Bringing Safety and Health Expertise into the Classroom

Lessons from the Technical Education Curricula for Health and Safety (TECHS) Study (2015 – 2018)

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BACKGROUND

Technical Education Curricula for Health and Safety (TECHS) study is an educational intervention conducted in partnership with three vocational colleges in Minnesota. After an extensive baseline evaluation of the materials and methods used prior to enrolling in the TECHS study, new curricula was designed and developed by two industrial hygienists with input from all instructors in the auto body collision technology (ABCT) and machine tool technology (MTT) programs in both colleges, an occupational physician, and an experienced curriculum writer. The new (TECHS) curricula was implemented during 2015-2018 academic years. Students attend the ABCT or MTT program for 2 years before receiving a diploma or Associate degree.

Goal: evaluate the impact of the TECHS curricula on students' knowledge, skills and work practices in school and at 1 year post-graduation

Hypothesis: students' increase in knowledge and improvement in safety and health-related skills and work practices varies with *their instructors*' level of engagement in the study as measured by the frequency of using the TECHS curricula elements during each school year.

METHODS AND MATERIALS

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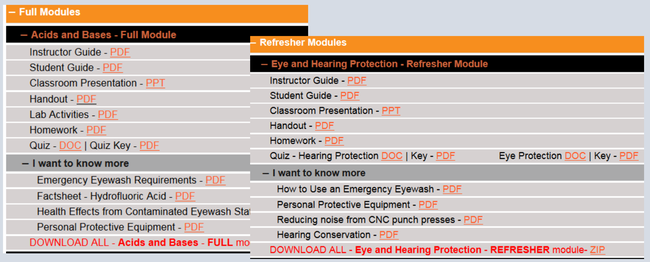


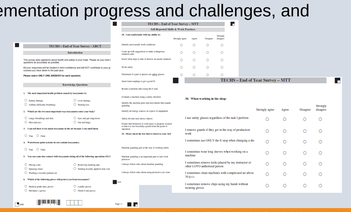
MTT	
FULL MODULES	**REFRESHER MODULES**
1. Machine Guarding	1. Machine Guarding
2. LOTO Awareness	2. LOTO Awareness
3. Material Handling	3. Material Handling
4. Eye Protection	4. Eye and Hearing Protection
5. Hearing Protection	
6. Fire Safety*	5. Electrical and Fire Safety*
7. Electrical Safety*	

ABCT	
FULL MODULES	**REFRESHER MODULES**
1. Acids and Bases	1. Solvents, Acids and Bases
2. Solvents	2. Isocyanates
3. Isocyanates	3. Dust and Fumes
4. Dust and Fumes	4. Electrical and Fire Safety
5. Electrical Safety	
6. Fire Safety	5. Eye and Hearing Protection
7. Eye Protection	
8. Hearing Protection	6. Respirators
9. Respirators	

Instructor activities: Prior to the start of each academic year, instructors attended a 4-hour training session, which covered topics such as: managing course content in school's online learning platform; adult education principles, teaching methods, OSHA (regulations, inspection process, reports). Instructors planned curricula delivery for the academic year, practiced the classroom presentations, and reviewed the lab activities, homework, and quizzes. Instructors met with study staff two times each semester to review curriculum implementation progress and challenges, and review and discuss student survey results.

Curricula delivery: Full modules were to be used during the Fall semester, and Refresher modules were to be used during the Spring semester each academic year.

Student surveys: Students completed surveys at the beginning and end of each school year, from August 2016 to May 2018. ABCT students answered 31 questions on isocyanates, respirators, solvents and acids, fire and electrical safety, and, eyes and hearing protection. MTT students answered 27 questions on machine guarding, lockout/tagout, materials handling, and, eyes and hearing protection. All students rated their safety skills, work practices, and attitudes at the end of each school year.



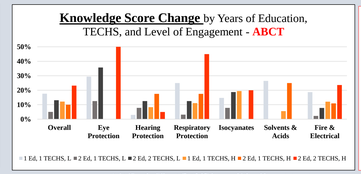
RESULTS

Instructors: Instructors' level of engagement in the study varied with their perception of teaching an adequate amount of safety and health as documented in baseline interviews and surveys[1]. Instructors who believed they were already teaching an adequate amount of safety information displayed low enthusiasm for using the new curricula and made limited efforts to integrate it in their practice (low engagement; ABCT – colleges A and C; MTT – college B). Instructors that recognized a need for a comprehensive safety curricula were more likely to use materials provided (high engagement; ABCT – college B; MTT – college C). College administration did not appear involved in guiding their staff through the process of new curricula implementation. Instructors indicated that as their confidence in teaching the classroom presentations increased (2nd and 3rd year of use), they were more likely to incorporate other curricula elements in their practice. Despite these improvements, instructors' level of engagement did not change during the study period. Instructors cited a lack of time, not knowing how to complete some lab activities, and concern for their students' workload as the most common barriers to curriculum implementation. Instructors' use of the school's online learning platform was the key factor determining student access to the TECHS materials.

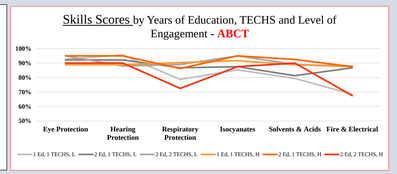
Students: Survey return rates were between 50% and 100%. Matching records were available for 68 ABCT and 70 MTT students. Of these, 51 ABCT and 51 MTT students received 1 year of TECHS curricula, and 17 ABCT and 19 MTT students received 2 years of TECHS curricula. Students' online access to the TECHS materials was minimal throughout the study.

Years of Education	Years of TECHS	Year(s) of data collection	Level of Engagement	N	Knowledge Scores - ABCT						
					Overall Score	Eye Protection	Hearing Protection	Respiratory Protection	Isocyanates	Solvents & Acids	Fire & Electrical
					Mean (SD) (%)						
1	1	1st	low	17	74‡†(9)	94‡(17)	59 (15)	54 (38)	76‡(12)	76‡(31)	80‡(10)
2	1	2nd	low	16	70‡(10)	59 (33)	55 (21)	64 (20)	78‡(13)	63 (39)	75 (17)
2	2	1st & 2nd	low	14	67‡†(12)	79 (32)	59 (16)	57 (23)	73‡†(17)	57 (39)	69‡†(13)
1	1	1st	high	9	77‡(11)	67 (35)	58 (28)	56 (21)	88‡(9)	94 (17)	82‡(12)
2	1	2nd	high	10	78 (8)	95 (16)	80‡(11)	60 (29)	84 (12)	85 (24)	76 (11)
2	2	1st & 2nd	high	5	85‡(7)	100‡(0)	70 (11)	70‡(21)	88 (9)	90 (22)	89 (8)

‡ significant improvement (p<0.05) from baseline - college A † significant improvement (p<0.05) from baseline - college C ‹ significant improvement (p<0.05) from baseline - college B

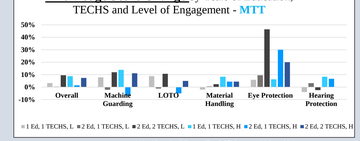


* significantly different (P < 0.05) between high and low engagement

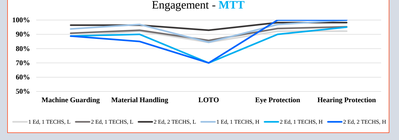


Years of Education	Years of TECHS	Year(s) of data collection	Level of Engagement	N	Knowledge Scores - MTT					
					Overall	Machine Guarding	Material Handling	LOTO	Eye Protection	Hearing Protection
					Mean (SD) (%)					
1	1	1st	low	17	85 (5)	72 (12)	93 (12)	92 (8)	100 (0)	82 (21)
2	1	2nd	low	21	87 (6)	74 (11)	88 (17)	95 (7)	100 (0)	92 (15)
2	2	1st & 2nd	low	14	89(8)	77(15)	91 (16)	95 (7)	100‡(0)	95 (12)
1	1	1st	high	8	85(9)	69 (19)	88 (13)	94 (10)	100 (0)	92 (15)
2	1	2nd	high	5	85 (9)	66 (18)	90 (14)	96 (8)	90 (22)	100 (0)
2	2	1st & 2nd	high	5	88 (3)	73 (6)	95 (11)	98 (5)	100 (0)	87 (18)

‹ significant improvement (p <0.05) from baseline – college B



* significantly different (P < 0.05) between high and low engagement



Years of education →	ABCT 1 (N=36)	ABCT 2 (N=35)	MTT 1 (N= 57)	MTT 2 (N=19)
Working in the trade during the school year?				
yes	28%	69%	65%	84%
no	69%	31%	23%	16%
Working in the trade before attending college?				
did not work	72%	63%	49%	58%
< 1 year	14%	17%	18%	21%
1-4 years	6%	14%	14%	21%
> 5 years	6%	6%	7%	0%
Have you ever experienced a work-related injury that you thought was serious?				
yes	17%	9%	5%	11%
no	81%	91%	82%	89%

Years of Education/TECHS	Eng.	ABCT N	ABCT Attitudes	ABCT Work Practices	MTT N	MTT Attitudes	MTT Work Practices
			Mean (SD) (%)			Mean (SD) (%)	
1/1	low	17	84 (12)	76 (15)	17	80 (10)	82 (22)
2/1	low	16	82 (12)	78 (19)	21	70 (21)	80 (20)
2/2	low	14	77 (17)	77 (14)	14	81 (15)	89 (15)
1/1	high	9	80 (11)	83 (18)	8	91 (11)	89 (10)
2/1	high	10	82 (17)	83 (20)	5	79 (16)	80 (16)
2/2	high	5	82 (11)	80 (17)	5	76 (18)	71 (20)

Student Work Practices Scores	
ABCT	**MTT**
$R^2 = 0.12$ (attitudes only)	$R^2 = 0.21$ (attitudes only)
$R^2 = 0.14$ (knowledge, skills, attitudes, work history, education)	$R^2 = 0.27$ (knowledge, skills, attitudes, work history, education)

CONCLUSIONS

The number of curriculum materials used by vocational college instructors is not a good indicator of their effectiveness as teachers. ABCT students exposed to more TECHS materials had better safety and health knowledge overall and in several topic-specific domains. This effect was not observed in MTT students. Instructors expressed concerns about reliability of survey answers given by 2nd year students within days of graduation and thought the results under-estimated their students' knowledge. The number of years of TECHS curricula does not appear to have a consistent effect on students' estimates of their safety-related skills. Students' work practices are poorly explained by their knowledge, skills, and work history, and best explained by their attitudes towards safety. The study results must be interpreted with caution due to small sample size in all intervention groups. This study identified several barriers to curricula implementation: 1) administrative (e.g. instructors' familiarity with virtual educational platforms; insufficient institutional support); 2) gaps in instructor knowledge of safety and health; 3) gaps in instructors' pedagogic skills. Additional research is needed to better understand the issues related to teaching effectiveness in vocational education, and evaluate changes in student attitude s towards safety.

1. Bejan A. Parker D, Skan M, Xi M (2018) Health and Safety Education in Auto Body Collision and Machine Tool Technology Programs in Vocational Colleges: Challenges and Opportunities. Ann Work Expo Health. 2018 Sep 13;62(suppl_1):S81-S92.

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