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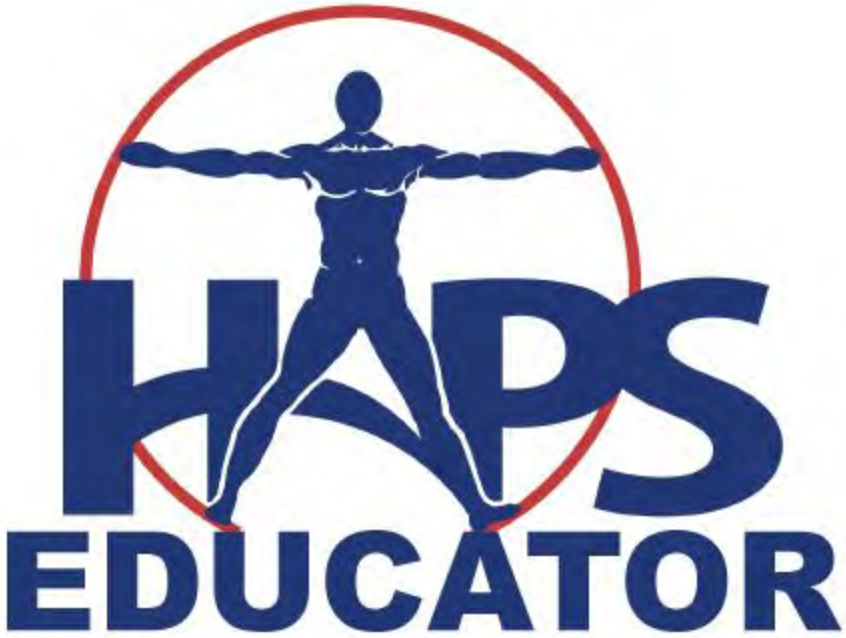

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Writing Intensive High Impact Practice along with Transparency in Learning and Teaching Promote Critical Thinking in Writing Assignments in Two Community College Science Courses

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Abstract

Writing Intensive (WR) High Impact Practice (HIP), which incorporates Transparency in Learning and Teaching (TILT), was applied to written assignments in Human Biology and Anatomy and Physiology II (A&P II) courses. As part of our study sponsored by the Association of American Colleges and Universities (AAC&U), certified AAC&U Valid Assessment of Learning in Undergraduate Education (VALUE) Institution rubric scorers assessed 100 assignments from students in two science courses for critical thinking using the critical thinking VALUE rubric. Students in A&P II, who had completed on average 75% of degree credits, had statistically significant higher distributions of critical thinking scores than those in Human Biology who will have completed on average 25% of degree credits at completion of the course. The distribution of scores between race and gender did not reveal any statistical differences. WR with TILT in written assignments promotes learning, equity and critical thinking.
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Key words: Case Study, Heart Failure, Transparency in Learning and Teaching, VALUE rubric, Writing Intensive, High Impact Practice

Introduction

Transparency in learning and teaching (TILT) is a technique that involves a collaboration among teachers and students about the processes of learning and the rationale for required learning activities. It involves a precise overview of an assignment including its purpose, how it relates to objectives of the course, and if it provides resources related to the topic of an assignment. This teaching approach helps level the understanding of assignments among students, making learning and achievement equitable. It began at the University of Illinois in 2009-2010.

Thousands of students in hundreds of courses and institutions in the United States have been involved in the development and assessment of the process. In 2014-2015 TILT partnered with the Association of American Colleges and Universities (AAC&U) to focus on advancing underserved students, including racial minorities, in higher education (Winkelmas 2013). Racial minorities include Black, African American, Asian, South Asian, Middle Eastern, Pacific Islander, Latinx, Chicanx, Native American, and multiracial students.

The AAC&U promotes sixteen essential learning outcomes, two of which are critical thinking and creative thinking (AAC&U 2005). Critical thinking involves comprehensive research of issues, ideas, and facts before coming to a conclusion. The literature is replete with articles on the importance of teaching critical thinking in the classroom. It is vital to all students and especially students in science who are heading for a medical field that requires rational thinking (Bellaera 2021; Morris 2021). Critical thinking and science literacy are learning objectives of biology courses at Monroe Community College (MCC).

High impact practice (HIP) courses, including writing intensive (WR) and undergraduate research (UR), are established teaching and learning methods that have been proven to be effective (Finley 2011; Finley 2019; Kuh 2008). HIP structure and organizational methods have been effective in retention and completion especially for students who are considered underserved (Finley and McNair 2013). The WR HIP has been shown to be effective in enhancing undergraduate biology students' perception and understanding of science (Brownell et al. 2013).

In this study, we used the WR HIP. Faculty at MCC who want a course designed WR must meet criteria and receive approval through MCC's Writing Intensive Committee. It would appear

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that WR HIP and TILT processes complement each other, promoting equity in teaching and learning especially for underserved students (Finley and McNair 2013; Winkelmas 2013; 2014; Winkelmas et al. 2016).

The AAC&U VALUE (Valid Assessment of Learning in Undergraduate Education) rubric is an assessment approach developed by faculty. The VALUE Institute was established (2014-2017) by the AAC&U. VALUE rubrics have become a widely used validated standard assessment of outcomes including critical thinking across the United States (AAC&U 2009).

MCC was one of 20 community colleges selected by the AAC&U to participate in a competitive study grant, *Strengthening Guided Pathways and Career Success by Ensuring Students Are Learning* (https://www.aacu.org/strengthening-guided-pathways). MCC's research team developed a protocol for the grant. Our study determined whether integrating the WR HIP with TILT in science assignments, which incorporates topics taught in class, has clear instructions and prompts critical thinking in a beginning level Human Biology course and a progressive enhancement of critical thinking in an upper-level Anatomy and Physiology II (A&P II) course as assessed by the VALUE rubric.

Methods

The study was conducted during the Spring 2020 semester. Seven sections of Human Biology taught by seven full-time faculty and two sections of A&P II taught by two full-time faculty were involved in the study. The curricula of courses in the study had to be modified to meet WR criteria. Not all sections of Human Biology or A&P II are designated WR and only sections of courses designated WR (designed to meet MCC WR criteria) were included in this study.

Research faculty worked together to develop the same assignments. This ensured that assignments used by all sections of Human Biology and the two A&P II classes, respectively, were the same. Student criteria for entry into the study was enrollment in a Human Biology or an A&P II course and that they were in a Health Science program. A total of 100 Health Science students from Human Biology and A&P II participated in this project.

A&P II is a gateway course for many health careers, and most students taking A&P II are in a Health Science program and have completed, on average, 75% of the credits toward their degree. Human Biology is an entry level biology course for science and non-science students. Students finishing Human Biology will have completed, on average, 25% of credits toward their associate degree. A few students in Human Biology are in the Health Sciences program and take this course prior to taking Anatomy and Physiology, but this is not a requirement. As a result, we had to include seven different sections of Human Biology in the study to enroll the required number of 50 Health Science students from this course. Faculty identified eligible students with the help of MCC's Department of Institutional Research and students were enrolled by random selection. However, there was not a large excess of eligible students in Human Biology or A&P II.

Monroe Community College's Institutional Review Board reviewed and approved this study. It was considered minimal risk with the only risk being disclosure of student names and the design of the study prevented this. It was placed in the exempt category by MCC's Institutional Review Board.

As part of the study design and WR course criteria, each student was given a written assignment, allowing a total of 100 assignments to be collected. We provided Human Biology students with an assignment at the beginning level of the scientific critical thinking process. Students could choose from two possible writing assignments that were based on a current issues topic: "Head Trauma in Young Athletes" or "Drug Abuse Among Athletes" (Johnson 2017). The Human Biology assignments were shorter and considered less difficult than the assignment for the A&P II students. Human Biology students based their paper on the current issues topic, textbook, lectures, and references.

The A&P II assignment was a case-study: "Mark's Failing Heart: A Look at Three Blood Volume Regulating Hormone Systems" (Cronmiller et al. 2020). We chose a case-study that involved the cardiovascular system and blood volume regulation because these are important concepts in A&P II, given that most students in this class are in a Health Science program. We felt this assignment would provide a practical exercise that would teach critical thinking, an important skill in their chosen field. A&P II students were provided information from the textbook, lectures, laboratories, and the case study about the cardiovascular assignment.

Student Instructions

In creating the assignment, we used the TILT method (Winkelmas 2013, Winkelmas 2014; Winkelmas et al. 2016). We provided clear instructions and criteria as guidance for success on the assignment. Instructions included:

- A statement of the assignment goals which are to stimulate analytical, critical, and reflective thinking, develop scientific literacy, and improve understanding of concepts in biology
- Formatting guidelines for word processing, including font and margins
- Length of the submission (7 to 10 pages for the A&P assignment and 3 to 5 pages for the Human Biology assignment)
- Due date
- Grade points for the assignment as an incentive
- Prompts of topics/issues to cover in the paper
- Sources to be used as references and the method for citing sources
- List of examples on how to format references from different sources
- Copy of the AAC&U critical thinking rubric

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Case-Study

The cardiovascular case study was slightly modified by adding TILT methodology. In order to complete the case-study assignment, students needed to have an understanding of the anatomy and physiology of the heart, mean arterial pressure (MAP), factors that affect MAP, cardiac output and total peripheral resistance. Students needed to understand the hormones which regulate blood volume: the renin-angiotensin-aldosterone-system (RAAS), antidiuretic hormone (vasopressin), atrial natriuretic peptide and brain (ventricular) natriuretic peptide. They also needed a basic understanding of heart failure. The case-study provides a brief description of the above anatomic and physiologic cardiovascular terms, conditions, and heart failure, multiple resources including images, as well as video and written references for students to research in order to learn more.

Based on what students have read and learned in class, laboratory, and references, they were required to write a 7-to-10-page paper. A list of TILT prompts were added to the case-study to help students write the paper such as: describe mean arterial pressure and its importance, describe the factors that influence MAP and how they achieve this, identify hormones affecting blood volume and explain their pathways and how they achieve these changes, explain the factors that are contributing to Mark's heart failure, explain why Mark has edema around the lungs and throughout the body, address the question of whether or not the fact Mark is an African American could have an influence on his heart failure.

Critical Thinking Rubric

Each of the 100 assignments was assessed for critical thinking by the AAC&U Value Rubric Institute. External scorers, who were trained and certified by the AAC&U, evaluated five categories of critical thinking: explanation of issues, evidence, influence of context and assumptions, student's position (perspective, thesis/hypothesis), and conclusions (implications and consequences) using the rubric (Table 1).

At the completion of the study, we sent to AAC&U the 100 assignments and an Excel metafile. The assignments and Excel

Category	Capstone	Milestones		Benchmark
	4	3	2	1
Explanation of issues	Issue/problem to be considered critically is stated clearly and described comprehensively, delivering all relevant information necessary for full understanding.	Issue/problem to be considered critically is stated, described, and clarified so that understanding is not seriously impeded by omissions.	Issue/problem to be considered critically is stated but description leaves some terms undefined, ambiguities unexplored, boundaries undetermined, and/or backgrounds unknown.	Issue/problem to be considered critically is stated without clarification or description.
Evidence Selecting and using information to investigate a point of view or conclusion	Information is taken from source(s) with enough interpretation/evaluation to develop a comprehensive analysis or synthesis. Viewpoints of experts are questioned thoroughly.	Information is taken from source(s) with enough interpretation/evaluation to develop a coherent analysis or synthesis. Viewpoints of experts are subject to questioning.	Information is taken from source(s) with some interpretation/evaluation, but not enough to develop a coherent analysis or synthesis. Viewpoints of experts are taken as mostly fact, with little questioning.	Information is taken from source(s) without any interpretation/evaluation. Viewpoints of experts are taken as fact, without question.
Influence of context and assumptions	Thoroughly (systematically and methodically) analyzes own and others' assumptions and carefully evaluates the relevance of contexts when presenting a position.	Identifies own and others' assumptions and several relevant contexts when presenting a position.	Questions some assumptions. Identifies several relevant contexts when presenting a position. May be more aware of others' assumptions than one's own (or vice versa).	Shows an emerging awareness of present assumptions (sometimes labels assertions as assumptions). Begins to identify some contexts when presenting a position.
Student's position (perspective, thesis/hypothesis)	Specific position (perspective, thesis/hypothesis) is imaginative, taking into account the complexities of an issue. Limits of position (perspective, thesis/ hypothesis) are acknowledged. Others' points of view are synthesized within position (perspective, Thesis/ hypothesis).	Specific position (perspective, thesis/hypothesis) takes into account the complexities of an issue. Others' points of view are acknowledged within position (perspective, thesis/ hypothesis).	Specific position (perspective, thesis/hypothesis) acknowledges different sides of an issue.	Specific position (perspective, thesis/hypothesis) is stated, but is simplistic and obvious.
Conclusions and related outcomes (implications and consequences)	Conclusions and related outcomes (consequences and implications) are logical and reflect student's informed evaluation and ability to place evidence and perspectives discussed in priority order.	Conclusion is logically tied to a range of information, including opposing viewpoints; related outcomes (consequences and implications) are identified clearly.	Conclusion is logically tied to information (because information is chosen to fit the desired conclusion); some related outcomes (consequences and implications) are identified clearly.	Conclusion is inconsistently tied to some of the information discussed; related outcomes (consequences and implications) are oversimplified.

Table 1. *Critical thinking rubric (Association of American Colleges and Universities 2009).*

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metafile substituted student names with ID codes. Student personal and education records are stored in MCC's Office of Institutional Research. We sent the AAC&U student data to help generate a multiple faceted assessment report. These included information on student gender and race to help determine whether these variables had an influence on critical thinking outcomes.

Results were expressed using descriptive statistics including raw data, tables, and percentages. We analyzed the probability of a relationship between critical thinking data using Chi Square with a cut off *p* value of 0.05.

This study was performed during the Spring 2020 semester. The COVID-19 pandemic closed the school on March 18, 2020, and education moved from face-to-face to remote.

The conversion was a challenge that involved technical training and support to get us through to the end of the semester. Education, especially labs, were affected. However, the performance of this study did not appear to be affected. Instructions for study assignments were in the course information sheet given to students at the beginning of the semester, lecture and lab information on the assignment topic were covered prior to the move to remote teaching and learning, faculty remained accessible to students concerning assignments before and during remote teaching, and students and faculty did not feel that remote teaching/learning affected their performance on the assignment.

In this article, we refer to Black, African American, Asian, South Asian, Middle Eastern, Pacific Islander, Latinx, Chicanx, Native American, and multiracial as racial minority students. White students are in a separate category. Thirty eight percent of students at MCC are minority students.

Results

Tables 2 & 3 reveal the distribution of results for each critical thinking category for Human Biology and A&P II students. A&P II students had a significant ($p < 0.05$) higher distribution of critical thinking scores than Human Biology students for each category. Table 4 reveals *p* values of the probable relationship between Human Biology and A&P II students for each category of critical thinking rubric results. The mean grade point average (GPA) for A&P students was 3.3 while that for Human Biology students was 2.8.

Category	Capstone	Milestones		Benchmark	No Evidence
	4	3	2	1	0
	Count (%)	Count (%)	Count (%)	Count (%)	Count (%)
Explanation of Issues	1 (2%)	28 (56%)	19 (38%)	2 (4%)	0
Evidence	0	5 (10%)	22 (44%)	20 (40%)	3 (6%)
Influence of Context and Assumptions	0	7 (14%)	27 (54%)	14 (28%)	2 (4%)
Student's Position	0	7 (14%)	21 (42%)	12 (24%)	10 (20%)
Conclusion and Related Outcomes	0	2 (4%)	31 (62%)	13 (26%)	4 (8%)

Table 2. *Critical thinking results for Human Biology students (N=50)*

Category	Capstone	Milestones		Benchmark	No Evidence
	4	3	2	1	0
	Count (%)	Count (%)	Count (%)	Count (%)	Count (%)
Explanation of Issues	12 (24%)	32 (64%)	4 (8%)	0	2 (4%)
Evidence	3 (6%)	11 (22%)	34 (68%)	2 (4%)	0
Influence of Context and Assumptions	1 (2%)	14 (28%)	31 (62%)	4 (8%)	0
Student's Position	0	18 (36%)	19 (38%)	3 (6%)	10 (20%)
Conclusion and Related Outcomes	0	13 (26%)	35 (70%)	2 (4%)	0

Table 3. *Critical thinking results for A&P II students (N=50)*

Critical Thinking Rubric Category	*P* Value
Explanation of Issues	0.00011
Evidence	0.00004
Influence of Context and Assumptions	0.02477
Student's Position	0.01588
Conclusion and Related Outcomes	0.00014

Table 4. *P values of the probable relationship between Human Biology and A&P II students for each category of critical thinking rubric results.*

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Tables 5 & 6 reveal the distribution of critical thinking results for each category for white students and racial minority students in Human Biology and A&P II. We did not have race data on one student. There was no difference ($p \geq 0.05$) in the distribution of any of the critical thinking categories between races taking Human Biology and A&P II. Table 7 reveals *p* values of the probable relationship between white and minority Human Biology and A&P II students for each category of critical thinking rubric results.

Category	Capstone	Milestones		Benchmark	No Evidence
	4	3	2	1	0
	Count (%)	Count (%)	Count (%)	Count (%)	Count (%)
Explanation of Issues	10 (17%)	36 (61%)	12 (20%)	0	1 (2%)
Evidence	2 (3%)	8 (14%)	34 (57%)	14 (24%)	1 (2%)
Influence of Context and Assumptions	0	15 (25)	33 (56%)	11 (19%)	0
Student's Position	0	15 (25%)	24 (41%)	8 (14%)	12 (20%)
Conclusion and Related Outcomes	0	10 (17%)	41 (69%)	7 (12%)	1 (2%)

Table 5. *Critical thinking results for white Human Biology and A&P II students (N=59)*

Category	Capstone	Milestones		Benchmark	No Evidence
	4	3	2	1	0
	Count (%)	Count (%)	Count (%)	Count (%)	Count (%)
Explanation of Issues	3 (7%)	23 (58%)	11 (28%)	2 (5%)	1 (2%)
Evidence	1 (2%)	8 (20%)	22 (55%)	7 (18%)	2 (5%)
Influence of Context and Assumptions	1 (2%)	6 (15%)	25 (63%)	6 (15%)	2 (5%)
Student's Position	0	10 (25%)	16 (40%)	6 (15%)	8 (20%)
Conclusion and Related Outcomes	0	5 (13%)	24 (60%)	8 (20%)	3 (7%)

Table 6. *Critical thinking results for Human Biology and A&P II racial minority students (N=40)*

Critical Thinking Rubric Category	*P* Value
Explanation of Issues	0.26
Evidence	0.56
Influence of Context and Assumptions	0.19
Student's Position	0.99
Conclusion and Related Outcomes	0.29

Table 7. *P values of the probable relationship between white and minority Human Biology and A&P II students for each category of the critical thinking rubric results.*

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There also was no difference ($p \geq 0.05$) in the distribution of any of the critical thinking categories between students of different races within the individual courses (table not shown). There was a higher percent (53%) of minority students taking Human Biology and a higher percent (72%) of white students taking A&P II. The mean GPA for racial minority students in A&P II was 3.1 while that of racial minority students in Human Biology was 2.7. The mean GPA of white A&P II students was 3.4 while that of white Human Biology students was 3.1.

Tables 8 & 9 reveal the distribution of critical thinking results for each category for male and female students in Human Biology and A&P II. There was no difference ($p \geq 0.05$) in the distribution of any of the critical thinking categories between male and female students in the Human Biology and A&P II. Table 10 reveals *p* values of the probable relationship between male and female Human Biology and A&P II students for each category of critical thinking rubric results.

Category	Capstone	Milestones		Benchmark	No Evidence
	4	3	2	1	0
	Count (%)	Count (%)	Count (%)	Count (%)	Count (%)
Explanation of Issues	3 (11%)	15 (58%)	7 (27%)	1 (4%)	0
Evidence	1 (4%)	3 (11%)	13 (50%)	8 (31%)	1 (4%)
Influence of Context and Assumptions	0	6 (23%)	14 (54%)	5 (19%)	1 (4%)
Student's Position	0	5 (19%)	7 (27%)	5 (19%)	9 (35%)
Conclusion and Related Outcomes	0	6 (23%)	12 (46%)	7 (27%)	1 (4%)

Table 8. *Critical thinking results for male Human Biology and A&P II students (N=26)*

Category	Capstone	Milestones		Benchmark	No Evidence
	4	3	2	1	0
	Count (%)	Count (%)	Count (%)	Count (%)	Count (%)
Explanation of Issues	10 (13%)	45 (61%)	16 (22%)	1 (1%)	2 (3%)
Evidence	2 (3%)	13 (17%)	43 (58 %)	14 (19%)	2 (3%)
Influence of Context and Assumptions	1 (1%)	15 (21%)	44 (60%)	13 (17%)	1 (1%)
Student's Position	0	20 (27%)	33 (45%)	10 (13%)	11 (15%)
Conclusion and Related Outcomes	0	9 (12%)	54 (73 %)	8 (11%)	3 (4%)

Table 9. *Critical thinking results for female Human Biology and A&P II students (N=74)*

Critical Thinking Rubric Category	*P* Value
Explanation of Issues	0.63
Evidence	0.37
Influence of Context and Assumptions	0.89
Student's Position	0.10
Conclusion and Related Outcomes	0.07

Table 10. *P values of the probable relationship between male and female Human Biology and A&P II students for each category of critical thinking rubric results.*

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There also was no difference ($p \geq 0.05$) in the distribution of any of the critical thinking categories between male and female students within the individual courses (data not shown). There was a higher percent of female students in Human Biology and A&P II, 70% and 78% respectively. The mean GPAs for male students in A&P II and Human Biology were 3.2 and 3.0, respectively. The corresponding mean GPAs for female students were 3.3 (A&P II) and 2.8 (Human Biology).

Discussion

The distribution of critical thinking results for A&P II students were significantly higher than those for Human Biology students. A&P II students performed better even though their assignment was more complex, more demanding, and longer (7 to 10 pages versus 3 to 5 pages). This is not a surprise and follows our teaching strategy. A&P II students have more degree credits than Human Biology students. A&P II is a higher-level gateway course for Health Science programs such as Nursing. These students, particularly those in competitive admission programs, are focused and committed to success in this field. They have a good GPA by MCC standards and more science experience and understanding. Human Biology is an entry-level course, and students may be taking the course to gain exposure to this science to see if they have the capability, aptitude and interest in moving forward. However, the assignments for Human Biology students were an appropriate initiation to scientific literacy and the transition in critical thinking results from Human Biology to A&P II revealed a good progression.

We believe that fitting a written assignment, as part of an WR HIP, into the science curriculum is effective and supports earlier research (Brownell et al. 2013). Adding TILT to the assignment enhances the effectiveness. Incorporating WR HIP and TILT into assignments is difficult considering time constraints. The length and difficulty of the assignment should match the level and objectives of the course.

There was no statistically significant difference in critical thinking results among racial groups or between genders. This equity in results among racial minority and white students supports previous studies (Finley and McNair 2013; Winkelmas 2013). A study assessing critical thinking on an assignment by one group of students with a mix of race in a class using WR and TILT with a similar mix of students in another class not using WR or TILT would be very helpful. The critical thinking results and GPAs support a transition in learning and scholarship from Human Biology to A&P II regardless of race or gender.

We do not have critical thinking data on individual students from Human Biology to A&P II. A future study following the progress of individual students from Human Biology to A&P II would be informative. A College's Office of Institutional Research could help track students as they move from one class to the next.

We believe that including TILT in a HIP assignment is a technique that could help level the learning playing field (Finley and McNair 2013; Winkelmas 2013). The results of this study, as noted above do, support this premise. As a primer to the assignment, instructors should review the categories of the critical thinking rubric with students and provide a copy to the student. They should cover each category and the definition of each level and provide written examples. Students also need to understand the proper scientific language to use in order to express themselves. This could help them move up to a higher level in each rubric category (Jurecki & Wander 2012; Savage 2014). Some students found the student position perspective, thesis/hypothesis category of the critical thinking rubric challenging, and results reflect this. Spending more time reviewing the definition of this category with students might be helpful.

We also believe assignment topics like the ones used in this study should incorporate information taught in class in order to reinforce that material being taught is applicable to student degree and career aspirations. This could hold their interest and motivation (Eyler 2009).

As part of the grant agreement, the VALUE Institute assessed our student assignments for critical thinking (AAC&U 2009). Faculty at the VALUE Institute are trained and certified in the assessment process. Their involvement standardized the process and helped legitimize our results. MCC believes in this process and a number of faculty have become certified in the assessment of different essential outcomes through the VALUE Rubric Institute. Training in their certificate program has assured MCC faculty of the proper interpretation of rubrics and instilled confidence in their understanding of the process. This will enable MCC to sustain and expand the assessment process.

Conclusion

We believe the overall distribution of critical thinking rubric results for Human Biology and A&P II students suggest that the WR HIP along with TILT, were effective in improving students' critical thinking in Human Biology and A&P II. MCC's plan is to use our study design as a template to expand the process for courses using different HIPs and essential outcomes throughout MCC. Colleges interested in adopting this process should understand that one key to success of this study and expansion of this process at MCC is collaboration at all organizational levels at the college. Future studies could further assess the efficacy of this process by comparing sections of a course that incorporate the WR HIP, TILT, and VALUE rubric with those that do not, study its effectiveness among courses in different disciplines, and study the progress of individual students taking different levels of courses within their program.

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About the Authors

This study was a collaborative effort. All co-authors contributed to the study. Julie A. Babulski, MS, Assistant Professor Biology has a specialty in Human Biology lecture and laboratory. Michele Finn, MS, a professor of Biology has a specialty in Human Physiology and Human Biology. Jennifer A. Hill, PhD, Professor of Biology has a specialty in Human Biology, General Biology and Human Anatomy. Jennifer A. Markham, PhD, Associate Professor of Biology has a specialty in Human Biology, General Biology and is on the WR HIP Committee. James A. Murphy, MS, Professor and chair of the Biology Department has a specialty in Human Biology and Biotechnology. MaryJo Vest, MS, Professor of Biology has a specialty in Human Biology, Anatomy and Physiology, Curriculum, and is a member of the WR HIP Committee. She also helped write and publish the case study. Artif Wahba, MD, Assistant Professor Biology has a special interest in Human Biology and human cadaver dissection. James R. Cronmiller, MA, Associate Professor Emeritus, has a specialty in Human Anatomy and Physiology, is co-chair of the MCC Undergraduate Research committee, and Chair of the HIP committee. He helped organized the study, write the design and protocol for Human Biology & A&P II assignments, and helped design, write and publish the case study. Christopher D. Wendtland, MS, Professor of Biology has a specialty in Biochemistry and helped design and write protocol of A&P II assignment. All of the above faculty helped design and write the protocols for the Human Biology or A&P II assignments, ensured students in their classes met criteria for the study, gathered study data, and contributed to writing the article. Kimberley P. Collins, MS, Associate Vice President, Academic Services and Michael Jacobs, D.Arts, Dean, Humanities and Life Science helped write the application to the AAC&U for the study grant, organized the study, wrote the design and protocol, and contributed to writing the article. Associate Vice President Collins and Dean Jacobs are also on the HIP committee. Susan L. Hall, PhD, Associate Director, Curriculum and Program Development helped organize the study, write the design and protocol, gather and organize study data, and contributed to writing the article. She is also on the HIP committee.

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