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Abstract

Introduction: Nuclear security education covers essential topics related to the security of nuclear materials. In order to provide effective training, educators are faced with the challenge of improving the trainees' ability to retain and utilize knowledge. This project investigated whether academic research is beneficial for educators seeking to enhance nuclear security education.

Methods: A survey using Google Forms was sent to nuclear security educators in academic and research institutes. The survey included questions on their experience with different aspects of nuclear security education, how research may influence nuclear security education, and how to increase knowledge retention.

Results: In total, 45 people participated in the survey, with 71.1% of respondents from university settings and 13.3% from research institutes. Of these university and research institute respondents, 93.3% were members of the International Nuclear Security Education Network (INSEN), and 75.6% identified as educators. All participants indicated that research is important in order to enhance nuclear security education.

Conclusion: Research on training and education in nuclear security can support trainees' knowledge retention and application. Research is also useful for developing nuclear security training programs and curricula.

Keywords: Nuclear security, education, research

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1. Introduction

The purpose of research is to investigate and study, address gaps in knowledge, generate new knowledge, and find solutions. Although research is often linked to or grouped together with education, research can also be done to improve education [1]. Nuclear security education research should aim to explore learning needs and assessments for trainers and trainees in the context of adult learning. The continuous development and improvement of nuclear security education will encourage the examination of technical, operational, and political aspects of the field. Research will allow for the thoughts, ideas, and talents of regional professionals to be shared with the greater nuclear energy community in a consistent and rigorous manner.

2. The Role of the International Nuclear Security Education Network

Nuclear security has received increased attention since the 2010–2016 Nuclear Security Summits. The last decade has seen the development of new policies and guidelines in this regard, as well as the rise of new groups and networks. In particular, the IAEA now hosts the International Nuclear Security Education Network (INSEN), a partnership through which educational and research institutions, as well as other stakeholders, cooperate to promote sustainable nuclear security education. INSEN is significant not only because it helps states at the national level but also because it has a multiplier effect at the international level [2]. INSEN has the ability to bring together academics and researchers from around the world, help them to cooperate on curriculum development, provide opportunities for faculty exchange, and organize faculty and professional development courses to multiply existing knowledge.

Significant examples of work on nuclear security education include programs set up by King's College London, such as the Centre for Science and Security Studies, as well as many regional initiatives such as those run by the Gulf Nuclear Energy Infrastructure Institute and Nuclear Non-proliferation Education Faculty Forum. In partnership with INSEN, the Centre for Science and Security Studies launched the world's first professional development course in nuclear security education in 2010. Adopting a train-the-trainer approach, the course combined pedagogy with nuclear security topics in order to equip future nuclear security educators with the tools they need to develop tailored courses. Currently, the Gulf Nuclear Energy Infrastructure Institute is working specifically to institutionalize key security and safety safeguards and instill nonproliferation norms amongst future decision-makers of the Gulf region nuclear power programs.

INSEN strives not only to continue setting up new initiatives but also to improve existing curricula. As educators learn from practice which teaching and learning methods do and do not work, new research areas come to light. For example, new research topics include the influence of different learning styles [3], the use of case studies and table-top exercises [4], and the importance of the language in which the materials are presented [5]. Thus, a pressing need exists for assessing research needs and priorities in the context of nuclear security education, and by addressing nuclear security professionals, educators, and policy makers, researchers can identify areas for

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improvement for a better and longer-term retention of nuclear security educational concepts among trainees. Consequently, for this study, we developed a survey to gather ideas and perceptions on how educators can benefit from research and which research topics are priorities for nuclear security education. The following section details the methods, results, and conclusions of this qualitative survey regarding the research priorities to enhance nuclear security education.

3. A Survey on Research Priorities to Enhance Nuclear Security Education

a. Methods

From the available research, we seek to answer two questions: How exactly can research improve nuclear security education, and what do we work on next? To answer these questions, we designed a questionnaire using Google Forms and distributed it among INSEN members. The questionnaire had 26 questions. In total, in the first half of 2021, we surveyed 45 participants.

b. Results

When discussing their profession, participants indicated they were educators (75.6%), operators (5.3%), regulators (5.1%) or that they worked on policy (5.1%), with 8.9% responding with “other.” Participants said they worked at universities (71.1%), research centers (13.3%), government (11.1%), and nongovernmental organizations (4.5%). Notably, 84.1% of respondents said they had attended a workshop related to nuclear security education in the past 5 years, and 64.4% also taught in a workshop related to nuclear security education. Sixty percent of respondents indicated that they are currently involved in teaching academic courses with a nuclear security element (though it is important to note that respondents were answering this question during the COVID-19 pandemic). Figures 1–4 explain in graphical formats the important results of the survey as different job categories and the interest of participants in research in the context of nuclear security education. Also, the figures show the interest of participants to participate in research on nuclear security education and their interest for attending training workshops to enhance the use of research in nuclear security education.

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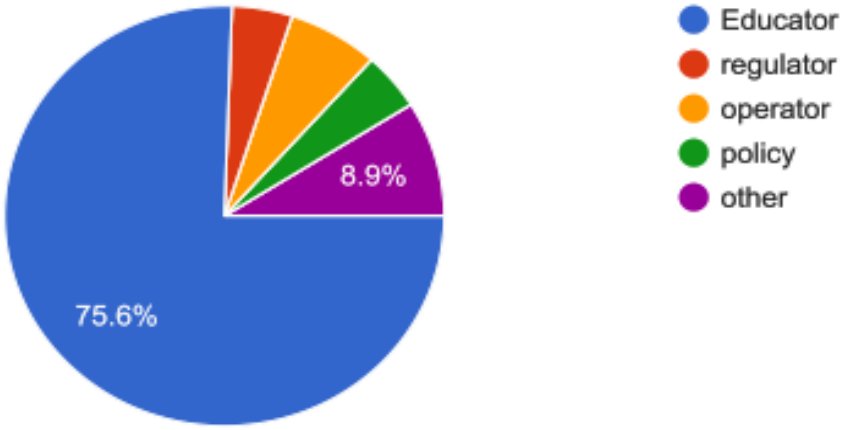

Figure 1. Participant occupation categories (45 responses).

All respondents agreed that research is important to enhance nuclear security education, and 97.7% were interested in contributing to this research. Of these interested, 65.1% said they are currently working on this type of research. This result means that we still need to find a way to include the other 32.6% of interested respondents in ongoing or new projects. As a follow-up to this study, it would be interesting to find out why these interested parties would like to participate in nuclear security education research but are currently not doing so. We should investigate potential challenges relating to access and opportunity, and we should seek to improve involvement and collaboration. Additionally, respondents agreed that they would benefit from a workshop on research methods for nuclear security education, and 95.6% of participants were interested in publishing more papers related to nuclear security education.

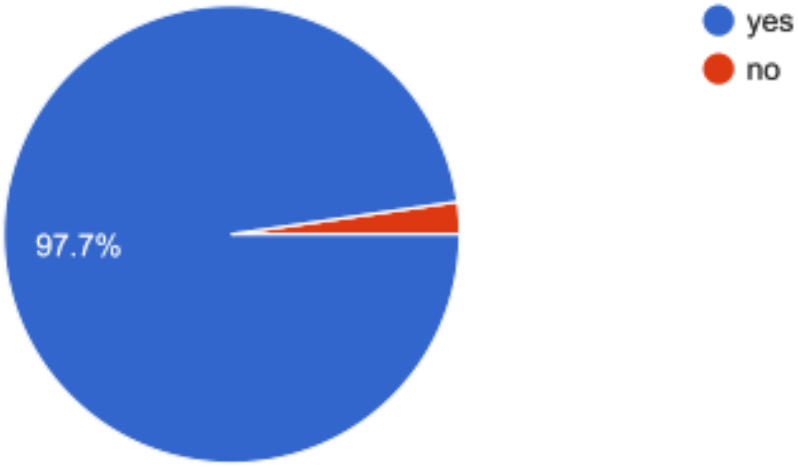

Figure 2. Interest in research on nuclear security education (44 responses).

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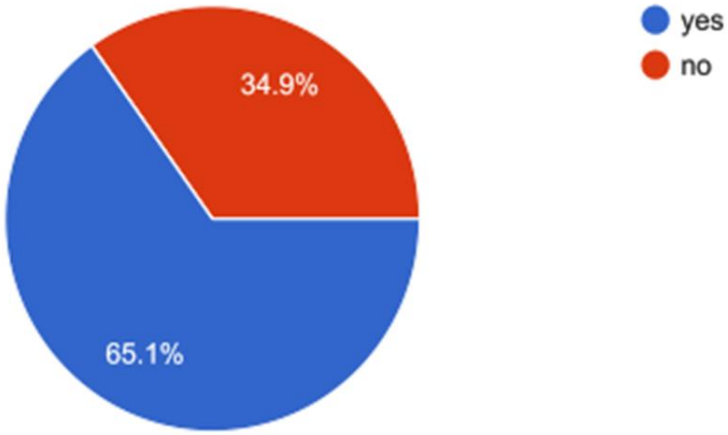

Figure 3. Participation in nuclear security education research (43 responses).

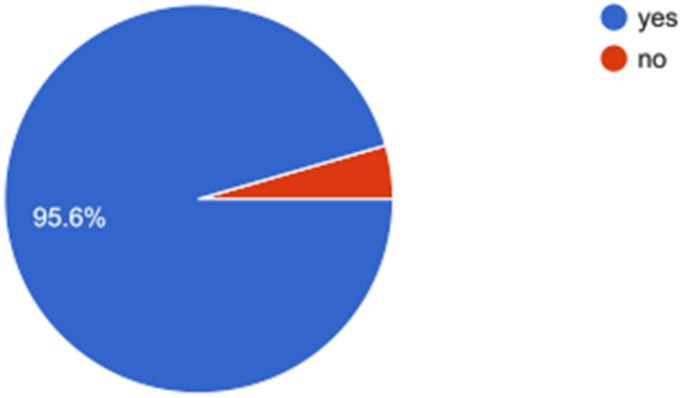

Figure 4. Interest in attending nuclear security training workshops (45 responses).

We asked participants about research priorities in nuclear security education. In addition to prioritizing the topics of publication and funding, participants also mentioned the importance of ecological impact and sustainability. They also mentioned the need for integrating and assessing standardized international practices, as well as emphasizing the synergy between science and policy within nuclear security education. Specifically, they were interested in the development of practical exercises in nuclear security (e.g., the use of table-top exercises, self-learning techniques, and standard assessment tests). Important themes that emerged were the increasing threat of terrorism, especially in relation to the following topics: detection and physical protection, regulation safety and safeguards, radioactive materials and nuclear material detection and characterization, and information and cyber security. Participants also brought up the implementation of nuclear security among the general public and other diverse audiences. Finally, they raised the difference between teaching and training and the role of different cultures in the development of nuclear security culture.

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4. Conclusion

Based on the results from this study, further research can support nuclear security education. Research can be a useful tool to improve learning, and it can augment nuclear security education by applying different styles of learning. Research can also be used to address trainees' learning needs and knowledge gaps, IAEA Nuclear Security Research priorities, and priority topics in nuclear security education.

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6. Appendix

The questionnaire was a simple 26-question survey with the following questions.

1. What is your job?
2. What is your gender?
3. What type of your institution are you affiliated?
4. What is your country?
5. Are you a member of INSEN of NSSC (Nuclear Security Support Centre) networks?
6. If so, for how many years you have you been a member of INSEN or NSSC networks?
7. Did you attend a workshop related to NS (nuclear security) education in the past 5 years?
8. Did you participate in teaching in a workshop for NS education in the past 5 years?
9. Do you currently participate in teaching/teach in an academic NS course?
10. How many NS education workshops did you participate in related to NS education in the past 5 years?
11. Do you supervise undergraduates for NS education?
12. How many undergraduate students did you supervise for NS education in the past 5 years?
13. Do you supervise postgraduates for NS education?
14. How many postgraduate students did you supervise for NS education in the past 5 years?

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15. How many courses did you teach on topics related to NS during the past 5 years?
16. What is your perception of the importance of research to enhance NS education?
17. Are you interested in participating in researching topics related to NS education?
18. Do you currently participate in research related to NS education?
19. How many NS education publications related to NS education have you participated in in the past 5 years?
20. Are you interested to start conducting research related to enhancing NS education?
21. Are you interested in attending a workshop on NS education?
22. Are you interested in attending a workshop on the fundamentals of NS education?
23. Are you interested in attending a workshop on state-of-the-art, modern pedagogical approaches in NS education?
24. Are you interested in attending a workshop on research methods in NS education?
25. Are you interested in attending a workshop on how to publish in NS education?
26. What are your research topics priorities in the context of NS education?

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