Missouri Instructor Survey Assessment of Project Lead The Way Programs

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Abstract

There have been several studies that show the benefits of Project Lead The Way (PLTW) courses for K-12 students in the preparation for high school students on statewide and national exams, high school academic performance, college level academic performance in particular areas of study, high school student engagement, and other areas. The challenge is how are schools being prepared to attract students to such programs and are the students excited about the curriculum. This study examines the impact of PLTW courses at the middle through high school level. Survey results from 208 instructors who attended the 2013 Missouri State PLTW Conference. Instructor observations from the survey indicated that: 1) hands-on projects promote reinforcement of PLTW course curricula, 2) PLTW courses provide useful college preparatory experiences for students and expose students to STEM related areas, and 3) school districts reasonably support PLTW courses.

Introduction

In recent years, there have been numerous K-12 programs to promote science, technology, engineering and mathematics (STEM) education programs that have promoted the growth and interest of science and math related fields. These STEM programs branch across a variety of areas and grade levels. Project Lead The Way (PLTW) provides STEM education curricular programs in high schools and middle schools in all 50 states of the U.S. Missouri S&T is the state of Missouri school for providing teacher training, professional development and program information for counselors and administrators in the Midwest region. PLTW provides programs to more than 5,000 elementary, middle, and high schools in all 50 states and the District of Columbia[1]. As a rapidly growing program, the Missouri PLTW network currently has 238 programs in 198 high schools and middle schools [2]. Project Lead The Way (PLTW) [1] currently has PLTW Launch (K-5), PLTW Gateway (Middle), PLTW Engineering (High School), PLTW Biomedical Science (High School) and PLTW Computer Science (K-12) programs [1].

There have been several studies comparing academic performance of PLTW students with non-PLTW students on measures, including High Schools That Work Assessment [3], academic achievement and student engagement [7], ethnic diversity [5,10], improved student grades [8] and improved attendance [9]. The goal of this study is to examine the impact of PLTW courses at the middle through high school level. Survey results from 208 instructors from across the state of Missouri are presented.

Missouri S&T Student Survey

A survey was administered in December 2013-January 2014 to instructors from middle to high school who have taught one or more PLTW courses. The list of participants consisted of all attended the state wide PLTW conference in Columbia of November 2013. There were 208 respondents. Table 1 provides the curriculum area the instructors have taught.

Table 1. Curriculum area background of survey respondents.

Curriculum	**% of Survey Respondents**	**Number of Survey Respondents**
Gateway to Technology	10.1%	21
Pathway to Engineering	67.8%	141
Biological Sciences Program	22.1%	46

The survey questions are presented with respondent responses are presented as follows.

Question 1: Which Project Lead The Way course(s) do you teach (select one)?

PLTW Course	**% of Survey Respondents**	**Number of Survey Respondents**
Computer Science & Software Engineering (CSE)	2.9%	6
Introduction to Engineering Design (IED)	43.8%	91
Principles of Engineering (POE)	33.2%	69
Digital Electronics (DE)	21.6%	45
Civil Engineering and Architecture (CEA)	15.9%	33
Aerospace Engineering (AE)	5.3%	11
Biotechnical Engineering (BE)	1.9%	4
Computer Integrated Manufacturing (CIM)	3.4%	7
Engineering Design and Development (EDD)	13.5%	28
Principles of Biomedical Systems (PBS)	15.9%	33
Human Body Systems (HBS)	9.6%	20
Medical Interventions (MI)	7.7%	16
Biomedical Innovation (BI)	4.8%	10
Automation and Robotics (AR)	7.7%	16
Design and Modeling (DM)	10.1%	21
Energy and the Environment (EE)	2.9%	6
Flight and Space (FS)	1.0%	2
Green Architecture (GA)	1.0%	2
Magic of Electrons (ME)	1.4%	3
Science of Technology (ST)	2.9%	6

Medical Detectives (MD)	1.9%	4

Question 2: Number of years you have taught PLTW courses?

Years	% of Survey Respondents	Number of Survey Respondents
1	23.6%	49
2	14.4%	30
3	12.5%	26
4	10.1%	21
5	10.6%	22
6	8.7%	18
7	11.1%	23
8	3.4%	7
9	2.4%	5
>9	3.4%	7

Question 3: Number of years you have taught pre-college courses?

Years	% of Survey Respondents	Number of Survey Respondents
1	1	7.2%
2	2	2.9%
3	3	6.3%
4	4	3.8%
5	5	7.7%
6	6	8.7%
7	7	5.8%
8	8	5.3%
9	9	4.3%
>9	>9	48.1%

Question 4: Based on your experience as a Project Lead the Way instructor, check the box for your response for the following statements:

Answer Options	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Rating Average
1.) Students are actively engaged in the hands-on projects in PLTW	1	2	4	81	120	4.52

courses.						
2.) Hands-on projects reinforce the curriculum in PLTW courses.	1	2	5	66	134	4.59
3.) Students have become more interested in engineering as a result of taking PLTW courses.	1	1	50	78	74	4.09
4.) Students have a better understanding of STEM careers after taking PLTW courses.	1	0	16	107	84	4.31
5.) Students have become more interested in the biological sciences as a result of taking PLTW courses.	0	8	115	44	27	3.46
6.) It is difficult for me to complete all of the required curriculum for my PLTW courses.	4	22	20	94	68	3.96
7.) PLTW courses attract students with strong academic backgrounds.	2	18	38	114	36	3.79
8.) PLTW courses are more challenging for you to teach than other courses.	9	62	33	69	32	3.26
9.) PLTW courses are more challenging for your students than other courses.	0	16	39	105	48	3.89
10.) PLTW courses are useful college preparatory courses.	0	1	14	96	96	4.39
11.) PLTW course have challenging math content.	5	14	35	87	65	3.94
12.) PLTW course have challenging teamwork content	0	5	29	107	65	4.13
13.) Your school district provides reasonable support for your PLTW courses.	2	15	19	79	93	4.18
14.) Your school district promotes the PLTW programs.	3	13	28	88	75	4.06
15.) It is difficult to get students to enroll in PLTW courses.	23	77	52	48	8	2.72
16.) The resources and training available for PLTW teachers is effective.	2	9	33	110	54	3.99

Question 5: What is the most difficult aspect of teaching a PLTW course?

Response	**Response Percent**
Preparation Time	20.7%

Time to Teach Curriculum	29.3%
Student Backgrounds	23.6%
Teacher Backgrounds	1.9%
Grading and Assessment	6.7%
Curriculum	6.7%
Support from School/District	2.9%
Difficulties with computers, technology, equipment, etc.	5.3%
None	2.9%

Question 6: In what area(s) do students tend to struggle with the curriculum in PLTW courses?

Response	**Response Percent**
Background (Math, Science, Vocabulary)	48.7%
Course Documentation (including Engineering Notebook)	10.6%
Course Pace	9.5%
Project-based Learning	12.1%
Technology	6.1%
Critical Thinking/Problem Solving	7.5%
Main Idea of Activity	2.5%
Other	3.0%

Question 7: Which PLTW courses that you teach have the highest enrollment?

Course	**Response Percent**
IED	46.6%
POE	13.7%
EDD	1.3%
CIM	2.0%
CEA	0.7%
DE	2.0%
AE	3.3%
DM	0.7%

MD	5.3%
HBS	3.3%
MI	0.7%
BI	15.7%
PBS	2.0%
GTT	2.0%
BE	0.7%

Summary of Survey

Missouri S&T is the state of Missouri university for high school teacher training through the Curriculum Training Institute (CTI) for the courses offered through the PLTW programs. Missouri S&T began this role in 2006, offering Pathway to Engineering courses. The Biomedical Sciences Pathway courses, Computer Science Pathway (2014), Gateway to Technology, and the AE (2013) and EDD courses, which are part of the Pathway to Engineering, have been added after 2009. High school instructors can complete their PLTW certification at CTIs from other states as well as courses offered through university programs.

There are a number of observations from the seven survey question results. First, of the 208 survey participants, most of the instructors from this survey teach PLTW courses in the Pathway to Engineering program (67.8%), with 22.1% and 10.1% of the instructors teaching courses in the Biological Sciences and Gateway to Technology programs, respectively. Second, from Question 3, the majority of survey participants expressed having more than 9 years of teaching experience (48.1%), followed by 6 years teaching experience (8.7%), 5 years (7.7%), and 1 year (7.2%). Third, as observed from Question 4, there are several indicators given as why students are engaged in PLTW courses including: Hands on projects reinforce the curriculum (4.59/5.0), student engagement (4.52/5.0), students are better prepared for college (4.39/5.0) and students understanding of STEM careers (4.31/5.0). Fourth, from Question 4, what area(s) do students tend to struggle with in the PLTW curriculum? The participants indicated math, science and vocabulary as the largest area most students seem to struggle with (48.7%). A second area that students struggle with is problem-based learning (12.1%), followed by course documentation in the form of an engineering notebooks (10.6%). Fifth, as seen from Question 5, instructors indicated that time to teach the PLTW course curriculum (29.3%), accommodating for student backgrounds (23.6%), and course preparation time (20.7%) were the most difficult aspects of teaching PLTW courses. Sixth, from Question 6, students tend to struggle with requisite math, science and vocabulary backgrounds (48.7%), project-based learning (12.1%), and course documentation including engineering notebooks (10.6%) in taking PLTW courses. Finally, Question 7 shows that IED (46.6%) and POE (13.7%) from the Pathway to Engineering program and BI (15.7%) from the Biological Sciences program most commonly have the highest enrollments.

Overall, the survey results highlight that the majority of high school instructors teaching PLTW courses tend to be experienced (more than 9 years working as an instructor), including pre-college courses (also greater than 9 years working as an instructor). The majority of the teachers surveyed tend to teach IED and POE, which also typically have higher enrollments than other PLTW courses. Many teachers indicated that PLTW courses typically require more time to prepare for and are challenging to cover the course curriculum. Teachers' observations about students taking their PLTW courses include: lacking appropriate math and science backgrounds, hands on projects reinforce the curriculum in the courses, challenging teamwork content (4.13/5), PLTW courses better prepare students for college, and exposing students to and understanding STEM related careers. PLTW courses, as indicated with the survey results, are well promoted by the School Districts (4.18/5) that provide college preparatory experiences for their students, especially in the awareness of STEM related careers.

Conclusions

In this study, survey results were examined for 208 instructors who attended the 2013 Missouri State PLTW Conferences. Most of the instructors surveyed have considerable teaching experience and have taught pre-college courses (over 9 years in both areas). Instructors indicated that PLTW courses are reasonably promoted by their school districts and that they do not have difficulty attracting good students for their PLTW courses. Instructors most commonly taught Pathway to Engineering courses, which is consistent with the years of experience for the instructors and the relatively short duration that the Biological Sciences and Gateway to Technology programs have been offered compared to the Pathway to Engineering program. As the PLTW programs continue to grow, teachers will become more diversified in their backgrounds and in the PLTW courses that they teach. All of the PLTW programs use the same course curriculum structure, which include hands-on projects and team oriented activities to promote student engagement. PLTW courses provide useful college preparatory experiences for students and foster exposure to STEM related areas.

Future Directions

There is an ongoing study of S&T student degree audits for PLTW and non-PLTW students at S&T for academic performance comparison. We have completed a preliminary study of surveying PLTW high school teachers for teacher backgrounds and student assessments. This survey has been extended to a second year for a longitudinal study. We are planning to continue the S&T student survey to evaluate student backgrounds, degree programs pursued, and career choices. These studies are of particular interest with the significant increase in offering of PLTW programs and courses throughout Missouri and the U.S.

Acknowledgments

References

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