studios used for collaboration, working with digital audio, and presentations. OUGL Learning Commons is open 24 hours a day during the week, with slightly reduced hours on weekends.

In addition, LST currently supports 200 Access+ workstations in several libraries. These workstations allow students to access their email, the Internet, library databases, and select software (Microsoft Office and academic research software). Several departments also provide separate computing centers for their students.

The computing centers and distributed Access + workstations managed by LST are heavily used by students. Figure 1 (see Appendix) shows the number of unique users that logged into the MGH CRC, OUGL Learning Commons, and Access+ workstations last quarter (autumn 2009). Across all LST-managed spaces and systems, 28,353 users logged in at least once during the quarter; this number is equivalent to more than two-thirds of the total student body. Figure 2 (see Appendix) shows the total logins for these computing centers and workstations. Together these data demonstrate that students are repeat users of LST-managed computing centers and workstations. For instance, OUGL Learning Commons had an average of 10 logins per unique user during the quarter.

Heavy use of these computing centers has persisted over time. Use of OUGL Learning Commons has remained steady over the past five years: 16,508 unique users visited OUGL in autumn 2005, compared with 16,665 in

autumn 2009. While use of MGH CRC has dropped during this same time period (10,114 unique users visited the facility in autumn 2005, compared with 8,014 in autumn 2009), this difference is due to a decrease in hours in 2008 that eliminated evening access. When we look at the average number of users in MGH CRC by hours open, we see an increase over time (see Appendix, Figure 3). These data demonstrate that a substantial number of students continue to seek regular access to campus computers.

To better understand how students are using the LST computing centers, we included an item on the survey that asked students to select all of the activities that they "typically do" in these facilities. The results suggest ***important distinctions between MGH CRC and OUGL Learning Commons in the kinds of work conducted.*** In both spaces the highest percentage of student respondents reported that they work alone—91% in MGH CRC and 88% in OUGL Learning Commons (see Appendix, Figures 4 and 5). In OUGL Learning Commons, however, 56% of students reported also working with others, while only 20% of MGH CRC users reported the same. In addition, users of OUGL Learning Commons more often reported using (32%) or recharging (19%) a laptop or netbook compared with 12% and 10%, respectively, of MGH CRC users. These data suggest that ***students working in MGH CRC are more likely to work alone and to use UW-provided computers exclusively*** than are students working in OUGL Learning Commons.

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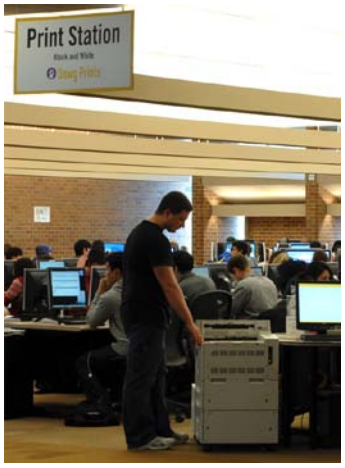
While the hardware, software, and services that MGH CRC and OUGL Learning Commons provide are the same, these computing centers have different environmental characteristics that impact how they are used. Another item on the survey asked students how important various factors were to their decision to use each space; they rated these features on a scale of low importance (1), medium importance (2), and high importance (3). For MGH CRC the top four reasons for visiting were: little or no wait time for a computer (mean of 2.58); location (2.48); good lighting (2.39); and a quiet environment (2.37). For OUGL Learning Commons, the top four were: location (2.52), printing (2.37), and a tie between good lighting and room to spread out papers and books (2.35). Figures 6 and 7 (see Appendix) show the complete ranking of items. These responses indicate that ***some of the unique features of MGH CRC, specifically the "quiet environment" and "little or no wait time," are highly valued by students***.

Students' written comments about their use of MGH CRC and OUGL Learning Commons echoed many of the same patterns described above.



Print Station in OUGL: Multiple computing activities take place in the Learning Commons.

"OUGL is close and accessible. Also, I like the new Mac desktops (everybody loves them)."

"I like that it is quiet in MGH compared to the Odegaard computer center."

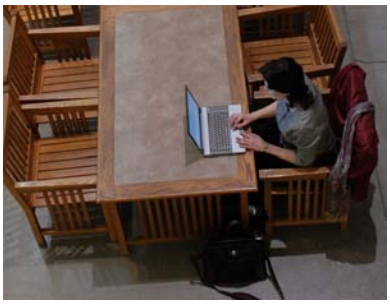
"OUGL Learning Commons is often so busy that it is difficult to find a place to work."

"I have used the computers for printing as well as using the latest version of Microsoft office, especially to convert .doc and .ppt into .pdf (I only have the 2003 version)."

Use of Laptops

Laptop ownership is high among students. Only 40% of student respondents reported owning a desktop computer. On the other hand, 85% reported owning a laptop, 2% owned a netbook, and 7% owned both a laptop and a netbook. Only 7% of student respondents did not own either a laptop or netbook (see Appendix, Figure 8).

Although laptop ownership is high, ***students vary in how often they bring their laptops or netbooks to campus.*** When we asked laptop and netbook owners how frequently they carried this equipment with them to campus, most (53%) answered "rarely" or "sometimes," while 35% answered "most of the time" or "always," and 12% answered "never" (see Appendix, Figure 9). While most students reported having their laptops with them occasionally, rather than regularly, it is important to note that the majority of laptop owners (88%) do bring their laptops to campus at least some of the time. The students who reported bringing their laptops to campus with the greatest frequency were graduate students: 52.4% of graduate students (N=950) brought their laptops to campus most of the time or always compared with 26.5% of upperclassmen (N=113) and 23.1% of lowerclassmen (N=757). When we consider that the closure of MGH CRC will mean a decrease in UW-provided computers, finding ways to facilitate students' use of laptops and other devices on campus to compensate for this decrease becomes crucial.



MGH Atrium: Many common spaces have limited access to power outlets for laptops.

Improving Public Spaces

In addition to understanding the current use of computing centers and laptops, another goal of our investigation was to consider how some of the

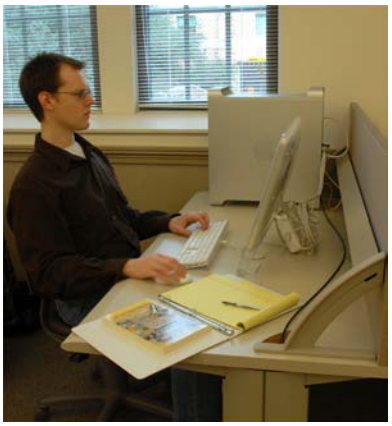
needs currently being addressed by MGH CRC could be met using other spaces on campus. We directly focused on this issue in one survey question, which asked participants how public spaces around campus could be improved to better accommodate students' computing and studying needs. For the purposes of the survey, "public spaces" were defined as "locations (computing centers, libraries, coffee shops, eateries, and open areas) that students use to do their school work." Participants were asked to rate how important different features in those spaces (e.g., availability of coffee or food services) were to them on the following scale: low importance (1), medium importance (2), and high importance (3). ***Four features stood out as exceptionally important for both graduate and undergraduate students: electrical outlets*** for charging laptops, netbooks, and mobile devices (mean of 2.71); ***quiet areas*** to work without distraction (2.60); ***evening access*** (2.55); and ***comfortable furniture*** (2.48). Also high in importance were natural lighting (2.32) and access to printing (2.27) (see Appendix, Figure 10). These results are not surprising considering that features such as "lighting," "printing," and a "quiet environment" were among the top reasons students visited MGH CRC and/or OUGL Learning Commons.

"I choose work spaces with natural light, coffee/food availability, reliable wireless, and access to electrical outlets."

Survey participants were also asked what they would need or want in campus public spaces to do their work. We received 1,894 written responses to this question. Results of our content analysis were consistent with the quantitative data and underscored the ***importance of particular environmental features***. The top five features most frequently cited (in descending order) included ***electrical outlets*** for laptops, ***comfortable furniture, quiet spaces*** to work, ***large tables/surfaces*** on which to spread study materials, and ***collaborative study areas*** suited to larger groups. In addition, participants requested food and beverages nearby, access to printers, reliable wireless access, and natural lighting.

> "I choose work spaces with natural light, coffee/food availability, reliable wireless, and access to electrical outlets."
>
> "While I'm dreaming, I'd like to be able to find a power outlet […] After a few hours of writing MATLAB code even the best laptop is a brick without a power outlet."
>
> "Generally speaking there need to be more spaces on campus that are conducive to technology-augmented collaboration, particularly for Humanities students."
>
> "I would like a semi-comfortable (not too comfortable to sleep in or have other people nearby hang out and sleep there) place that has 'happy' colors instead of drab colors."

The type of detail provided by students in their responses to the open-ended questions discussed above is also what we sought from participants in our focus groups. These design sessions provided us with an opportunity to better understand exactly what students meant when they said they wanted "quiet areas" or "comfortable furniture." We also wanted to better understand if and how needs differed when students were engaged in individual work versus collaboration, or how we could best support these activities in a mixed-use or drop-in space. The findings are summarized below.



MGH CRC: Students want adequate desk space to coordinate study materials, including books, papers, and a laptop or desktop computer.

Accommodating Individual Focused Work

What type of space best supports individual work? In our focus groups, we asked participants to imagine that they needed to sit down and finish a solo class project that was going to take several hours of work. We asked them to describe, ideally, where they were and what they had nearby to support them in the completion of their task.

Focus group participants reported that they did not want to feel isolated when working individually. They preferred to have other people around them who were also working (at a "low hum"), but *not* socializing or gaming. While some participants said they would work on an individual project at a café (Suzzallo café or a coffee shop near campus), most preferred a quieter noise level, citing MGH CRC or the second floor of Suzzallo/Allen as examples of appropriately quiet spaces; OUGL Learning Commons was cited as a space that was too loud.

Almost all participants reported that they typically carried a variety of materials with them (books, papers, and/or laptops), and that they required a work surface large enough to coordinate these items, and some wanted to work with two monitors. Several commented that they wanted space for a laptop or netbook next to a desktop computer; space for additional items (such as a coffee mug or phone) was also appreciated.

Space to spread out work appeared to be more important for students than privacy. Some participants preferred working at a large open table while others preferred individual spaces defined by partitions. Several participants expressed that they did not want to be "too close" to their neighbor or to have their belongings "spill over" into the space of someone near them (and vice-versa). While some liked study carrels, participants did *not* want to work in a space that looked and felt like an office cubicle.

Light and comfort emerged as an important component of participants' ideal work/study environment. Almost all ***participants described natural light, or a combination of natural and artificial light, as an important component of their ideal work/study environment.*** Preferences for light varied widely from very bright to very dim (typically those working with computers). Participants also mentioned that ***comfortable chairs were important for work or study sessions lasting several hours***. Examples of comfortable chairs included those that were ergonomically molded or adjustable, supportive ("shouldn't slouch") and mobile. Participants did *not* want to sit for long periods in chairs with worn-out upholstery or in heavy wooden chairs; they also did not like stationary chairs. In addition, participants said that "too comfy" (overstuffed upholstered) chairs and beanbag chairs were not conducive to work. Finally, for study/work sessions lasting for long periods, participants wanted access to power outlets for laptops, an attractive and colorful environment, and nearby access to beverages and snacks.

Accommodating Collaborative Work

The focus groups were also an opportunity to understand what environments best support collaborative work. We asked participants to imagine that they were completing a collaborative project with their classmates, and that everyone needed to get together to share their work and coordinate a final project. Again, participants described their ideal learning space for this task.

Collaboration Studio in OUGL: Students use a wide variety of resources to accomplish group work. Enclosed spaces help the groups to focus as well as control noise.

Several features emerged in the focus groups as essential to effective collaborative work. ***Focus group participants wanted to meet in spaces that would accommodate four to six people as well as their materials, including books, papers, and "at least one laptop."*** Participants frequently described collaborative work scenarios in which one group member's computer—ideally connected to a wall-mounted plasma screen or tabletop projector—would be used to access and coordinate many project components online in a way that was visible to other group members. In addition, one or more group members might use laptops to record notes. Participants also mentioned whiteboards as an important resource for group work. As with individual work, participants wanted surface space for their materials. Participants preferred working at one large table or several smaller tables that could be easily reconfigured. Regardless of the work surface, participants wanted chairs that could be easily moved.

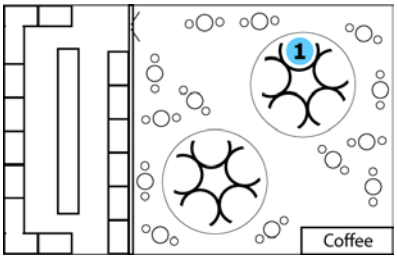
The inflatable pod (Glasgow Caledonia University) and glassed-in study room (Emory University) were focus group participants' favorite images of collaborative spaces.

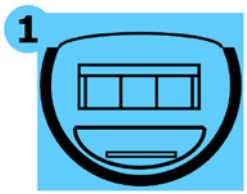
Almost all focus group participants preferred a fully or partially enclosed area for collaborative work; they cited walled "pod" or "stall" configurations as well as fully enclosed group study rooms with a glass wall ("privacy without isolation") as ideal environments. Participants said these spaces would be "perfect" if they could also have mounted plasma screens and whiteboard walls. Some participants cited the OUGL Collaboration Studios as effective spaces, although they would prefer a more enclosed room, like the study rooms in Suzzallo. Participants did not want to do group work in a space that felt like a "dungeon" (no windows) or that was "ugly," "dirty," or had poor lighting or uncomfortable furniture. In terms of location, participants wanted spaces for collaborative work nearby places where they could get coffee or food. Almost all participants said that they would put collaborative spaces in central campus, ideally in a well-known building ("so everyone knows where to meet") and/or in a library.

When we asked participants when they typically met with classmates to complete projects, there was a high demand for group spaces during the same hours. While individual work might be done at any time, including late at night, ***participants reported that group work typically took place during the day or early evening on weekdays (before 6pm).***

Providing for Mixed Use

Focus group participants were also asked how accommodations for individual work and group work might be made in a single location: What were their concerns? What features might make such mixed use effective?





Student sketches featured pods (1) and small tables for group work. They also included distinct areas, separated by glass walls and doors, for quiet, individual work.

Students thought that mixed-use spaces could be effective if areas were specifically designed to accommodate individual and collaborative work. According to focus group participants, ***features of the physical environment could indicate what types of activities were most appropriate there.*** Participants considered open spaces to be more conducive for collaborative activities while quieter space for individual work might require walking through a door. Participants imagined glass barriers between the designated areas, and preferred that it be easy to move between individual work and group work. Some sketched ideas that placed different activities on different floors (most located social activities and food on the ground floor and individual work on the uppermost floor, through a door). Some wanted group work areas to be clustered together so that they would not need to "wander around" looking for an available space to meet. Individual study spaces were often sketched along the outer edges of a space; participants liked the way the current stacks in Suzzallo and Allen libraries act as a noise

and activity buffer to carrels and tables by the windows. Participants thought that it would be helpful if students were able to see the range of environments/furniture configurations available for different types of work.

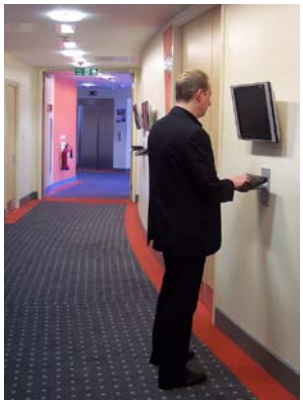
Noise was the major concern of participants in imagining mixed-use spaces. They pointed out that if group spaces are not entirely enclosed (e.g. OUGL Collaboration Studios), noise can spill over the walls and out the door as group members enter and exit. Again, they mentioned a desire to enclose group work in some substantial way (they described the movable dividers shown in some images as "flimsy" and "extra furniture"). Participants also did not want the noise of a café to intrude on spaces for quiet study.

Participants made clear that study spaces (individual or group) were different from spaces for socializing. They described social spaces as lounge areas with couches, lots of chairs, and low and high round tables ("round tables are more social than square"); these spaces also have few barriers, making it easy to spot friends across the room. Nearby food, newsstands, and music or a few, muted televisions ("By George has too many televisions") would also indicate a social space. Interestingly, Suzzallo Café was the only space students said they used for both social and study purposes, although they encountered a few problems. Participants complained about the café's limited power outlets and room to move: "There is not enough traffic room between tables, chairs are banging into each other, there are bags on the floor […] too many people in too small a space."

Accommodating Drop-in Computing Needs

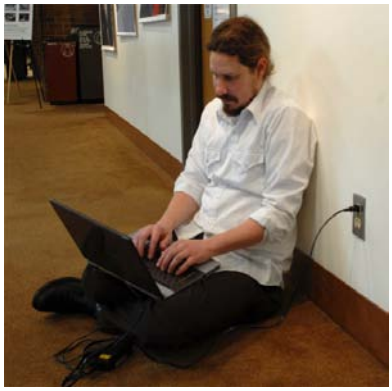
While students might work for long periods of time on individual or group projects, they also have the need to complete short tasks at a computer. When asked what they would do with 20 minutes before a class, students described ideal configurations of space and/or furniture near their classrooms that would maximize efficiency.

Several focus group participants explained that ***it would be great to have three to four walk-up computer stations near their classrooms where they could access email, the Internet, or the contents of their flash drive*** without having to log in. They also wanted an easy-to-access printer nearby where they could print their homework before class. They imagined kiosks distributed throughout a building; a walk-up space, participants said, was "not a space for studying" and did not belong in a computing lab.



Focus group participants imagined walk-up computers (like these at Matthew Boulton College) connected to a nearby printer and distributed throughout classroom buildings.

Others imagined combinations of informal chairs, low tables, and couches in open spaces or "a quiet corner" near classrooms (they liked the variety of furniture shown in the sidebar image); they did not want stools. While a few students wanted outlets in these spaces ("at least one for every table"), many others said that they would not pull out their laptops with only 20 minutes before a class unless it was necessary.



Students would like better access to electrical outlets for charging laptops.

Eliminating Obstacles to Laptop Use

Laptops figure prominently in the scenarios described above as essential tools for completing school work. However, data from our online survey indicate that ***students encounter several obstacles to using a laptop on campus.*** While 93% of survey participants reported owning a laptop or netbook, only 35% reported bringing their laptop to campus "most of the time" or "almost always." One item on the survey asked participants what obstacles exist to using their laptop or netbook on campus (excluding dorms). Participants were given a list of potential reasons and asked to rate their severity using the following scale: not an obstacle (1), minor obstacle (2), and major obstacle (3) (see Appendix, Figure 11). The top three obstacles for all participants were the weight of the laptop/netbook (mean of 2.11); concern about damage or theft (2.10); and insufficient access to electrical outlets for charging (1.96). Although both graduate and undergraduates rated these obstacles as their top three, a comparison revealed that undergraduates rated each of these obstacles as more severe than did graduate students. For example, undergraduates were more concerned about damage or theft (2.13) than were graduate students (2.04, $p=0.001$). This may be because many graduate students have offices in which to work and securely store their belongings. For students, particularly undergraduates, who are already carrying books and have few options for storing a backpack, the weight of a laptop and security concerns may be prohibitive.

In the write-in comments about laptop use, students mentioned the top obstacles highlighted above—insufficient access to outlets, weight of laptops, and concern about damage or theft—but they also frequently complained of inconsistent wireless access on campus and highlighted the need for access to printing services from a laptop. Below is a representative selection of students' comments.

> "We really need more electrical outlets or more computers in the school. There are never any computers available in the library."

"I prefer not to have to bring my laptop to campus because it is heavy to carry and easy to lose or break."

"It would be nice to have secure storage somewhere."

"I'm a grad student with an office and desk, so I rarely use any other campus space for computer work. When I'm not in my office, I'm using my computer in a conference room in my building or at the library."

"It is a pain you cannot print to Dawg Prints from laptops."

The weight of laptops and lack of secure storage options are obstacles to using laptops on campus.

In transitioning to a new computing support model that expands support for students' use of laptops and netbooks, it is important to maintain student access to expensive software, such as Adobe Creative Suite, SPSS, and MATLAB, that few students can afford to purchase. LST's Online Software Access (OSA) is a new service, currently being tested, that will allow students to access commercial software over the Internet from the computer and location of their choice free of charge. We asked participants in our survey how likely they were to use this service on the following scale: not likely (1), somewhat likely (2), and very likely (3). Students responded positively to this item (mean of 2.31), and several wrote comments about their need for such a service.

"That sounds great!! I am still using Office 2000 because the new version is too expensive. But I have trouble opening .docx files and it is becoming increasingly difficult to send and receive files and turn in assignments."

"This is one of the best things I've ever heard […] please make it be so!"

"I would also like to see this applied to the large and expensive products like SPSS and GIS. I don't always want to come all the way to campus to run data."

Participants also thought it was important that they have the ability to access software from any computer, at any time, and from any location; these conveniences will be offered by this service. OSA and other similar services, along with new spaces that match students' work needs, are important components to consider when developing new strategies for student computing.

RECOMMENDATIONS

The recommendations that follow will help LST meet students' current and future needs, and should also prove useful to other units on campus as they strive to make effective and efficient use of a variety of campus spaces.

- ***Continue to provide general-access workstations and access to high-end software.*** Comfortable spaces, general-access workstations, and evening access continue to be highly-desired components of student computing services. In addition, it is important to provide access to high-end software that not all students are able to afford on their own.

- ***Minimize obstacles to laptop use.*** Provide more electrical outlets in a wide variety of study spaces (near chairs, couches, café tables, group study tables, and individual desks). To address security concerns, consider offering secure storage and/or secure charging stations for laptops, netbooks, and mobile devices in multiple campus locations. As more students bring laptops and other devices to campus, it will also be important to consider enhancements to the campus wireless and Ethernet infrastructure.

- ***Provide dedicated spaces for quiet, individual study.*** Individual work spaces should include adequate desktop space for students to coordinate study materials including books, notebooks, papers, and a laptop and/or desktop computer. In some cases, students will need to work with all of these materials; in others, they will use a subset. Spaces for individual study should be located in central campus locations with evening hours.

- ***Establish or enhance spaces for collaborative work and study.*** Collaborative spaces should be fully or partially enclosed and should include plasma screens or projectors, connectors and outlets for laptops, and whiteboards. Ideally, such spaces would also be furnished with chairs and tables that can be easily moved to allow for different configurations while providing adequate surface space for six individuals and their study materials. Collaborative spaces should be located in well-known buildings and have nearby access to food and beverage services.

- ***Design mixed-use spaces thoughtfully.*** When designing spaces that support multiple activities, it is important to reinforce intended space use through environmental cues such as having a doorway entrance to a quiet area or designating different floors for different

activities. Students should be able to quickly assess which types of activities are encouraged in what areas.

- ***Increase access to printing***. Take steps to provide more access to printing services from a variety of campus locations. In particular, consider locating printing services in building foyers, outside of large lecture halls, and in other similar areas where students congregate before class. At the same time, encourage electronic document exchange in place of printing.

- ***Consider aesthetics and comfort***. Student spaces should be "attractive and colorful" and utilize natural light wherever possible; natural light should be supplemented with adequate or adjustable light appropriate to work areas. Spaces should also be equipped with furniture that is comfortable for long periods of work. In particular, invest in chairs and tables that are height adjustable. Also, consider making cleaning supplies available to students in more study spaces (they are currently in OUGL Learning Commons and MGH CRC).

- ***Continue to involve students in the design of spaces.*** The research we share in this report is an important first step for identifying student needs, but it should not be the only point at which students are involved in the design of new spaces. It is important to continue to seek input from students at all stages of the design process. In addition, new and existing student spaces should be frequently evaluated to ensure that they continue to meet students' evolving needs.

CONCLUSION

Several projects are currently underway that respond to many of the needs identified in this report. With the closure of the MGH CRC, the UW plans to make infrastructure enhancements to several central campus spaces to better support students' use of laptops and netbooks—including the addition of electrical outlets and improvements to wireless and Ethernet access. In addition, LST's new Online Software Access (scheduled to launch in autumn 2010) will allow students to "step outside" the computing center and access the software they need in the space of their choice. LST is also expanding the software available on Access+ workstations; beginning in autumn 2010 these workstations will offer the full range of software available on workstations in OUGL Learning Commons. The Research

Commons in Allen Library will also provide new spaces for students to engage in individual and collaborative activities.

The usefulness of this report, however, is not limited to major space renovations. The findings and recommendations from our survey and design sessions are specific enough that academic departments and centers across campus can use them to begin imagining a variety of effective learning spaces for students that make efficient use of resources. Whether a space is an open hallway, an unused office, or a departmental computing center, there are many simple changes, such as providing comfortable furniture, good lighting, a colorful environment, access to electrical power and wireless, and sufficient table or desk space, that can greatly enhance a student's computing and studying experience.

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Carleson, Scott. (July 28, 2009) In the U. of Rochester's Library, Students Ceaselessly Redesign Their Study Space. The Chronicle of Higher Education.

Cattier, Alan R. (2006) In Learning Spaces, edited by Diana G. Oblinger, Educause: www.educause.edu/learningspaces

Shaefer, Beth. (February 3, 2010) What Happened to the Computer Lab? Educause Live! Web Seminar, http://net.educause.edu/live103.

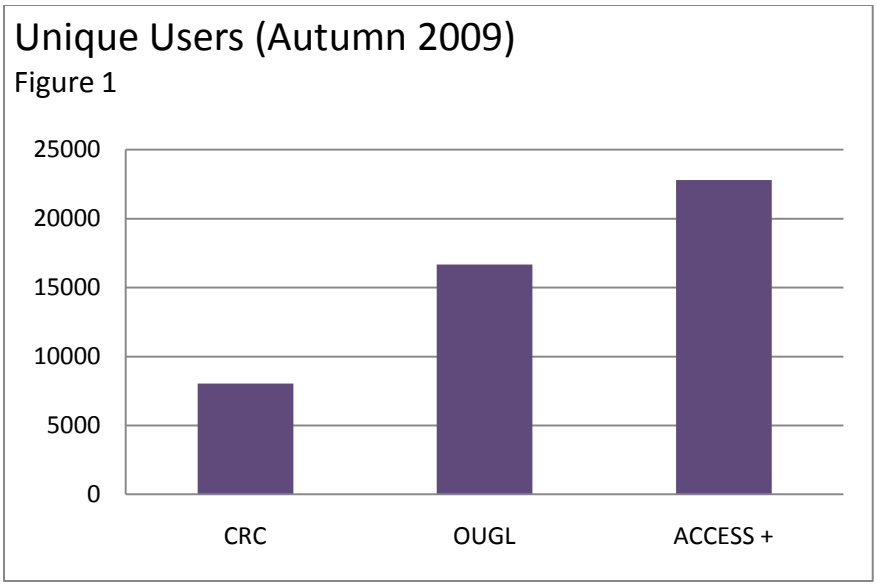
Images from other institutions used in design sessions:

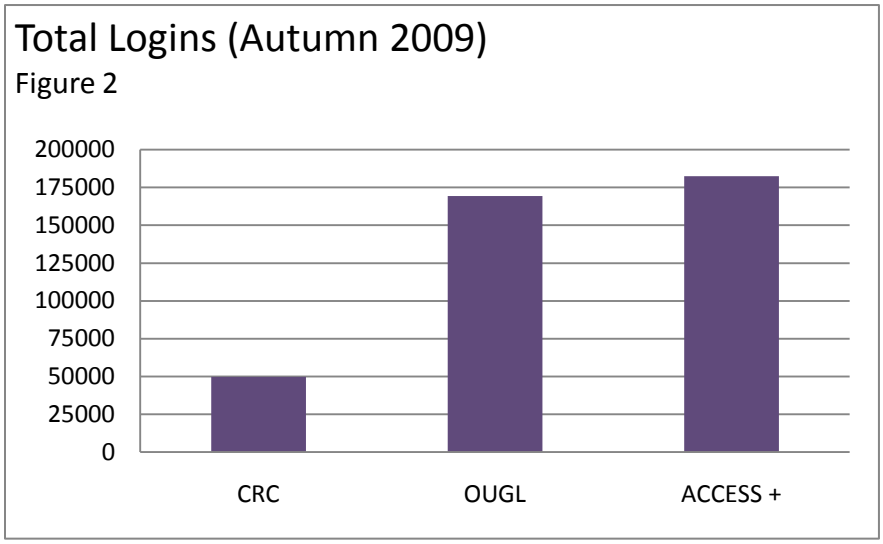
Inflatable Pod Glasgow Caledonian University,
http://www.flickr.com/photos/jiscinfonet/146800599/in/set-72057594135346630

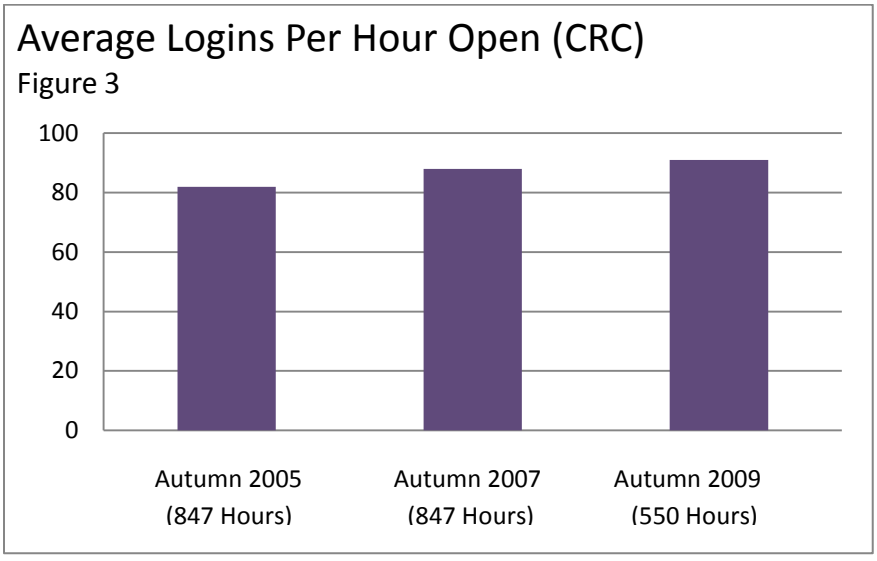
Group Study Incubator Space Emory University,
http://www.flickr.com/photos/jiscinfonet/464981876/in/set-72157600049238567/

Corridor PC Matthew Boulton College,
http://www.flickr.com/photos/jiscinfonet/161653580/in/set-72157594157469000/

APPENDIX

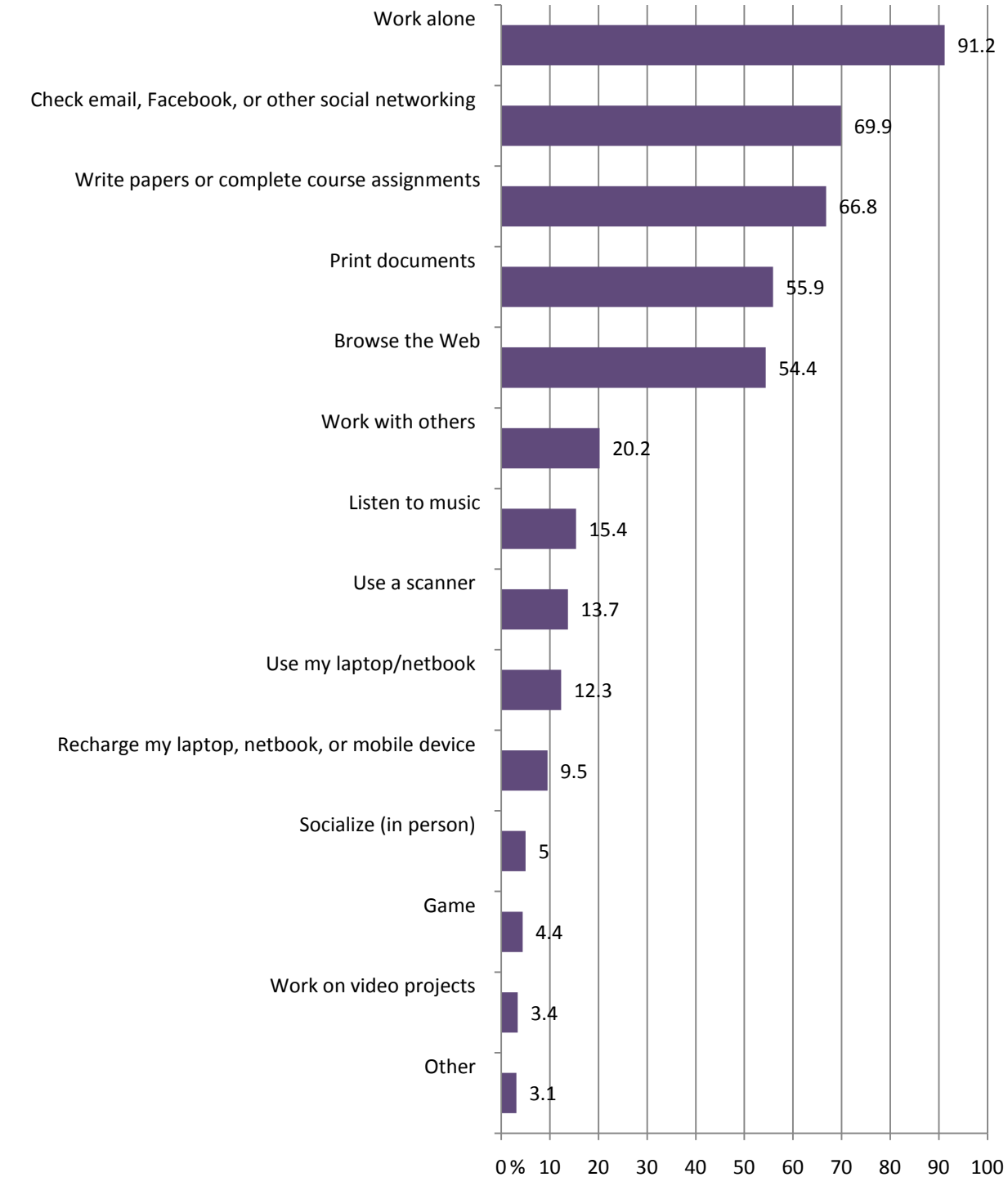

Unique Users (Autumn 2009)
Figure 1
25000
20000
15000
10000
5000
0
CRC
OUGL
ACCESS +


Total Logins (Autumn 2009)
Figure 2
200000
175000
150000
125000
100000
75000
50000
25000
0
CRC
OUGL
ACCESS +


Average Logins Per Hour Open (CRC)
Figure 3
100
80
60
40
20
0
Autumn 2005
(847 Hours)
Autumn 2007
(847 Hours)
Autumn 2009
(550 Hours)

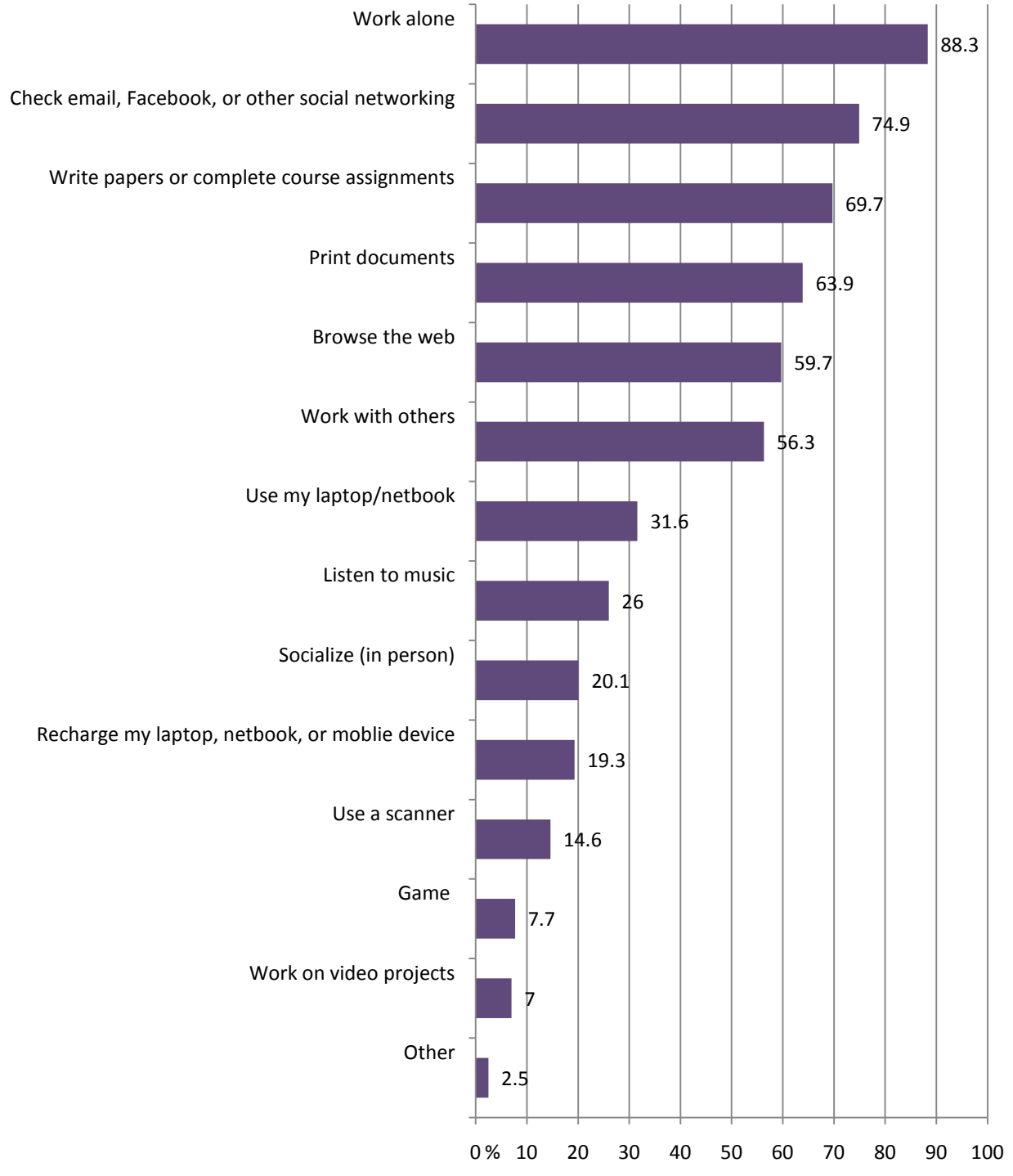
What do you typically do in the MGH Computing Resource Center? (N = 1023)

Figure 4



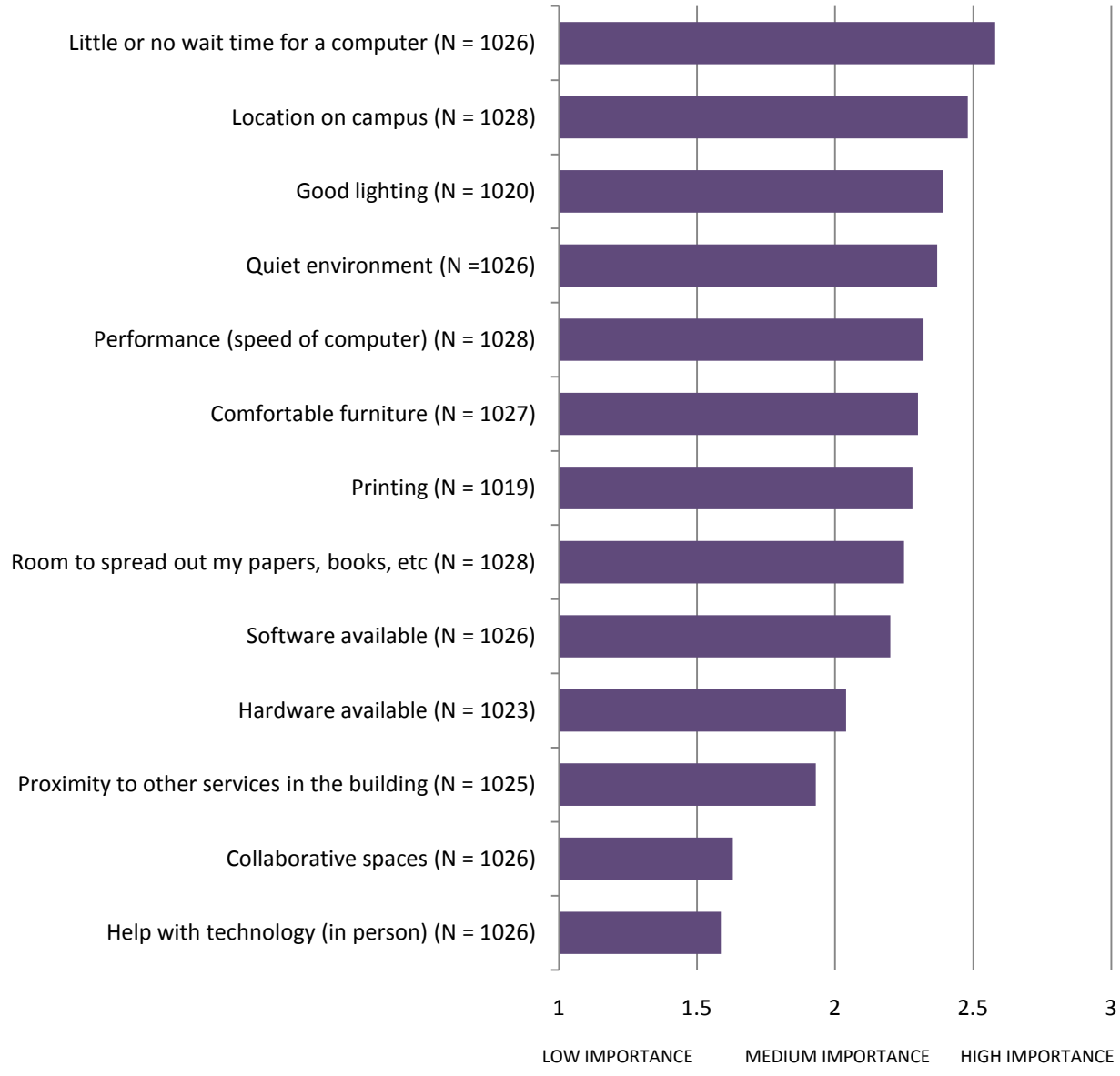
What do you typically do in the OUGL Learning Commons? (N = 1464)

Figure 5



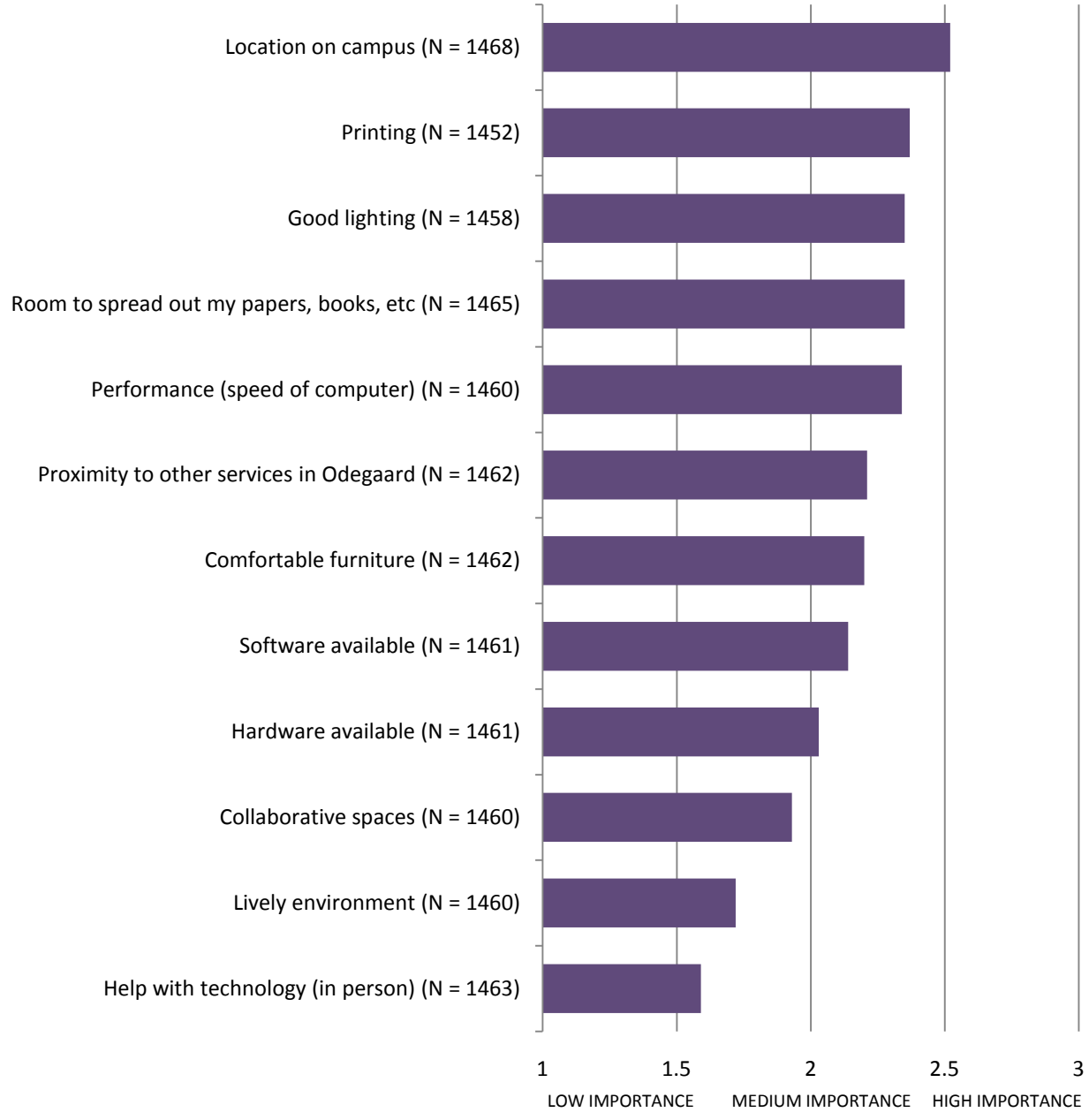
How important are the following in your decision to use the MGH Computing Resource Center?

Figure 6

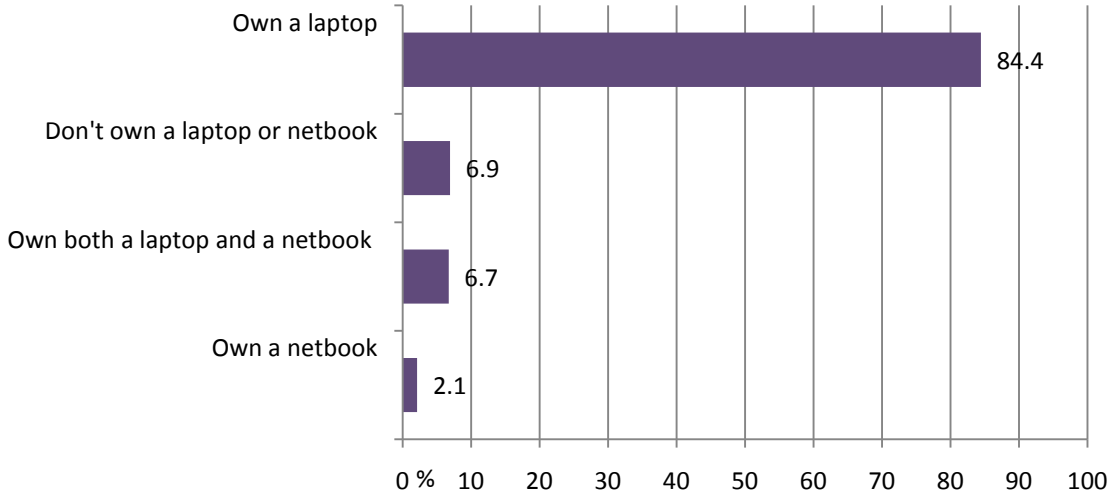


How important are the following in your decision to use the OUGL Learning Commons?

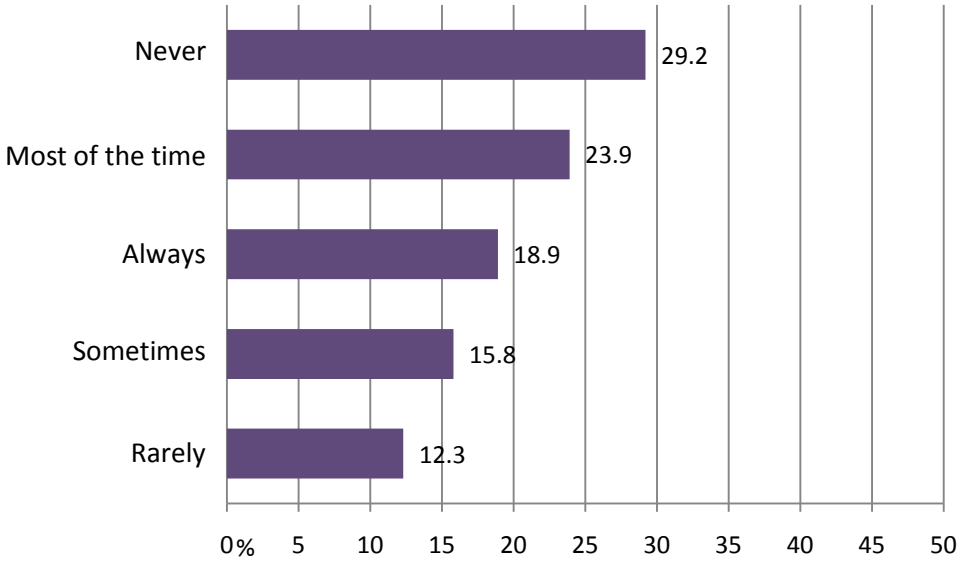
Figure 7



Do you own a laptop or a netbook (an inexpensive, lightweight laptop with a 10" or smaller screen)?
(N = 3157)
Figure 8

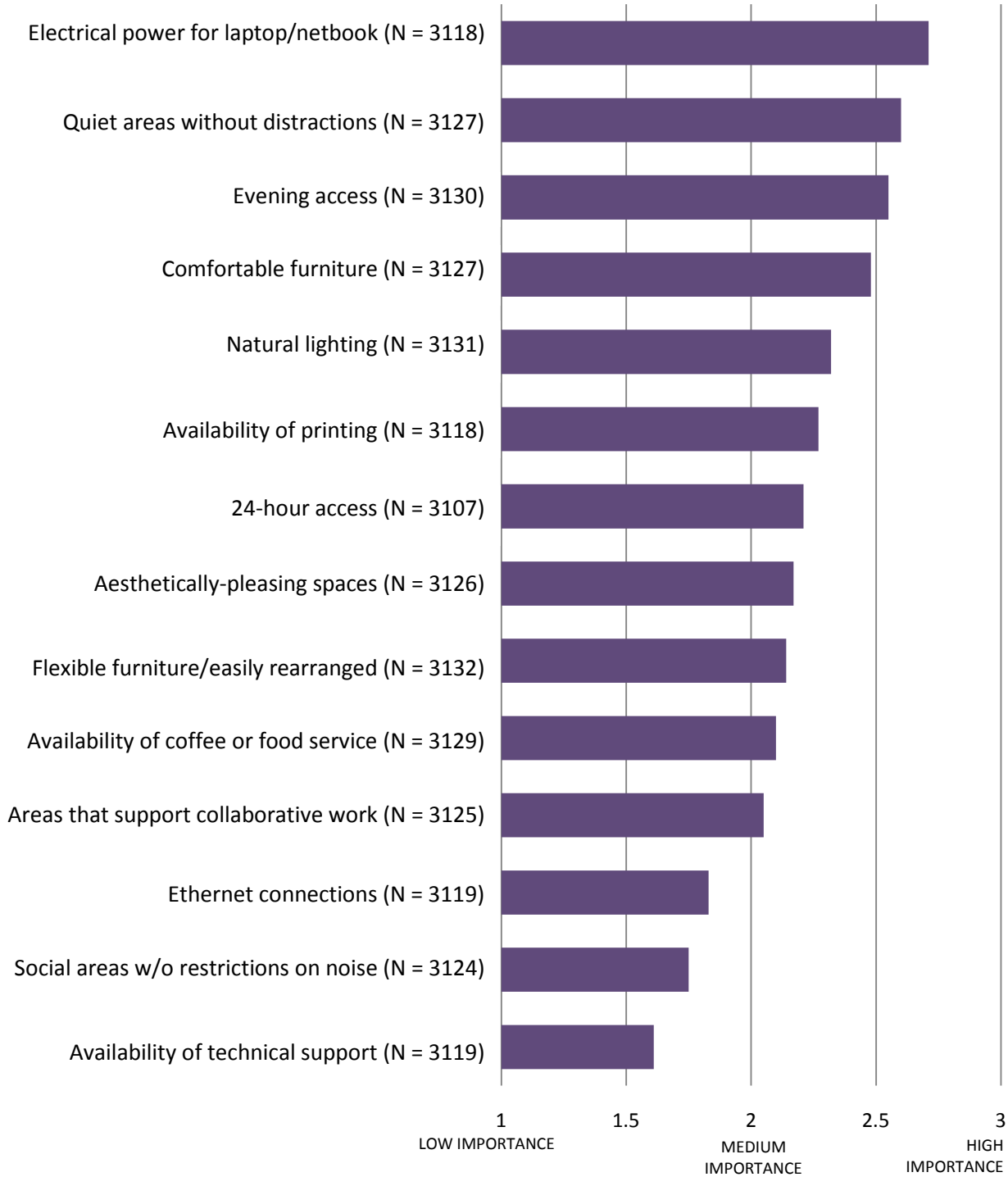


How often do you bring a laptop or netbook with you to the UW campus (excluding dorms)? (N = 2936)
Figure 9



How important are the following to you in public spaces on campus?

Figure 10



What obstacles exist to using your laptop or netbook on campus (excluding the dorms)?

Figure 11