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*Canvas (LMS) as a Means for Effective Student Learning  
Assessment across an Institution of Higher Education*

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**Abstract**

Programmatic and institutional assessment initiatives emerged and continuously evolved across higher education institutions for the past twenty years (Dudley, 2005; Muñoz, Jaime, McGriff, & Molina, 2012). These initiatives stemmed from a growing emphasis on assessing the quality of learning that occurs throughout the collegiate education. Assessment processes in higher education generally reflect a paradigm focused around: (1) learning as best assessed through the educational experiences in which students demonstrate indicators of achievement; (2) a recognition that the sources of learning, typically programs/units, have the ultimate ownership of preparation for and assessment of student learning; and (3) a purpose of exposing specific aspects of learning upon which improvement decisions can be made. Developing an assessment process within this paradigm requires an institution to clearly define the expected learning that is to result from successful completion of higher education. Fortunately, technology has provided solutions that can remove the tedium and time-consumption from student learning assessment. The purpose of this article is to provide a thorough understanding of the assessment capabilities and data-collecting automaticity processes of Instructure's Canvas™ learning management system.

**Keywords:** Assessment, Student Learning Outcomes, Technology

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## Introduction

Programmatic and institutional assessment initiatives emerged and continuously evolved across higher education institutions for the past twenty years (Dudley, 2005; Muñoz, Jaime, McGriff, & Molina, 2012). These initiatives stemmed from a growing emphasis on assessing the quality of learning that occurs throughout the collegiate education.

Assessment processes in higher education generally reflect a paradigm focused around: (1) learning as best assessed through the educational experiences in which students demonstrate indicators of achievement; (2) a recognition that the sources of learning, typically programs/units, have the ultimate ownership of preparation for and assessment of student learning; and (3) a purpose of exposing specific aspects of learning upon which improvement decisions can be made.

Developing an assessment process within this paradigm requires an institution to clearly define the expected learning that is to result from successful completion of higher education. The ways a student demonstrates learning are most often represented within each degree program and co-curricular unit. Authentic reflection of learning through assigned tasks and assessed using defined criteria most often occur within a program/unit. An assessment process that involves faculty and staff collecting, analyzing, and discussing the data over time to guide improvement decisions sounds like a reasonable pursuit. Unfortunately, such a process sometimes results in apathy and dissent and remains “an elusive endeavor fraught with resentment and misgiving” (Muñoz, Jaime, McGriff, & Molina, 2012, p.34).

Faculty often consider the process of assessment as an additional burden unrelated to their perceived purpose that produces reports that are neither relevant nor useful. The path to gaining useful data involves documenting the quality of student learning directly related to the faculty’s instructional goals. In agreement with Collins and Ashley (2010) and Mourier and Smith (2001), usefulness results from the capacity of the data to expose both successful and unsuccessful learning specific to the course and program expectations. The impact of the data is experienced through adjustments made within programs and units. If the assessment data is relevant to the faculty and staff’s goals for student learning, then scoring the achievement criteria as indicators of student learning becomes purposeful. But even when scoring assessment tasks is recognized as purposeful, the process of assessing can feel overwhelming for an overworked and stressed educator.

Fortunately, technology has provided solutions that can remove the tedium and time-consumption from student learning assessment. The purpose of this article is to provide a thorough understanding of the assessment capabilities and data-collecting automaticity processes of Instructure’s Canvas™ learning management system (LMS). Provided are examples of ways to extract and disseminate Canvas data to be used for decisions making. The article includes (a) the structure of Canvas, (b) steps for how to set up Canvas for collecting student achievement data directly from coursework, sortable by outcomes and associated criteria, (c) strategies to export data from Canvas, and (d) ideas for visualizing outcome data.

## Canvas (LMS) assessment tools

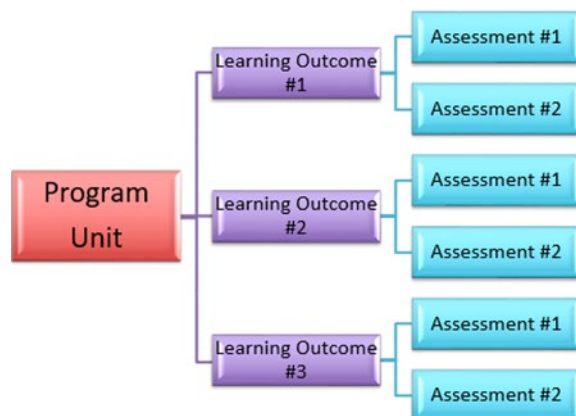
There are a number of higher education institutions that use the Canvas LMS to create a learning environment to “equitably scale student achievement” (Instructure, 2020). Canvas offers assessment tools to track and provide information regarding student learning in courses and across an academic program. It has the capability to collect achievement scores for learning outcomes based upon assessable criteria from assessment tasks embedded in courses and other opportunities through which students demonstrate proficiencies. When a scoring device is used with an assignment, the scores can be automatically collected at a program, college, or institution level. This process can occur simultaneously with assignment and course grading. Although many educational institutions use the Canvas LMS, many do not know how to take full advantage of its assessment capabilities.

### Background leading to advanced Canvas usage

It is important to emphasize that the presence of technology does not make an assessment process effective. Technology can be a tool to facilitate efficiency through automation; it can collect, organize, and present information in ways to be understood and useful, and it can provide a structure that enables maintenance and comparison of data. The Canvas LMS has proven to be an effective tool in these ways for our university, which is a large research institution. We began developing a student learning assessment structure in 2004 in response to a regional accreditation expectation. Our assessment structure is designed around each program and co-curricular unit defining the knowledge, skills, and dispositions expected of academic program degree completion or the co-curricular unit mission. Then each program unit integrates assessments into their curricular processes to identify the qualities of learning to guide further enhancements of instruction, the curriculum, and student educational experiences (see figure 1).

**Figure 1.**

*Assessment Structure*



Using a matrix (see figure 2), each program or unit identifies where in their curriculum each outcome is introduced, learning is developed, and at what point the student is expected to demonstrate program completion competence.

**Figure 2.**

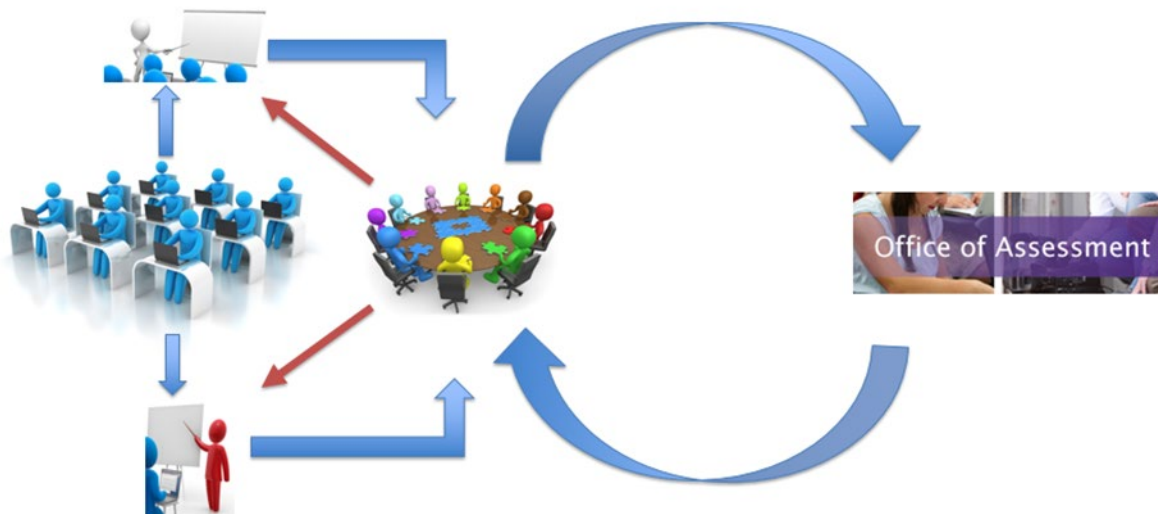
*Assessment Matrix*

	Intro Course	Research Methods	Advanced Concepts	Laboratory	Advanced Techniques	Capstone / Practicum
<b>Knowledge</b>						
SLO 1: Disciplinary knowledge, models and theories.	Introduce		Reinforce		Reinforce	Mastery/Assessed
SLO 2: Disciplinary methods		Introduce				
<b>Critical Thinking</b>						
SLO 3: Analysis and use of evidence.		Introduce	Reinforce		Reinforce	Mastery/Assessed
SLO 4: Evaluation, selection, and use of sources.			Introduce	Reinforce	Reinforce	Mastery/Assessed
<b>Communication</b>						
SLO 5: Written communication Skills	Introduce	Reinforce		Reinforce	Mastery/Assessed	
SLO 6: Oral Communication Skills		Introduce	Reinforce		Mastery/Assessed	
<b>Integrity / Values</b>						
SLO 7: Disciplinary ethical standards		Introduce		Reinforce	Reinforce	Mastery/Assessed
<b>Diversity / Teamwork</b>						
SLO 8: Interpersonal skills			Introduce	Reinforce		Mastery/Assessed

Each assessment plan includes a selected assessment task, or set of tasks, from coursework and educational experiences through which students demonstrate degree-credentialing competence. Collected and reviewed annually, student achievement data become a mechanism to guide instructional and curricular decisions. Annual reports on the assessment of student learning are submitted to the institutional Office of Assessment for feedback with the primary purpose of enhancing the assessment process and providing guidance on improving validity and reliability of the measures (see Figure 3).

**Figure 3.**

*Assessment Process*



By the time our institution began using Canvas, this process was already in place. In 2014 when our university began piloting Canvas, the institution’s Office of Assessment pursued oversight in faculty and program development for the implementation of the assessment components of Canvas. To facilitate efficiency and smooth integration, the Office of Assessment pre-populated all learning outcomes into Canvas. Then, when programs and their faculty began using the system, outcomes could be aligned with assessment tasks for student achievement data collection. Immediate usefulness with limited technical skills was the early goal for implementation.

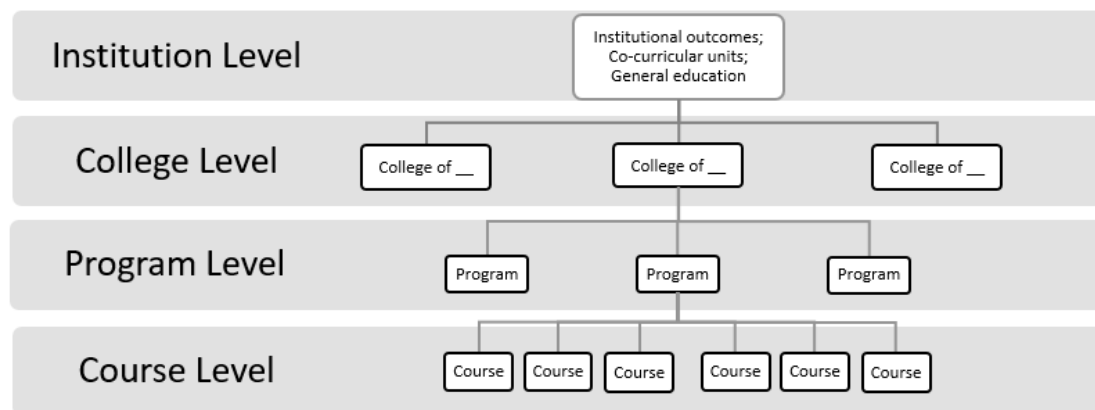
## Understanding Canvas assessment architecture

The structure of Canvas is hierarchical (see Figure 4). What is immediately viewed by faculty is the course level. At the course level, faculty interact with students by sharing documents, scheduling instructional sequences, creating assignments, placing scores in a grade book, and many other aspects associated with teaching. This level is where student achievement for outcomes can be collected, but this is not the level where the programmatic outcomes exist.

The levels above the course level that require administrative access are: (a) the program level, which connects all of the courses that are under the program’s oversight; (b) the college level, which connects all of the program within the college; and (c) the institution level, which connects all of the colleges as well as any unit that is broadly administered. Understanding this hierarchy is essential to effectively implementing the assessment module for automating data collection from the source of student engagement in learning.

**Figure 4.**

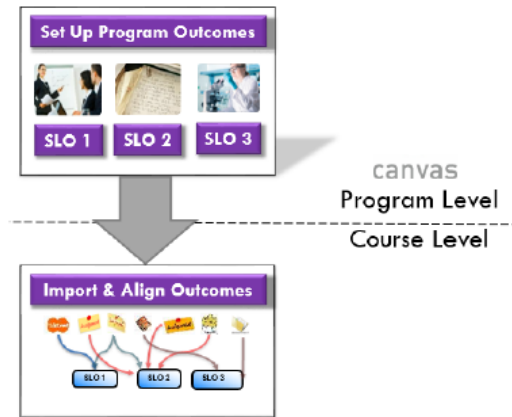
*Canvas Hierarchy*



It is important to recognize that this hierarchy is the fundamental structure upon which outcomes are created in the Canvas technology. The level at which an outcome is placed is where the achievement score is recorded. Another construct to understand is that an outcome created at one level can be used by any connected group below the level but is not attainable for the levels above. For example, the assessment structure at our university is focused around program-level outcomes. It is on the program level in Canvas where program outcomes are created and brought down into the courses associated with that program (see Figure 5).

**Figure 5.**

*Aligning Program Outcomes into Courses*




As another example, if a college uses some of the same outcomes across all their programs, then these outcomes should be created at the college level so to be available for use in courses across their entire college. Extending this construct more broadly, if outcomes are to be assessed in courses across the entire institution, then those outcomes should be created at the institutional level to be available for all courses. Similarly, since co-curricular units often involve all students, these outcomes would be created on the institution level. In general, the hierarchy defines who will have access to the outcomes that will be imported into a Canvas course for use in scoring student achievement.

## The Canvas Assessment Process

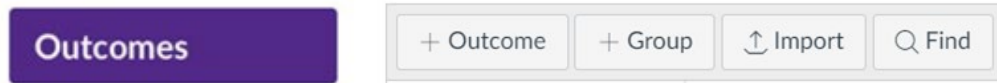
### Creating outcomes in Canvas

Since achievement data are intended to be aggregated by outcome and analyzed beyond individual course assignments, the highest level at which aggregation occurs is where the outcome should be created in the Canvas technology. The process that will be described in the coming section works the same at all levels. The pedagogy that follows provides a step-by-step process that can work at any institution.

It is important for those creating the outcomes in Canvas to have access to the specific level and curricular area into which the outcomes will be hosted. Those that oversee the Canvas technology on your campus can provide individuals access to particular levels and specific programs. When administrative access is given to individuals for a particular area, an icon that looks like a key on a shield will be visible at the top of the left access panel on the Canvas page . Clicking on this key will open the administrative portal at the access point for which you have been granted permission. Once in the administrative portal, the outcome button on the left side of the page will open the *outcome creating page* (see Figure 6). This page will be empty unless outcomes have already been created.

**Figure 6.**

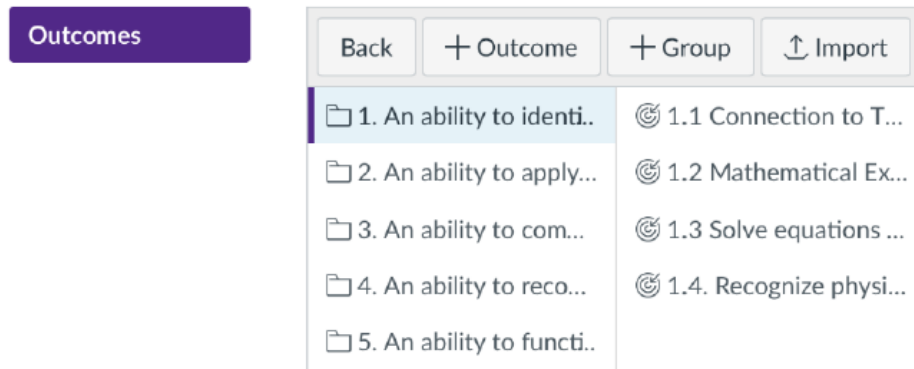
*Outcome Creating Page*



At this point, one of the most important constructs to understand is the difference in terminology used by Canvas as compared to the meaning typically understood by assessment professionals. Most faculty and assessment coordinators are used to the term 'Learning Outcome' as referring to a specific category of learning such as a broad learning construct. Then in an assessment process, each time an outcome is assessed, it is typically comprised of multiple criteria that provide indicators of achievement. These criteria are often part of a scoring rubric or aligned with individual questions on an exam. For example, an outcome that states, "Students will be able to communicate effectively in writing," is usually comprised of multiple criteria that are assessable such as: "Structure is clear, logical, and easy to follow"; "Uses correct mechanics such as grammar, spelling, and punctuation"; and "Effectively incorporates appropriate supporting materials." In Canvas, what is typically called an outcome by faculty is called a Group by Canvas and is visualized with a folder icon. What is typically called criteria is called an Outcome in Canvas. These Outcomes (criteria) are the components that are scored in an assignment or other means through which a student demonstrates qualities of achievement.

To create the outcome structure in Canvas, the first step is to create a Group (outcome folder) for each category that we refer to as an outcome. As discussed earlier, what we often refer to as an outcome is actually a category of learning that is comprised of multiple assessable criteria (see Figure 7). In this example you see five outcome categories:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

**Figure 7.***Outcome Structure*

When creating the outcome folders, we found it best to number each Group for sorting and filtering purposes after the data is extracted from Canvas. If the program is an accredited program, the number system becomes a valuable aspect for aligning to future reporting expectations. In the figure 7 example, the Group (outcome folder) names truncate. In most instances, it is advisable to begin each outcome name with short and descriptive text.

After the outcome folders are created, the assessable criteria can be created inside of each folder. By clicking on a 'Group' (outcome folder) as seen highlighted in Figure 7, 'Outcomes' (assessed criteria) can be added into that folder. An 'Outcome' (assessed criteria) is created using the '+Outcome' button in the top ribbon. A window will appear in which the outcome is created.

When creating an Outcome, the technology asks for a title, which should begin with the numerical organizer connected to the Group that will be used in sorting and filtering during analysis. The title can be short because a text box is provided where you can include a more thorough description of the Outcome (criterion). This detailed text can be extracted and placed in a report when a full description is needed. It could be also used in online visualizations as a mouse-over pop-up.

The creation of an Outcome will require a categorical scale of achievement that clearly defines the rigor expected for the varying levels of Outcome (criterion) achievement (see figure 8). When creating these achievement levels, differentiated achievement is important. The differentiation must be sufficiently clear so that multiple assessors can find usefulness and applicability across a variety of assessments. The technology provides a template that can be manipulated to add levels, assign values, and clarify a textual description. The description and detail included for each category is dependent upon its use in a scoring device. One reason for clear communication of expectations is that students will see the description if used in a rubric. Another purpose of clarity is in reliability if multiple scorers use the same outcome. In reference to the point values, these are not necessarily the points that will be used in grading. Grading exists on the course level, and it is at the discretion of the instructor to determine how to incorporate the Outcome (criterion) into the course.



## Figure 8.

### *Levels of Achievement*

#### 🎯 1.1 Connection to Theory

Exceeds Standards - Can relate all theoretical concepts to practical problem solving	Meets Standards -Can relate most theoretical concepts to practical problem solving	Progressing Towards Standards - Can connect theoretical concepts to practical problems with prompting	Below Standards - Cannot see the connection between theory and practical problem solving	Total Points
4 Points	3 Points	2 Points	1 Points	4 Points

Mastery: 3 Points

Calculation Method: Highest Score

In Figure 8, the indication of a Mastery level is situated below the achievement levels. This defines the benchmark expectation for acceptable Outcome achievement. Note that this does not mean perfectly mastered as we typically think with the word “mastery.” It refers the level that fully meets the rigor of expectation on this specific Outcome. Below Mastery is a selection for Calculation Method. Our university usually selects ‘Highest Score’. Overall, Canvas keeps track of every score that is obtained each time the Outcome is used in an assessment, so calculations can be made at a later date. It is important to always save any work that you have done with the Save button at the bottom of the section before you move on, otherwise you may have to reproduce your work.

After the outcome is created, the name will appear with the target icon indicating that this is an outcome (criteria) that will collect data when used in an assessment as seen in Figure 7. This distinction is important because outcomes can be created within a course and not have the target icon. The target indicates that the score will be collected at the program, college, or institution level at which it was created. This automated process greatly facilitates data collection.

If further specificity is required, it is possible to add a group folder inside of the original outcome folder for further subdivision. This decision depends upon the specificity required of the assessment process and the complexity desired of future analysis.

## Creating program rubrics

If the program/unit intends to collect achievement data from a rubric that will be used across multiple courses or programs, this rubric can be created on the program, college, or institution level made up of Outcomes (criteria) from one or multiple Groups (outcome folder). While in the administrative portal at the program/college/institutional level, by selecting ‘Rubrics’ on the left ribbon (see Figure 9), you will build it with Outcomes (criteria) using the ‘Find Outcome’ command. Rubrics created in one of these levels can be brought as a whole into a course assignment. Then, when the rubric is aligned with an

assignment and used for scoring, each Outcome (criterion) score will be automatically collected at the level where each Outcome was created.

**Figure 9.**

*Creating a Rubric on an Administrative Level*

Aural Skills

Aural Skills					
Criteria	Ratings				Pts
4.4 Sight Singing <small>threshold: 3.0 pts</small>	3.0 pts Pass (meets expectations)	2.0 pts Almost (needs more work)	1.0 pts Does not meet expectations	0.0 pts Not assessed yet	3.0 pts
4.5 Triads <small>threshold: 3.0 pts</small>	3.0 pts Pass (meets expectations)	2.0 pts Almost (needs more work)	1.0 pts Does not meet expectations	0.0 pts Not assessed yet	3.0 pts
4.1 7th Chords <small>threshold: 3.0 pts</small>	3.0 pts Pass (meets expectations)	2.0 pts Almost (needs more work)	1.0 pts Does not meet expectations	0.0 pts Not assessed yet	3.0 pts

The Rubric option would be an ideal way to incorporate AAC&U Value Rubrics or General Education Rubrics. Each criterion would be created as an Outcome in an appropriate Outcome folder and brought together as the rubric to be connected to an assignment for scoring. As an example, our university uses the Institution level to create a rubric used across the institution to assess learning in the first-year experience courses. Another example in which a rubric is created on the college level comes from our College of Education. They use rubrics to score internship experiences and teaching portfolios to address licensure and accreditation expectations. In doing so, all licensure programs in the college can use the common scoring rubrics with the scores automatically collected by the college as well as the program.

**Involving the faculty**

Without thoughtful consideration in defining learning outcomes and the associated assessable criteria that provide differentiated levels of attainment, the value of the Canvas hierarchy would be of little use. There is a clear advantage in working with program/units to define their educational mission in reference to what students gain as a result of active involvement with the program/unit activities. In nearly all instances of implementing the Canvas assessment technology, thoughtful discussions among the faculty greatly impact the usefulness of the technology and, consequently, the resulting data. Active involvement with the stakeholders is essential in the development of the assessment structure (Burrack & Urban 2014; Eder, 2007; Tang and Chow, 2007). An honest respect of beliefs and autonomy faculty value enable ownership in outcomes and a consensus of purpose with the assessed criteria when it comes directly from current assessment processes.

In the development of the Canvas assessment structure on our campus, we usually begin by meeting with the program or unit's assessment coordinator(s) to demonstrate the Canvas assessment technology, specifically focusing on the automation of data collection

and the usefulness of the data to be collected. When possible, multiple, and varied examples from other programs or units are used to enable the assessment coordinators to recognize the flexibility of the technology to fit within their own processes. Discussion and

review of the current assessment practices are necessary because it is not possible to create the Canvas Outcome Groups or associated Outcomes Criteria unless a well-defined assessment plan is already designed. This discussion always includes the faculty reviewing course assessments and the currently administered scoring devices. Once the assessment plan is thoroughly vetted, we give the assessment coordinator administrative access to their program or unit level in Canvas and teach them to create the Groups (outcome folders) and the Outcomes (criteria) so they can directly input their Outcomes into the Canvas technology.

When the Groups (outcome folders) and the Outcomes (assessed criteria) are in the appropriate Canvas level, it is wise to move to a pilot implementation to test the integration and the structure. This step is imperative before introducing the outcomes assessment process to the entire program or unit. Without a pilot to work out the problems that may occur, a full integration that has not worked through problems may disillusion those involved. At our institution, a typical timeline of Canvas assessment development begins with one full semester to develop the Groups and Outcomes into the technology. A second semester allows the program or unit to implement a pilot and collect data that can be extracted and visualized for assessment analysis. Having faculty describe the efficiency of automated data collection directly from assignment scoring and having the visualized data disaggregated by outcomes and assessed criteria provides a strong foundation for faculty discussion. A third semester is when we communicate the success of the pilot to the rest of the program or unit and answer important questions of implementation. During this third semester, training of faculty to align outcomes with selected assignments will prepare for the fourth semester and beyond for gradual integration into Canvas courses. We have found success with this process and continue to see faculty and programs or units come to us wanting to enhance their assessment processes as they have seen other programs or units flourish.

### **Aligning outcomes from an administrative level on the course level**

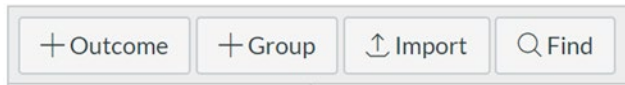
In a Canvas course, whether working with a scheduled academic course or a created course that has been aligned with a program or unit, Outcomes (assessed criteria) can be aligned into the scoring device used to measure students' attainment of the desired outcome. This paper does not address how to create in Canvas the variety of assignments that can be scored, as there are many online tutorials to do so. However, there are a few important steps in aligning Program, College, or Institutional outcomes to an assignment scoring device.

The primary reason to bring outcomes into a course is to automate the collection of achievement data. There are two basic ways of bringing outcomes into courses. The most flexible option is to bring each outcome into the course individually to be aligned to an assignment. This is accomplished by selecting the 'Outcomes' button that is in the left ribbon on any Canvas page. When the Outcomes panel opens, the command to use is 'Find' (see Figure 10). For clarification, you will not want to use the '+Outcome' as was

used in the administrative level because this will create an Outcome (assessed criteria) in the course but the score will remain on the course level. Remember that the primary purpose of creating the outcome structure on an administrative level is to automate data collection and remove the time consumption of collecting and reporting individual student scores for program or institutional assessment. The same rationale applies for not creating a 'Group' on the course level. The '□ Import' is used for importing prepared outcomes into the course, but again will not be tied to a level outside of the course itself.

**Figure 10.**

*Alignment Toolbar*



When '🔍 Find' is selected, a window will appear showing the outcomes that are available from the Program, College, and/or Institution levels under which the course is aligned. Each outcome can be imported individually into the course to later align into a scoring device that will assess demonstrations of outcomes achievement.

To align an outcome with selected-response types of assessment, the Canvas technology can align specific questions from within an exam using Question Banks. When aligned, the answered response of each question will be recorded at the appropriate program, college, or institution level. The meta-data collected will enable sorting by the student identifier, date recorded, applied semester, and all necessary data for each time the question was answered. There are many online tutorials for creating selected-response assessments, sorting questions into questions banks, and aligning question banks to outcomes (KSU, 2020). Any analysis of the data will occur outside of CANVAS and will be described later in this article.

If an Outcome (assessable criterion) is to be used in a scoring rubric, there are many choices to make:

1. If the program, college, or institution has created a rubric that is intended to be used across multiple assignments, the button 'Find a Rubric' will open a window to select the appropriate rubric and import it to the assignment. Then in the edit mode:
  - a. Individual criteria lines (Outcomes) can be deleted within the course if they are not relevant to the particular assignment.
  - b. Additional criteria lines can be added to be used for assignment scoring. Remember that the scores of additional criteria lines will only go to the assignment grade and not the program, college, or institution level.
  - c. Choose whether to use the rubric for assignment grading or not.
  - d. Choose whether to remove points from the rubric, enabling the instructor to assign their own points for grading while the level of performance will still be scored for the program, college, or institution.

2. The instructor could create their own rubric for the assignment and include scoring lines as part of the overall assignment scoring. The 'Find Outcome' button is used to align Outcomes into the rubric (assessable criteria) that had been imported.

Note: before clicking the import button it is important for the instructor to select or unselect ' Use this criterion for scoring'. This box is selected by default, but sometimes the faculty wishes to score student achievement of this criterion line for the program and not bring this score into the assignment grade.

3. Sometimes an instructor will use multiple assessments that are scored outside of Canvas and determine the level of achievement with calculations on a spreadsheet. In this case, some have created hidden assignments that are published after the course has ended and score the Outcome from a calculated score from across the course.

The most valuable aspect of using Outcomes in Canvas is that the faculty do not have to duplicate the scoring of student achievement in a separate report. Another advantage is that the scores being submitted are authentic to the students' demonstration of achievement that occurs within coursework. In all assessment situations, longitudinal tests of validity and reliability can and should be reviewed.

### **Extracting the Data from Canvas**

We consider Canvas as a data-collection technology tool as the analysis of data occurs outside of this technology. Data is to be downloaded in multiple ways. Canvas has Cloud access to data for an extra fee, but this may not be feasible for many institutions. Since data from the program, college, and institution levels is collected on the administrative level, it can be extracted in the settings. In the settings found at the bottom of the left ribbon, by opening 'Reports' found in the top ribbon of links, the Groups and Outcomes are downloaded by selecting 'Outcome Export'. This extracts a .csv file that includes all learning outcomes within the account and will show the details of all associated attributes of each outcome.

The collected achievement data from the outcomes are downloaded when selecting 'Outcome Results'. The technology allows a selection of the entire dataset or from individual semesters. The extracted .csv report shows the learning outcome results of all outcomes for all students. It includes all the scoring data and meta-data associated with the course, assignment, outcome, and timestamps needed for many types of analysis.

From these .csv files, data will need to be organized in some form of visualization. Whether these visualizations include tables or graphs, it is essential that the data is presented so the program and faculty can assess the meaning and implications to guide instructional and curricular decisions that can lead to improved student learning.

### **Data visualizations**

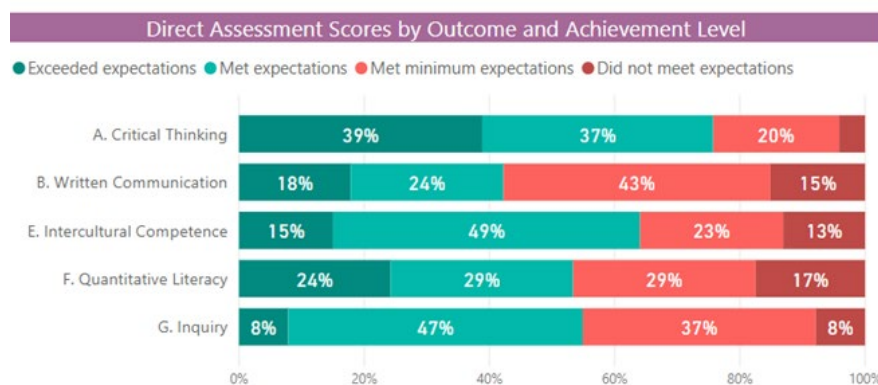
There are multiple ways to visualize assessment data. Depending upon technology skills, the .csv files can create visualizations in the form of tables and charts using Excel,

RStudio, PowerBI, Tableau, or other visualization products. The most important reason for collecting student achievement data by outcome categories and the assessable criteria is to identify both successful learning as well as areas in which learning could be improved.

The usefulness of creating outcome categories (Groups in Canvas) and the component criteria (Outcomes in Canvas) comes in the production of visualizations used in analyzing the data to better understand learning. When combining achievement scores over time and across courses or assignments, achievement can be understood through a chart (see Figure 11).

**Figure 11.**

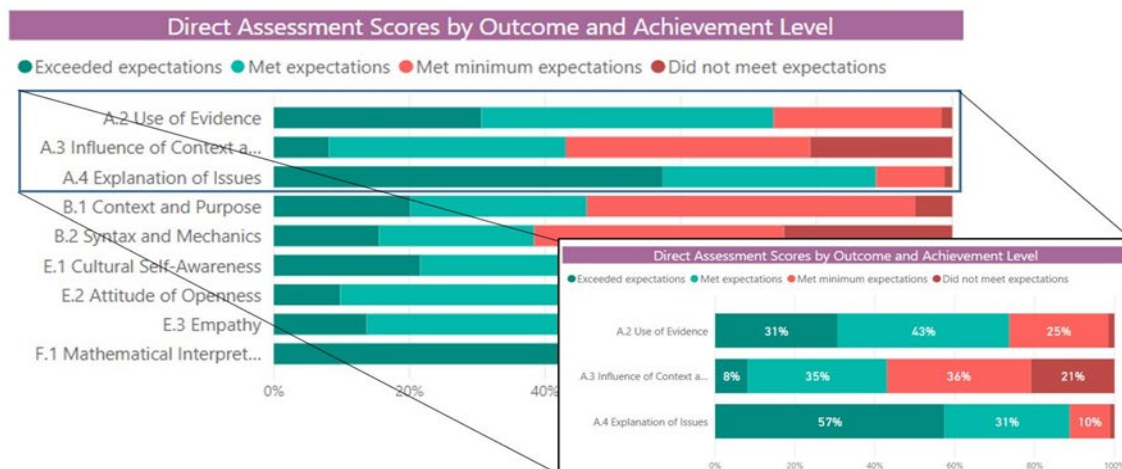
*Visualization chart of outcome groups*



Because the Groups (outcome categories), seen in aggregate in the previous chart, were collected via Outcomes (assessed criteria), achievement can be disaggregated by the criteria to better understand both the successful demonstration and the challenges (see Figure 12).

**Figure 12.**

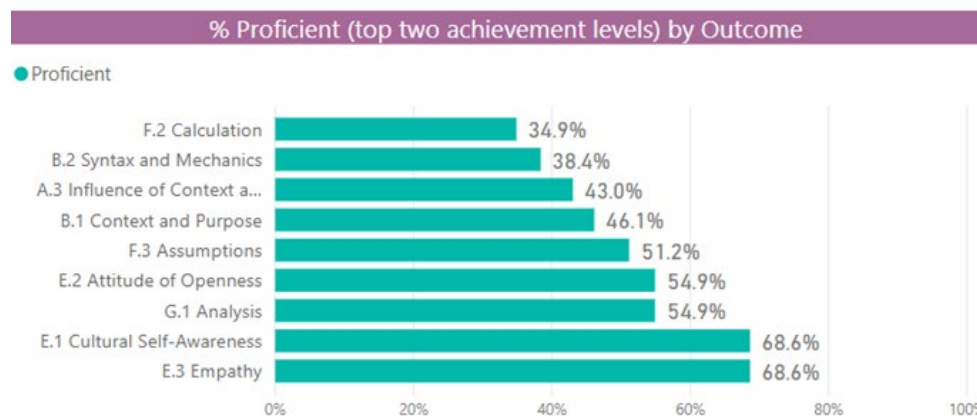
*Visualization chart of assessed criteria*



Visualized another way, meeting and exceeding the expected level of achievement can be sorted to expose which criteria is most challenging for students to demonstrate in the selected assessments (see Figure 13).

**Figure 13.**

*Visualization chart sorted by lowest to highest score*



For some, a table is the preferred way to view the composite achievement data (see Figure 14). The most important factor when presenting student learning data from Canvas is its ability to expose what is not visible in the typical grading scheme. Seldom does an assignment or a course teach only one learning outcome. Singular outcome scores are aggregations of multiple criteria and assignment grades and course grades are aggregations of multiple outcomes. To fully understand what students are learning and, more importantly, what challenges exist in their learning achievement, disaggregating scores by criteria is essential. The advantage of collecting these scores using the Canvas assessment technology is in its automation. The faculty score students as they demonstrate learning through assessment tasks. These tasks are embedded in the learning process by automating the collection of assessable criteria scores across multiple assignments and courses.

**Figure 14.**

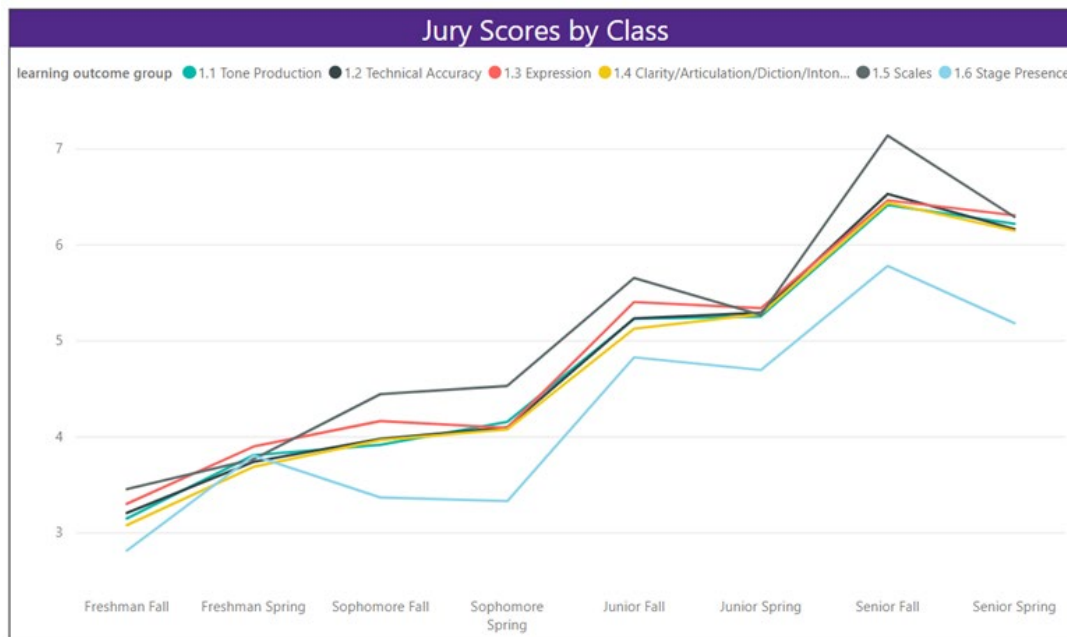
*Table visualization of achievement data*

Direct Assessment Scores by Outcome and Achievement Level										
Outcome	Exceeded expectations		Met expectations		Met minimum expectations		Did not meet expectations		Total	
	Count	%	Count	%	Count	%	Count	%	Count	%
<b>A. Critical Thinking</b>	<b>234</b>	<b>38.9%</b>	<b>222</b>	<b>36.9%</b>	<b>121</b>	<b>20.1%</b>	<b>25</b>	<b>4.2%</b>	<b>602</b>	<b>100.0%</b>
A.2 Use of Evidence	79	30.6%	111	43.0%	64	24.8%	4	1.6%	258	100.0%
A.3 Influence of Context and Assu...	7	8.1%	30	34.9%	31	36.0%	18	20.9%	86	100.0%
A.4 Explanation of Issues	148	57.4%	81	31.4%	26	10.1%	3	1.2%	258	100.0%
<b>B. Written Communication</b>	<b>92</b>	<b>17.8%</b>	<b>126</b>	<b>24.4%</b>	<b>220</b>	<b>42.6%</b>	<b>78</b>	<b>15.1%</b>	<b>516</b>	<b>100.0%</b>
B.1 Context and Purpose	52	20.2%	67	26.0%	125	48.4%	14	5.4%	258	100.0%
B.2 Syntax and Mechanics	40	15.5%	59	22.9%	95	36.8%	64	24.8%	258	100.0%
<b>E. Intercultural Competence</b>	<b>23</b>	<b>15.0%</b>	<b>75</b>	<b>49.0%</b>	<b>35</b>	<b>22.9%</b>	<b>20</b>	<b>13.1%</b>	<b>153</b>	<b>100.0%</b>
E.1 Cultural Self-Awareness	11	21.6%	24	47.1%	12	23.5%	4	7.8%	51	100.0%
E.2 Attitude of Openness	5	9.8%	23	45.1%	14	27.5%	9	17.6%	51	100.0%
E.3 Empathy	7	13.7%	28	54.9%	9	17.6%	7	13.7%	51	100.0%
<b>F. Quantitative Literacy</b>	<b>54</b>	<b>24.2%</b>	<b>65</b>	<b>29.1%</b>	<b>65</b>	<b>29.1%</b>	<b>39</b>	<b>17.5%</b>	<b>223</b>	<b>100.0%</b>
F.1 Mathematical Interpretation	30	58.8%	15	29.4%	6	11.8%			51	100.0%
F.2 Calculation	12	14.0%	18	20.9%	24	27.9%	32	37.2%	86	100.0%
F.3 Assumptions	12	14.0%	32	37.2%	35	40.7%	7	8.1%	86	100.0%
<b>G. Inquiry</b>	<b>4</b>	<b>7.8%</b>	<b>24</b>	<b>47.1%</b>	<b>19</b>	<b>37.3%</b>	<b>4</b>	<b>7.8%</b>	<b>51</b>	<b>100.0%</b>
G.1 Analysis	4	7.8%	24	47.1%	19	37.3%	4	7.8%	51	100.0%

The Canvas assessment technology can be administered with the flexibility to provide data in ways that programs find valuable. When skills are developed and assessed over time, scoring devices should be created that can differentiate gradual progress toward the outcome development. This is implemented in programs like the visual and performing arts, teacher training, public speaking, and other developmental skill areas. Developmental tendencies are visualized over students' educational experience (see Figure 15).

**Figure 15.**

*Visualization of longitudinal achievement*



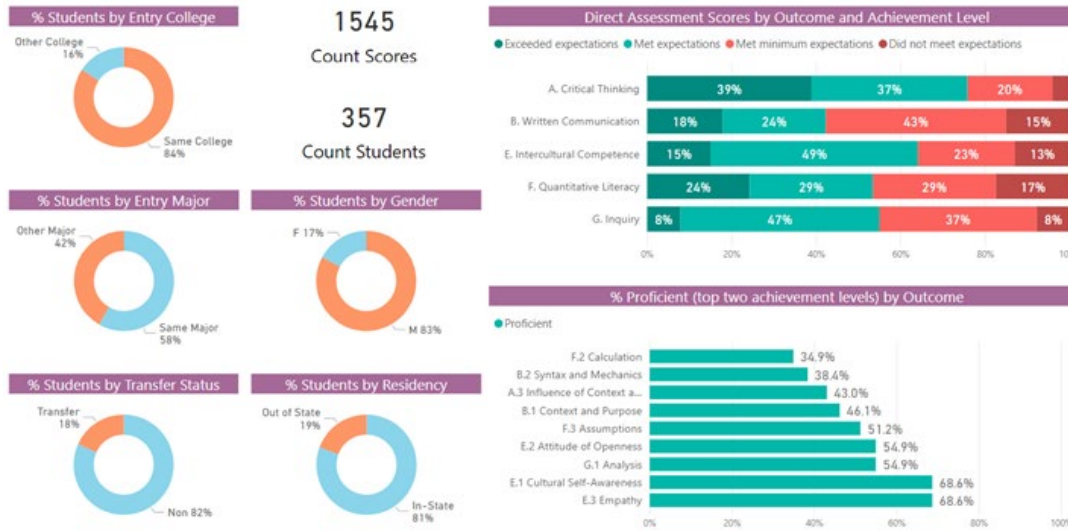
It is possible to purchase or to build automated connections to the Canvas data, which would eliminate the step of downloading data to align into the visualizations. With an automated connection, data flows directly to the visualization so instructors can efficiently analyze and assess the meaning to support instructional and curricular decisions.

One important advantage to collecting student achievement data through the Canvas outcomes technology is its connection to the student identifier used at your institution. With this identifier, the student achievement data collected can be connected to the Student Information System enabling filtering by demographic identifiers such as gender, first-generation applicants, transfer, GPA, ethnicity, residency, registered major, academic status, and any other identifier that could differentiate learning needs that could be addressed. In the following example, the identifiers serve two purposes: (1) visualizing demographic calculations and (2) filtering when selected to change the adjoining tables showing the results from the selected cohort (see Figure 16).



**Figure 16.**

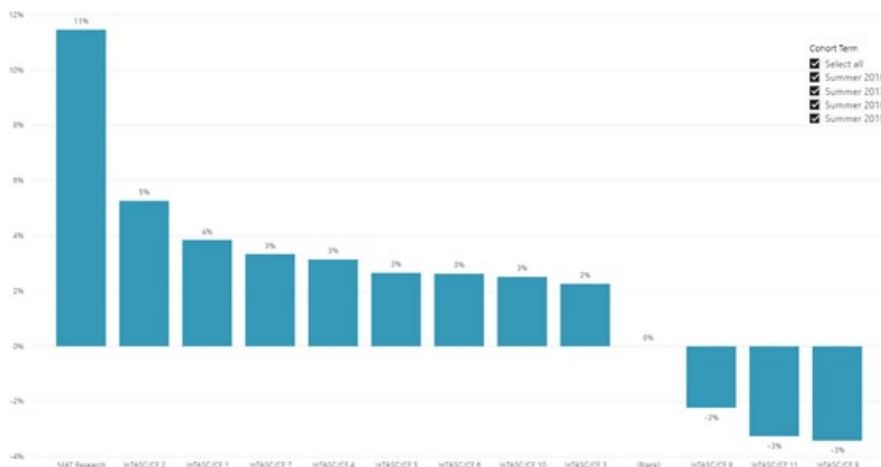
*Visualization of data filterable by demographic categories*



Another use of the student identifier is to align with other data sources, such as surveys and tools that exist outside of CANVAS. Programs and units can align outcomes in Canvas to questions surveyed to students, alumni, internship directors, or other data sources that can provide alternative scoring of the outcomes and assessable criteria. One example that some programs have found useful is to survey the students on their perceived level of achievement using the same scale as being used by faculty and/or internship directors. When student scores (indirect assessments) are compared against the direct assessment scores from coursework, students' inflated concept of their learning or lack of conception of proficiencies is exposed (see Figure 17). In this example, the bars that go up show the percentage that students over-inflate their perceived capabilities on a criterion as compared to the instructor scores. Bars that go down demonstrate the percentage that students do not recognize the level of achievement as scored by the instructor.

**Figure 17.**

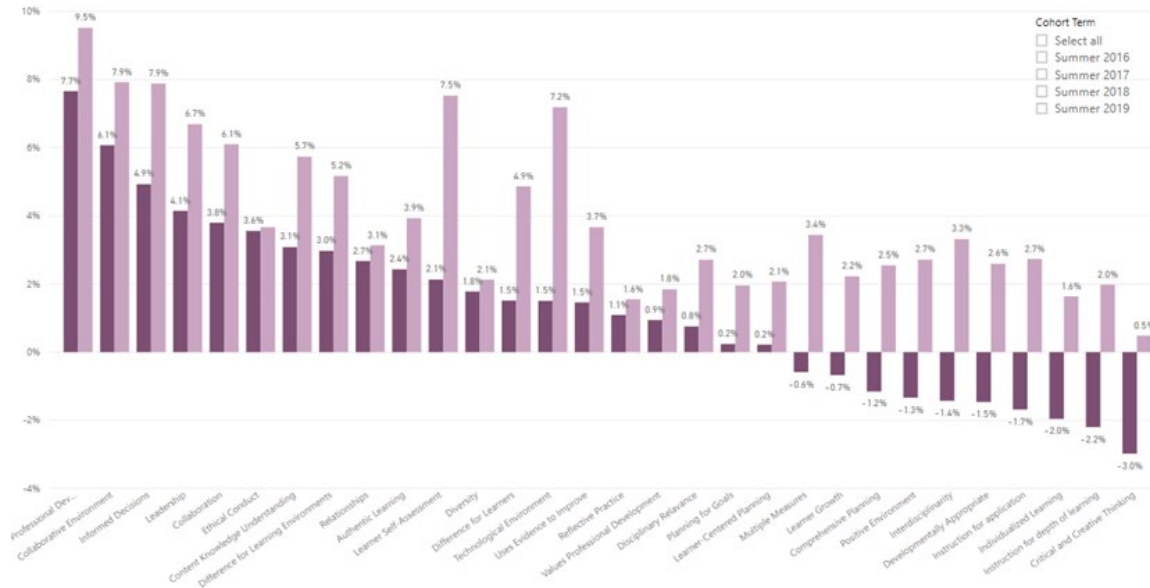
*Visualization chart comparing direct to indirect assessments*



Another useful visualization is to compare faculty scores of achievement in coursework as compared to internship scores for fieldwork (see Figure 18). When validity of the measure and reliability of scoring are confirmed, these comparisons could expose the level of scoring rigor in coursework as compared to applied expectations beyond the institution.

**Figure 18.**

*Visualization chart comparing two data scoring sources*



There are many other ways that Canvas outcomes can be useful to guide instructional and program improvements. Using the automated data collection and the Canvas organizational structure, the necessary foundation is built for effective and efficient integration.

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