

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

*How Does Minnesota Compare to the  
National Averages?*



*What are the Implications for School  
Systems?*

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Prepared for the  
Minnesota Department of Education  
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## Permissions

These findings were derived from a larger data set:

- Love, T. S., & Roy, K. R. (2022). *Safer engineering and CTE instruction: A national STEM education imperative*. International Technology and Engineering Educators Association. <https://www.iteea.org/SafetyReport.aspx>
- Love, T. S., & Roy, K. R. (2020). K-12 technology and engineering education safety and facilities survey. [Data set]. National Safety Consultants, LLC. <https://sites.google.com/view/2020-te-safety-study/>

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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

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- Last national survey on T&E safety is unknown
- Large focus on safety in T&E education due to:
  - Potential hazards, resulting risks, and teacher liability
  - Alternative certification
  - STEM/Makerspaces
  - After school clubs

## Previous Research - CTE

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- 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 legal occupancy loads
  5. Small classroom/lab space

## Previous Research - Science Ed

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

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

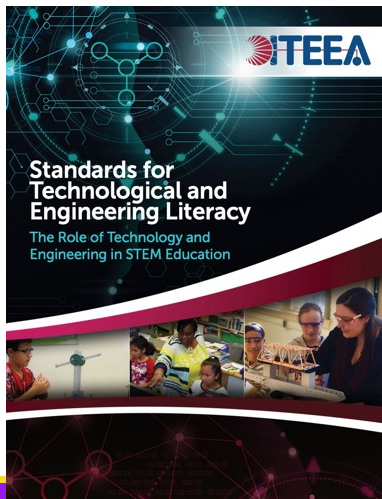
-Incidents/Accidents increased:

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!

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-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

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-**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, 75 MN educator responses

-Questions on:

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

# Demographics

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### Gender and Race

#### Minnesota

Answer	%	Count
Male	95%	71
Female	5%	4
<b>Total</b>	<b>100%</b>	<b>75</b>
White	96 %	72
Black	1 %	1
Two or More Races	3 %	2
Asian	0 %	0
Hispanic or Latino	0 %	0
Native Hawaiian or Pacific Islander	0%	0

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

### Certification(s)

#### Minnesota

Answer	Percent	Count
Alternative or Emergency	2%	2
Elementary Education	2%	2
Technology Ed or T&E Education	49%	62
A Science Education area	1%	1
CTE area	37%	47
Other (please specify)	10%	13

**National** – T&E = 78%, Elementary = 3%, CTE = 8%

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

### Minnesota

Answer	%	Count
0-3	4%	3
4-8	7%	5
9-15	17%	13
16-25	37%	28
26+	35%	26

### 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

### Minnesota

Grade Level	%	Count
K-5	0%	0
Middle School	12%	9
High School	60%	45
6-12 (Middle & High School)	27%	20
K-12	1%	1

### National

Grade Level	%	Count
K-5	3%	21
Middle School	29%	207
High School	55%	394
6-12 (Middle & High School)	11%	82
K-12	2%	14

# Courses and Enrollment

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## Course Preps

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<u>Preps</u>	<u>Minnesota</u>	<u>National</u>
1	1%	3%
2	7%	14%
3	20%	31%
4	27%	25%
5	21%	13%
>5	24%	14%



# Primary Focus of Your Courses

## Minnesota

1. Materials Processing (woods and metals combined)
2. Pre-engineering (ex. PLTW)
3. Engineering Design, T&E Literacy

## National

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

## Enrollment in your classes: Average and Largest Class sizes

### Minnesota

**Average:** 25% said 16-20  
21% said 21-24  
32% said 25-30  
7% said more than 30

**Largest:** 35% said 25-30  
33% 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

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

**Minnesota**

Answer	%	Count
0-5%	12%	9
6-15%	36%	27
16-25%	37%	28
26-50%	15%	11
More than 50%	0%	0

**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?**

**Minnesota**

Answer	%	Count
Poor	9%	7
Fair	11%	8
Good	48%	36
Excellent	32%	24

**National**

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

**Have a sufficient budget to maintain safety**

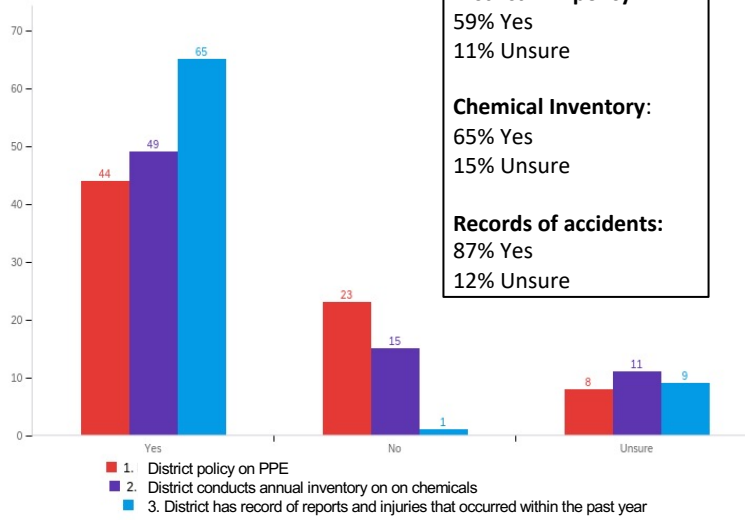
**Minnesota**

Answer	%	Count
Yes	59%	44
No	41%	31

**National**

Answer	%	Count
Yes	53%	380
No	47%	338

### District Safety Practices



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

Answer	Minnesota	National
Yes	77%	43%
No	15%	37%
Unsure	8%	21%

### Do the Following Have A Written Safety Policy?

Answer	Minnesota	National
T&E Classes	89%	82%
T&E Department	64%	56%
School District	48%	44%

### How does your district dispose of hazardous chemicals?

Answer	Minnesota	National
Hazardous waste contractor	55%	26%
Green disposal methods	3%	2%
Municipality	16%	11%
Down the drain/trash	3%	6%
Unsure	20%	37%
Do not use hazardous chemicals	4%	18%

## Recommendations

- Work with your district safety compliance officer, legal counsel, fire marshal, administrators/supervisors, and teachers to **develop a written safety program**, including protocols, inspections, training, etc.
- Work with your **Board of Education** to help develop a written 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 safety **consistently and fairly**

## Further Recommendations

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Minnesota has adopted the federal OSHA rules by reference, and also adopted several rules that are stricter than federal standards. These rules apply to public-sector (state and local government offices and operations) and private-sector workplaces within the state with some limited exceptions. Contact the Minnesota OSHA (MNOSHA) office at the Minnesota Department of Labor and Industry to inquire about specific rules pertaining to schools.

<https://www.osha.gov/stateplans/mn>

## Safety Training

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

<b>Answer</b>	<b>Minnesota</b>	<b>National</b>
UG tech/eng or lab courses	65%	62%
UG teaching methods courses	56%	54%
Grad tech/eng or lab courses	25%	28%
Grad teaching methods courses	24%	32%

**When initially hired did your district provide safety training?**

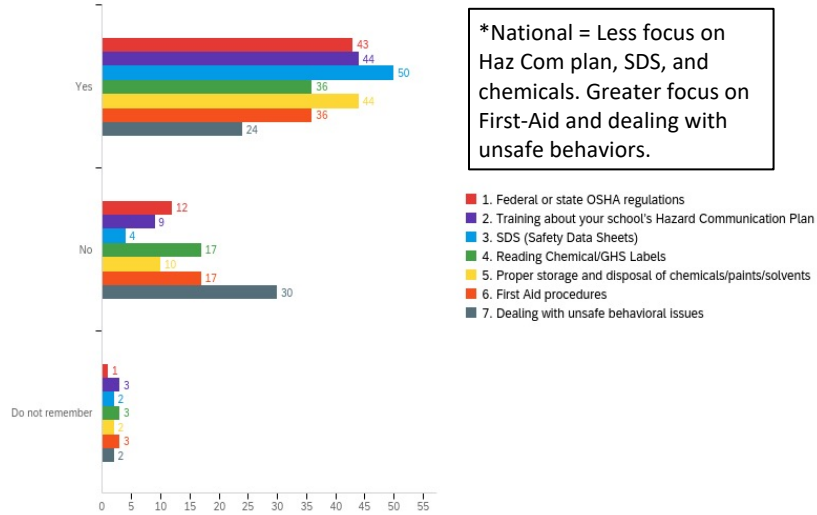
<b>Answer</b>	<b>Minnesota</b>	<b>National</b>
Yes	48%	32%
No	52%	68%

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

<b>Answer</b>	<b>Minnesota</b>	<b>National</b>
<6 months	24%	15%
6 months -1 year	31%	21%
1-2 years	7%	7%
2-5 years	3%	5%
>5 years	11%	7%
Never received training from my district	25%	44%

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

**Minnesota**



\*National = Less focus on Haz Com plan, SDS, and chemicals. Greater focus on First-Aid and dealing with unsafe behaviors.

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

**Minnesota**

Answer	%	Count
Yes	16%	12
No	84%	63

\*National = 18% said Yes



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

MN Answer	MN%	MN Count	National %
Local training source (not my school district)	42%	5	26%
State teacher's association	17%	2	12%
State department of education	0%	0	6%
National teacher's association	0%	0	3%
A university	0%	0	11%
OSHA	33%	4	17%
Other (ex. PLTW)	8%	1	25%
Total	100%	12	

## Recommendations

**According to Federal 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 or standard 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

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

Answer	Minnesota	National
Portable Classroom	0%	0.28%
Regular Classroom/computer room	5%	17%
T&E classroom/lab combo	69%	66%
T&E Lab	20%	12%
Makerspace	0%	2%
Varied due to floating	5%	3%

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### Approximate size of the instructional area?

Answer (NFPA 101 Fire Code Capacity)	Minnesota	National
Less than 600 square feet (<12 students)	3%	8%
600-800 square feet (12-16 students)	16%	20%
800-1,000 square feet (16-20 students)	15%	22%
1,000-1,200 square feet (20-24 students)	37%	24%
Greater than 1,200 square feet (>24 students)	29%	26%

**Review:**

**MN Average Enrollment:**

39% said more than 24

**MN Largest Enrollment:**

68% said more than 24

## Soldering Ventilation

	<u>Minnesota</u>	<u>National</u>
Do soldering activities	52%	52%
Under external vented fume hood	28%	15%
Under internal fume extractor	5%	12%

## 3D Printer Ventilation

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	<u>Minnesota</u>	<u>National</u>
Have 3D printer(s)	70%	75%
Built in filter (HEPA)	29%	17%
Used inside of a fume hood	4%	2%
Used near internal vent system (ex. electrostatic air filter)	6%	6%
No ventilation used	62%	75%

## Laser Engraver

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	<u>Minnesota</u>	<u>National</u>
Have a laser engraver	53%	44%
Internal Exhaust	43%	31%
External Exhaust	55%	64%
No ventilation	3%	5%

## Recommendations

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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

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

Question	Never	Rarely	Usually	Always
1. Sign a <b>safety acknowledgement form</b> ?	24% (MN) 16% (US)	7% 6%	8% 10%	<b>61%</b> 69%
2. Be <b>tested</b> for their knowledge of safety procedures prior to participating in new hazardous T&E activities/using new hazardous equipment?	5% 8%	5% 5%	7% 12%	<b>83%</b> 76%
3. Safely <b>demonstrate a new procedure</b> or use of a new tool/piece of equipment while directly supervised?	3% 5%	5% 3%	21% 16%	<b>71%</b> 76%
4. Be tested on safety knowledge on their quizzes/exams?	5% 10%	13% 15%	19% 24%	<b>63%</b> 52%
5. Be provided both written and oral safety precautions by the instructor prior to each lab?	7% 7%	8% 14%	19% 24%	<b>41%</b> 52%

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

Question	Never	Rarely	Usually	Always
6. Secure <b>long hair</b> /tie it back?	3%(MN) 6% (US)	3% 2%	13% 14%	<b>81%</b> 78%
7. Remove <b>loose jewelry</b> , roll up long sleeves, secure baggy clothing?	4% 7%	3% 3%	11% 14%	<b>83%</b> 76%
8. Wear close toed shoes?	4% 7%	4% 4%	15% 20%	<b>77%</b> 69%
9. Wear <b>safety glasses</b> when working with solid hazards	4% 11%	1% 3%	7% 10%	<b>88%</b> 77%
10. Wear <b>safety goggles</b> when working with liquid hazards	17% 31%	23% 13%	19% 12%	<b>41%</b> 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



## Safety tests and posters used with students?

Answer	Minnesota	National
ITEEA's safety website	7%	10%
Virginia Tech's lab safety resource website	1%	1%
Power Tool Institute resources	3%	3%
School district/department developed resources	13%	15%
State developed resources	4%	4%
Student developed safety resources	0%	1%
Teacher (my own) developed resources	<b>67%</b>	<b>58%</b>
I do not use safety tests or posters	<b>5%</b>	<b>8%</b>

## Teachers Reported Having the Following:

	<u>Minnesota</u>	<u>National</u>
Safety Zones on Floor	52%	48%
Non-skid strips near machines	57%	27%
Eyewash w/in 10 second access		
Plumbed	72%	47%
Portable	15%	22%
Adequate Ventilation	67%	45%
Workspace accessible to wheelchair bound students	48%	47%
Accessible master power shut offs	57%	61%
Sufficient number of outlets	67%	61%

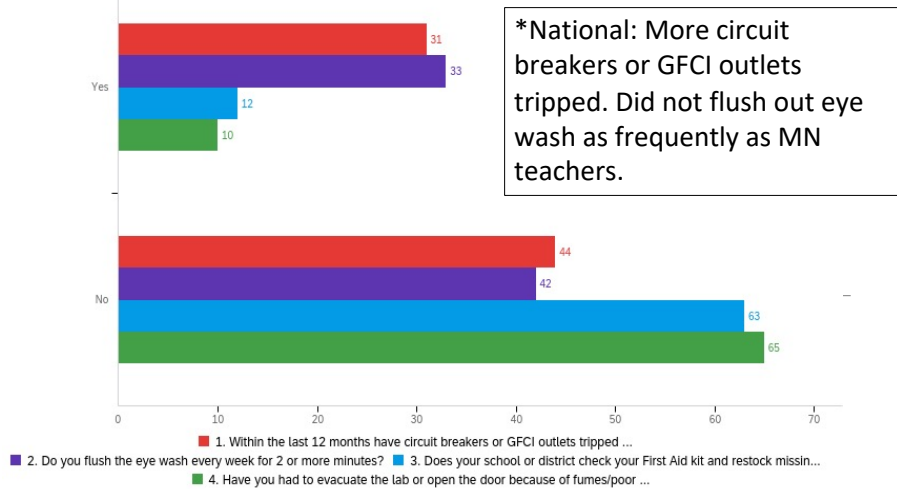
## Teachers Reported Having the Following:

	<u>Minnesota</u>	<u>National</u>
Lockable tool storage	80%	78%
Sufficient work space per student	61%	60%
Sufficient project storage	57%	61%
ANSI Z87.1 glasses for entire class	91%	83%
Cabinet to sanitize goggles	29%	50%
A sink in the facility	84%	76%
First Aid Kit	68%	61%
Lockable chemical storage cabinet	87%	67%
Fire extinguisher	95%	86%
Dust collector for woodworking	89%	64%



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

### Minnesota



## 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** near 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 and ensure that they **work properly**.

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

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

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

## Accidents

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

**Minnesota**

Answer	%	Count
Yes	13%	10
No	73%	55
Unsure	13%	10

**National**

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

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

**Minnesota**

Answer	%	Count
0	32%	24
1-10	64%	48
11-20	3%	2
21-30	0%	0
More than 30	1%	1

**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?

**Minnesota**

Question	Involved	
1. Hot glue gun	19%	14
2. Broken glass	5%	4
3. Spills/splashes (of any kind)	16%	12
4. Student Operated Equipment/Machinery (ex. scroll saw, band saw, etc)	40%	30
5. Automated equipment (ex. CNC, laser cutter, 3D printer, robotics, etc.)	1%	1

Question	Involved	
6. Hand or portable power tools (ex. cordless drill, Dremel, etc.)	27%	20
7. Fumes	9%	7
8. Fires	3%	2
9. Projectiles	13%	10
10. Electrical Short	4%	3
11. Outdoor activities	0%	0

National = Hot glue guns 38%, Equipment 23%, Automated equipment 4%, Hand/portable power tools 21%

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

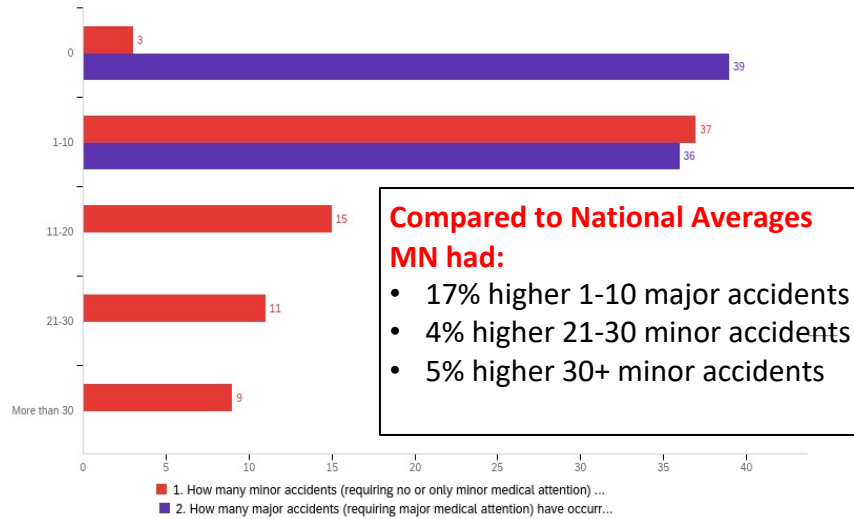
**Minnesota**

Question	0		1-5		6-10		11-15	
1. How many minor accidents in the past 12 months?	9%	7	67%	50	15%	11	4%	4
2. How many major accidents (requiring major medical attention) occurred in your classes within the past 12 months?	91%	40	9%	4	0%	0	0%	0

National = 20% had no minor accidents and 62% had 1-5 minor accidents; 88% had no major accidents and 12% had 1-5 major accidents

**How many T&E lab accidents occurred within the past 5 years in your classes?**

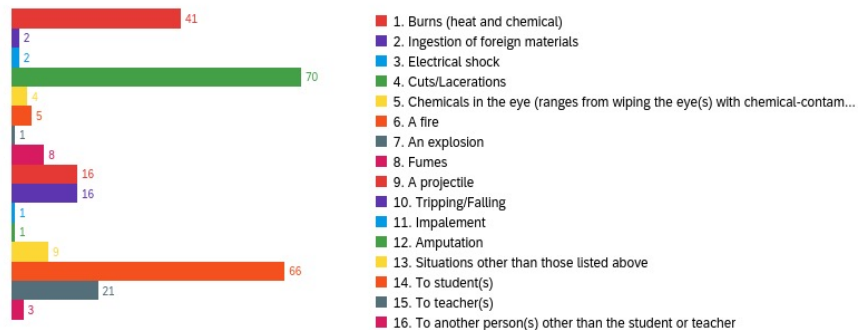
**Minnesota**



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

**Minnesota**

**\*National had less burns, cuts/lacerations, and projectile accidents.**



**Minnesota**

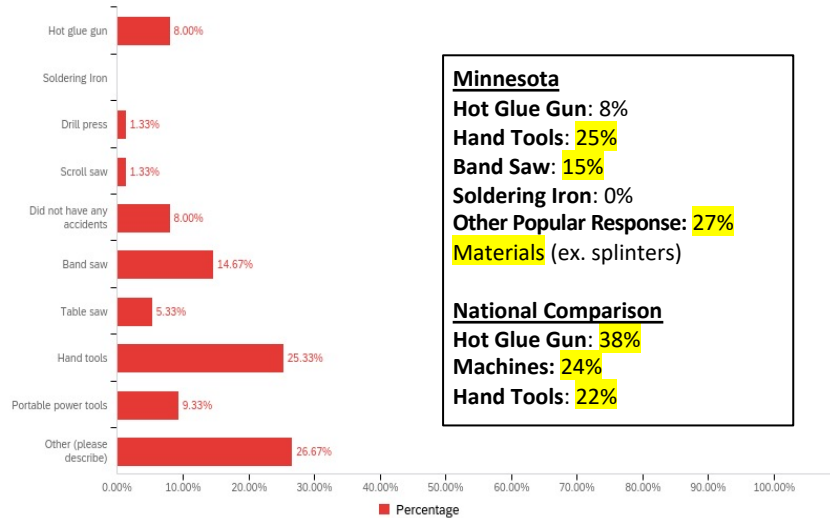
**Most commonly injured body part?**

Answer	%	Count
Did not have any accidents	7%	5
Fingers/hands	92%	69
Eyes/face	1%	1
Arms	0%	0
Legs	0%	0
Other body part	0%	0

**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

**Of all accidents that have occurred during the past 5 years in your classes, what was the most common tool/equipment that caused injury?**



## Table Saws

	<u>Minnesota</u>	<u>National</u>
Have a table saw	83%	65%
SawStop brand	82%	56%
Instructor only use	11%	34%
Student use with strict guidance	16%	31%
Student use with Teacher in Lab	73%	35%

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

#### Minnesota

1. Student Failure to follow safety protocols
2. Overcrowding
3. Tie- Inadequate facilities and inadequate equipment
3. Tie - Classroom management/discipline and Inclusion of students w/ various special needs
4. "Floating" or travel from room to room

#### 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

\*Derived from the national results of this study. More details about the analyses and results can be accessed at: [https://www.researchgate.net/publication/356186501\\_Examining\\_Factors\\_Associated\\_with\\_Accidents\\_in\\_CTE\\_and\\_STEM\\_Education\\_Labs\\_A\\_National\\_Safety\\_Study](https://www.researchgate.net/publication/356186501_Examining_Factors_Associated_with_Accidents_in_CTE_and_STEM_Education_Labs_A_National_Safety_Study)

## 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

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Polychoric correlation tests ( $p = 0.05$ )

<b>Protective Factors</b>
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.

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Polychoric correlation tests ( $p = 0.05$ )

<b>Protective Factors cont.</b>
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 and secure (locked)
Appropriate gloves for all students when needed
Appropriate aprons for all students when needed
Sinks 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
<b>Comprehensive training</b> (undergrad or graduate safety coursework + training from district upon initial hiring + training updates from district within past 5 years)	Y*
*37% lower odds of $\geq 1$ accidents occurring	
Comprehensive training + years of teaching experience	N

## Questions?

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Additional Results:

<https://sites.google.com/view/2020-te-safety-study/>



<https://www.iteea.org/SafetyReport.aspx>