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

How Does Kentucky Compare to the National Averages?

What are the Implications for School Systems?

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Permissions

These findings were derived from a larger data set:

- 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/
- 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.

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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

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-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

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-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:

- Potential hazards, resulting risks, and teacher liability
- Alternative certification
- STEM/Makerspaces
- After school clubs

Previous Research - CTE

-Recent studies on safety in various CTE areas by Threeton and Evanoski (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

-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, 44 KY responses

-Questions on:

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

Demographics

Gender and Race

Kentucky

Answer	%	Count
Male	57%	25
Female	43%	19
Total	100%	44
White	98 %	43
Black	0 %	0
Two or More Races	0 %	0
Asian	0 %	0
Hispanic or Latino	0 %	0
Native Hawaiian or Pacific Islander	2 %	1

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

Certification(s)

Kentucky

Answer	Percent	Count
Alternative or Emergency	7%	4
Elementary Education	8%	5
Technology Ed or T&E Education	25%	15
A Science Education area	16%	10
CTE area	12%	7
Other (please specify)	33%	20

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

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

Kentucky

Answer	%	Count
0-3	23%	10
4-8	25%	11
9-15	14%	6
16-25	25%	11
26+	14%	6

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

Kentucky

Grade Level	%	Count
K-5	14%	6
Middle School	23%	10
High School	55%	24
6-12 (Middle & High School)	7%	3
K-12	2%	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

Course Preps

Preps	Kentucky	National
1	5%	3%
2	5%	14%
3	18%	31%
4	25%	25%
5	20%	13%
>5	27%	14%

Primary Focus of Your Courses

Kentucky

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

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

Kentucky	**National Comparison**
Average: 41% said 16-20	**Average**: 33% said 16-20
18% said 21-24	25% said 21-24
20% said 25-30	22% said 25-30
16% said more than 30	8% said more than 30
Largest: 75% said 25-30	**Largest**: 34% said 25-30
23% said more than 30	23% said more than 30

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

Kentucky

Answer	%	Count
0-5%	36%	16
6-15%	41%	18
16-25%	20%	9
26-50%	2%	1
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?

Kentucky

Answer	%	Count
Poor	7%	3
Fair	18%	8
Good	41%	18
Excellent	34%	15

National

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

Have a sufficient budget to maintain safety

Kentucky

Answer	%	Count
Yes	39%	17
No	61%	27

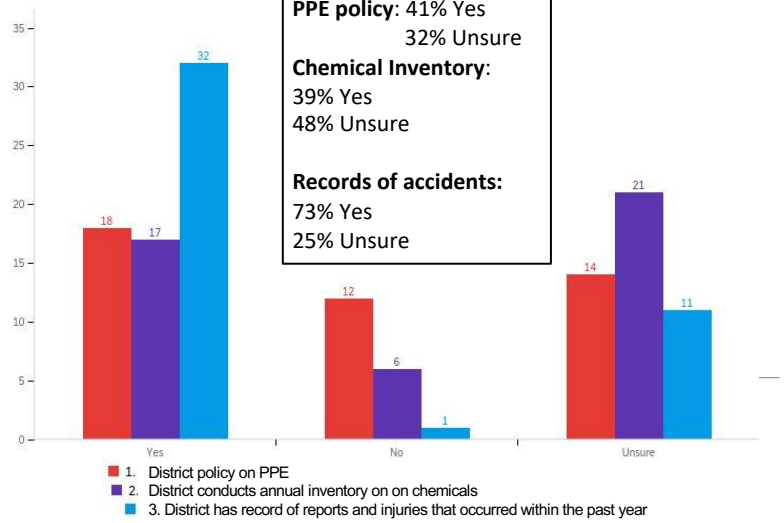
National

Answer	%	Count
Yes	53%	380
No	47%	338

District Safety Practices

Kentucky
PPE policy: 41% Yes
32% Unsure
Chemical Inventory:
39% Yes
48% Unsure

Records of accidents:
73% Yes
25% Unsure



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

Answer	Kentucky	National
Yes	39%	43%
No	23%	37%
Unsure	39%	21%

Do the Following Have A Written Safety Policy?

Answer	Kentucky	National
T&E Classes	61%	82%
T&E Department	39%	56%
School District	48%	44%

How does your district dispose of hazardous chemicals?

Answer	Kentucky	National
Hazardous waste contractor	11%	26%
Green disposal methods	2%	2%
Municipality	5%	11%
Down the drain/trash	0%	6%
Unsure	48%	37%
Do not use hazardous chemicals	34%	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

Refer to Kentucky's rules governing public sector (state and local government offices and operations) workplaces under the jurisdiction of the Kentucky Occupational Safety and Health office (https://labor.ky.gov/standards/Pages/Occupational-Safety-and-Health.aspx). The state has adopted the federal OSHA rules by reference and additionally, has adopted several rules that are stricter than federal standards.

Safety Training

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

Answer	Kentucky	National
UG tech/eng or lab courses	36%	62%
UG teaching methods courses	27%	54%
Grad tech/eng or lab courses	27%	28%
Grad teaching methods courses	27%	32%

When initially hired did your district provide safety training?

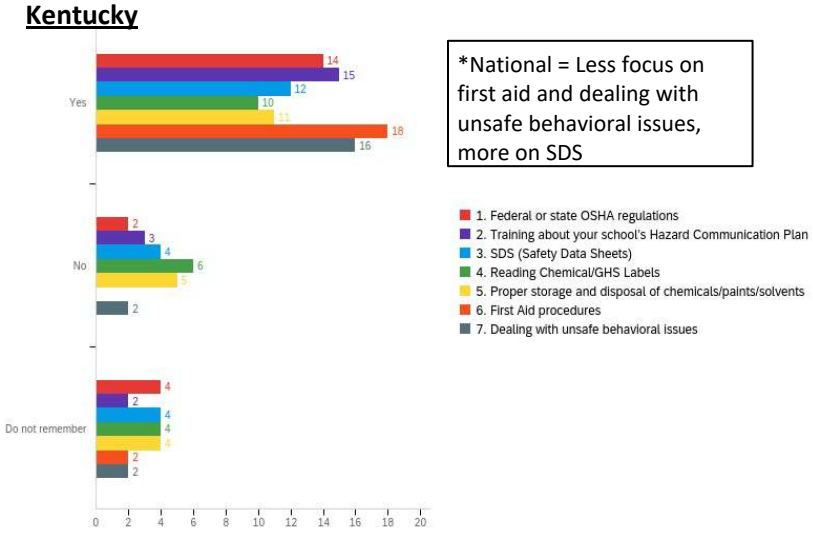
Answer	Kentucky	National
Yes	39%	32%
No	61%	68%

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

Answer	Kentucky	National
<6 months	11%	15%
6 months -1 year	25%	21%
1-2 years	2%	7%
2-5 years	0%	5%
>5 years	7%	7%
Never received training from my district	55%	44%

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

Kentucky



*National = Less focus on first aid and dealing with unsafe behavioral issues, more on SDS

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

Kentucky

Answer	%	Count
Yes	16%	7
No	84%	37

*National = 18% said Yes

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

KY Answer	KY %	KY Count	National %
Local training source (not my school district)	29%	2	26%
State teacher's association	14%	1	12%
State department of education	14%	1	6%
National teacher's association	0%	0	3%
A university	0%	0	11%
OSHA	0%	0	17%
Other (ex. PLTW)	43%	3	25%
Total	100%	7	

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

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

Answer	Kentucky	National
Portable Classroom	0%	0.28%
Regular Classroom/computer room	34%	17%
T&E classroom/lab combo	57%	66%
T&E Lab	9%	12%
Makerspace	0%	2%
Varied due to floating	0%	3%

Approximate size of the instructional area?

Answer (Fire Code Capacity)	Kentucky	National
Less than 600 square feet (<12 students)	7%	8%
600-800 square feet (12-16 students)	30%	20%
800-1,000 square feet (16-20 students)	34%	22%
1,000-1,200 square feet (20-24 students)	7%	24%
Greater than 1,200 square feet (>24 students)	23%	26%

Review:
KY Average Enrollment:
36% said more than 24

KY Largest Enrollment:
75% said more than 24

Soldering Ventilation

	Kentucky	National
Do soldering activities	39%	52%
Under external vented fume hood	12%	15%
Under internal fume extractor	6%	12%

3D Printer Ventilation

	Kentucky	National
Have 3D printer(s)	84%	75%
Built in filter (HEPA)	30%	17%
Used inside of a fume hood	5%	2%
Used near internal vent system (ex. electrostatic air filter)	3%	6%
No ventilation used	62%	75%

Laser Engraver

	Kentucky	National
Have a laser engraver	41%	44%
Internal Exhaust	11%	31%
External Exhaust	78%	64%
No ventilation	11%	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:

Question	Never	Rarely	Usually	Always
1. Sign a safety acknowledgement form?	32% (KY) 16% (US)	9% 6%	16% 10%	43% 69%
2. Be tested for their knowledge of safety procedures prior to participating in new hazardous T&E activities/using new hazardous equipment?	18% 8%	11% 5%	18% 12%	52% 76%
3. Safely demonstrate a new procedure or use of a new tool/piece of equipment while directly supervised?	16% 5%	0% 3%	30% 16%	55% 76%
4. Be tested on safety knowledge on their quizzes/exams?	18% 10%	11% 15%	43% 24%	27% 52%
5. Be provided both written and oral safety precautions by the instructor prior to each lab?	18% 7%	11% 14%	23% 24%	48% 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?	23% (KY) 6% (US)	5% 2%	20% 14%	52% 78%
7. Remove loose jewelry, roll up long sleeves, secure baggy clothing?	25% 7%	9% 3%	16% 14%	50% 76%
8. Wear close toed shoes?	20% 7%	9% 4%	23% 20%	48% 69%
9. Wear safety glasses when working with solid hazards	23% 11%	9% 3%	14% 10%	55% 77%
10. Wear safety goggles when working with liquid hazards	32% 31%	16% 13%	7% 12%	45% 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	Kentucky	National
ITEEA's safety website	0%	10%
Virginia Tech's lab safety resource website	0%	1%
Power Tool Institute resources	2%	3%
School district/department developed resources	7%	15%
State developed resources	2%	4%
Student developed safety resources	0%	1%
Teacher (my own) developed resources	75%	58%
I do not use safety tests or posters	14%	8%

Teachers Reported Having the Following:

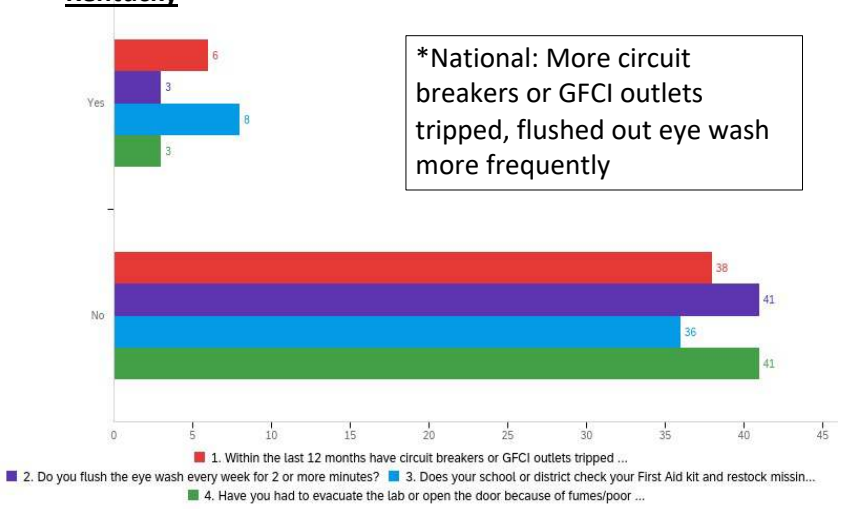
	Kentucky	National
Safety Zones on Floor	27%	48%
Non-skid strips near machines	16%	27%
Eyewash w/in 10 second access		
Plumbed	20%	47%
Portable	9%	22%
Adequate Ventilation	30%	45%
Workspace accessible to wheelchair bound students	57%	47%
Accessible master power shut offs	37%	61%
Sufficient number of outlets	37%	61%

Teachers Reported Having the Following:

	Kentucky	National
Lockable tool storage	66%	78%
Sufficient work space per student	59%	60%
Sufficient project storage	64%	61%
ANSI Z87.1 glasses for entire class	68%	83%
Cabinet to sanitize goggles	30%	50%
A sink in the facility	52%	76%
First Aid Kit	64%	61%
Lockable chemical storage cabinet	66%	67%
Fire extinguisher	75%	86%
Dust collector for woodworking	32%	64%

Have any of the following occurred/do they occur?

Kentucky



*National: More circuit breakers or GFCI outlets tripped, flushed out eye wash more frequently

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

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

Kentucky

Answer	%	Count
Yes	0%	0
No	68%	30
Unsure	32%	14

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?

Kentucky

Answer	%	Count
0	64%	28
1-10	36%	16
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?

Kentucky

Question	Involved	
1. Hot glue gun	27%	12
2. Broken glass	0%	0
3. Spills/splashes (of any kind)	7%	3
4. Student Operated Equipment/Machinery (ex. scroll saw, band saw, etc)	9%	4
5. Automated equipment (ex. CNC, laser cutter, 3D printer, robotics, etc.)	2%	1
6. Hand or portable power tools (ex. cordless drill, Dremel, etc.)	12%	5
7. Fumes	2%	1
8. Fires	0%	0
9. Projectiles	0%	0
10. Electrical Short	0%	0
11. Outdoor activities	2%	1

National = Projectiles more involved

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

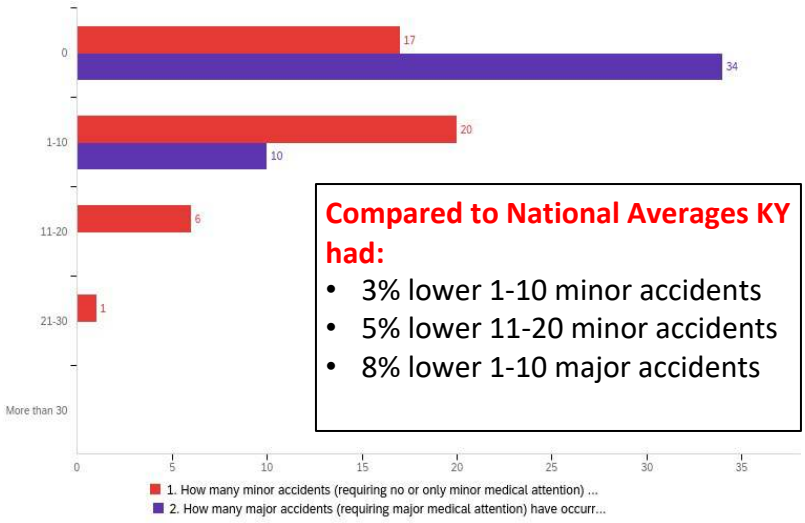
Kentucky

Question	0		1-5		6-10		11-15	
1. How many **minor accidents** in the past 12 months?	41%	18	50%	22	9%	4	0%	0
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?

Kentucky



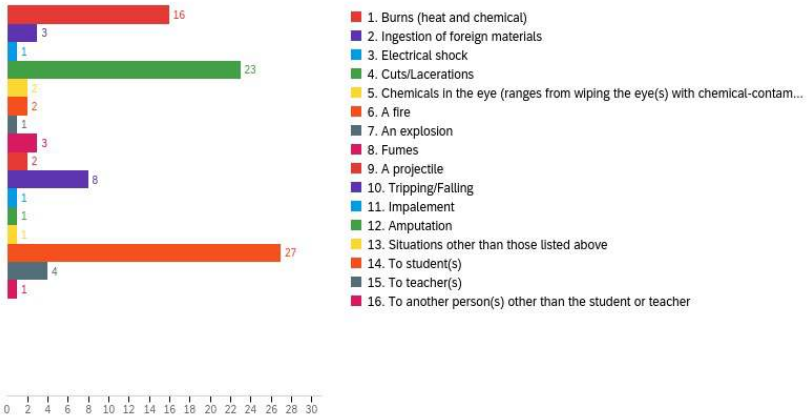
Compared to National Averages KY had:

- 3% lower 1-10 minor accidents
- 5% lower 11-20 minor accidents
- 8% lower 1-10 major accidents

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

Kentucky



Most commonly injured body part?

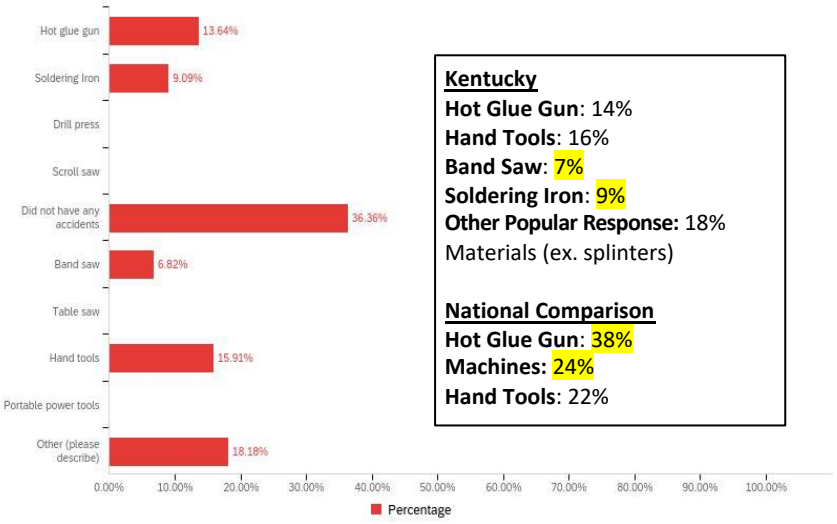
Kentucky

Answer	%	Count
Did not have any accidents	34%	15
Fingers/hands	64%	28
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

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



Kentucky
Hot Glue Gun: 14%
Hand Tools: 16%
Band Saw: 7%
Soldering Iron: 9%
Other Popular Response: 18%
Materials (ex. splinters)

National Comparison
Hot Glue Gun: 38%
Machines: 24%
Hand Tools: 22%

Table Saws

	Kentucky	National
Have a table saw	39%	65%
SawStop brand	35%	56%
Instructor only use	41%	34%
Student use with strict guidance	24%	31%
Student use with Teacher in Lab	35%	35%

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

Kentucky

1. Student Failure to follow safety protocols
2. Overcrowding
3. Lack of Safety Training
4. Inadequate Equipment

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 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
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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Additional Results:
https://sites.google.com/view/2020-te-safety-study/