Quantitative Literacy Report: 2020/21

Data Collection and Analysis: Action year

Contents

Section 1: Previous Results and Plan of Action

In the 2019/2020 academic year, the Quantitative Literacy (QL) committee met to consider the results of the previous QL assessment cycle. Evaluation and Reflection cycles were taken within the 2017/18 and 2018/19 academic years for QL, and previous results indicated that a generic assessment methodology beyond the foundational level appears to be ineffective as different departments have very different standards for what they consider "proficiency" within quantitative literacy. In effect, departmental and programmatic standards very so widely, that a single artifact or instrument was deemed insufficient for measuring student outcomes at the institutional level.

In effect, this means that our review in this cycle needs to address a combination of viewpoints including foundational proficiency, departmental expectations, and student perspectives. During the 2019/20 "design" stage, a three-pronged approach to addressing QL assessment was devised. First, faculty of many different departments were to be surveyed as an indirect measure of student proficiency within departmental expectations. In this way, we can get an overview of where departments think their students are (with reference to expectations) within the foundational, practicing, and capstone levels of proficiency. Second, a student survey was designed as a direct measure of student knowledge with regards to financial literacy and access to resources on the campus. This allows the QL assessment to serve both as an assessment, resource, and perhaps even an instigator for students to learn about their own financial situation. Finally, we formulated a plan for direct measurement within the foundational QL coursework (Math 361 and Math 243) which most of the students on campus will take at some point.

Section 2: Sampling Design

Indirect Measure 1: Faculty Perceptions of Student Proficiency

A survey was designed for individual departments/programs to respond to regarding how faculty perceive the strengths and weaknesses of their specific major students within the area of Quantitative Literacy. Questions were designed to break down the major characteristics of QL at each of the foundation, practicing, and capstone levels and investigate faculty opinions on the strength of their students relative to the expectations of their specific programs. Furthermore, rather than drawing results from individual faculty, departments were encouraged to have a departmental discussion to rate their "average" student and discuss strengths and weaknesses within their own programs. Ratings were given on a scale of 1-10 where both ends of the scale were supposed to be considered "unreachable" so that data would not be truncated on this scale. This survey was sent to all departments on campus to be reviewed and responded to during the 2020/21 academic year.

Direct Measure 1: Student Survey on Financial Literacy

While not being the traditional, classroom view of quantitative literacy, the QL committee viewed student knowledge of financial literacy as a being a foundational skill that all students should exhibit and would be an excellent place to directly measure student knowledge and perception. A survey was designed for individual students to respond to regarding their knowledge of their own financial situation including student loans, expected loan payments, and resources that are available to them with regards to financial planning and literacy. This survey was provided to all students within the institution and student advisors were asked to have their students fill out this survey to facilitate a discussion on financial viability and planning for each of their students.

Direct Measure 2: Student Performance in Foundation Level Course Artifacts

For this measure, faculty within the Mathematics Department were asked to include a number of specific topics within the QL rubric on exams. These questions were to specifically address each of the five key areas of QL from the rubric (Communicate, Interpret, Apply in Context, Calculate, and Construct) but did not have to be the same questions on every faculty member's exams in order to make it easier on the faculty to implement the assessment within each of their courses. Faculty were also encouraged to correlate the scores on the exams with student grades as an indirect measure of the results.

Section 3: Summary of Results

Indirect Measure 1: Faculty Perceptions of Student Proficiency

A total of fifteen reports were filled from eleven separate departments representing the specific competencies regarding the domains of quantitative literacy according to the rubric developed in 2017 (https://www.oit.edu/sites/default/files/document/2016-17-eslo-5-quantitative-literacy-rubric.pdf)

Scores were provided on a scale of 1 to 10 and averaged by department for domains where multiple questions were asked to tease out different aspects of the domain. A summary of the scores follows, and a description of the scoring interpretations is provided in section 4.

Average Responses by Domain and Level

Domain\Level	Lower Division	Upper Division	Graduates
Calculation	6.847	7.452	8.538
Interpretation	6.230	7.565	8.487
Constructing Representations	6.646	7.541	8.250
Application in Context	6.775	7.286	8.342
Communication	5.506	7.482	8.513

The general result of this analysis is that, while on average, departments feel their students meet to exceed field specific proficiency within all domains by the time they graduate, Oregon Tech students are weak in specific competencies in general at the foundational level. In addition, specific departments have very specific concerns about specific domains. Discussions about these concerns should take place at the departmental level and between departments as appropriate (described in section 4). In addition, an institution wide conversation on communication (and in some respects interpretation as it applies to the identification of quality quantitative evidence) needs to take place regarding foundation level skill sets. These discussions, and any initiatives enacted, could help to set a stronger foundation and better success and retention of students down the road in their programs.

Direct Measure 1: Student Financial Literacy Survey

A total of 313 students reported to this survey with demographics that are fairly representative of the university as a whole. A wide variety of majors were represented with a near even spread of Freshmen through Seniors and a significant portion of students who claim dependents on their taxes. The data was explored to discover patterns (and deviations from patterns) associated with specific characteristics such as year in school, whether or not they claim dependents, and whether or not they have attended financial aid or financial literacy seminars. Measures of knowledge of their financial conditions including use and adherence to a budget, unmet need, loan types, and the post-graduation burden of loans were taken and assessed for correlations with the stratifying characteristics mentioned.

While reportedly attending workshops or events focused on financial aid and financial literacy does not appear to be correlated with those questions measured in this survey, it does appear that students

become more aware of their financial situation, with regards to loan repayments and types of loans, by the time they get to their senior year. Other specific characteristics as measured do not appear to have a correlation with the responses to the knowledge questions. Student intuition on the burden of debt after school seems to be on track for the "average" student; however, some students are tending to underestimate the true burden of this debt's post graduation effects.

Direct Measure 2: Direct Assessment of QL within Gen-Ed coursework

This measure required multiple faculty to include specific questions on their exams within the class that cover the five primary domains within the grading rubric for quantitative literacy. The intent of this measure was to provide a sense of the proportion of students who meet foundational level proficiency standards within quantitative literacy as assessed directly with exam questions.

Sadly, the data was not "normed" well in terms of scoring or difficulty of questions, and thus, no significant insights could be found. A follow up study will be done next year in an attempt to solve these issues and collect meaningful data.

Section 4: Faculty Survey – Perspectives on Student Proficiency

Fifteen reports were submitted representing twelve separate departments. Faculty were asked to assess students on five domains of quantitative literacy at three different levels: lower division students, upper division students, and graduates. In some areas, multiple questions were asked to get a more rounded view of faculty perception of student ability. For those domains with multiple questions, the results were calculated using the average scores of these questions by department for reporting purposes. In the following analysis, we will also highlight departments that report exceptionally high or low on their perceptions of student ability in specific domains in order to determine perceived strengths and weaknesses. Particular attention will be put on the qualitative commentary as well.

Faculty were given the following scale to describe their answers:

1 – No competence at all on the topic
3 – Minimally competent, but insufficient to function well in professional, civic, or personal lives
5 – Sufficient to function in professional, civic, or personal lives, but at a bare minimum level
7 – Reasonably competent beyond the bare minimum for the departmental expectations, but not exceptional.
9 – Highly competent at this skill, and well beyond the department expectations for a student at this level in their field.
10 – Excellent competence. The students excel far beyond similar students of any other institution you could think of comparing to for an equivalent program.

Average Responses by Domain and Level

Domain\Level	Lower Division	Upper Division	Graduates
Calculation	6.847	7.452	8.538
Interpretation	6.230	7.565	8.487
Constructing Representations	6.646	7.541	8.250
Application in Context	6.775	7.286	8.342
Communication	5.506	7.482	8.513

In general, from these results, we can see a general upward trend in all areas in the average response from the departments. The averages for these departments start in the 5-7 range of bare minimum functionality within the society to bare minimum for departmental expectations for lower division students. Students at the upper division level seem to be rated as meeting departmental expectations for quantitative literacy in all areas on average. Finally departments seem to perceive the graduates of their departments as meeting and slightly exceeding departmental expectations for their graduates. This average view is promising to the QL committee. A more in depth look at each of the domains of QL will be considered next.

Calculation

Performance Criteria	Foundational (instructions given in detail)	Practicing (general instructions given)	Capstone (little to no instruction)
Calculate	Perform fair short single computations with tools provided.	Perform longer and more complicated computations, or solve problems involving sequences of linked computations selecting from a list of possible tools.	Perform challenging computations and sequences of computations, knowing the tools needed.

Descriptive Statistics

	N	Missing	Mean	Median	Minimum	Maximum
LD Calculation	15	0	6.847	7.000	2.667	9.333
UD Calculation	14	1	7.452	7.667	5.667	9.667
GR Calculation	13	2	8.538	9.000	6.000	10.000

The distribution of faculty perception of student abilities within calculation tasks for quantitative literacy for lower division students has a wide spread with the lowest averaged score by department being 2.66 and 9.33 being the highest score. Recall that 2.66 may be interpreted as minimal competence which is insufficient to function in their personal, professional, or civic lives. This score comes from the Medical Imaging Technology department and indicates a significantly lower assessment of incoming student abilities in calculation than other departments with regards to their expectations of lower division students. This pattern of scores will follow in all future domains as well with the department leaving the comment that students demonstrate an "inability to apply previous knowledge."

The highest score (9.33) comes from the Portland CSET faculty, indicating that they assess their lower division student's ability to complete computations as highly exceptional. This may reflect a difference in the typical student between campuses, and seems promising for the success of these students. For the most part, the scores reflect values between 6 and 8, indicating that students meet the expectations for lower division students within their programs.

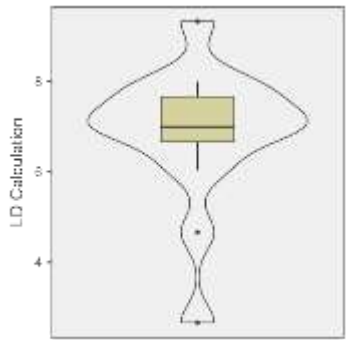
With regards to upper division standards, faculty in almost all areas rate students with abilities between 6 (minimum competence for the department expectations) and 9 (well beyond expectations) in the area of calculation. The high score this time comes from Environmental Sciences with a rating of 9.66, indicating that by upper division, these faculty view their students as top tier within comparative programs. There are no particular low scores to take note of here.

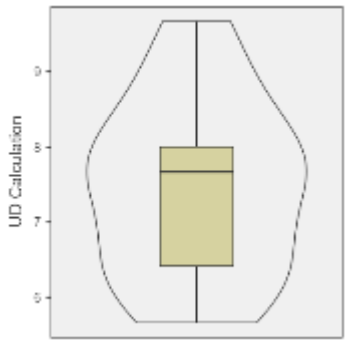
Finally, with regards to rating our graduates, departments scored programs quite highly indeed. The minimum score in this regard was from Communication Studies with a score of 6 (around minimum competence for department expectations) with a number of departments rating their graduates as a 10

(above the graduates of any comparable program). While these scores may seem inflated, at the very least, we can say that the average graduate seems to be rated as highly competent for their fields within the domain of calculation. Of note, even the Medical Imaging department, who initially scored their lower division students quite low, rated their graduates as a 9 (beyond department expectations) for these graduates. Support for this view could be indicated by the high pass rates licensing exams that they have recorded for many years.

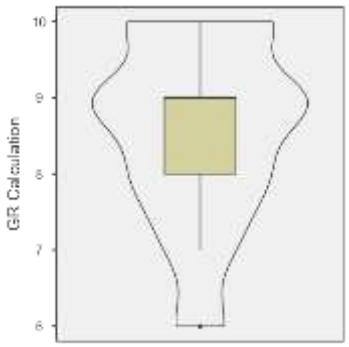
With regards to commentary left by departments, the lower division comments that impact calculation focused on the inability of students to apply previous knowledge and not being able to work independently. It is recognized in several comments that there is a wide variety of ability within the lower division students, so it was particularly hard to represent these students as an average. At least one department noted that their students could memorize and calculate well, but have particular problems in other areas of QL.

LD Calculation





GR Calculation

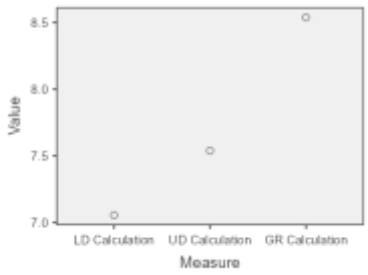


UD Calculation

Friedman's Repeated Measures ANOVA

χ^2	df	p
7.36585	2	0.02515

Descriptive Plot


8.5
8.0
7.5
7.0
Value
LD Calculation
UD Calculation
GR Calculation
Measure

Interpretation

Performance Criteria	Foundational (instructions given in detail)	Practicing (general instructions given)	Capstone (little to no instruction)
Interpret	When prompted, identify specific parts of equations or expressions, interpret specific data points on graphs, interpret results of computations literally.	In response to broad instructor prompting, interpret equations or expressions in a general sense, interpret overall patterns and trends in graphical information. When appropriate, interpret differences in computational results.	Give holistic interpretations of methods, tools used, and results, with little to no instructor prompting or guidance.

Descriptive Statistics

	N	Missing	Mean	Median	Minimum	Maximum
LD Interpretation	15	0	6.231	6.458	1.000	8.000
UD Interpretation	14	1	7.565	7.667	5.333	10.000
GR Interpretation	13	2	8.487	9.000	6.000	10.000

The distribution of faculty perception of student abilities within interpretation tasks for quantitative literacy for lower division students has both a significant spread, and some disconcerting data. While the mean value of 6.23 indicates meeting departmental expectations on average, this also indicates substantial concern by some departments with regards to incoming and lower division students. These departments including medical imaging (who indicate with a score of 1 that their students have no competence whatsoever) and the CSET programs on the Klamath Falls campus who score in the 4-5 range indicate that at best, the students can barely handle interpreting quantitative information for everyday life, let alone their profession. There is at least one comment to the effect that students not being able to identify bias in information as a particular concern. A discussion should be held with these departments in order to brainstorm solutions that can help these students be more prepared for upper division coursework. All other departments reported sufficient (though not exemplary) perceptions of student ability within the interpretation area.

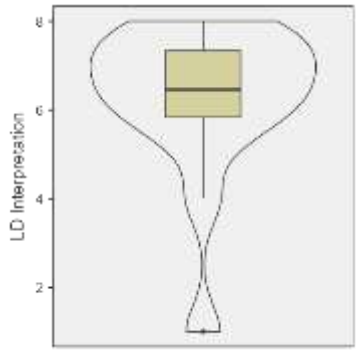
The assessment of perceptions of upper division students is slightly better with all but one program (CSET again) reporting that their students tend to meet or exceed the expectations within the department for upper division students (scores of 6-10 on average). CSET again rates their students as a 5.33 on average; however, no more commentary is available to draw inference regarding the reason for this score. There is no comparative data from these CSET programs in the information about graduates to indicate if the problems are solved by graduation. A follow-up with this department seems in order from these scores regarding how to provide support for students within their Klamath Falls programs.

The assessment of graduates in terms of interpretation seems promising with the lowest department rating being a 6 (meeting departmental expectations) and all others being a 7 or higher (exceeding department expectations on average.) With the Communication Studies department tending to score their students slightly lower on all areas, if desired, a discussion may occur regarding support to help

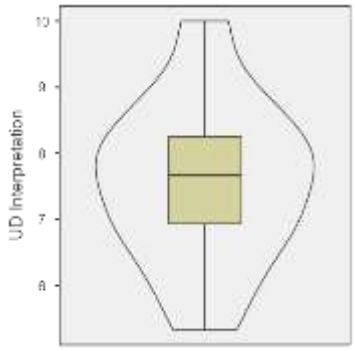
enhance the ability of their graduates in quantitative literacy (in particular, the next section regarding constructing representations of quantitative information.)

Comments surrounding the interpretation of quantitative information tend to simply list this as an area of weakness for some fields. Specifically, faculty are discouraged by the amount of prompting required to get insightful responses, and the difficulty of transferring knowledge from general education mathematics courses into program specific applications. Furthermore, as noted above, the identification of bias within source material seems to be a problem. One program also noted that former graduates may contact faculty with regards to "really understanding the significance of what they found with…" an instrument they created. This indicates an increased focus on interpretation on quantitative information could aid graduates in being functional professionals within their fields.

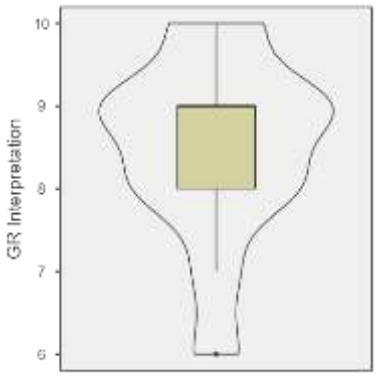
LD Interpretation



UD Interpretation



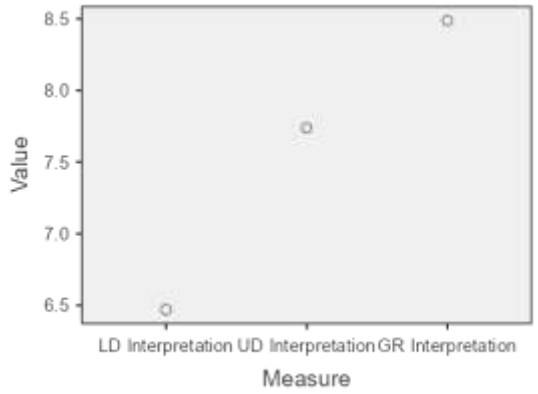
GR Interpretation



Friedman's Repeated Measures ANOVA

χ^2	df	p
13.348	2	0.00126

Descriptive Plot



Constructing Representations

Performance Criteria	Foundational (instructions given in detail)	Practicing (general instructions given)	Capstone (little to no instruction)
Construct Representations	Construct graphical models of statistical information in response to specific instructor prompting.	Construct analytical (equation) or graphical models of mathematical relationships in response to broad instructor prompting.	Construct appropriate, complex, and clearly labeled analytical and/or graphical models with little to no instructor prompting or guidance.

Descriptive Statistics

	N	Missing	Mean	Median	Minimum	Maximum
LD Constructing Representations	15	0	6.050	6.000	1.000	9.000
UD Constructing Representations	13	2	7.346	8.000	5.000	10.000
GR Construct Representations	13	2	8.385	9.000	5.000	10.000

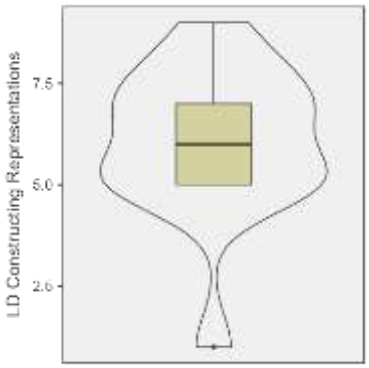
With one department (Medical Imaging Technology) rating Lower Division students as having a complete lack of competency (rating of 1) with regards to constructing representations of quantitative information, many other departments were also not particularly confident in their students' abilities in this area. Six of the remaining departments scored students as being "barely sufficient" in terms of competency for constructing representations. In this case, it was noted that "choosing the appropriate graphical representation" of data may be difficult. Given the fact that lower division students are generally expected to be at the "Foundational" level, substantial prompting is a fine requirement; however, a curricular alignment issue may be at fault for a poor showing on this topic. The "Foundational" requirement talks about constructing graphical models of "statistical information." For many students, this is not addressed until Math 361 during their junior year, and for Medical Imaging Technology, it is not addressed in any general education courses that are typically focused on quantitative literacy in the lower division.

This being said, we would hope that, for most fields, this weakness has been remedied by the time they are upper division students. On average, this is true based on faculty reports. All reporting fields scored 6 or above (meet's departmental expectations or higher) save for 3 programs: CSET (software engineering in Klamath Falls) whose students do not take a statistics course until senior year, Dental Hygiene whose students take a Math 243 course which is focused on consumption of statistical literature rather than production of statistical representations, and Natural Sciences. While the first two are explainable, the third is not. A discussion should take place with this department regarding aligning expectations with the general education statistics curriculum to meet these required outcomes.

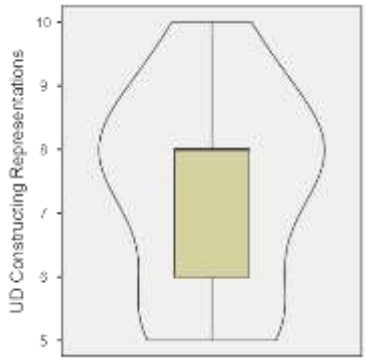
Fortunately, by the time students graduate, all fields save for Communication Studies report that their perception of the graduate's ability to construct representations of quantitative information exceeds the departmental expectations. As mentioned above, a discussion on improving this skill for communication studies majors should be considered.

Particular qualitative feedback regarding the construction of representations of quantitative information is focused on the lower division level regarding required a substantial amount of prompting and choosing the right (or meaningful) graphical representation for data.

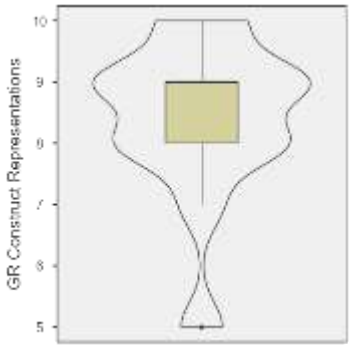
LD Constructing Representations



UD Constructing Representations



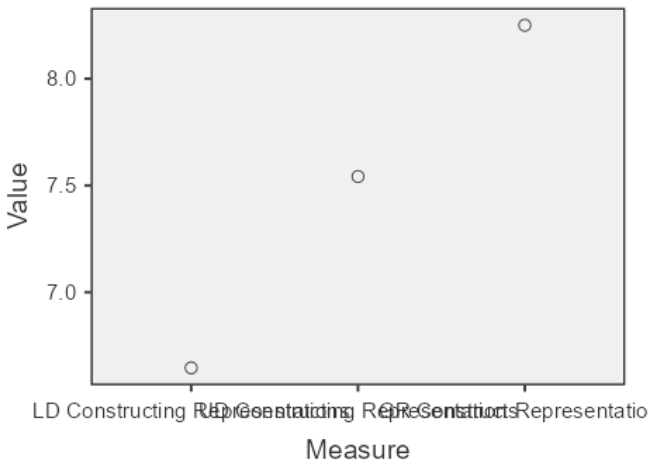
GR Construct Representations



Friedman's Repeated Measures ANOVA

χ^2	df	p
12.667	2	0.00178

Descriptive Plot



Applications in Context

Performance Criteria	Foundational (instructions given in detail)	Practicing (general instructions given)	Capstone (little to no instruction)
Apply in Context	Solve problems using given formulas or frameworks.	Choose correct formulas, set up correct equations (or systems of equations), and/or choose correct frameworks to solve problems in response to broad instructor prompting. Acknowledge assumptions used in solving problem(s).	Solve relevant complex, multifaceted problems, with little to no instructor prompting, or guidance. Acknowledge and justify assumptions used in solving problem(s).

Descriptive Statistics

	N	Missing	Mean	Median	Minimum	Maximum
LD Application in Context	15	0	6.775	7.000	3.000	9.000
UD Applications in Context	14	1	7.286	7.250	5.000	9.000
GR Applications in Context	13	2	8.342	8.667	6.667	10.000

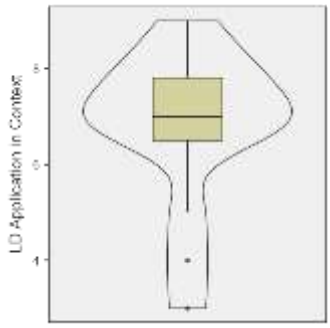
Application in context reported much stronger in most fields, but still has some points that need addressing. For CSET Embedded System, Communication Studies/Professional Writing, and Medical Imaging, the faculty perception of lower division student ability was low (5, 4, and 3 respectively indicating bare minimum proficiency or less). This may indicate either lower preparation by students on average for some departments, or perhaps unfamiliarity with the context of the subject matter. Either way, this indicates discussions should take place regarding how support departments can aid in preparation in foundational, field specific skills in QL. Since general education doesn't address all possible fields, the problem here may be that students demonstrate a disconnect between QL in general education coursework and recognizing these applications within field specific context.

This minimal proficiency seems to switch departments at the upper division (practicing) level where the Medical Lab Sciences and Natural Sciences departments rate proficiency below a six (5 and 5.5 on average for these departments.) No specific feedback is provided from either department regarding why these ratings are given or if this is a specific concern of the department.

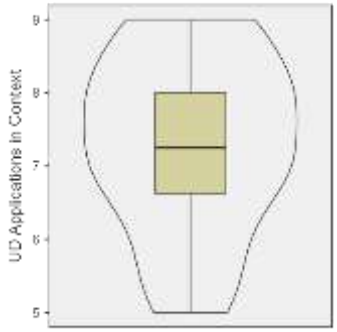
Both the averages and department specific values associated with application in context are at 6.66 to 10, indicating sufficient proficiency or exceeding field specific expectations for graduates in all fields. Interestingly, the department that scores students the lowest (meets expectations) here is the department of Applied Mathematics, so the bar for meeting expectations is substantially high in this program, and given that students are rated as exceeding expectations in all other areas provides an area that the department can focus on developing (and has been talking about developing regarding potential coursework in mathematical modeling as this is already a recognized "weakness" of the students.)

There is not a lot of specific, qualitative feedback regarding applications in context, so perhaps a discussion between specific departmental expectations at the foundational and developing levels should take place within some departments and with the general education providers regarding specific topics that need to be added or emphasized in pre-requisite coursework.

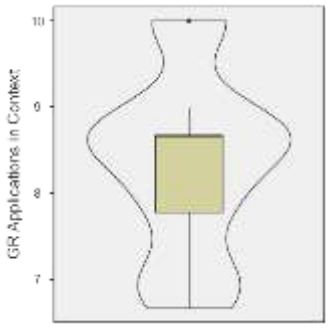
LD Application in Context



UD Applications in Context



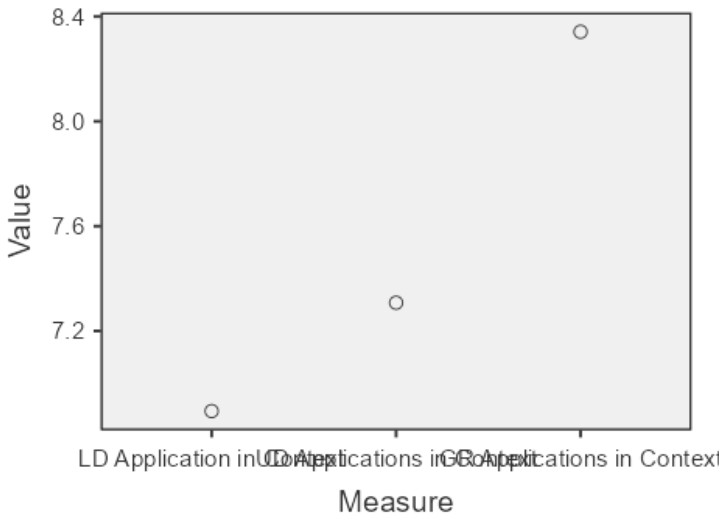
GR Applications in Context



Friedman Repeated Measures ANOVA

χ^2	df	p
6.542	2	0.03797

Descriptive Plot



Communication

Performance Criteria	Foundational (instructions given in detail)	Practicing (general instructions given)	Capstone (little to no instruction)
Communicate	Accurately integrate quantitative evidence into basic arguments in response to specific prompts. Quantitative evidence is conveyed and explained in such a way that a competent non-expert reader can follow along.	Accurately integrate quantitative evidence into an extended argument in response to a broad prompt. While instructor provides guidance, student uses quantitative evidence to identify, explain, and/or solve a problem. Quantitative evidence is conveyed and explained in such a way that a competent non-expert reader can follow along.	Accurately integrate quantitative evidence into complex arguments with little to no prompting or guidance. Quantitative evidence is conveyed and explained in such a way that a competent non-expert reader can follow along.

Descriptive Statistics

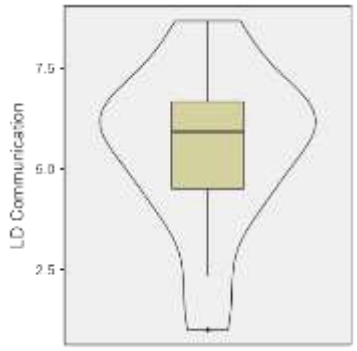
	N	Missing	Mean	Median	SD	Minimum	Maximum
LD Communication	15	0	5.506	5.917	2.041	1.000	8.667
UD Communications	14	1	7.482	7.667	1.429	4.000	10.000
GR Communication	13	2	8.513	8.333	0.909	7.000	10.000

Communication is, distinctively, the weakest faculty reported field for the foundational level students, and understandably so. Eight of the fifteen reporting departments rate their students as below departmental expectations for the field (a score of 6) with four of these stating that lower division students are not even proficient at the minimum level to function in society (a score of less than 5). We argue that this is understandable, as the communication of mathematical concepts, results, and logical quantitatively back arguments are not a focus of student education prior to the university level. Specific concerns are brought up by many departments regarding the inability of students to tell the difference between reputable and non-reputable sources, inability to synthesize the conclusions of others work correctly, and even understanding whether the findings are significant or meaningful.

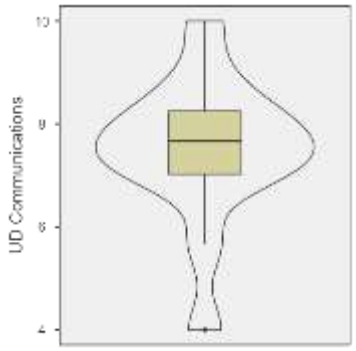
While in most departments, this seems to have been adequately addressed by the upper division (practicing) level, and certainly by graduation according to faculty assessment, the lack of this skill at the lower division is both worrisome and needs addressing.

Indeed, with the Journal Club championed by the natural sciences department, and restructuring of the focus of introductory statistics classes in focusing on students as "consumers" rather than "producers" of statistics, this work has begun; however, it seems that this would be the strongest place for an institution wide initiative for improvement in quantitative literacy for introductory level students.

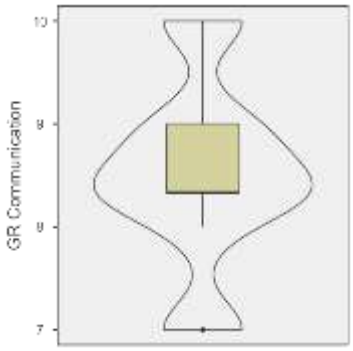
LD Communication



UD Communications



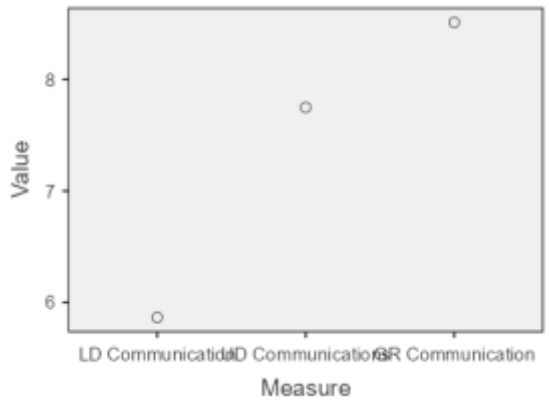
GR Communication



Friedman

χ^2	df	p
23.306	2	< .00001

Descriptive Plot



Pre-requisite knowledge

One more question was added to the end of the survey regarding the instruction and course content of non-departmental quantitative literacy courses. These courses involve subjects like mathematics, statistics, physics, etc… that are intended to introduce students to the concepts, techniques, and critical thinking skills required for success within the department's major courses. Specifically, the committee is interested in knowing whether sufficient foundations are provided within these courses to support student success within the programs. Most departments rated this preparation with scores between 8 and 10 with a few scores at 7. On department (Communication Studies) rated this as a 6 which indicates that it meets departmental expectations in terms of preparation.

Based on the results from this question, and others presented above, there does appear to be some disconnect between expectations and preparation for lower division students, so some curricular alignment discussions should take place. In terms of specific departments, CSET, Medical Imaging, and the Communication department should all have both internal and external discussions regarding how to improve student preparation in quantitative literacy. Most likely all departments should have a significant discussion on how to implement changes regarding the communication outcome of quantitative literacy, and how to emphasize the needed topics within this area.

Section 5: Student Survey – Financial Literacy

Three hundred thirteen students responded to the survey on financial literacy comprised of a reasonable cross-section of the student population by year level, college and department.

The breakdown by year level included 76 (24.3%) freshmen, 91 (29.1%) sophomore, 83 (26.5%) junior, 47 (15%) senior, and 16 (5.1%) beyond senior level. The breakdown by department may be viewed in the tables in the appendix; however, proportions are moderately in line with the institutional proportions. Furthermore, of the respondents, 81 (26%) indicate that they claim dependents on their tax forms adding to the diversity of the sample, and enabling a significant stratification for the analysis of the results.

The purpose of this questionnaire was to investigate student knowledge in terms of their personal circumstances for financial health currently and after college. As this data is not necessarily a well randomized sample, and is based on self report, the following insights may be biased, but every effort will be made to provide significant insight into our students reported financial knowledge, concerns, and differences between student strata. Furthermore, several outliers within the self-report data must be removed before analysis, as they are clearly improper (a respondent indicating they have a million dollars in student loans or are willing to take out up to 1 billion dollars for example).

In terms of some quick insights, 255 of the respondents (81.5%) report that their parents have not taken a “parent loan” on their behalf, while 46 (14.7%) report that they had. Not all students responded to this question. Of those 46 students who reported that their parent had taken out a parent loan, 69.6% (32) of them responded that they expect to pay back this loan while 8 responded that their parents would have the responsibility and the remaining 6 chose not to answer.

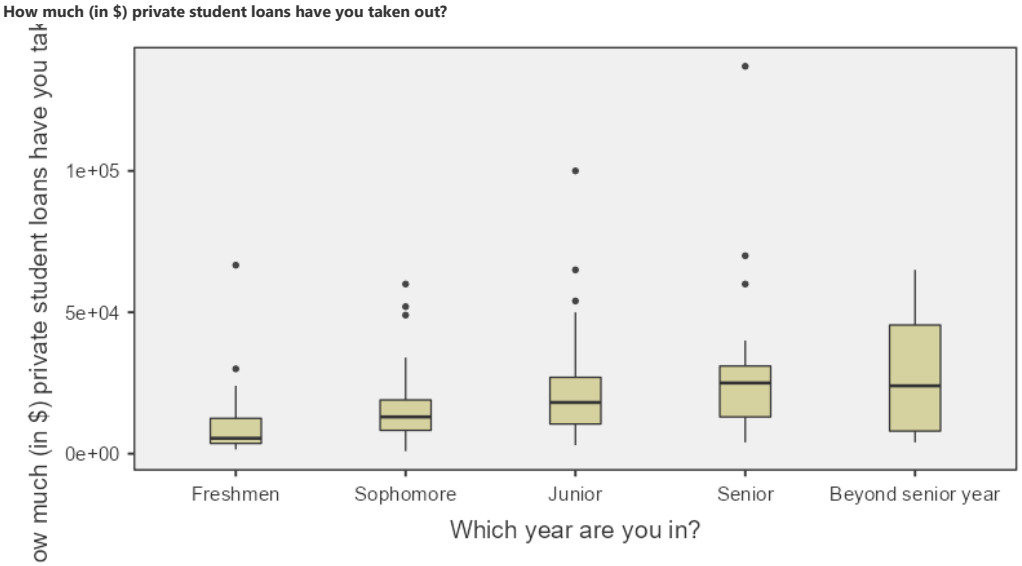
In the question on budget, 70.4% of the respondents (219) reported that they have a budget, but only 129 (59.2%) of those reports being able to live within this budget. In addition, 32.2% of all respondents (100) indicate that they have unmet financial need. The combination of these indicates that many of our students are likely taking on significant debt while studying at Oregon Tech.

In terms of knowledge of their financial wellness, 45.7% (142) indicate that they have attended financial literacy presentations. Oddly, when cross-tabulating this question with the question of what type of loan is better for the long-term financial outlook, there is no significant correlation (chi-square = 2.148, p= 0.34). This is similarly true for questions regarding having a budget (chi-square=2.244, p=0.134), knowing total loan debt (chi-square = 0.008, p=0.92), and knowing monthly payment (chi-square = 0.175, p=0.676). So, while these presentations are available, there does not seem to be a correlation with knowledge on these particular topics.

Continuing on the exploration of correlations, there does not appear to be a relationship between year in school and parents taking out student loans (p = 0.209), having a monthly budget (p=0.667), having attended presentations on financial aid or literacy (p = 0.66382), or having unmet financial need (p = 0.527).

Where patterns can be noted is in the year in school when compared to knowing the current amount of their loans ($p < 0.1$), knowing their monthly payment ($p<0.001$), and knowing what kind of loan is better for long term financial outlook ($p < 0.1$). While there is a reasonable chance that the first and last of these are a statistical artifact, the proportion of students who respond positively (or correctly) to these questions is of practical significance as well. Knowledge that subsidized loans are better for long term finances is reported at 57 to 60% among students at the senior level or beyond, whereas juniors and below only answered this question correctly 38-48% of the time. Similarly, less than 80% of students that were junior and below reported knowing their current student loan debt whereas 87% (and 100% for those beyond senior) of seniors reported knowing their current loan debt. Finally, over 61-75% of seniors and beyond report knowing what their monthly payments will be whereas, only between 36 to 45% of juniors and below report knowing the answer to this question.

After the removal of outliers, when considering those only those students who have actually taken student loans, we can quickly stratify to look at the reported loan burden of our students.

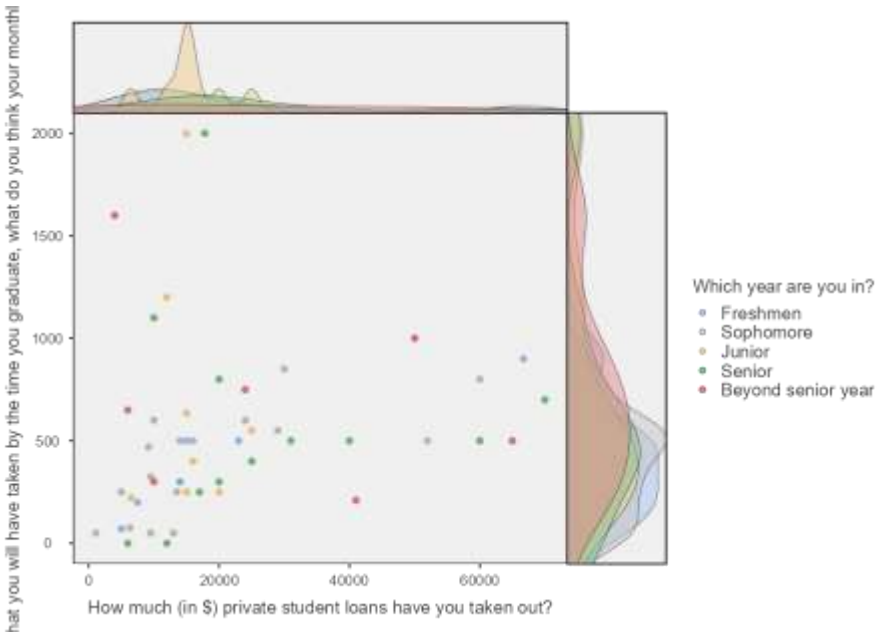


Of the 28 freshmen who reported taking out student loans, the median loan burden is $5450.00 with a with a median willingness to borrow of $20,000. Based on this, the median expected monthly payment is estimated by students to be $400. Current student loan rates for federal loans average 3.73% subsidized and unsubsidized undergraduate, 5.28% graduate unsubsidized, and 6.28% PLUS loan according to https://studentaid.gov. At the estimated burden of $20,000 for direct subsidized loans, the monthly payment would be about $365 with unsubsidized loans (based on equal dispersion) being about $401 on a standard 5-year repayment plan. Hence, based on expectations, the median estimate by students is realistic to their situation if these loans are federal loans.

Where the freshmen seem to fail to predict is that, among the sophomores that reported taking out student loans (n=46) the median reported student loan debt jumps to 13,000 with a median willingness to borrow going to $30,000. Students here report an expected monthly payment of $470. The actual

payment for this loan ends up substantially higher at about $548 for subsidized loans and closer to $600 for unsubsidized. Assuming that these students are not planning to reach this "maximum borrowing" threshold, the $470 estimate may be in the ballpark. In fact, the median maximum borrowing number does not change much between the 30,000 for sophomores and the 31,000 maximum reported by seniors. This is promising, as the estimated monthly estimates for loan repayment go from a median of $475 for juniors to $500 for seniors. Given the actual median amount reportedly borrowed by seniors is $25,000, these monthly estimates are nearly spot on. (With only 7 students reporting in the "beyond seniors" category, the summary statistics are not particularly useful.)

While the "median" student seems to have a good intuition for student loan repayment versus debt, sadly, the set of students who are taking out significantly more than the average in loans seems to sadly underestimate the true burden of that debt.



If students were correct on the assessment of debt, the student with close to $60,000 in loans would be looking at a near $1000 per month payment. This indicates that there are approximately 10 to 12 students in this dataset that vastly underestimate the true burden of their student loans.

So, while reportedly attending workshops or events focused on financial aid and financial literacy does not appear to be correlated with those questions measured in this survey, it does appear that students become more aware of their financial situation, with regards to loan repayments and types of loans, by the time they get to their senior year. Other specific characteristics as measured do not appear to have a correlation with the responses to the knowledge questions. Student intuition on the burden of debt after school seems to be on track for the "average" student; however, some students are tending to underestimate the true burden of this debt's post graduation effects.

Section 6: Direct Assessment of QL within Gen-Ed coursework

A simple conclusion here is that this attempt was a complete failure. While several faculty members within the courses did submit results for their courses, the question difficulty and normalization of scoring varied widely between courses and faculty members. The committee found it impossible to compile the data into a meaningful report with only single artifact scoring for each domain within the courses.

A follow-up plan has been considered for the 2021/22 academic year where the Math 361 courses will be used to test the viability of a different scoring system. In this plan, questions on multiple exams will be tagged with the appropriate QL outcome for foundation level assessment, and then scored. Scores will then be scaled to being worth a single point for every question, and average values for each student may be determined for all five domains of quantitative literacy. In this way, multiple questions can be assessed to get a significantly more complete view of the student's ability within each domain. In addition, if a single question is very hard vs. very simple, each question will not have high leverage on the overall assessment of the student's ability. This will, hopefully, provide a more balanced and complete view of student proficiency while avoiding the problems that made analysis of this year's attempt intractable. Please look forward to this report.

Section 7: Conclusions and Recommendations

An evaluation of quantitative literacy for assessment purposes might begin by asking two fundamental questions: 1) Are we meeting basic proficiency? 2) Where can we improve?

In response to the first question, there is sufficient data here to argue that we are meeting basic proficiency in all major areas (calculation, interpretation, representation, application, and communication) as well as financial literacy from both student and faculty perspectives. We have improved the process over the previous cycle by standardizing the tools that we use to assess both quantitative and financial literacy.

In response to the second question, we suggest three areas that might be possibilities for future improvements: training on more modern methods for quantitative literacy, improving calibration/normalization/standardization of the evaluation and reporting process, and broadening and deepening disciplinary connections and the applications of quantitative literacy to those disciplines. On the topic of modern methods, we note that technology continues to evolve and support increasingly sophisticated quantitative methods and the research base on quantitative literacy is also growing, and there are many new tools that may be worthy of additional training or instructional time for faculty and/or students. One specific example given by a committee member is using visualization alternatives for pie charts. Another example might include using simple coding or computational tools e.g., in a spreadsheet to gather or process data- this should not be misconstrued to imply that every student needs to take a CSET class, but all students would probably benefit from learning more about computational tools for quantitative literacy. On the topic of calibration/normalization/standardization, we observe that there has been quite a bit of churn in the mid-level management of the process, and in that churn, there have been some missed opportunities. We note that one weakness in our data is that there was no effort to establish inter-rater reliability or do training to calibrate the evaluation of student responses by individual faculty members; these are areas for future improvement. We tried multiple times to obtain reports and presentations from previous cycles and other essential student learning outcomes (ESLO) teams, but we were not successful. We believe that there is room to improve the quality of the data by improving the calibration of the faculty doing the evaluation; there might also be room to better leverage the learning management system (LMS) to facilitate the collection, aggregation, and evaluation of student data. Improved communication may help lead to reduced workload if done well. On the topic of broadening and deepening disciplinary connections, we believe that the concepts that students are taught, and that faculty are learning regarding quantitative literacy are valuable, but we are concerned anecdotally that perhaps in some disciplines the students are not seeing and making the connections to their disciplinary studies that they should be. We also note that within a discipline, there may be multiple sub-disciplines that may vary widely in the quantitative skills needed. For example, in software engineering, a student with interests in graphics or machine learning will need substantially more quantitative skills than a student interested in programming operating systems or databases.

We also observe anecdotally that many faculty have expressed a degree of survey fatigue, and we are a small school- this combination suggests that perhaps some more training on quantitative methods for smaller populations might be appropriate along with other quantitative literacy techniques that are contextually relevant for our campus.

Appendix: Charts and Tables for the Student Financial Literacy Survey

Frequencies of Which year are you in?

Levels	Counts	% of Total	Cumulative %
Freshmen	76	24.3 %	24.3 %
Sophomore	91	29.1 %	53.4 %
Junior	83	26.5 %	79.9 %
Senior	47	15.0 %	94.9 %
Beyond senior year	16	5.1 %	100.0 %

Frequencies of Which department are you in?

Levels	Counts	% of Total	Cumulative %
Applied Mathematics Department	4	1.3 %	1.3 %
Civil Engineering	19	6.1 %	7.4 %
Communication Department	7	2.3 %	9.7 %
Computer Systems Engineering Technology Department	27	8.7 %	18.4 %
Dental Hygiene Department	21	6.8 %	25.2 %
Electrical Engineering and Renewable Energy Department	28	9.1 %	34.3 %
Emergency Medical Services Department	3	1.0 %	35.3 %
Geomatics Department	5	1.6 %	36.9 %
Humanities and Social Sciences Department	15	4.9 %	41.7 %
Management Department	27	8.7 %	50.5 %
Manufacturing and Mechanical Engineering and Technology Department	43	13.9 %	64.4 %
Medical Imaging Technology Department	66	21.4 %	85.8 %
Medical Laboratory Science	9	2.9 %	88.7 %
Natural Sciences Department	15	4.9 %	93.5 %
Nursing	17	5.5 %	99.0 %
Respiratory Care and Sleep Health	3	1.0 %	100.0 %

Frequencies of Do you claim dependent(s) on your tax form?

Levels	Counts	% of Total	Cumulative %
No	231	74.0 %	74.0 %
Yes	81	26.0 %	100.0 %

Frequencies of Have your parents taken out a parent loan on your behalf?

Levels	Counts	% of Total	Cumulative %
No	255	81.5 %	81.5 %
Prefer not to answer	12	3.8 %	85.3 %
Yes	46	14.7 %	100.0 %

Frequencies of Your parents are legally responsible for the parent loan, but who will be repaying this loan?

Levels	Counts	% of Total	Cumulative %
Me	32	69.6 %	69.6 %
Parent	8	17.4 %	87.0 %
Prefer not to answer	6	13.0 %	100.0 %

Frequencies of Do you have a monthly budget as a student at Oregon Tech?

Levels	Counts	% of Total	Cumulative %
No	92	29.6 %	29.6 %
Yes	219	70.4 %	100.0 %

Frequencies of Are you able to live within this budget without going into extra debt?

Levels	Counts	% of Total	Cumulative %
No	76	34.9 %	34.9 %
Prefer not to answer	13	6.0 %	40.8 %
Yes	129	59.2 %	100.0 %

Frequencies of Do you have unmet financial needs at Oregon Tech?

Levels	Counts	% of Total	Cumulative %
No	211	67.8 %	67.8 %
Yes	100	32.2 %	100.0 %

Frequencies of What loan is better for your long-term financial outlook?

Levels	Counts	% of Total	Cumulative %
I don't know.	140	45.3 %	45.3 %
Subsidized	139	45.0 %	90.3 %
Unsubsidized	30	9.7 %	100.0 %

Frequencies of Do you know your total amount of student loan debt?

Levels	Counts	% of Total	Cumulative %
No	65	20.8 %	20.8 %
Yes	248	79.2 %	100.0 %

Frequencies of Do you know how much your monthly payment will be for your student loans?

Levels	Counts	% of Total	Cumulative %
No	180	57.7 %	57.7 %
Yes	132	42.3 %	100.0 %

Frequencies of Have you attended any financial aid, financial literacy or scholarship presentations?

Levels	Counts	% of Total	Cumulative %
No	169	54.3 %	54.3 %
Yes	142	45.7 %	100.0 %

The jamovi project (2021). *jamovi*. (Version 2.2) [Computer Software]. Retrieved from https://www.jamovi.org.

R Core Team (2021). *R: A Language and environment for statistical computing*. (Version 4.0) [Computer software]. Retrieved from https://cran.r-project.org. (R packages retrieved from MRAN snapshot 2021-04-01).