

Evaluation of Outcomes Among Participants in the Iowa State University's Science with Practice Program

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Introduction and Literature Review

Involvement in hands-on experiences, such as undergraduate research, are a formative part of making post-graduation decisions. Borrego et al. (2021) suggested participating in undergraduate research contributed to finalizing graduate school decisions based on students' experiences working with graduate students and faculty. High-impact practices, including undergraduate research, have major influences on future career plans in both continuing post-undergraduate studies and job placement (Miller et al., 2018). Not only do these experiences have impacts on student outcomes, but they also have strong implications for student skill development (Borrego et al., 2021). Further, students involved in research experiences were found to make meaningful gains in communication and critical thinking skills (McClure-Brenchley et al., 2020). Existing literature suggests students who build these skills can achieve greater levels of academic performance (Tadese et al., 2022), and ultimately, career satisfaction (Sembiring, 2015).

The Science with Practice program is designed to provide students with hands-on experiences in the research process to build these communication, critical thinking, and technical skills needed by undergraduate students to help them identify and be successful in their future academic and career opportunities (Borrego et al., 2021; Miller et al., 2018). As such, the purpose of this study was to evaluate perceived outcomes of Science with Practice on the academic and professional careers of alumni. Objectives were to: 1) describe the post-graduate outcomes of program participants and 2) identify specific skills or outcomes developed based on their participation in the program.

Theoretical Framework

Kolb's (1984) experiential learning model served as the framework for this study. The model indicates that learning consists of a *concrete experience* (i.e., a hands-on learning opportunity, such as the research engagements within Science with Practice), *reflective observation* (i.e., taking time to consider and think about the implications of the experience, such as journaling or class discussions), *abstract conceptualization* (i.e., forming ideas for how to apply learning into the future), and *active experimentation* (i.e., applying what was learned into future experiences). This cycle continues as students engage through the learning process. Within the Science with Practice program, students are able to continuously engage in each of these areas of Kolb's (1984) model through ongoing class assignments, engagement in research, and guided reflection.

Methods

A quantitative descriptive study guided this work. A 28-question instrument was distributed to all 750 program completers. Ultimately, 76 responded to the instrument, providing a response rate of 10.1%, which is said to be appropriate for a study of this scope (Wu et al., 2022). Potential respondents were encouraged to participate up to three times using Dillman et al.'s (2014) tailored design method. The instrument was evaluated for face and content validity by two faculty members with experience in quantitative research and familiarity with Science with Practice (Thyer, 2010). These experts offered feedback and ensured relevance to the theoretical framework. Further, the instrument is considered highly reliable with a Cronbach's alpha of 0.94 (Nunnally, 1978). Prior to analysis, data were de-identified; given the objectives and scope of this study, standard descriptive statistics were calculated via SPSS (Creswell & Creswell, 2018).

Findings

The purpose of Objective 1 was to describe the post-graduate outcomes of program participants. Of the respondents, 32 ($f = 42.1\%$) entered the workforce after their bachelor's degree and 36 ($f = 47.4\%$) entered graduate school. Additionally, 44 ($f = 57.9\%$) pursued a graduate degree at any

point in their career, and the majority of respondents said that their first job after their bachelor's degree was related to their undergraduate field of study ($n = 54; f = 71.1\%$).

Further, Objective 2 identified specific skills or outcomes alumni perceived they developed based on their participation in the program. Findings showed respondents most strongly agreed that self-confidence ($\bar{x} = 4.18; \sigma = 0.96$) and research skills ($\bar{x} = 4.16; \sigma = 1.14$) were enhanced by Science with Practice. Additionally, critical thinking ($\bar{x} = 4.12; \sigma = 0.86$) and self-accountability ($\bar{x} = 4.12; \sigma = 0.86$) were identified as enhanced skills (see Table 1).

Table 1

Science with Practice Alumni Reported Skills Gained from Participation

Item	SD	D	N	A	SA	$\bar{x}$	σ
Self confidence	3	1	8	31	33	4.18	0.96
Research skills	4	5	5	23	39	4.16	1.14
Self accountability	2	1	9	38	26	4.12	0.86
Critical thinking skills	2	1	9	38	26	4.12	0.86
Public speaking skills	2	3	11	31	29	4.08	0.96
Time management skills	2	3	13	33	25	4.00	0.95
Problem-solving skills	3	1	14	35	23	3.97	0.95
Written communication	2	2	18	32	22	3.92	0.94
Organizational skills	2	3	16	37	18	3.87	0.91

Note. SD = strongly disagree (1), D = disagree, N = neutral, A = agree, SA=strongly agree (5)

Conclusions, Impact, and Recommendations

This study evaluated perceived outcomes of Science with Practice on alumni academic and professional careers. A key limitation of the study was the small sample size. Future work should seek to increase the number of respondents to generate more confidence in the findings (Creswell & Creswell, 2018). Objective 1 described the post-graduate outcomes for Science with Practice alumni; a majority of responding alumni pursued a master's or doctorate degree ($n = 44; f = 57.9\%$), and found work related to their undergraduate major ($n = 54; f = 71.1\%$). The framework (Kolb, 1984) would support that students applied their learning from the program (i.e., concrete experience) and implemented skills they gained from engaging in high-impact practices, such as research (Miller et al., 2018). In addition, Objective 2 highlighted key skills or outcomes alumni perceived they gained in Science with Practice. Alumni reported development of both employability skills, such as self-confidence ($\bar{x} = 4.18; \sigma = 0.96$) and self-accountability ($\bar{x} = 4.12; \sigma = 0.86$), and technical skills, such as research ($\bar{x} = 4.16; \sigma = 1.14$) and written communication ($\bar{x} = 3.92; \sigma = 0.94$). Kolb's (1984) model supports that providing students with these concrete experiences in the research process, coupled with reflective observation, enabled students to develop these essential skills and apply them after graduation (Borrego et al., 2021).

Findings support recommendations for research and practice. Next steps for research include: (a) engaging alumni in interviews to explore how they apply these skills in their careers and (b) conducting another longitudinal study with alumni in a few years to assess any changes. Further, practice recommendations include: (a) encourage other institutions to implement programs modeled from Science with Practice given the impact research experiences have on students (Borrego et al., 2021) and (b) have an intentional effort of scaffolding opportunities for organizational skills and written communication in the Science with Practice curriculum, as those were the lowest-scoring.

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