

Pennsylvania's
Results from
the 2020
National T&E
Education
Safety Survey

*How Does Pennsylvania Compare to
the National Averages?*

*What are the Implications for School
Systems?*

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TEEAP Webinar
April 14, 2021

Permissions

These findings were derived from a larger data set and will appear in an upcoming TEEAP article:

- Love, T. S., & Roy, K. R. (2020). K-12 technology and engineering education safety and facilities survey. [Data set]. National Safety Consultants, LLC.
- Love, T. S., Roy, K. R., & Sirinides, P. (2021). What factors have the greatest impact on safety in Pennsylvania's T&E courses? *Technology and Engineering Education Association of Pennsylvania Journal*, 69(1), 5-22.

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CURRENTLY

- Assistant Professor of Elementary/Middle STEM Education at Penn State Harrisburg
- Safety Editor for ITEEA
- NSTA Safety Advisory Board Member
- OSHA Authorized Trainer for General Industry
- 2018 CareerSafe® Safety Educator of the Year

PREVIOUS EXPERIENCES

- Coordinator and Associate Professor of T&E Ed in MD
- Technology and Engineering teacher in Maryland's Public School System

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CURRENTLY

- ON STAFF AT Glastonbury Public Schools (CT)
- Director of Environmental Health & Safety/Chemical Hygiene Officer

PRIVATE SAFETY PRACTICE

- National Safety Consultants, LLC – General Manager/Senior Safety Consultant
- National Science Teaching Association (NSTA)
Chief Science Safety Compliance Adviser and Blogger
- National Science Education Leadership Association (NSELA)
Safety Compliance Officer
- International Council of Associations for Science Education (ICASE)
Safety Committee Member
- Author of over 10 safety books and ~ 800 Professional Journal Articles on Safety



*Background Info

- Last national survey on T&E safety is unknown
- Large focus on safety in T&E education due to:
 - Liability
 - Alternative certification
 - STEM/Makerspaces
 - After school clubs

*Previous Research - CTE

- Recent studies on safety in various CTE areas by Threeton and Evanski (2014, 2015, 2019)
 - 57 CTE teachers from 30 counties in PA
 - 93% had safety plan in place
- Top 5 obstacles to implementing safety in CTE classes
 1. Chronic student absences
 2. SPED modifications/accommodations
 3. Lack of funding
 4. High class enrollment surpassing occupancy loads
 5. Small classroom/lab space

*Previous Research - Science Ed

-Stephenson, West, Westerlund, & Nelson (2003)

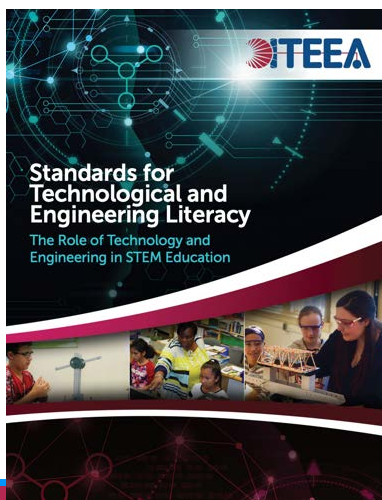
- 856 science teachers in TX
- 81 incident/accident report forms returned

-Incidents/Accidents increased:

1. 8% to 62% as **class size** increases from <14 to >24 students
2. 11% to 66% as **room size** decreased below 60 sq. ft per student
3. 11% to 47% as **room size** decreased below 800 sq. ft
4. 35% did not have adequate training
5. Only 69% had a written safety policy

-Study redone in 2014, similar findings

*Safety – Embedded in Our Standards!



-Love, T. S., Duffy, B. C., Loesing, M. L., Roy, K. R., & West, S. S. (2020). Safety in STEM education standards and frameworks: A comparative content analysis. *Technology and Engineering Teacher, 80*(3), 34-38.



T&E 2020 National Safety Survey

-**TEE-FASS** (T&E Ed Facilities and Safety Survey)

Adapted from Stephenson et al. study

April 2020 - sent out to ITEEA/TEEAP members

718 responses from 42 states, 67 PA responses

-Questions on:

- Info and Demographics
- Experience and Certification
- Classroom Conditions
- T&E facilities
- Teacher and Student Safety Training
- Recent Incidents/Accidents

Demographics

Presentation derived from: Love, T. S., Roy, K. R., & Sirinides, P. (2021). What factors have the greatest impact on safety in Pennsylvania's T&E courses? Technology and Engineering Education Association of Pennsylvania Journal, 69(1), 5-22.

Gender and Race

Pennsylvania

Answer	%	Count
Male	84%	56
Female	16%	11
Total	100%	67
White	97 %	65
Black	0 %	0
Two or More Races	2 %	1
Asian	0 %	0
Hispanic or Latino	0 %	0

National - 74% male; 90% White, 5% Black (718 total responses)

Certification(s)

Pennsylvania

Answer	Percent	Count
Alternative or Emergency	0%	0
Elementary Education	6%	5
Technology Ed or T&E Education	73%	61
A Science Education area	6%	5
CTE area	1%	1
Other (please specify)	14%	12

National - Very similar

Presentation derived from: Love, T. S., Roy, K. R., & Sirinedes, P. (2021). What factors have the greatest impact on safety in Pennsylvania's T&E courses? Technology and Engineering Education Association of Pennsylvania Journal, 69(1), 5-22.

***Total Years Teaching T&E/Tech Ed/Indust. Arts**

Pennsylvania

Answer	%	Count
0-3	5%	3
4-8	16%	11
9-15	18%	12
16-25	39%	26
26+	22%	15

National

0-3	10%	70
4-8	20%	142
9-15	20%	143
16-25	28%	201
26+	23%	162
Total	100%	718

***Grade Level Taught**

Grade Level	%	Count
K-5	5%	3
Middle School	31%	21
High School	52%	35
6-12 (Middle & High School)	5%	3
K-12	8%	5

Courses and Enrollment

Course Preps

<u>Preps</u>	<u>Pennsylvania</u>	<u>National</u>
1	2%	3%
2	13%	14%
3	34%	31%
4	25%	25%
5	9%	13%
>5	16%	14%

*Primary Focus of Your Courses

Pennsylvania

1. Engineering Design, T&E Literacy
2. Materials Processing - Woods
3. CAD, 3D modeling, Architecture

National

1. Engineering Design, T&E Literacy
2. Tie - Materials Processing (woods and metals)
CAD
Electronics/Programming/Robotics
3. Pre-engineering (ex. PLTW)

*Enrollment in your classes: Average and Largest Class sizes

Pennsylvania

Average: 53% said 16-20
19% said 21-24
8% said 25-30
6% said more than 30

Largest: 25% said 25-30
9% said more than 30

National Comparison

Average: 33% said 16-20
25% said 21-24
22% said 25-30
8% said more than 30

Largest: 34% said 25-30
23% said more than 30

Presentation derived from: Love, T. S., Roy, K. R., & Sirinides, P. (2021). What factors have the greatest impact on safety in Pennsylvania's T&E courses? Technology and Engineering Education Association of Pennsylvania Journal, 69(1), 5-22.

Percentage of students in your classes this past year that had special needs?

Pennsylvania

Answer	%	Count
0-5%	9%	6
6-15%	45%	30
16-25%	34%	23
26-50%	9%	6
More than 50%	3%	2

National

0-5%	20%	146
6-15%	41%	297
16-25%	27%	191
26-50%	10%	73
More than 50%	2%	11
Total	100%	718

Administrative and District Support

Administration's progressive disciplinary support?

Pennsylvania

Answer	%	Count
Poor	2%	1
Fair	15%	10
Good	42%	28
Excellent	42%	28

National

Poor	12%	79
Fair	21%	152
Good	42%	303
Excellent	26%	184

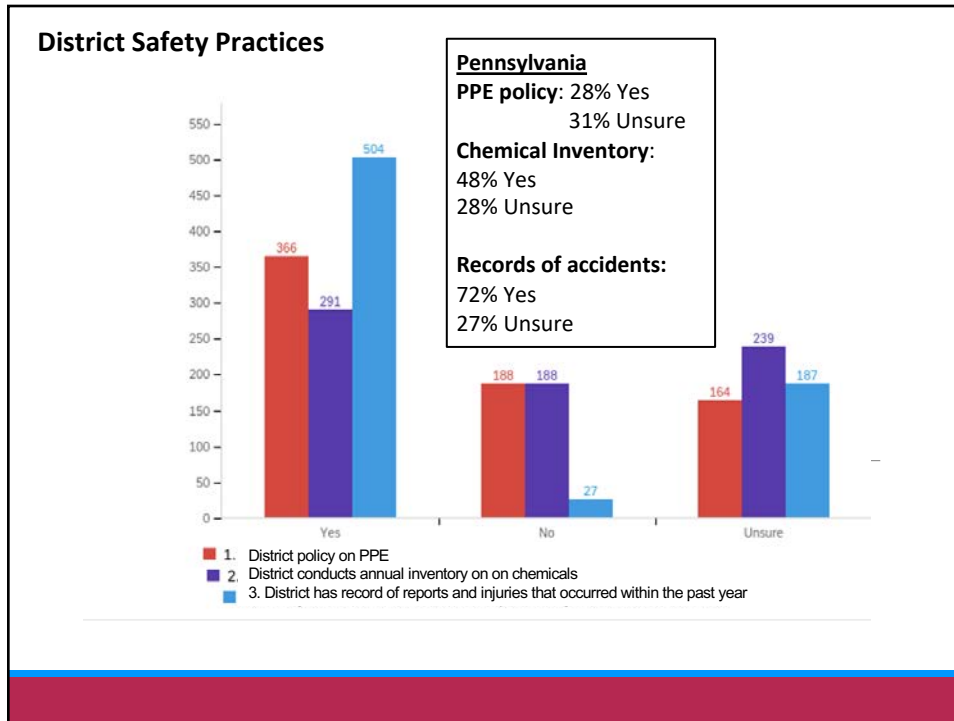
***Have a sufficient budget to maintain safety**

Pennsylvania

Answer	%	Count
Yes	64%	43
No	36%	24

National

Answer	%	Count
Yes	53%	380
No	47%	338



*Does your district conduct annual safety audits of T&E facilities?

Answer	Pennsylvania	National
Yes	39%	43%
No	36%	37%
Unsure	25%	21%

Do the Following Have A Written Safety Policy?

Answer	Pennsylvania	National
T&E Classes	81%	82%
T&E Department	55%	56%
School District	28%	44%

How does your district dispose of hazardous chemicals?

Answer	Pennsylvania	National
Hazardous waste contractor	45%	26%
Municipality	8%	11%
Down the drain/trash	8%	6%
Unsure	31%	37%
Do not use hazardous chemicals	9%	18%

Recommendations

- Work with your district safety compliance officer, legal counsel, fire marshal, administrators/supervisors, and teachers to **develop a safety program**, including protocols, inspections, training, etc.
- Work with your **Board of Education** to help develop a safety policy.
- Ask your district's chemical hygiene officer or safety officer how to properly **dispose of chemicals**
- Refer to **legal resources** (e.g. OSHA, NFPA) and professional resources (e.g. ITEEA, NSTA) for additional information in developing the safety program.
- Enforce **consistently and fairly**

Safety Training

***Did you receive any form of safety training during the following?**

Answer	Pennsylvania	National
UG tech/eng or lab courses	81%	62%
UG teaching methods courses	75%	54%
Grad tech/eng or lab courses	19%	28%
Grad teaching methods courses	22%	32%

When initially hired did your district provide safety training?

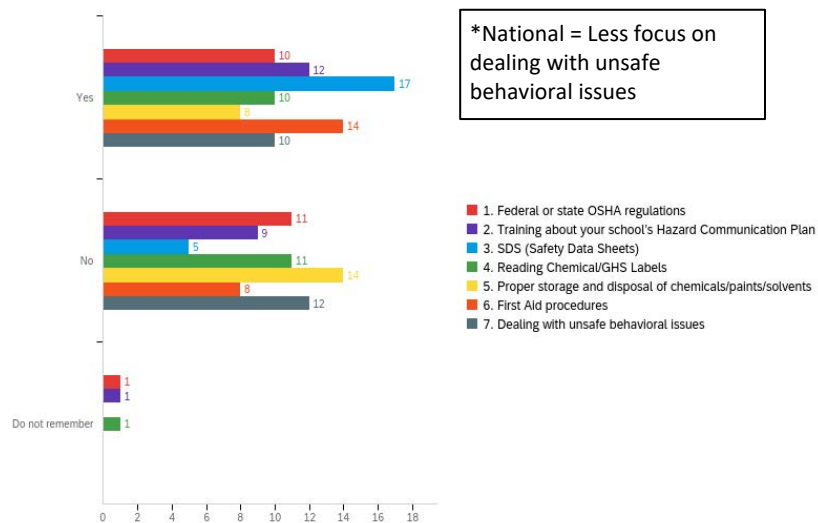
Answer	Pennsylvania	National
Yes	9%	32%
No	91%	68%

How long has it been since your district last offered you safety training?

Answer	Pennsylvania	National
<6 months	9%	15%
6 months -1 year	7%	21%
1-2 years	6%	7%
2-5 years	1%	5%
>5 years	9%	7%
Never received training from my district	67%	44%

***Did the training mentioned in the previous question provide information on the following:**

Pennsylvania



Have you participated in any T&E safety training provided by someone other than your district within the last 12 months?

Pennsylvania

Answer	%	Count
Yes	7%	5
No	93%	62

*National = 18% said Yes

Who delivered the safety training you attended within the past 12 months?

PA Answer	PA %	PA Count	National %
Local training source (not my school district)	0%	0	26%
State teachers association	20%	1	12%
State department of education	0%	0	6%
National teachers association	0%	0	3%
A university	0%	0	11%
OSHA	0%	0	17%
Other (please describe)	80%	4	25%
Total	100%	5	

Recommendations

According to OSHA

- Safety Training must be administered **upon initial hire**, again any time a **new hazard is introduced** (chemical, equipment, etc.), **change in teaching assignment**, and/or updates in safety plans
- Under duty of care the employer (school) has a legal and professional responsibility to **provide these trainings**
- Employee can **request in writing** to receive these trainings

Facility Characteristics

***In what type of room did you primarily conduct your T&E activities this past year?**

Answer	Pennsylvania	National
Portable Classroom	0%	0.28%
Regular Classroom/computer room	13%	17%
T&E classroom/lab combo	63%	66%
T&E Lab	18%	12%
Makerspace	4%	2%
Varied due to floating	1%	3%

***Approximate size of the instructional area?**

Answer (Fire Code Capacity)	Pennsylvania	National
Less than 600 square feet (<12 students)	4%	8%
600-800 square feet (12-16 students)	12%	20%
800-1,000 square feet (16-20 students)	25%	22%
1,000-1,200 square feet (20-24 students)	24%	24%
Greater than 1,200 square feet (>24 students)	34%	26%

Review:

Average Enrollment:
14% more than 24

Largest Enrollment:
34% more than 24

Soldering Ventilation

	<u>Pennsylvania</u>	<u>National</u>
Do soldering activities	52%	52%
Under external vented fume hood	14%	15%
Under internal fume extractor	9%	12%

*3D Printer Ventilation

	<u>Pennsylvania</u>	<u>National</u>
Have 3D printer(s)	79%	75%
Built in filter (HEPA)	9%	17%
Used inside of a fume hood	2%	2%
Used near internal vent system (ex. electrostatic air filter)	11%	6%
No ventilation used	77%	75%

*Laser Engraver

	<u>Pennsylvania</u>	<u>National</u>
Have a laser engraver	60%	44%
Internal Exhaust	13%	31%
External Exhaust	85%	64%
No ventilation	3%	5%

Recommendations

Fire code NFPA 101 Life Safety Code requires **50 sq. ft. per student** (net square footage) in academic **labs and shops**

Research suggests at a minimum 60 sq ft. limits accident rates

Conduct at a minimum **annual safety inspections** to make sure your facilities have proper safety controls and space (ITEEA website and NIOSH have excellent checklists)

Make sure the **instructional space meets all** OSHA, NFPA, and other legal safety **standards** and better professional safety practices like ANSI/ISEA, ITEEA, etc. to make it safer for both teachers and students.

Use non-lead based **solder** when possible with ventilation at the source.

Source: <https://www.iteea.org/102756.aspx>

Classroom Management Safety Practices

***How often are all students in your T&E class required to: (PA/Ntl)**

Question	Never	Rarely	Usually	Always
1. Sign a safety acknowledgement form?	24% (PA) 16% (US)	6% 6%	6% 10%	64% 69%
2. Be tested for their knowledge of safety procedures prior to participating in new hazardous T&E activities/using new hazardous equipment?	5% 8%	5% 5%	12% 12%	79% 76%
3. Safely demonstrate a new procedure or use of a new tool/piece of equipment while directly supervised?	3% 5%	3% 3%	11% 16%	84% 76%
4. Be tested on safety knowledge on their quizzes/exams?	11% 10%	13% 15%	24% 24%	52% 52%
5. Be provided both written and oral safety precautions by the instructor prior to each lab?	42% 7%	22% 14%	12% 24%	24% 52%

***How often are all students in your T&E class required to:**

Question	Never	Rarely	Usually	Always
6. Secure long hair /tie it back?	6% (PA) 6% (US)	3% 2%	8% 14%	84% 78%
7. Remove loose jewelry , roll up long sleeves, secure baggy clothing?	6% 7%	3% 3%	11% 14%	81% 76%
8. Wear close toed shoes?	5% 7%	8% 4%	27% 20%	61% 69%
9. Wear safety glasses when working with solid hazards	8% 11%	2% 3%	5% 10%	87% 77%
10. Wear safety goggles when working with liquid hazards	42% 31%	22% 13%	12% 12%	24% 44%

Recommendations

Have all students be safety **trained, tested** and sign a **safety acknowledgement** form before starting any work involving hazards (ex. hand and/or power tools)

All students need **safety glasses with side shields** on when an activity is being conducted in a room or lab (**indirectly vented chemical splash goggles** for liquid hazards)

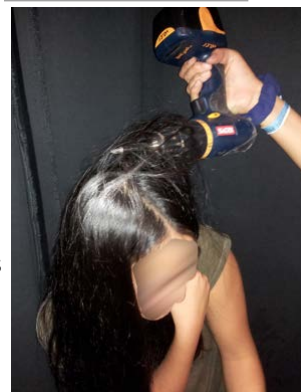
Students should be **directly supervised** when using any equipment (after meeting all other criteria like safety tests)

Include some key safety questions on unit tests/quizzes

Provide written and oral forms of safety instruction/reminders

No **open toed shoes** or **flip flops** allowed during lab activities

Always require students to **tie back** long hair/**secure** loose clothing and jewelry



Presentation derived from: Love, T. S., Roy, K. R., & Sirinides, P. (2021). What factors have the greatest impact on safety in Pennsylvania's T&E courses? Technology and Engineering Education Association of Pennsylvania Journal, 69(1), 5-22.

Safety tests and posters used with students?

Answer	Pennsylvania	National
ITEEA's safety website	7%	10%
Virginia Tech's lab safety resource website	0%	1%
Power Tool Institute resources	1%	3%
School district/department developed resources	12%	15%
State developed resources	12%	4%
Student developed safety resources	1%	1%
Teacher (my own) developed resources	60%	58%
I do not use safety tests or posters	6%	8%

*Teachers Reported Having the Following:

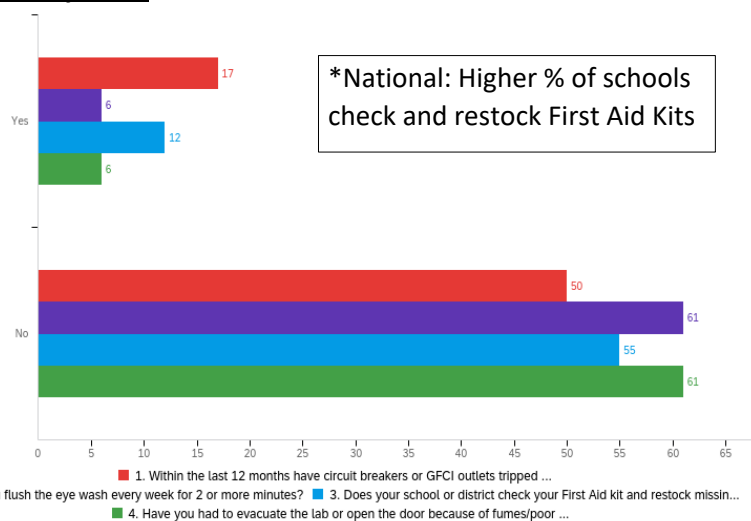
	<u>Pennsylvania</u>	<u>National</u>
Safety Zones on Floor	37%	48%
Non-skid strips near machines	40%	27%
Eyewash w/in 10 second access		
Plumbed	40%	47%
Portable	22%	22%
Adequate Ventilation	52%	45%
Workspace accessible to wheelchair bound students	52%	47%
Accessible master power shut offs	79%	61%
Sufficient number of outlets	72%	61%

*Teachers Reported Having the Following:

	<u>Pennsylvania</u>	<u>National</u>
Lockable tool storage	87%	78%
Sufficient work space per student	58%	60%
Sufficient project storage	54%	61%
ANSI Z87.1 glasses for entire class	88%	83%
Cabinet to sanitize goggles	54%	50%
A sink in the facility	81%	76%
First Aid Kit	55%	61%
Lockable chemical storage cabinet	81%	67%
Finishing or chemical storage room	70%	46%
External exhaust paint booth	72%	83%

*Have any of the following occurred/do they occur?

Pennsylvania



Recommendations

Flush out emergency eye wash & shower once a week for 1-3 minutes

Check first aid kit each semester to **restock**, work with school nurse

Use a U-V goggle **sanitizer** with a UV-C Germicidal bulb to sanitize eye protection devices after each individual's use.

Have at least one or more **sinks** with running cold and hot water sources dependent on class enrollment

Have a **lockable**/secure finishing or chemical storage room and chemical storage cabinet to prevent student access.

Have a **lockable/secure tool cabinet** to prevent student access when not in use instructionally.

Recommendations

Have appropriate taped or painted safety **work zones** are all machines.

Have **non-skid strips** near machines to prevent slip/fall hazards.

Have appropriate **ventilation** to accommodate particulate and aerosol hazards.

Have a **wood dust collection system** with the intake vent placement **at the machine source** of wood dust production to prevent exposure to air-borne wood dust.

Have **workspace accessible to wheelchair** bound students per ADA requirements.

Have all electrical receptacles **GFCI** protected.

Have easily accessible **emergency power shut-off** switches.

Have a sufficient number of electrical receptacles to eliminate use of extension cords.

Accidents

During your time of employment, has your school district been involved in litigation or a settlement because of a T&E laboratory accident?

Pennsylvania

Answer	%	Count
Yes	11%	7
No	73%	49
Unsure	16%	11

National

Yes	7%	51
No	62%	444
Unsure	31%	223

Presentation derived from: Love, T. S., Roy, K. R., & Sirinedes, P. (2021). What factors have the greatest impact on safety in Pennsylvania's T&E courses? Technology and Engineering Education Association of Pennsylvania Journal, 69(1), 5-22.

Within the last 12 months, how many T&E safety incidents (no injury) have occurred in your classes?

Pennsylvania

Answer	%	Count
0	33%	22
1-10	67%	45
11-20	0%	0
21-30	0%	0
More than 30	0%	0

National

0	38%	274
1-10	60%	427
11-20	2%	15
21-30	0%	0
More than 30	0.3%	2

***If a T&E safety incident has occurred, did it involve any of the following?**

Question	Involved	
1. Hot glue gun	36%	24
2. Broken glass	6%	4
3. Spills/splashes (of any kind)	16%	11
4. Student Operated Equipment/Machinery (ex. scroll saw, band saw, etc)	31%	21
5. Automated equipment (ex. CNC, laser cutter, 3D printer, robotics, etc.)	3%	2

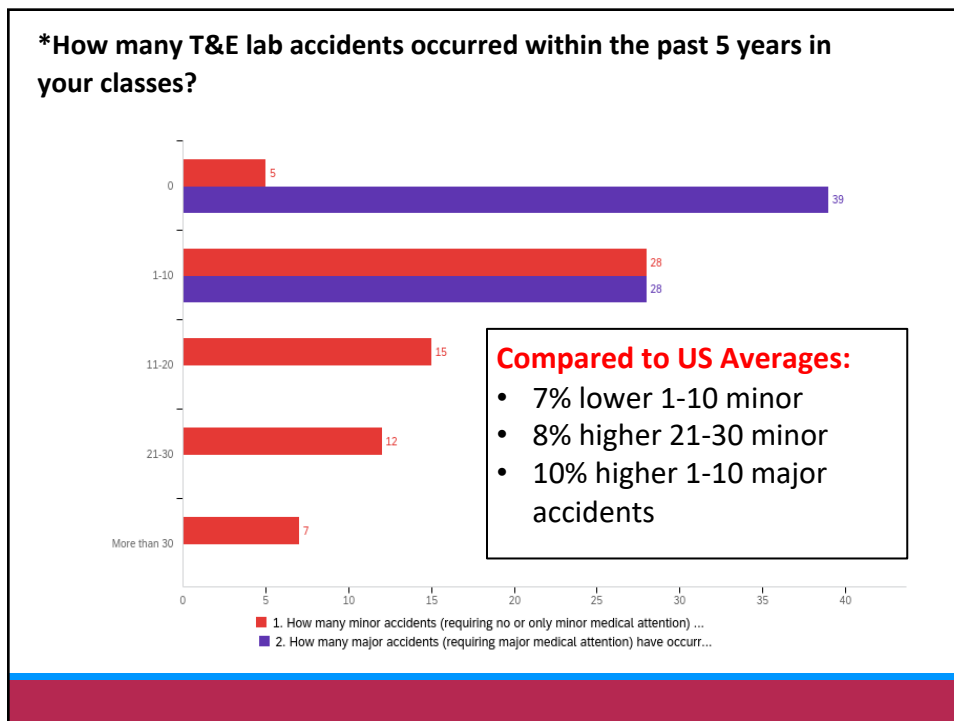
Question	Involved	
6. Hand or portable power tools (ex. cordless drill, Dremel, etc.)	18%	12
7. Fumes	6%	4
8. Fires	0%	0
9. Projectiles	13%	9
10. Electrical Short	6%	4
11. Outdoor activities	0%	0

Similar to national findings

***How many T&E lab accidents occurred within the past year in your classes?**

Question	0		1-5		6-10		11-15	
1. How many minor accidents in the past 12 months?	11%	7	60%	40	21%	14	3%	2
2. How many major accidents (requiring major medical attention) occurred in your classes within the past 12 months?	90%	60	11%	7	0%	0	0%	0

Similar to national findings



If an accident (minor or major) has occurred in your classes within the past 5 years, did it involve any of the following:

Similar to national findings.
Mostly cuts/lacerations or burns to students



Pennsylvania

***Most commonly injured body part?**

Answer	%	Count
Did not have any accidents	12%	8
Fingers/hands	87%	58
Eyes/face	0%	0
Arms	0%	0
Legs	0%	0
Other body part	2%	1

National

Did not have any accidents	13%	93
Fingers/hands	86%	615
Eyes/face	0.4%	3
Arms	0.1%	1
Legs	0%	0
Other body part	0.8%	6

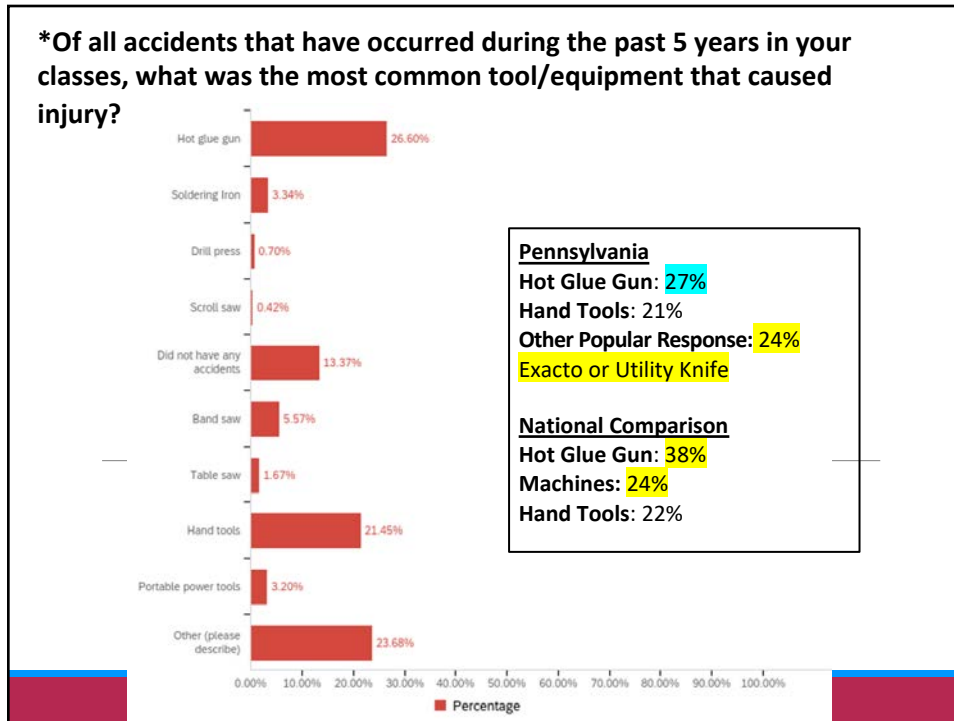


Table Saws

	<u>Pennsylvania</u>	<u>National</u>
Have a table saw	75%	65%
SawStop brand	50%	56%
Instructor only use	30%	34%
Student use with strict guidance	32%	31%
Student use with Teacher in Lab	38%	35%

***Top 3 Factors for Unsafe Conditions/Accidents in a T&E lab?**

Pennsylvania

1. Student Failure to follow safety protocols
2. Overcrowding
3. Classroom management/discipline

National

1. Student Failure to follow safety protocols
2. Overcrowding
3. Classroom management/discipline
4. Percentage of Students with Disabilities in class
5. Inadequate facilities

Correlations and Predictors of Accidents

*Statistically Significant Factors Contributing to Accident Rates

Polychoric correlation tests ($p = 0.05$)

Contributing Factors
Type of course taught (more hazardous, greater risk) Ex. 24% more likely to have minor accident, 30% more likely to have major accident
Greater than 25% of class doing hands-on T&E activities
Hybrid classroom/lab higher than other facility designs
Independent student use on table saw

*Statistically Significant Factors Reducing Accident Rates

Polychoric correlation tests ($p = 0.05$)

Protective Factors
Safety glasses for every student in class Ex. 16% less likely minor accident, 25% less likely major accident
Dust collection connected directly to equipment
Fire extinguisher within 25 feet
Circuit breakers that had tripped
Have GFCI outlets
Lockable flammables cabinet
Lockable tool storage cabinet
Master shut off switch

*Statistically Significant Factors Reducing Accident Rates cont.

Polychoric correlation tests ($p = 0.05$)

Protective Factors cont.
Safety zones on the floor around equipment
Non skid strips on the floor around equipment
Type of Table Saw: SawStop
Finishing/chemical storage room separate from lab/classroom
Appropriate gloves for all students when needed
Appropriate aprons for all students when needed
Sink in lab/classroom

*Statistically Significant Predictors of Accidents

Logistic regression tests ($p = 0.05$)

Contributing Factors cont.	Statistically Significant?
Undergraduate T&E methods course	N
Comprehensive training (undergrad or graduate safety coursework + training from district upon initial hiring + training updates from district within past 5 years)	Y*
*37% lower odds of ≥ 1 accidents occurring	
Comprehensive training + years of teaching experience	N

Questions?

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[https://sites.google.com/view/
2020-te-safety-study/](https://sites.google.com/view/2020-te-safety-study/)

TEEAP Spring 2021 Digital Journal Article