Quantitative and Computational Thinking 2018-2019

Quantitative and Computational Thinking (QCT) courses are designated as either Foundational or Advanced/Applied. Courses or course sequences addressing this concept must meet a majority of the student learning outcomes (SLOs). During the Fall 2018 and Spring 2019 semesters, Virginia Tech offered 38 Pathways courses that included the Core Concept of QCT. Of those, 19 courses were approved as Foundational and 19 courses were approved as Advanced/Applied.

	Foundational	Advanced/ Applied	Overall
Pathways Sections Offering QCT	237	88	325
Pathways Sections Reporting QCT Data[1]	198 (84%)	73 (83%)	271 (83%)
Pathways Sections Included in Analyses[2]	182 (77%)	65 (74%)	247 (76%)
Enrollment in Sections Offering QCT*	13,061	5,401	18,462
Enrollment in Sections Included in Analyses*	9,982 (76%)	3,549 (66%)	13,531 (73%)

* Values include students who may be enrolled and/or assessed in multiple Pathways courses.

Table 1: Competency Levels per SLO for QCT

	Sections Included in Analyses*	Students Included in Analyses	Percentage of Students		
			Below Competent	Competent	Above Competent
SLO 1: Explain the application of computational or quantitative thinking across multiple knowledge domains.	233	9,796	19% (n=1,823)	31% (n=3,046)	50% (n=4,927)
SLO 2: Apply the foundational principles of computational or quantitative thinking to frame a question and devise a solution in a particular field of study.	240	10,420	20% (n=2,132)	40% (n=4,128)	40% (n=4,160)
SLO 3: Identify the impacts of computing and information technology on humanity.	14	461	13% (n=60)	42% (n=194)	45% (n=207)
SLO 4: Construct a model based on computational methods to analyze complex or large-scale phenomenon.	22	1,293	9% (n=117)	38% (n=495)	53% (n=681)
SLO 5: Draw valid quantitative inferences about situations characterized by inherent uncertainty.	233	9,849	18% (n=1,753)	36% (n=3,587)	46% (n=4,509)
SLO 6: Evaluate conclusions drawn from or decisions based on quantitative data.	229	10,217	20% (n=2,091)	36% (n=3,653)	44% (n=4,473)

* Includes sections required to report data for a specific outcome and additional sections reporting data.

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[1] Twelve sections (4%) were missing data for one or more required SLOs (7 Foundational and 5 Advanced/Applied); 259 sections (96%) provided complete data (191 Foundational and 68 Advanced/Applied).
[2] Data from 243 sections (90%) were fully included (182 Foundational and 61 Advanced/Applied); 4 sections (1%) were partially included (4 Advanced/Applied); 24 sections (9%) were excluded (16 Foundational and 8 Advanced/Applied).

SLO 1: Explain the application of computational or quantitative thinking across multiple knowledge domains.

	Foundational			Advanced/Applied		
	Sections Required to Report	Additional QCT Sections Reporting	Total Sections Included in Analyses	Sections Required to Report	Additional QCT Sections Reporting	Total Sections Included in Analyses
Pathways Sections Offering SLO 1	215	3	218	74	N/A	74
Pathways Sections Reporting Data	184 (86%)	3 (100%)	187 (86%)	65 (88%)	N/A	65 (88%)
Pathways Sections Included in Analyses	173* (80%)	3 (100%)	176 (81%)	57* (77%)	N/A	57 (77%)
Enrollment in Sections Offering QCT 1**	10,732	116	10,848	4,127	N/A	4,127
Students Included in Analyses**	7,533 (70%)	102 (88%)	7,635 (70%)	2,161 (52%)	N/A	2,161 (52%)

* Data from 19 sections (11 Foundational; 8 Advanced/Applied) were excluded.

** Values include students who may be enrolled and/or assessed in multiple Pathways courses.
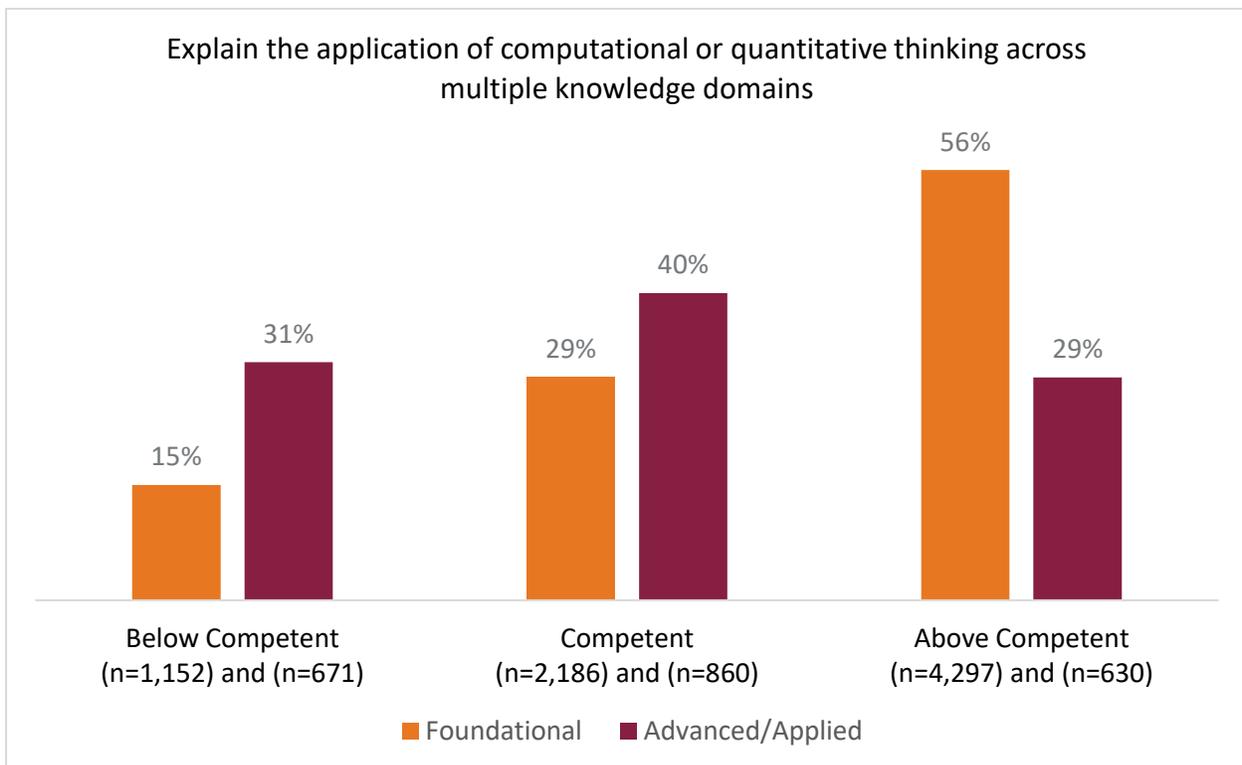

Figure 1. Foundational (n=7,635); Advanced/Applied (n=2,161)

SLO 2: Apply the foundational principles of computational or quantitative thinking to frame a question and devise a solution in a particular field of study.

	Foundational			Advanced/Applied		
	Sections Required to Report	Additional QCT Sections Reporting	Total Sections Included in Analyses	Sections Required to Report	Additional QCT Sections Reporting	Total Sections Included in Analyses
Pathways Sections Offering SLO 2	236	N/A	236	84	N/A	84
Pathways Sections Reporting Data	193 (82%)	N/A	193 (82%)	71 (85%)	N/A	71 (85%)
Pathways Sections Included in Analyses	179* (76%)	N/A	179 (76%)	61* (73%)	N/A	61 (73%)
Enrollment in Sections Offering QCT 2**	13,018	N/A	13,018	5,324	N/A	5,324
Students Included in Analyses**	7,709 (59%)	N/A	7,709 (59%)	2,711 (51%)	N/A	2,711 (51%)

* Data from 24 sections (14 Foundational; 10 Advanced/Applied) were excluded.
** Values include students who may be enrolled and/or assessed in multiple Pathways courses.
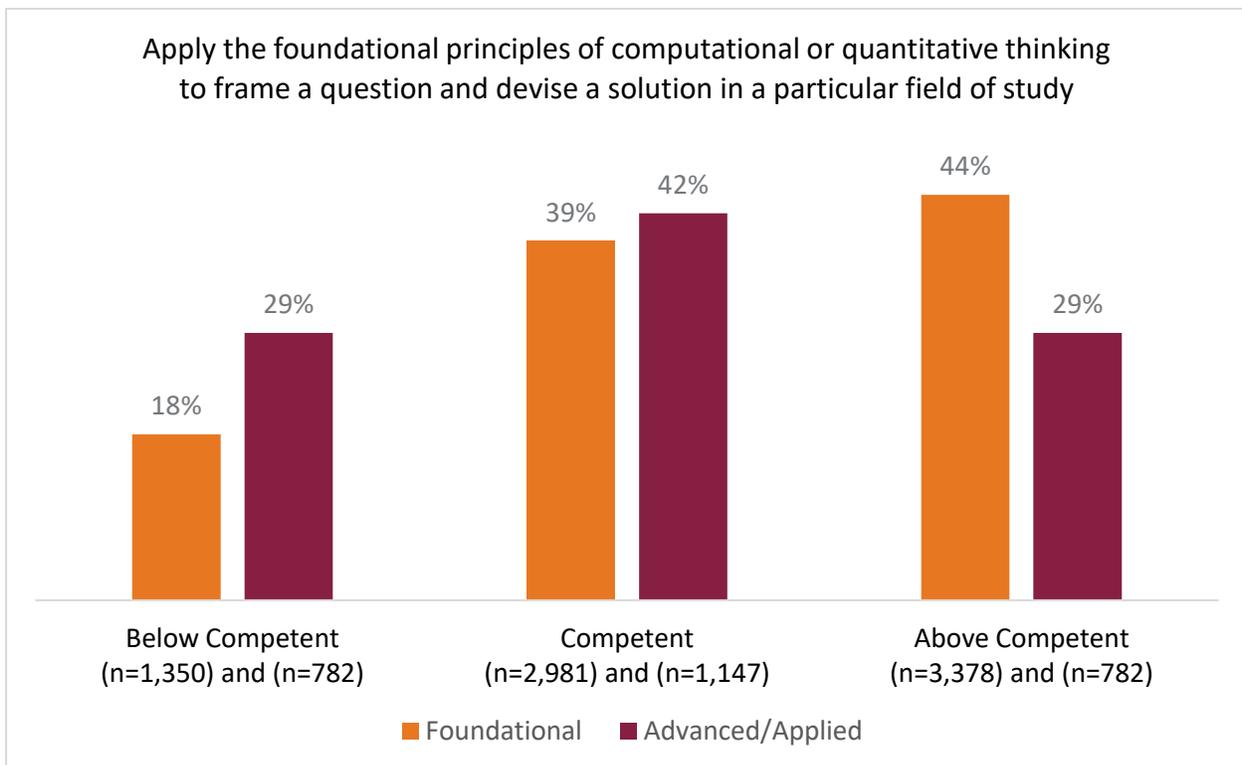

Figure 2. Foundational (n=7,709); Advanced/Applied (n=2,711)

3

SLO 3: Identify the impacts of computing and information technology on humanity.

	Foundational			Advanced/Applied		
	Sections Required to Report	Additional QCT Sections Reporting	Total Sections Included in Analyses	Sections Required to Report	Additional QCT Sections Reporting	Total Sections Included in Analyses
Pathways Sections Offering SLO 3	6	3	9	8	N/A	8
Pathways Sections Reporting Data	5 (83%)	3 (100%)	8 (89%)	7 (88%)	N/A	7 (88%)
Pathways Sections Included in Analyses	5 (83%)	3 (100%)	8 (89%)	6* (75%)	N/A	6 (75%)
Enrollment in Sections Offering QCT 3**	384	141	525	124	N/A	124
Students Included in Analyses**	258 (67%)	128 (91%)	386 (74%)	75 (60%)	N/A	75 (60%)

* Data from 1 section (Advanced/Applied) were excluded.
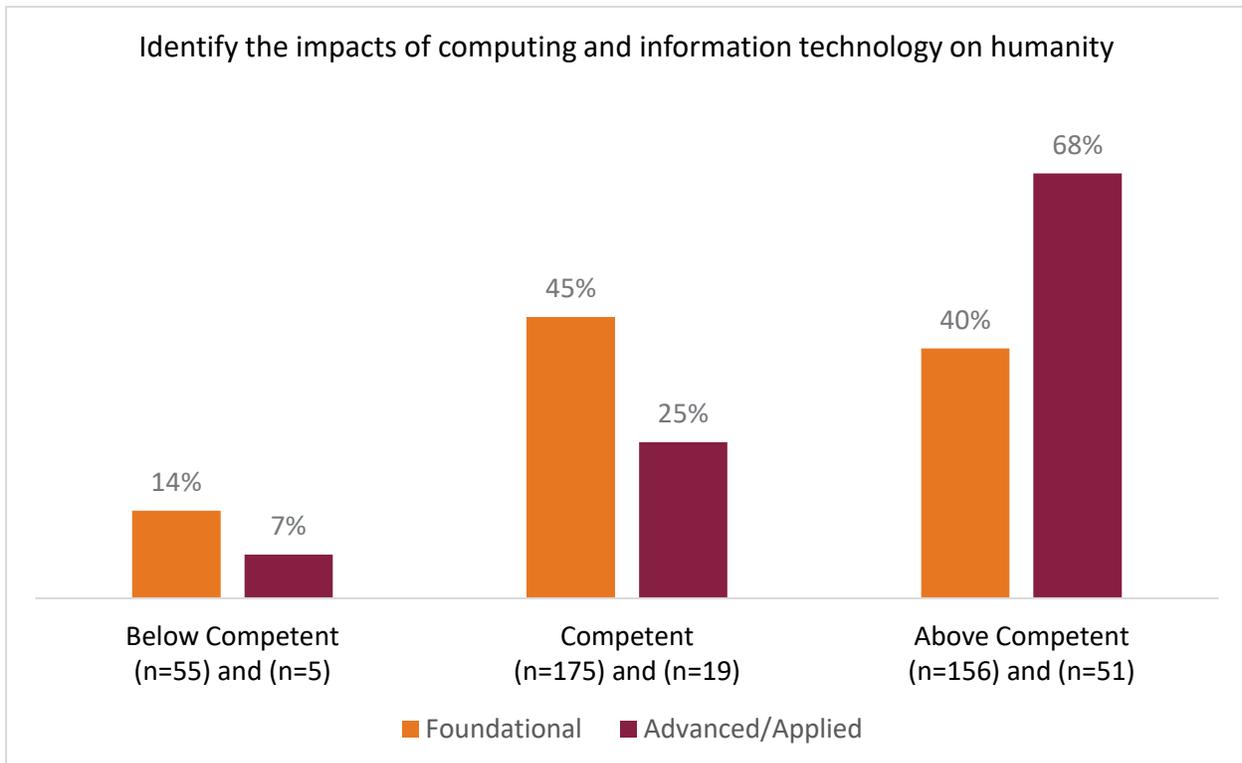** Values include students who may be enrolled and/or assessed in multiple Pathways courses.

Figure 3. Foundational (n=386); Advanced/Applied (n=75)

SLO 4: Construct a model based on computational methods to analyze complex or large-scale phenomenon.

	Foundational			Advanced/Applied		
	Sections Required to Report	Additional QCT Sections Reporting	Total Sections Included in Analyses	Sections Required to Report	Additional QCT Sections Reporting	Total Sections Included in Analyses
Pathways Sections Offering SLO 4	33	1	34	22	N/A	22
Pathways Sections Reporting Data	16 (48%)	1 (100%)	17 (50%)	12 (55%)	N/A	12 (55%)
Pathways Sections Included in Analyses	11* (33%)	1 (100%)	12 (35%)	10* (45%)	N/A	10 (45%)
Enrollment in Sections Offering QCT 4**	2,953	72	3,025	1,518	N/A	1,518
Students Included in Analyses**	455 (15%)	72 (100%)	527 (17%)	766 (50%)	N/A	766 (50%)

* Data from 7 sections (5 Foundational; 2 Advanced/Applied) were excluded.

** Values include students who may be enrolled and/or assessed in multiple Pathways courses.
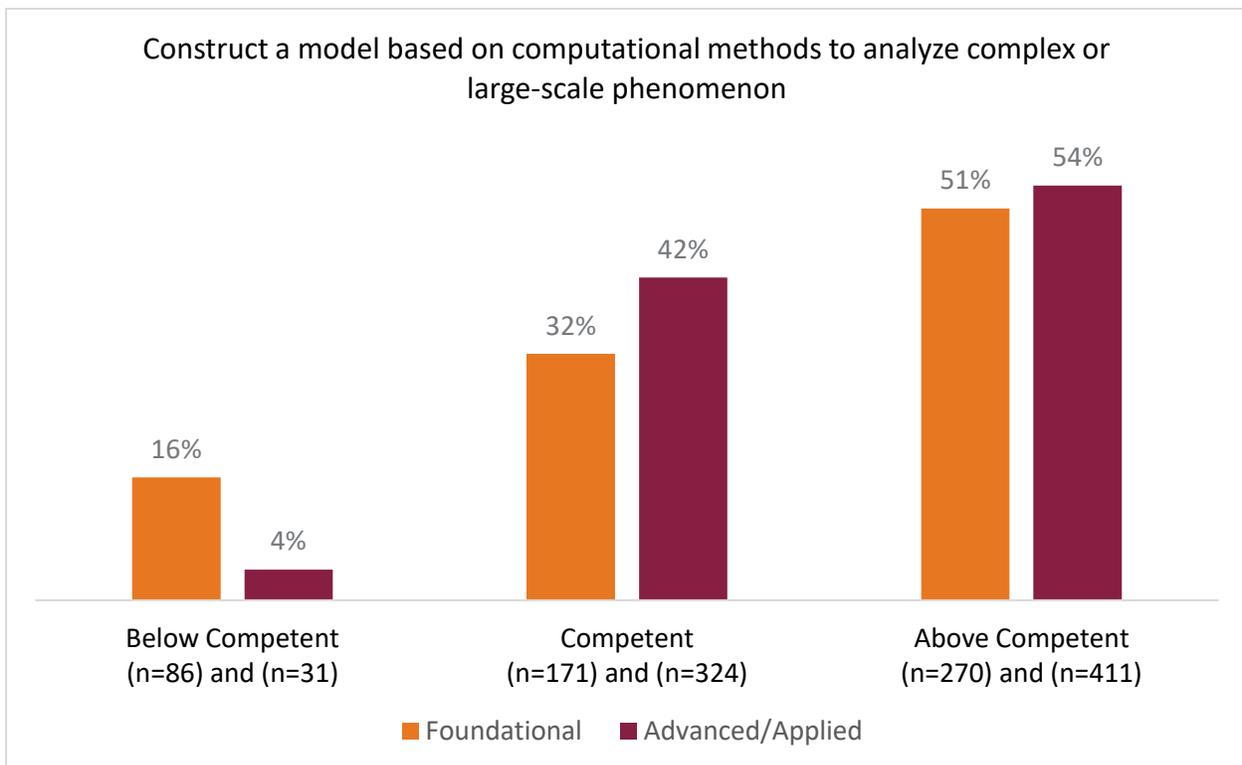

Figure 4. Foundational (n=527); Advanced/Applied (n=766)

SLO 5: Draw valid quantitative inferences about situations characterized by inherent uncertainty.

	Foundational			Advanced/Applied		
	Sections Required to Report	Additional QCT Sections Reporting	Total Sections Included in Analyses	Sections Required to Report	Additional QCT Sections Reporting	Total Sections Included in Analyses
Pathways Sections Offering SLO 5	224	2	226	79	N/A	79
Pathways Sections Reporting Data	189 (84%)	2 (100%)	191 (85%)	64 (81%)	N/A	64 (81%)
Pathways Sections Included in Analyses	175* (78%)	2 (100%)	177 (78%)	56* (71%)	N/A	56 (71%)
Enrollment in Sections Offering QCT 5**	12,347	99	12,446	5,102	N/A	5,102
Students Included in Analyses**	7,252 (59%)	97 (98%)	7,349 (59%)	2,500 (49%)	N/A	2,500 (49%)

* Data from 22 sections (14 Foundational; 8 Advanced/Applied) were excluded.

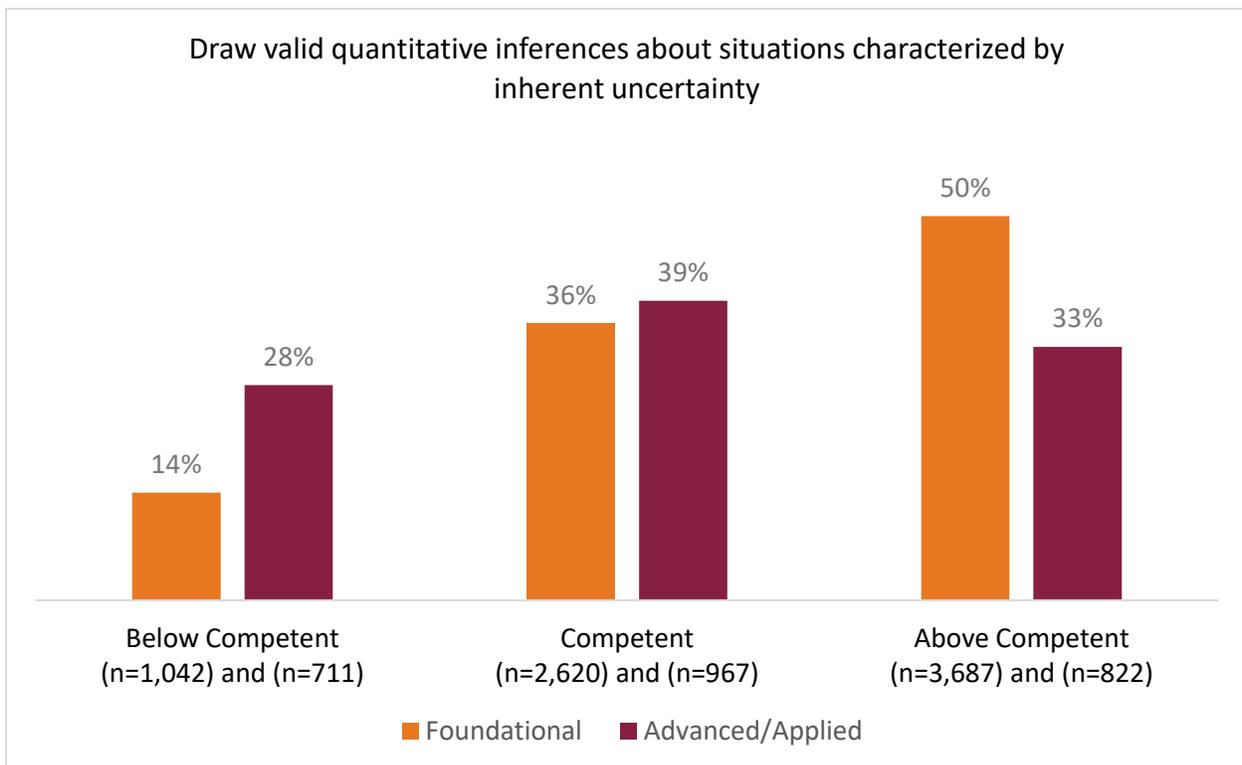** Values include students who may be enrolled and/or assessed in multiple Pathways courses.

Figure 5. Foundational (n=7,349); Advanced/Applied (n=2,500)

SLO 6: Evaluate conclusions drawn from or decisions based on quantitative data.

	Foundational			Advanced/Applied		
	Sections Required to Report	Additional QCT Sections Reporting	Total Sections Included in Analyses	Sections Required to Report	Additional QCT Sections Reporting	Total Sections Included in Analyses
Pathways Sections Offering SLO 6	231	N/A	231	83	1	84
Pathways Sections Reporting Data	190 (82%)	N/A	190 (82%)	65 (78%)	1 (100%)	66 (79%)
Pathways Sections Included in Analyses	174* (75%)	N/A	174 (75%)	54* (65%)	1 (100%)	55 (65%)
Enrollment in Sections Offering QCT 6**	12,687	N/A	12,687	5,319	20	5,339
Students Included in Analyses**	7,937 (63%)	N/A	7,937 (63%)	2,260 (42%)	20 (100%)	2,280 (43%)

* Data from 27 sections (16 Foundational; 11 Advanced/Applied) were excluded.

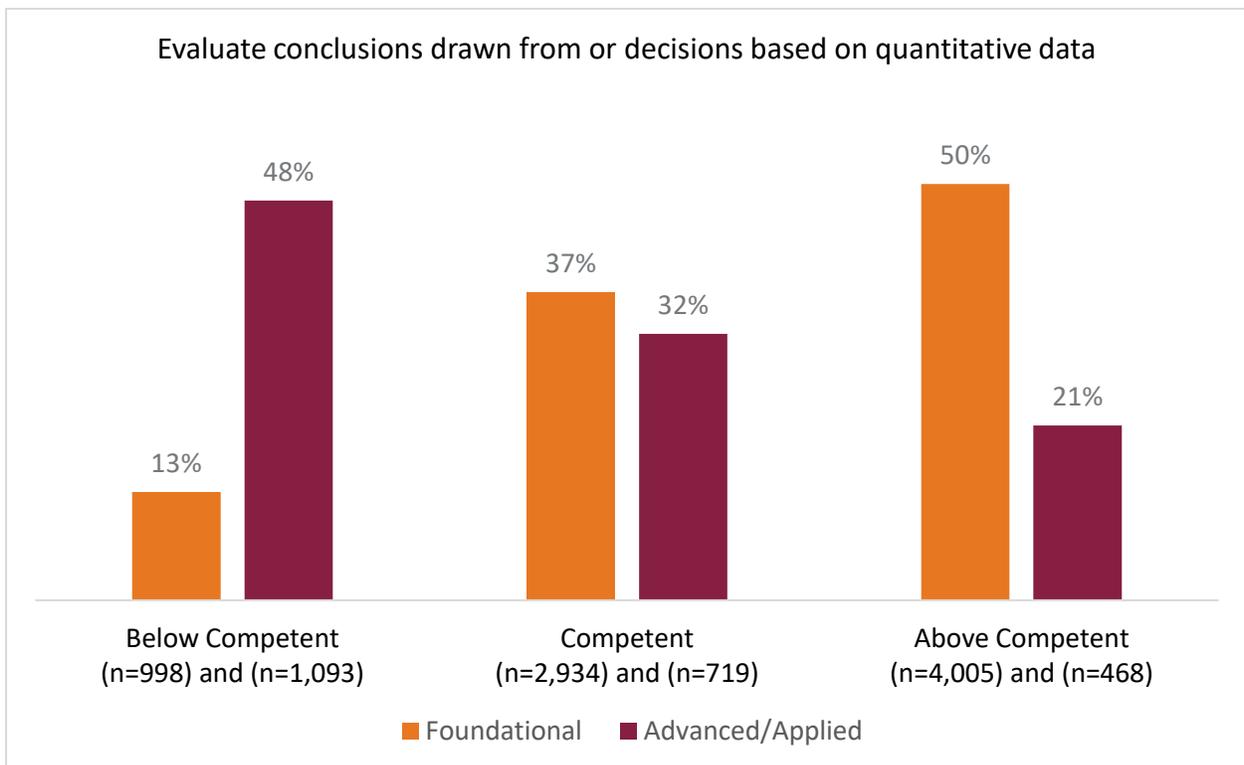** Values include students who may be enrolled and/or assessed in multiple Pathways courses.

Figure 6. Foundational (n=7,937); Advanced/Applied (n=2,280)