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The Development and Initial Testing of the Jacksonville Attitudes toward Research Survey

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Abstract

Undergraduate research experiences (UREs)—ranging in scope from introductory term papers to doctoral dissertations—comprise an important aspect of higher education. Many studies have undertaken to assess the benefits that students derive from UREs, finding that UREs foster students' technical, intellectual, critical, personal, & interpersonal skills. Many of these benefits are closely connected to the student's attitudes toward research. However, very little is known about the development of students' attitudes toward research, leaving many questions related to UREs unanswered: How can student attitudes toward research be classified? Does the development of these attitudes correlate with learning and work quality in an URE? Do UREs as they are currently practiced tend to improve these attitudes? What features of UREs tend to produce improvement or decline in these attitudes? Answering such questions requires a standardized assessment of student attitudes toward research, which currently does not exist. To meet this need, the authors have begun to develop and validate the Jacksonville Attitudes toward Research Survey (JARS). The JARS consists of a set of research-related statements to which students respond on a Likert (agree-disagree) scale. The overall survey responses are evaluated based on the percentage of statements to which the student provides an expert-like response (percent favorable score) or novice-like response (percent unfavorable score). By administering the JARS at the beginning and end of an URE, institutions can evaluate changes in the student's attitudes during the URE. The authors have developed a draft of the JARS statements, obtained a set of standardized responses from faculty, and are currently completing the preliminary student validation. This paper presents an overview of the survey, an analysis of the faculty validation, and comments on the ongoing student validation.

Keywords: Undergraduate research, Learning attitudes, Assessment

1. Introduction

In Fall 2011, Jacksonville University (JU) administrators sent out a call for white papers in anticipation of a new experiential learning graduation requirement beginning in 2013, as part of its quality enhancement program (QEP). This new requirement states that all JU students must complete 3.0 credit hours' worth of one of four possible experiential learning activities (ELAs): 1) URE, 2) service learning, 3) internship, or 4) study abroad. This new experiential learning program is known as ECHO, and its slogan, "everything you do comes back to you," alludes to the fact that, by participating in one of these activities, students will acquire valuable skills, gain real-world experience, develop cultural awareness, and forge lasting relationships that can serve them long after graduation.

It is significant that all JU students will soon be required to participate in an ELA, since it means that a sample of the whole spectrum of JU students will undertake UREs, whereas traditionally one would expect only the "best" students to voluntarily participate in research. According to the Jacksonville University QEP, just 70% of graduating seniors in the 2012 academic year participated in one of the four mentioned ELAs, with about half of those completed because of a graduation requirement. Assuming that roughly 25% of 2012 graduates chose UREs as their experiential learning activity, and ignoring the 50% who had to complete it as a graduation requirement, it would not be unreasonable to conclude that only about 9% of graduating seniors in 2012 participated in an elective URE. In contrast, a possible 25% or more of JU students will likely participate in UREs in the future.

The call for papers by JU administrators solicited ideas about how to assess these ELAs. The Jacksonville Attitudes toward Research Survey (JARS) was created in response to that call and offers a method to assess UREs.

1.1 Literature On Student Attitudes

It is a well-established conclusion that student attitudes (including their motivation, epistemological beliefs, and problem-solving approaches) toward learning have a powerful effect on student effort & learning gains. For example, students' attitudes toward college course format (web based vs. lecture) significantly affect their learning gains in those courses.[1] Numerous studies have found a strong positive correlation between a student's positive motivation & attitude toward learning and that student's learning gains, even showing that students' attitudes can have a more powerful impact on their performance than previous educational preparation.[2,3,4]

Based on this strong correlation between student attitudes and performance, student learning attitudes are a current focus of assessment & research in STEM education.[2,3,4,5] For example, the Colorado Learning Attitudes about Science Survey (CLASS) has been developed to assess students' learning attitudes toward physics, chemistry, and biology.[6,7] By administering this survey at the beginning and end of a science course, instructors can assess the impact their instruction has had on students' attitudes toward the field of instruction, which, in addition to affecting student performance, has important cultural implications.[8] Attitude assessment tools like the CLASS find that, in most introductory science courses (even those based on educational reforms that lead to improved conceptual gains), students' learning attitudes typically decline between pre- and post-instruction, leading science educators to prioritize improving student learning attitudes when developing pedagogical innovations, with some success.[9,10,11,12,13,14]

1.2 The Importance Of Student Attitudes Toward Research

By taking a closer look at many of the benefits of UREs outlined above, we can see that, just as a student's conceptual learning in the traditional course is strongly related to the student's attitudes toward the subject matter, many of the benefits of UREs are closely connected to the student's attitudes toward research.

Many of the most important benefits of UREs are related to attitude components already established in educational research. For example, students' confidence (in both their skill level and the quality of their work), subject matter interest, and desire to learn are well established motivational/attitudinal factors.[15] The idea of "where 'knowledge' comes from", manifested in students' epistemological beliefs and senses of originality/creativity, is one of Hammer's three dimensions of student beliefs about science.[9] Personal/interpersonal skills such as teamwork, coping with deadlines & setbacks, time management, and originality all speak to the "sophistication" of the student's approach to research, which shows that student's beliefs about how good research is conducted.

Improving students' attitudes toward research is a result of tending to URE participants' needs for what Lopatto termed "consideration items" (social/emotional needs of the student that require personal/interpersonal support features), such as opportunities for creativity, scaffolding through a combination of independent and collaborative work, a healthy mentoring relationship, a sense of ownership of the project, and a sense of the project's significance & meaning.[16] While structure items (physical/institutional needs) were ranked roughly equally with consideration items in a faculty poll, a student poll ranked consideration items more highly, leading Lopatto to hypothesize that "[s]tudents value consideration more than structure.... They learn from the mentor how scientists think, how obstacles are tolerated and how a career path develops. [The] broadest level of structure of an [UG] program, such as facilities, equipment, and programmed poster sessions, may fail to yield desired responses from undergraduate researchers without a concomitant attempt to develop… considerate mentoring."

Lopatto's "desired responses" of how researchers think and behave stand at the very heart of one's attitudes toward research.[12] Failing to develop in students expert-like attitudes toward research will keep them in a novice state. Just as learning attitudes have become the focus of pedagogical reforms in introductory science courses, it may be that learning attitudes need to become the focus of reforms in UREs.[5,9,17,18,19]

Many questions have largely remained unaddressed in the literature, including, Do UREs as they are currently practiced improve students' attitudes toward research? What factors during an URE impact improvement or decline in students' attitudes toward research? How can these attitudes be classified? Do URE participants and faculty mentors perceive/frame student attitudes toward research in the same way? This paper seeks to address these questions by presenting a standardized means of assessing student attitudes toward research.

1.3 Assessing Student Attitudes Toward Research

Ensuring a quality URE requires assessment of student attitudes toward research. In spite of the significant relationship between student attitudes and UREs, no standardized means of assessing student attitudes toward research currently exists. Student attitudes toward research have been investigated in discipline-specific contexts using tools that are insightful but limited in scope.[20,21] These studies illustrate a useful framework of attitudinal factors, noting possible correlations, and establishing the contextualization of students' attitudes toward research. Institutions of higher education and national research institutions would benefit from such means of assessment by gaining insight into the impact of their research endeavors on student participants.

The JARS gauges student attitudes toward research as a means of assessing UREs. The JARS has been validated by faculty with strong ongoing research activities to ensure that it accurately detects expert-like attitudes toward research; it is being validated by students for clarity and accuracy. Section 2 of this paper gives an overview of the JARS, along with comments on the faculty validation and the structure of the survey. Data collection methods are then briefly mentioned in Section 3. Section 4 follows with analysis and comments on the initial student validation on the aggregate level, with discussion specifically focusing on the positive and negative results of the student validation. Section 5 contains a discussion of a sample of the individual student scores. Section 6 summarizes these results and outlines the next steps for the JARS.

2. Overview of the JARS

The latest version of the JARS can be found at http://bit.ly/JU-JARS, along with the interview questions that were asked of student participants during survey validation. Because the JARS measures attitudes toward research, and because there are many different perceptions of what research is across the academic spectrum, it is important that the JARS be based on a definition of research that sufficiently encompasses that spectrum. Although specific aspects of research are manifested differently in different fields, research in all fields shares important characteristics. Broadly, research is a knowledge-building exercise which involves reviewing, analyzing, and synthesizing ideas into a form that adds value to a body of knowledge, including a review of what has already been thought, said, written, or done on a subject. Research also involves analyzing ideas, and requires the researcher to synthesize ideas into a form that is understandable, interesting, or informational. Thus, the JARS adopts a definition of "research" that is sufficiently broad to encompass all areas of university scholarship.

The validation of the JARS follows a four-stage process patterned after established guidelines:[6]

1. Creating an initial draft of the JARS.
2. Conducting faculty interviews to ensure the survey's clarity, completeness, & accuracy.
3. Administering the JARS to many faculty to check that each survey item produces a consistent response.
4. Interviewing students to confirm that students understand the survey statements.

Based on feedback received at each stage, the survey has been progressively revised.

2.1 Structure Of The JARS

The JARS is composed of 40 statements about research to which students respond on a 5-point agree-disagree (Likert) scale. The survey is scored based on the percentage of statements to which the student provides an expert-like response (the % favorable score), the percentage of statements to which the student provides a novice-like response (the % unfavorable score), and the percentage of statements to which the student provides a neutral response (the % neutral score).[22] The authors also examined the results via polarization binning, which tracks student responses in terms of strength, allowing a view of how strong students' views are.[23] JARS statements are arranged into tentative author-determined categories to examine themes in the survey statements; students' responses are also evaluated in terms of each category's % favorable and % unfavorable score. Table 1 below contains a brief description of each category and the JARS statements that comprise each category.

Table 1. Author-determined categories of the JARS statements

Category	Statements	Description
Communication & Reading Skills	7, 13, 17, 25, 29	Does the student feel capable of understanding documents within her discipline and of communicating her research?
Confidence in Self	3, 7, 13, 17, 20, 21, 23, 24, 25, 29	Does the student believe she can conduct good research? Does the student feel confident in her research abilities?
Confidence in Work	15, 36	Does the student feel her methods and results are reliable?
Future Hope	8, 11	Does the student look forward to research in the future?
Sense of Impact	6, 15, 24, 33, 36	Does the student feel that her research has positively affected others (within her field or society at large)?
Value of Collaboration	1, 9, 18, 38	Does the student consider collaboration to contribute to the quality of the work?
Value of Iteration/Revision	10, 14, 19, 21, 28, 30, 34, 38	Does the student view her research with an eye toward improving its quality?
Value of Learning	16, 20, 22, 23, 27, 32, 35	Does the student feel she has learned something important from her research—regardless of whether others ever do?
Value of Perseverance	26, 28, 30	Is the student prepared to press on in a research project in the face of difficulties?
Value of Skills	4, 27, 33, 35, 37, 39	Has the research project helped the student develop skills that are important to her?
Value of Work	6, 12, 16, 22, 23, 31, 32, 33, 35	Did the student find the project worthwhile?
Uncategorized	2, 5, 10, 34, 40	2, 5, 10, & 34 did not reach a consistent expert-like response among faculty. 40 is a means of correlating student responses with interest in research funding.

2.2 Faculty Validation Of The JARS

The goals of the faculty validation of the JARS were to see if faculty (presumably expert researchers) offered consistent responses to the JARS statements, to see if faculty members found any of the JARS statements redundant. and to improve the clarity, completeness, and accuracy of the JARS based on faculty feedback.

The overwhelming agreement of faculty responses to most JARS items indicates that the first goal was accomplished to a sufficient degree. The fact that faculty members from across the academic spectrum responded so consistently to the survey statements is an encouraging indication of the robustness of the JARS. There was also a strong consensus that while the statements overlapped slightly in a broad sense, no two statements seemed redundant, indicating that the second goal was accomplished to a sufficient degree.

Some faculty feedback resulted in revisions to statements. After taking the JARS, six faculty were asked for feedback on whether any JARS statements were confusing, vague, or detrimental to the purpose of the survey. Based on that feedback, for example, the wording on statement #39 was changed from the original text, ”Good researchers do something original, meaning they don’t need to worry about what others have done”, to, “If a researcher feels her ideas are original, she shouldn’t have to worry about what others have done previously.” This change added detail to the statement, improving its clarity. Statement #19 was also revised from, “Really good researchers work alone”, to, “Really good researchers never need any help or feedback.” Faculty members felt that the original statement could elicit a mixed response since there are many “really good” researchers who, by the very nature of their field of study, tend to work alone. The new version of this statement elicits a much more uniform expert-like response. Other statements were reworded based on more minor wording ambiguities. These revisions made at the suggestion of the faculty members helped accomplish goal #3 of the faculty validation of the JARS.

2.3 Large-Scale Faculty Validation

After these interviews, a second, large-scale faculty validation was undertaken, where 27 faculty members (about 90% of whom had been engaged in a research project within the previous year) from across the academic spectrum took the survey to see whether a large group from diverse academic disciplines would give consistent responses to the JARS statements. According to established guidelines, the threshold for expert consensus was set to 70% agreement; 36 of the 44 JARS statements met this threshold. Four of the JARS statements achieved 100% expert consensus, and 12 statements had a consensus of better than 90%.

3. Student Results: Data Collection

Student participants were then recruited by appealing to JU faculty to ask their research mentees to contact the authors about participating. Eleven students participated in the assessment. Student participants met the author or a trained research assistant privately for approximately one-half hour each. Participants were informed of the purpose of the study and that they would be asked to complete the JARS and participate in an audio-recorded interview. Each student spent approximately 10 minutes on the survey and approximately 20 minutes on the interview.

When completing the survey, students were asked to read the instructions and respond to each survey statement with their level of agreement on a five-point agree-disagree (Likert) scale. As is common practice, if a participant had questions about any statement, the interviewer took note and deferred discussion of the question until the end of the interview[24]. After completing the survey, the interviewer asked the student to review her answers out loud and describe the reasons why she chose each response. At the end of the interview, participant questions were discussed and the participant was thanked for her time. Each participant's responses were tabulated to produce a % favorable, % unfavorable, and % neutral scores for the survey as a whole and for the statement categories.

4. Overall & Category Scores

The results of this study are, overall, positive, with a few themes revealing important needs for students. Although the sample size (eleven students) does not constitute a representative sample of JU students, it is composed of some of JU's top-performing students, as evidenced by the fact that these students chose to participate in research as an extracurricular activity. Therefore, it is reasonable to conclude that whatever needs arise in these students' results more than likely apply to other JU students as well. As mentioned in the introduction, JU expects that soon approximately 25% of students from across the spectrum will undertake UREs. Here, we examine the aggregate overall and category scores for all eleven students followed by the individual scores for each student.

Figure 1 shows the overall and category scores averaged over seven of the students, graphed as % favorable score versus % unfavorable score. Data points in the upper-left hand corner represent more expert-like results; data points in the lower-right hand corner represent more novice-like results; and the data points in the lower-left hand corner represent more neutral results. Data points are labeled by statement category.

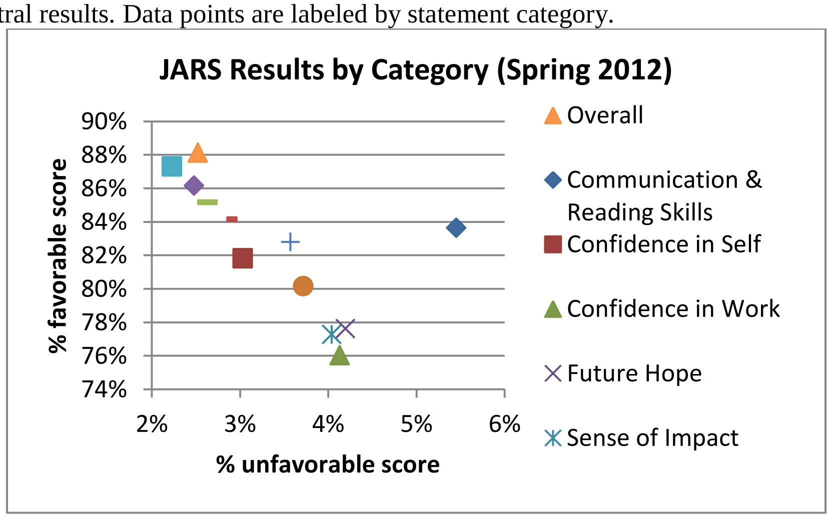

Figure 1. JARS results by category for seven JU students, plotted in terms of favorable v. unfavorable scores

4.1 Positive Results

No category shows a significantly high % unfavorable score. These students tended to make either expert-like responses or neutral responses to the JARS statements. The overall % favorable score is 88%, indicating that 88% of the students' responses were expert-like; in general, these students approach research in an expert-like manner (as measured by the JARS).

The categories with the greatest % favorable scores (and some of the lowest % unfavorable scores) are Value of Work, Value of Skills, Value of Perseverance, and Value of Learning. It therefore seems that these students find their research experiences to be very beneficial and personally rewarding, even if (as discussed below) they do not feel that their research may significantly impact anyone beyond themselves. The interviews confirmed that these students value their research projects as a learning experience and feel that these projects have helped prepare them for the future. For example, 9 out of the 11 students interviewed indicated that they will list their most recent research projects on their résumé or CV. One microbiology interviewee explained that she would definitely list her most recent research on her résumé because it would serve as a great conversation starter with potential employers or those involved in graduate school admission. Ten of the 11 students either disagreed or strongly disagreed that the skills they learned during their research project *will not* be very valuable to them in their future careers. Nine out of the 11 students either agreed or strongly agreed that their research has helped enhance their reading and writing skills. The English major interviewee pointed out that, while she felt her reading and writing skills were already excellent, her research has enhanced those skills and has given her practice in reading and writing in the sciences, a perspective from which she did not have prior experience. Significantly, all 11 interviewees agreed that they have developed important skills during their research projects. One interviewee doing a historical literature research project specifically mentioned critical thinking as the principle valuable skill he has developed during his research.

4.2 Negative Results

The categories with the lowest % favorable scores (and some of the highest % unfavorable scores and % neutral scores) are Confidence in Work, Sense of Impact, and Future Hope. The Confidence in Work and Sense of Impact % favorable scores, when considered alongside the interview comments, seem to indicate that these students perceive their research projects as taking place on a small scale (a "practice round," as it were) compared to "real" research conducted by faculty and graduate students. They readily acknowledge the limited timescale and resources with which they can approach their projects and the limited scope of the project topics. They seem to feel that their results could be proven wrong or insignificant rather easily. One striking example is that all 11 students were either neutral to or disagreed with the idea that their research will be cited in the future. One microbiology interviewee explained that her research project was very basic, and rather juvenile compared to some of the published papers on the subject. She noted that doing significant research in her field requires a lot of time, money, and expensive equipment. Six out of the 11 interviewees were either neutral to or agreed that the results of their research were not very accurate. These attitudes do not seem to abate the students' sense that their projects were a valuable learning experience; in fact, several students in the interviews made a clear distinction between their projects' personal impact on themselves and their projects' impact on their field and society.

The third category % favorable score—Future Hope—is slightly low, as many of the students indicated in the interview that they were uncertain whether their future careers (e.g., medical school, engineering, etc.) would include research.

5. Individual Student Scores

Figure 2 shows the aggregate overall scores for seven of the students individually, graphed as % favorable score versus % unfavorable score. Data points are labeled by important features of each student. The data points labeled "SJR group" represent students from the Division of Science & Mathematics who all worked on different aspects of the same project involving microbial degradation of pollutants along the St. Johns River. These students were mentored by the same faculty member (who is greatly thanked for so enthusiastically encouraging his students to participate) and collaborated with each other throughout the project. Note that these students all scored extremely well on the JARS, with one student obtaining a perfect % favorable score of 100%. These students were nearly finished with their projects at the time of their interviews. "Fine arts" represents a student from the College of Fine Arts, working on an art & graphic design project. "Microbiology I/S" represents a student from the Division of

Science & Mathematics who conducted research as part of an independent study in microbiology. This student was nearing the conclusion of her project at the time of her interview. “Physics: beginning stage” represents a student from the Division of Science & Mathematics who was beginning a research project with a physics faculty member. This student was at the beginning (primarily background research) of his project at the time of his interview. “Physics: beginning stage, no mentor” represents a dual degree engineering student from the Division of Science & Mathematics who was beginning a physics research project on his own, without a project mentor. This student was at the beginning (primarily background research) of his project at the time of his interview.

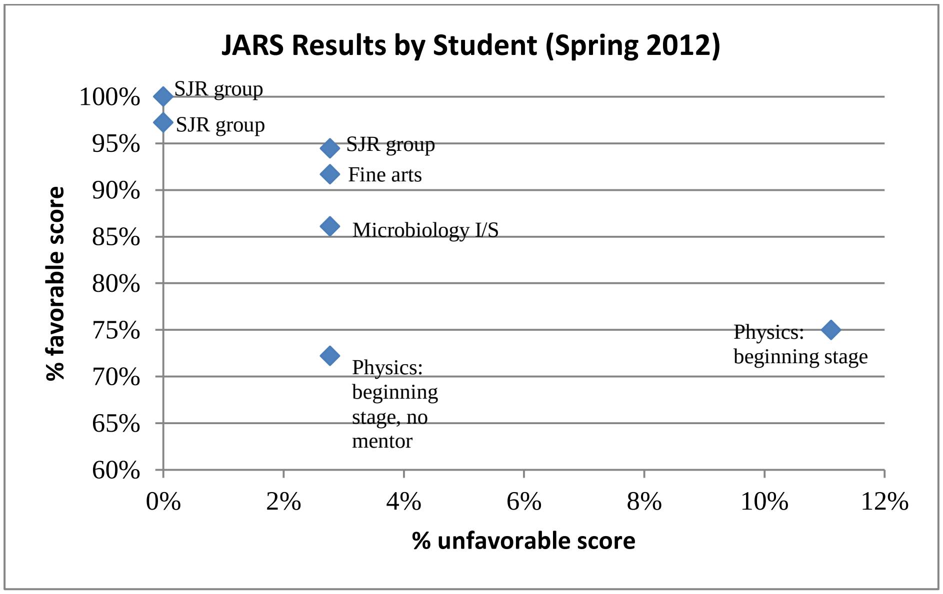

Figure 2. JARS results by student for seven JU students, plotted in terms of favorable v. unfavorable scores

The students with the lowest % favorable scores were those at the beginning stages of their projects (overall 78% favorable), while the students nearly finished with their projects received rather high % favorable scores (overall 94% favorable). A polarization binning of the data reveals that students at the beginning stages of a research project averaged a percent strong score (percentage of responses that were “Strongly disagree” or “Strongly agree”) of 39%, whereas students at the end of a project averaged a percent strong score of 61%. This suggests that students tend to give stronger responses as they gain experience in the research process. These results indicate that surveying the same students at the beginning and end of their research projects can show how student attitudes have shifted.

The highest % neutral score (25% on scored statements) was exhibited by the student who did not have a research mentor. This student’s interview suggests that this high % neutral score reflects a fair amount of frustration with his project and a lack of personal development; both features seem to be a result of a lack of structure and guidance. Also, interestingly, this student scored between 18%-22% favorable on the “Communication and Reading Skills”, “Confidence in Self”, and “Confidence in Work” categories, whereas the mentored students’ responses averaged between 80%-90% favorable in the same categories.

It is also important to note that the Fine Arts student was able to interpret the statements in much the same way as the science students as evidenced by the excellent 88% favorable score. Bridging the concept of research as understood on opposite sides of the academic spectrum is an important goal of this validation process.

6. Conclusion and Next Steps

We surveyed and interviewed six JU faculty members and 11 JU undergraduate students engaged in research projects to ascertain their learning attitudes toward research. Although the sample size was small, the results of this survey show some very important themes. The student participants place a great deal of value on their research experiences, even though they view their projects as not having a significant impact on their field or society. The students at the end of their projects displayed very expert-like attitudes while those at the beginning stages did not.

The one student who was pursuing a research project without a mentor showed evidence of frustration and lack of development. The next steps in the JARS project will be to finish validating the survey by administering the JARS to a large body of students to determine appropriate statement categories, and then to make JARS publicly available.

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