Training Lab Supervisors:

Enhancing Safety and Teaching in Chemistry

Dr Frane Vusio

Hello, my name is Frane.

- I am an applied psychologist and clinical associate working for NHS Scotland.
- I also work as a Low-Intensity CBT Therapist.
- In addition to my clinical roles, I engage in research and teaching at the University of Warwick's Doctoral College.

Dr Ehsan Ghadim

Hello, my name is Ehsan.

- **I have completed PhD in the chemistry department at the University of Warwick.**
- **Currently, I am a postdoctoral researcher at the School of Engineering at the University of Warwick.**
- **Member of RSC**

Dr Jonathan A. Foster

Hello, my name is Jonathan.

- I graduated from the University of Durham with a chemistry degree in 2008 and completed a PhD.
- In 2012, I moved to the University of Cambridge for post-doctoral work.
- I joined the University of Sheffield in 2015 with a Ramsay Fellowship and was promoted to Lecturer in 2019.
- Currently, I am a Senior Lecturer in Inorganic Chemistry.
- I am also a senior member of RSC.

Housekeeping

Please switch on your cameras

Please turn off your microphone

Please interact with us via chat box

This session will be recorded

Q&A will be available after the presentation

No fire alarms or drills are scheduled

Aims for today

- Talk about EDI principles
- Importance of Respect (EDI+R)
- Leveraging EDI+R builds a safe lab culture
- Introduce RAMP framework
- Understand Lab anxiety and its impact
- Use of evidence-based tools in assessment
- The importance of psychological empowerment
- Supervisory and mentoring practice

Glossary:

- **EDI**
  Equality, Diversity and Inclusion
- **RAMP**
  Recognise, Assess, Minimise, Prepare
- **CLAI**
  Chemistry Laboratory Anxiety Instrument

Leveraging EDIR to build a supportive and safe laboratory culture

The Equality Act 2010

Discrimination	Equal opportunities	Inclusivity
Prevention of Harassment	Victimisation	Nine Protected characteristics

Source:
Foster, S., & Harris, L. (2022). *Embedding Equality, Diversity, and Inclusion (EDI) in Laboratory Practices*

Respect

Respect plays a critical role in fostering a safe, inclusive, and effective learning and research environment in chemistry laboratories

Respect for individual differences:

- Culture must be created where diverse experiences and identities are recognised and respected.
- This includes acknowledging how different groups may experience safety and risk differently.

Sources:
Edmondson, A. C. (1999). Psychological safety and learning behaviour in work teams
Weiner, B. J., Hobgood, C., & Lewis, M. A. (2017). The role of leadership in creating a culture of safety

How the Equality Act Enhances Safety and Inclusion in Labs

Case Study

- American Chemistry Society (ACS)(2023) emphasised the crucial role of integrating Diversity, Equity, Inclusion and Respect (DEIR) principles into laboratory safety practices.

- Key findings include:
  - Enhanced Psychological Safety
  - Addressing Systemic Barriers
  - Respect and collaboration
  - Improved Learning Outcomes

RAMP

RAMP stands for:

- **Recognise Hazards:** Identify any potential dangers in the environment.
- **Assess Risks:** Evaluate the likelihood and severity of harm.
- **Minimise Risks:** Take steps to reduce or eliminate hazards.
- **Prepare for Emergencies:** Develop plans and protocols for dealing with unexpected events.

However, the crucial element is also to enable effective supervision and teacher empowerment in Lab safety.

Roles of academic staff in promoting psychological safety

Role of Supervisors and Teaching empowerment in Lab Safety

1. **Building Trust and Psychological Safety**
2. **Adapting Safety Training to Meet Diverse Learning Needs**
3. **Encouraging Student Ownership of Safety Practices**
4. **Mitigating Lab Anxiety Through Empowerment and Support**

- Supervisors, laboratory demonstrators, and Graduate Teaching Assistants (GTAs) play critical roles in fostering a **safe, inclusive, and supportive lab environment** that enhances student learning and engagement.

Supervisors

- **Role:** Supervisors oversee the implementation of safety policies, promote psychological safety, and empower students to take ownership of their learning and safety responsibilities.

- **Impact:** When supervisors emphasize inclusion and respect, they create an environment where all voices are heard, reducing anxiety and increasing student confidence in reporting safety concerns.

Lab Demonstrators

- Lab Demonstrators are the bridge between theory and practice
- **Their role is to** guide students through experiments, ensure adherence to safety protocols, and encourage active participation. They help create a supportive space where mistakes are treated as learning opportunities, not failures.
- **Impact:** Demonstrators who emphasise inclusion and adapt their teaching styles to meet individual student needs help reduce lab anxiety and build student confidence.

Graduate Teaching Assistants (GTAs)

- GTAs often serve as **peer mentors**, providing guidance and fostering a supportive environment where students feel comfortable seeking assistance.
- **Role:** GTAs support students by answering questions, offering individualised feedback, and ensuring safety procedures are followed. Their peer-level rapport often allows them to identify student concerns that may not be communicated to supervisors.
- **Impact:** When GTAs foster an atmosphere of psychological safety, they help reduce barriers for students from underrepresented backgrounds, allowing them to engage more fully in lab activities.

Example:

Fostering Psychological Safety in a Chemistry Lab:

- *In a second-year undergraduate chemistry lab, a GTA named Alex observed that one student, Sara, hesitated to ask questions during experiments. As an international student unfamiliar with UK lab protocols, she seemed anxious about making mistakes and worried about being judged by her classmates.*

- *Seeing Sara's discomfort, Alex decided to speak with her after the session, encouraging her to feel free to ask questions. In the following lab, Alex implemented a "question corner" where all students could anonymously submit questions for group discussion. This inclusive strategy helped alleviate Sara's anxiety, as it removed the feeling of being singled out. Gradually, Sara's confidence increased, and she started to participate more actively in class.*

Laboratory Anxiety

Sources of Anxiety

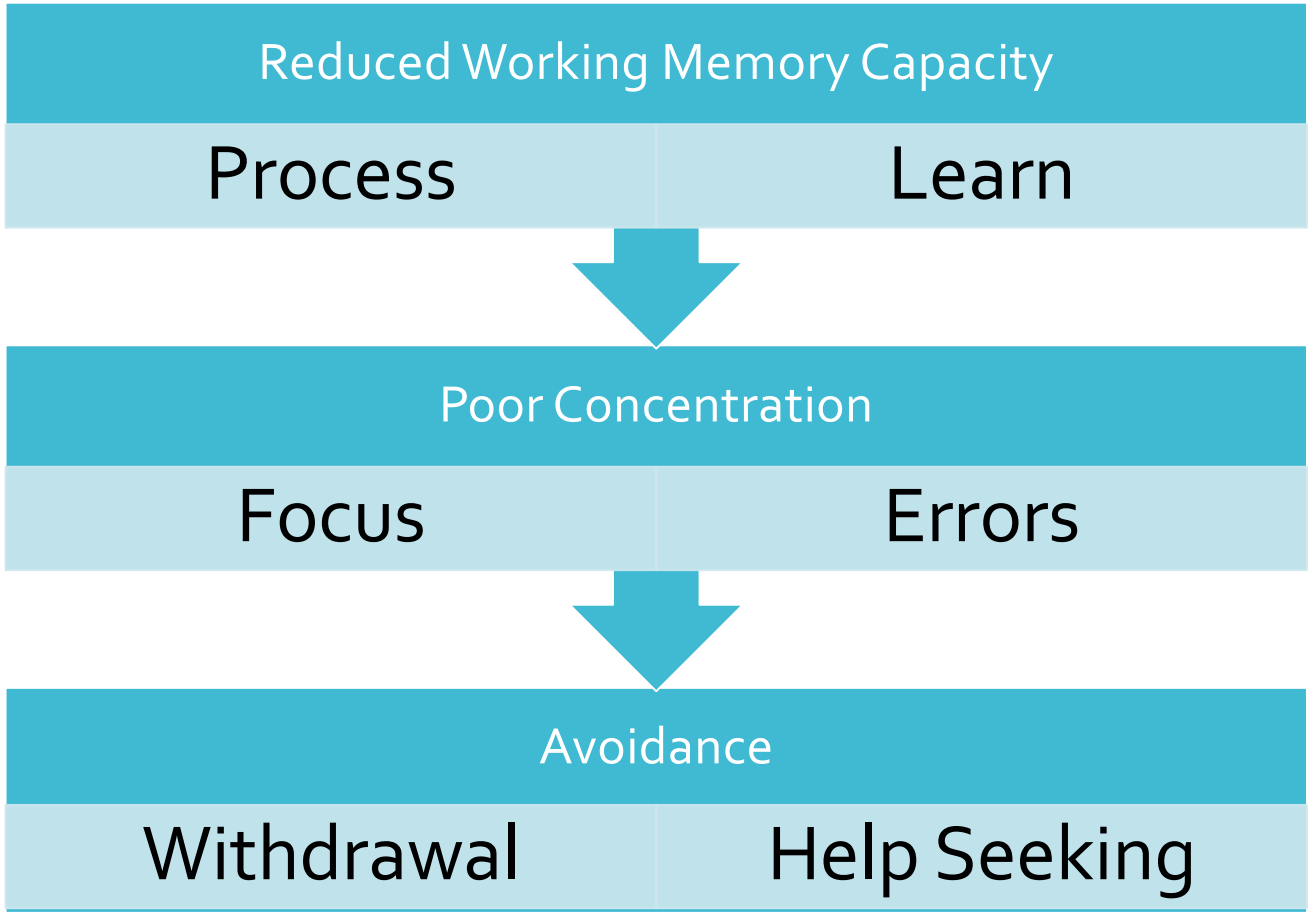
Performance anxiety	Safety Concerns	Evaluation anxiety	Time Pressures	Social and Cultural Factors

IMPACT: cognition, performance and self-esteem (confidence)

Source: **Abulibdeh, E. S., & Hassouna, F. M. (2019).**

Common sources of Students' Anxiety in Lab settings

How Anxiety impacts learning and performance?



Example

- A first-year university student, Alex, who has never taken a chemistry course before. During their first lab session, Alex is introduced to handling hazardous chemicals like concentrated acids and bases. The unfamiliar terminology, strict safety protocols, and fear of making mistakes make Alex feel anxious and overwhelmed.

- When the instructor notices Alex's hesitation, they take a moment to walk through the steps again, providing simple explanations and demonstrating how to handle the chemicals safely. The instructor also reassures Alex that asking questions is encouraged and mistakes are part of the learning process. Over time, this supportive guidance boosts Alex's confidence, reduces their anxiety, and allows them to engage more effectively with the experiments.

Importance of Compassion

- Compassion in the laboratory setting plays a pivotal role in alleviating student anxiety, particularly for those who may feel intimidated by the complexities of chemistry and the perceived dangers of lab environments.
- Compassionate teaching involves recognising students' emotional challenges, creating a supportive atmosphere, and fostering trust through empathy and understanding.
- **Compassionate teaching enhances belonging.**
- This approach reduces fear of judgment and empowers students to engage fully with learning processes.
- In addition, it reduces Chemistry and Lab Anxiety.

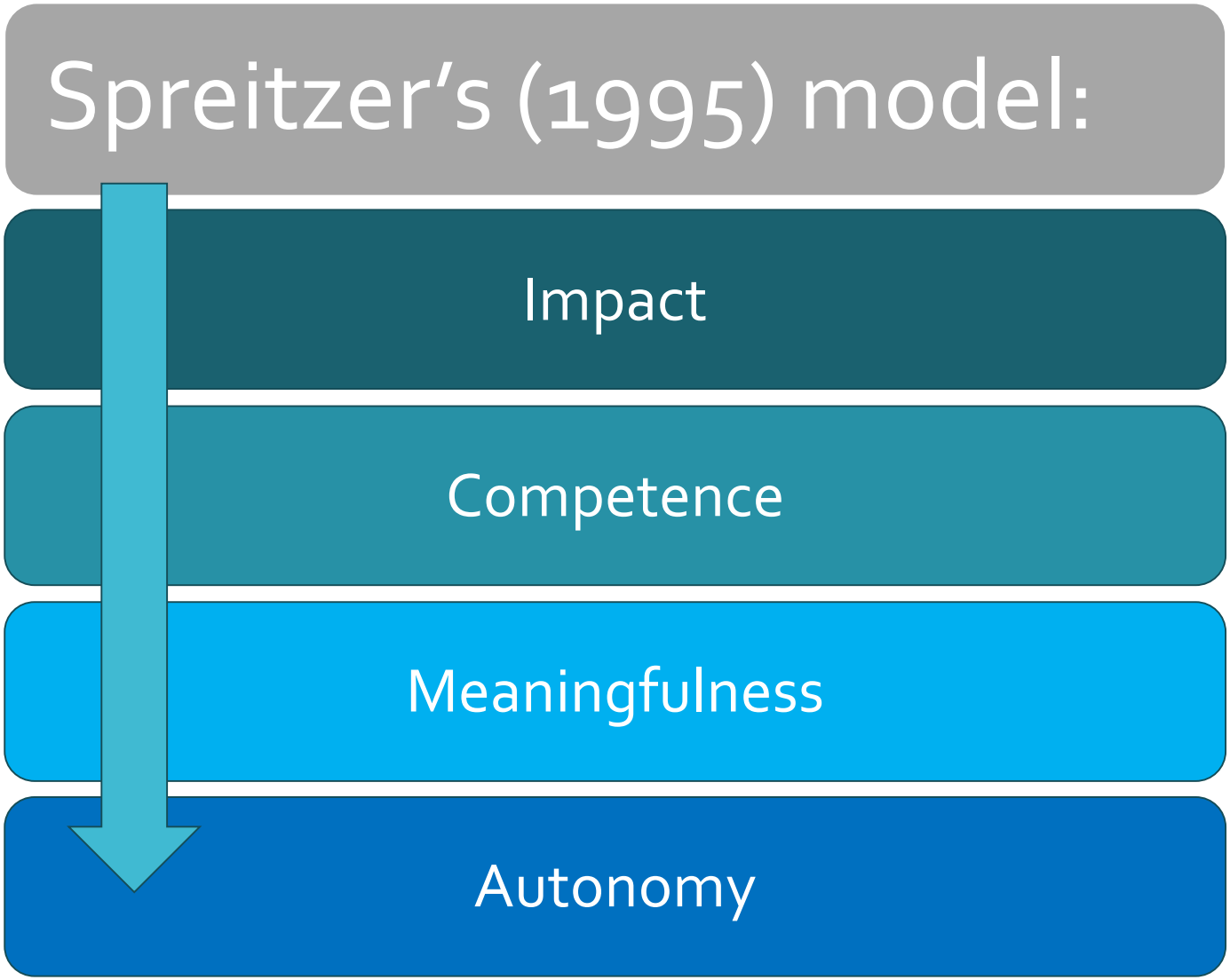
Source:
McKendree, J., & Tuckey, R. (2019). *Compassionate Pedagogy in Laboratory Teaching: Addressing Anxiety and Promoting Resilience*.

Psychological Empowerment and Teaching self image

Psychological Empowerment

- Students who received empowerment through clearly structured instructions, constructive feedback, and hands-on practice in chemistry labs reported lower anxiety and improved confidence (Liu & Chang, 2019).
- Psychological empowerment leads to increased motivation and reduced feelings of helplessness, which can directly apply to reducing anxiety in high-stakes lab settings (Thomas and Velthouse, 1990).
- Students' decision-making power and control over aspects of their lab work promote self-efficacy and reduce perceived threats, decreasing anxiety levels (Hein and Wimer, 2020).

Model of psychological empowerment



Teaching Self—image and its role in Lab Anxiety Reduction

- Positive teaching self-image contributes to creating a supportive, inclusive and confidence-boosting environment that mitigates students' anxiety in labs.
- A **strong teaching self-image** involves perceiving oneself as an **effective facilitator of learning** rather than merely a demonstrator of knowledge or technical skills.
- This self-concept shapes how educators approach their teaching, influencing their **pedagogical choices, student engagement, and the learning environment** (Beijaard et al., 2000).

Application to Chemistry and Lab Anxiety

- Importance of scaffolding and autonomy
- Modelling effective problem-solving

TCL-GTA Programme

TCL GTA (Teaching and Curriculum Leadership Graduate Teaching Assistant) programme:

- A crucial tool in transforming graduate students into empowered teaching assistants.
- Shift from demonstrating to facilitating meaningful learning by developing a teaching self-image. Emphasise clear objectives and goals for growth.
- Enhance teaching effectiveness with authentic pedagogy.

Main outcomes:

- Building confidence and pedagogical expertise
- Contribution towards engaging, inclusive, and effective learning environment in lab settings.

Dr Jonathan Foster

Evidence-based assessment tools and research insights

The Chemistry Laboratory Anxiety Instrument (CLAI)

- A validated tool designed to measure anxiety experienced by students in a lab setting
- **Five dimensions:**

1. **Working with Chemicals** – Concerns about handling hazardous substances safely.
2. **Using Equipment and Procedures** – Anxiety related to operating lab equipment and following protocols accurately.
3. **Collecting Data** – Worry about recording and interpreting data correctly.
4. **Working with Other Students** – Social anxiety associated with collaboration and teamwork.
5. **Having Adequate Time** – Stress caused by perceived time constraints during experiments.

- The tool has demonstrated high reliability (**α = 0.73-0.88)**
- **Strong internal consistency and reliability**

Safety Awareness, Attitudes, and Practices Studies

- Walters et al. (2017) found that **students exhibit strong awareness of basic safety protocols.**
- **However, a critical gap was identified in student's ability to interpret hazard pictograms and chemical labels accurately.**
- Need for **enhanced training in hazard identification and risk assessment**
- **Supervisory intervention and ongoing safety communication** as crucial elements.
- The study identified a need for enhanced training, regular safety briefing, feedback and reflection.

Supervisors' stress

- Mawritz et al. (2014) found that hindrance stress from difficult goals can provoke negative emotions like anger and anxiety in supervisors, heightening abusive supervision risks.

The Stressor–Appraisal–Emotion–Outcome Model explains how:

- **Stressors** (such as excessive workload or unattainable goals)
- Lead to **appraisals** (perceived as a threat or hindrance),
- Trigger **negative emotions** (frustration, anxiety),
- Resulting in **negative outcomes** (abusive or hostile supervision).

Implications for supervisors

Managing Hindrance Stress and Goal Setting

Emotion Regulation and Supervisory Reflection

Monitoring and Feedback Systems

Supervisory Strategies and Best Practices

Pre-Lab Preparation and Planning

- **Conduct Pre-Lab Briefings with EDI+R Integration**
- **Experimental Procedure Overview:**
  - Provide a **step-by-step explanation** of procedures, ensuring that all students understand the objectives, methods, and expected outcomes.
  - Address potential **safety hazards** and outline **risk mitigation strategies** to ensure safe lab practices.

- **Checklists and Visual Aids for Clarity Protocols**
  - **Checklists for Pre-Lab Readiness** (e.g Safety data sheets, PPE)
  - **Visual Aids and Demonstrations** (e.g Safety steps, diagrams)

- **Foster Inclusivity and Safety Communication**
  - Culturally Inclusive Communication
  - Clear Safety Protocols for Diverse Learners (e.g. multimodal safety instructions)

Effective communication	Coping Strategies	Roleplay
Open environment	Structured Breaks	Practice empathy
Lifelines for support	Visual reminders	Practice active listening
Peer Support networks	Grounding and relaxation	Provide clear and supportive guidance

Outcomes:

Reduced lab anxiety, improved communication culture, and enhanced coping strategies

In-Lab Coping Techniques and Communication

However, do not forget about your own wellbeing

- **Monitor and Manage Hindrance Stress, which arises from obstacles that prevent you from achieving your goals.**
- **Importance of self-monitoring and reflection (use of mindfulness, reflective journaling)**
- **Regular Self-Check-Ins**
- **Recognise Emotional Triggers (especially if you are frustrated)**
  - What situations triggered stress today?
  - How did I respond emotionally to this?
  - What could I do differently next time to manage stress more productively?
- **Engage in practical stress management techniques (e.g mindfulness, breathing, grounding or visualisation)**
- **Recognise Early Warning Signs:** Identify **emotional escalation** that may lead to **abusive supervision** and take proactive steps to mitigate these behaviours.

Activity

How do you look after yourself?

Creating a Supportive Lab Framework

Step by Step Approach

Pre-Lab Safety and EDI+R principles:

- Mandatory safety briefings
- Integrate EDI+R briefing
- Encourage open dialogue

Demonstration:

- Structured step-by-step demonstration of lab techniques and protocols
- Use of visual aids, hands-on examples and verbal explanations
- Encourage practice under supervision and feedback

Importance of relaxation and grounding:

- Incorporate timed breaks
- Use of mindfulness or grounding exercises

Roles and responsibilities

Define clear roles:

- Assign specific roles with clear expectations (e.g. lead researcher)
- Rotate roles periodically

Decision making:

- Empower team members by providing them with decision-making authority within their areas of responsibility
- Promote collaborative decision-making for problem-solving
- Provide and seek a feedback loop and reflection

- Use mentoring for further guidance and support

How to overcome institutional barriers to ensure sustained improvement?

To wrap up

Summary

- UK institutions can ensure a safe, supportive, and inclusive laboratory culture by integrating the Equality Act 2010 with the RAMP Framework and embedding EDIR principles into lab practices.
- This not only enhances physical and psychological safety but also creates a respectful and equitable environment that promotes scientific excellence.
- Respect is a cornerstone of creating a safe and supportive culture in chemistry laboratories.
- Supervisors, laboratory demonstrators, and GTAs are central to cultivating a lab environment where safety, inclusion, and respect are prioritised.

Summary

- By fostering impact, competence, autonomy and meaningfulness dimensions in both teaching and learning environments, educators can empower students, reduce anxiety, and promote meaningful learning experiences in chemistry and beyond.
- Building a strong self-image as an effective educator empowers instructors to create engaging, student-centred environments that reduce anxiety and enhance outcomes in chemistry.
- Supervisors can create a safe, inclusive, and growth-oriented lab environment by combining EDI+R principles, safety practices, and psychological empowerment.
- This self-efficacy allows teachers to apply evidence-based strategies, boost confidence, and promote resilience among learners, leading to improved learning experiences.

Summary

- Managing supervisor stress and cultivating a positive teaching self-image further enhances the learning experience, reducing student anxiety and improving overall outcomes


Thank you for joining us!
Any questions?

References

References

- **ACS Chemical Health and Safety (2023).** Advancing Laboratory Safety Through DEIR Principles. *ACS Chemical Health & Safety*, *30*(4), 223-230. DOI: 10.1021/acs.chas.3c00012
- **Edmondson, A. C. (1999).** Psychological safety and learning behavior in work teams. *Administrative Science Quarterly*, *44*(2), 350-383.
- **Shaw, K. J., et al. (2019).** The impact of diversity, equity, and inclusion on laboratory safety culture. *Journal of Safety Research*, *45*(3), 345-352.
- **Burke, M. J., et al. (2002).** The efficacy of workplace safety training: A meta-analysis. *Journal of Applied Psychology*, *87*(4), 123-132.
- **Weiner, B. J., Hobgood, C., & Lewis, M. A. (2017).** The role of leadership in creating a culture of safety. *Journal of Patient Safety*, *43*(5), 287-294.
- **Gaba, D. M., et al. (2001).** High-reliability teams and the culture of safety. *California Management Review*, *43*(4), 79-91.
- **Foster, S., & Harris, L. (2022).** Embedding Equality, Diversity, and Inclusion (EDI) in Laboratory Practices: A Case Study of UK Higher Education Institutions. Journal of Laboratory Safety and Compliance, 45(3), 123-134.
- **Munir, F., & Mason, C. (2020).** Promoting Psychological Safety Through Inclusive Practices in STEM Laboratories. Diversity in Higher Education, 12(2), 45-59.
- **Williams, H., & Malloy, R. (2021).** Mitigating Bias in Laboratory Safety Protocols: An Inclusive Risk Management Approach. Journal of Safety and Risk Management, 38(4), 89-102.

References

- **Abulibdeh, E. S., & Hassouna, F. M. (2019).** The effect of laboratory work on students' anxiety and learning outcomes. *International Journal of Instruction*, *12*(2), 97-114.
- **Gibbons, D. F., & Rudd, J. A. (1997).** Student anxiety in science laboratories: Causes and consequences. Journal of Chemical Education, 74(5), 531-534.
- **Abulibdeh, E. S., & Hassouna, F. M. (2019).** The effect of laboratory work on students' anxiety and learning outcomes. International Journal of Instruction, 12(2), 97-114.
- **Mallow, J. V. (2006).** Science anxiety: Research and measurement. Journal of Science Education and Technology, 15(3), 241-256.
- **Ballen, C. J., Wieman, C., Salehi, S., Searle, J. B., & Zamudio, K. R. (2017).** Enhancing diversity in undergraduate science: Self-efficacy drives performance gains with active learning. CBE—Life Sciences Education, 16(4), ar56.
- **Oliver, J. S., & Simpson, R. D. (1988).** Influence of attitude toward science, achievement motivation, and science self-concept on achievement in science. Science Education, 72(2), 143-155.
- **Ashcraft, M. H., & Kirk, E. P. (2001)**. The relationships between working memory, math anxiety, and performance. Journal of Experimental Psychology: General, 130(2), 224-237.

References

- **Frazier, B. N., & Ledbetter, L. (2018).** *The Role of Instructor Compassion in Promoting Student Success in STEM Education*. Journal of Chemical Education, 95(12), 2023–2031.
- **McKendree, J., & Tuckey, R. (2019).** *Compassionate Pedagogy in Laboratory Teaching: Addressing Anxiety and Promoting Resilience*. Advances in Physiology Education, 43(2), 125–132.
- **Owens, J., & Horn, J. (2020).** *Creating Safe and Inclusive Learning Environments in STEM: The Impact of Compassionate Teaching on Student Outcomes*. Journal of College Science Teaching, 49(3), 38–45.
- **Liu, Y., & Chang, H. (2019).** *The Impact of Psychological Empowerment on Reducing Science Anxiety in Chemistry Labs: A Mixed-Methods Approach. Journal of Chemical Education, 96(2), 230–238.*
- **Thomas, K. W., & Velthouse, B. A. (1990).** *Cognitive Elements of Empowerment: An "Interpretive" Model of Intrinsic Task Motivation. Academy of Management Review, 15(4), 666–681.*
- **Hein, S. F., & Wimer, J. W. (2020).** *Building Student Confidence and Competence: The Role of Empowerment in Laboratory Learning. Advances in Physiology Education, 44(3), 195–203.*

References

- **Spreitzer, G. M. (1995).** Psychological empowerment in the workplace: Dimensions, measurement, and validation. *Academy of Management Journal, 38(5),* 1442–1465.
- **Walters, A. U. C., Lawrence, W., & Jalsa, N. K. (2017).** Chemical laboratory safety awareness, attitudes, and practices of tertiary students. *Safety Science*, **96**, 161–171. https://doi.org/10.1016/j.ssci.2017.03.017
- **Mawritz, M. B., Folger, R., & Latham, G. P. (2014).** Supervisory abuse and procedural injustice: Investigating the moderating effects of power distance. *Journal of Organizational Behavior*, **35**(5), 705–721. https://doi.org/10.1002/job.1920
- **Beijaard, D., Verloop, N., & Vermunt, J. D. (2000).** Teachers' perceptions of professional identity: An exploratory study from a personal knowledge perspective. Teaching and Teacher Education, 16(7), 749-764.
- **Tschannen-Moran, M., & Hoy, A. W. (2001).** Teacher efficacy: Capturing an elusive construct. Teaching and Teacher Education, 17(7), 783-805.
- **Bandura, A. (1997).** Self-efficacy: The exercise of control. Freeman.
- **Ferrell, B., & Barbera, J. (2015).** Analysis of students' self-efficacy, interest, and effort beliefs in general chemistry. Chemistry Education Research and Practice, 16(2), 318-337.
- **Seery, M. K. (2009).** The role of pre-laboratory activities in enhancing laboratory learning. Chemistry Education Research and Practice, 10(3), 189-207.
- **Schraw, G., Crippen, K. J., & Hartley, K. (2006)**. Promoting self-regulation in science education: Metacognition as part of a broader perspective on learning. Research in Science Education, 36(1-2), 111-139.