



EGUsphere, author comment AC1
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Reply on RC1

Philip J. Heron and Jamie A. Williams

Author comment on "Building confidence in STEM students through breaking (unseen) barriers" by Philip J. Heron and Jamie A. Williams, EGU sphere,
<https://doi.org/10.5194/egusphere-2022-16-AC1>, 2022

Thank you for your review - we have responded to the points below. We show potential changes to the manuscript in *italics*.

General comments

Fig 1. The paper could benefit from a little more information as to how the outreach programme may link to existing education theories. For example Fig 1 refers to a "scaffolding technique" is this derived from known educational theorists e.g. Vygotsky?

Thanks for the comment – we can add the following descriptions on how the programme links to existing educational theories (scaffolding, plain language, supportive environment, inclusivity):

Scaffolding:

*Examples show scaffolding technique to build up the levels of questioning (e.g., **Vygotsky's sociocultural theory and his learning concept of the Zone of Proximal Development (ZPD), Berk and Winsler, 1995**)*

Berk, L. E., & Winsler, A. (1995). Scaffolding children's learning: Vygotsky and early childhood education. Washington: National Association for the Education of Young Children.

Plain Language:

*A positive step was to implement 'Plain Speak' English for universal accessibility, which meant using language and design strategies that make texts easier for target audiences to understand and use (Mazur, 2000; Garwood, 2014). The impact of applying plain language from the start of a course is to allow students to be clear on the content immediately when it is presented, rather than not being unable to understand a technical work and potentially derailing the learning experience. Applying plain language has been beneficial in the medical profession when communicating care to patients (Warde et al., 2018; Sagi et al., 2021) and we create accessible content through using plain language summaries of scientific research (such as the online magazine *The Conversation*).*

Mazur, B. 2000, Revisiting Plain Language, Technical Communication, 47: 2, p. 205.

Garwood, K., 2014, Plain, But Not Simple: Plain Language Research with Readers, Writers, and Texts, PhD Thesis, University of Waterloo.

Warde F, Papadakos J, Papadakos T, Rodin D, Salhia M, Giuliani M. Plain language communication as a priority competency for medical professionals in a globalized world. Can Med Educ J. 2018 May 31;9(2):e52-e59. PMID: 30018684; PMCID: PMC6044302.

Sagi, D., Spitzer-Shohat, S., Schuster, M. et al. Teaching plain language to medical students: improving communication with disadvantaged patients. BMC Med Educ 21, 407 (2021). <https://doi.org/10.1186/s12909-021-02842-1>

Supportive environment:

*For a behavioural, cognitive, and emotional engagement to be achieved for all learners, an open and dynamic teacher-learner relationship must be fostered, built upon sensitive understanding (and adjustment) to a learner's needs and social contexts (Darling-Hammond et al., 2020; **Breakey, 2006; Sanger, 2020**).*

Sanger, C.S. (2020). Inclusive Pedagogy and Universal Design Approaches for Diverse Learning Environments. In: Sanger, C., Gleason, N. (eds) Diversity and Inclusion in Global Higher Education. Palgrave Macmillan, Singapore.
https://doi.org/10.1007/978-981-15-1628-3_2

Breakey, C., 2006. The autism spectrum and further education: a guide to good practice. London: Jessica Kingsley.

Inclusive nature:

These two strategies (e.g., not implementing formal examinations and asking 'open' questions) produces a flattening of the power dynamic as compared to a traditional classroom. Linking to the previously mentioned theories on 'stereotype threat' (e.g., fear or anxiety of confirming a negative stereotype about one's social group, Steele and Aronson, 1995) and 'minority stress' (e.g., stress faced by members of stigmatized minority groups), implementing these strategies could remove critical barriers to students' learning (which teachers may or may not be aware of). Indeed, it has been recently highlighted that inclusive science communication could be crucial in addressing the systemic problems of inequitable access to (and engagement with) STEMM (science, technology, engineering, mathematics, and medicine) subjects (Canfield et al., 2020). Careful thought is required when creating content and engaging students if we would like to reach diverse audiences (Canfield et al., 2020).

Canfield KN, Menezes S, Matsuda SB, Moore A, Mosley Austin AN, Dewsbury BM, Feliú-Mójer MI, McDuffie KWB, Moore K, Reich CA, Smith HM and Taylor C (2020) Science Communication Demands a Critical Approach That Centers Inclusion, Equity, and Intersectionality. Front. Commun. 5:2. doi: 10.3389/fcomm.2020.00002

Figure 1 scientific method is unclear. You talk about a hypothesis (in essence to be proved or disproved), but the table reads more like a research question.

Perhaps you need to re-write it as a research question and not use the word hypothesis?

In terms of an approved flow chart for the scientific method, Figure 1 here is typical. Indeed, it was created based on the most common descriptions of the scientific method, where the word hypothesis is widely used.

1.75 It would be interesting to dig deeper into the ways in which a nurturing environment have been fostered in this programme to promote learning. You cite the Darling- Hammond paper (2020) which discusses the ways in which a supportive learning environment in schools fosters a healthy resilient pathway to adult learning. How does this work in other adult Further Education (FE) contexts?

We can add more references on supportive learning in FE contexts, such as adding in the work of Breakey (2006) (which looks at supporting adults with autism through university) and Sanger (2020) (which highlights Inclusive Pedagogy approaches in diverse environments). We can also expand upon the sentence below (shown in bold) with further examples into what we did to nurture the environment:

*A challenge here was to create course content that celebrated each student individually, rather than revert to our mainstream education norms. For a behavioural, cognitive, and emotional engagement to be achieved for all learners, an open and dynamic teacher-learner relationship must be fostered, built upon sensitive understanding (and adjustment) to a learner's needs and social contexts (Darling-Hammond et al., 2020; Breakey, 2006; Sanger, 2020). **In the preparation of course material, it was important to simply acknowledge the intersectionality of potential students and change the expectation of each submission of work based on the learner's needs. In class, the instructor would acknowledge that each student can bring individuality to the course through the open questions on scientific topics (see Inclusivity section). In addition, small acts of flattening the power dynamic within the prison environment can help to nurture a supportive learning landscape (e.g., making a coffee for students during the break).***

We also considered a number of points related to language. Resources whilst teaching in prison are scarce, and often the only teaching aid available (apart from a pen and paper, Figure 2) is language (which turns out to be key). If the language used was terminology heavy or uses allegory, metaphor, or other forms of figurative or culturally specific language, this may have been difficult to process for many students. Potentially, this may have disadvantaged autistic students, or those with learning differences (Kalandadze et al., 2018).

*A positive step was to implement 'Plain Speak' English for universal accessibility, **which meant using language and design strategies that make texts easier for target audiences to understand and use (Mazur, 2000; Garwood, 2014). In practice, this means not using technical words without a proper introduction. An example for discussing different types of volcanoes would be to avoid using the word viscosity in the initial comments, opting for 'runny' or 'thick' until low and high viscosity can be scaffolded in (Berk and Winsler, 1995).***

The impact of applying plain language from the start of a course is to allow students to be clear on the content immediately when it is presented, rather than not being unable to understand a technical work and potentially derailing the learning experience. Applying plain language has been beneficial in the medical profession when communicating care to patients (Warde et al., 2018; Sagi et al., 2021) and we create accessible content through using plain language summaries

of scientific research (such as the online magazine *The Conversation*). We also follow up with taking into consideration who and what was rewarded and prioritised in interactions with students (e.g., are we celebrating getting a correct answer or for asking question of clarification?).

Mazur, B. 2000, Revisiting Plain Language, *Technical Communication*, 47: 2, p. 205.

Garwood, K., 2014, *Plain, But Not Simple: Plain Language Research with Readers, Writers, and Texts*, PhD Thesis, University of Waterloo.

Warde F, Papadakos J, Papadakos T, Rodin D, Salhia M, Giuliani M. Plain language communication as a priority competency for medical professionals in a globalized world. *Can Med Educ J*. 2018 May 31;9(2):e52-e59. PMID: 30018684; PMCID: PMC6044302.

Sanger, C.S. (2020). Inclusive Pedagogy and Universal Design Approaches for Diverse Learning Environments. In: Sanger, C., Gleason, N. (eds) *Diversity and Inclusion in Global Higher Education*. Palgrave Macmillan, Singapore.
https://doi.org/10.1007/978-981-15-1628-3_2

Breakey, C., 2006. *The autism spectrum and further education: a guide to good practice*. London: Jessica Kingsley.

Sagi, D., Spitzer-Shohat, S., Schuster, M. et al. Teaching plain language to medical students: improving communication with disadvantaged patients. *BMC Med Educ* 21, 407 (2021). <https://doi.org/10.1186/s12909-021-02842-1>

Do you think that the learners on "Think like a scientist" are perhaps re-engaging with a learning hiatus from childhood? Why was there a hiatus? E.g do you have any stats about prisoners in general do they leave school early? And why? Can this link in to any research on positive support/emotion/nurture in adult learners in other disadvantaged contexts e.g. refugees, victims of abuse etc etc. Would just be interesting to see if this expands and links to other areas of adult FE.

Personally, I know that a number of students have indeed had a hiatus from learning since childhood. One of the comments on the pre-course questionnaire (attached) was:

"I am really looking forward to this course and being able to improve myself in a field I have not ventured into since my school days."

However, in visiting prisons to research the best way of teaching, it was clear from informal discussions that there had been a hiatus from a large number of people in prison and that there were many barriers to them accessing education. Therefore, we developed this framework to address what we understood was happening with potential students (without gathering formal data). We spent 18 months going in and out of different prisons (and talking to different education providers), gathering research to find best practices (culminating in this paper).

Data on education hiatus status of people in prison is not easy data to get a hold of and is something that would be difficult to measure in our students going forward. We'd be reluctant to ask potential students when the last time they were in formal education for fear of stigmatisation.

However, there is a study from the early 2000s in American prisons that does show that

people in prison have less time spent in education than the (non-prison) general population: <https://bjs.ojp.gov/content/pub/pdf/ecp.pdf>. We will add this reference into the paper at the following point:

However, due to restrictive prison environments (Rogers et al., 2014; O'Brien et al., 2021), a lack of funding for prison educational programs, and (most importantly) the impact of prisoners' previous struggles with traditional classroom settings (Harlow, 2003), teaching in prison is a complex endeavour. As such, educational needs are largely unmet for those in custody (Geib et al., 2011).

From our experience, the setup we outline here could be applied to any student (adult or otherwise) who has low confidence in the education system or themselves. So, to your point, we'd be very excited to apply these principles to any other adult FE setting (as we outline in the Conclusion).

I.105 It would be good to expand on these theories a bit more in the context of inclusivity and perhaps contrast to other research on the hierarchies in STEM classrooms there is some interesting work in inclusive sci-comm you could look at Canfield, K.N., Menezes, S., Matsuda, S.B., Moore, A., Mosley Austin, A.N., Dewsbury, B.M., Feliú-Mójer, M.I., McDuffie, K.W., Moore, K., Reich, C.A. and Smith, H.M., 2020. Science communication demands a critical approach that centers inclusion, equity, and intersectionality. *Frontiers in Communication*, p.2.

The section in question here is:

Related to the previously mentioned 'stereotype threat' and 'minority stress' theories, this flattening of the power dynamic within the classroom meant that learning was made more inclusive and critical barriers to students' learning (which teachers may or may not be aware of) were removed.

We can modify this paragraph to the following to take into consideration this comment:

These two strategies (e.g., not implementing formal examinations and asking 'open' questions) produces a flattening of the power dynamic as compared to a traditional classroom. Linking to the previously mentioned theories on 'stereotype threat' (e.g., fear or anxiety of confirming a negative stereotype about one's social group, Steele and Aronson, 1995) and 'minority stress' (e.g., stress faced by members of stigmatized minority groups), implementing these strategies could remove critical barriers to students' learning (which teachers may or may not be aware of). Indeed, it has been recently highlighted that inclusive science communication could be crucial in addressing the systemic problems of inequitable access to (and engagement with) STEM (science, technology, engineering, mathematics, and medicine) subjects (Canfield et al., 2020). Careful thought is required when creating content and engaging students if we would like to reach diverse audiences (Canfield et al., 2020).

- **120 I like the framework for breaking down barriers. It is a useful how-to guide.**

Thanks for this comment – we sought it fitting to share to see if it could be useful to others.

Overall an interesting read and engaging information about this programme which is clearly valuable outreach to such a marginalised community. Do you think this work can transfer some aspects to other marginalised communities within the prison system? E.g. have you considered working in Mother and Baby/Child units within prisons?

Yes, we have been working on transferring this education framework to other areas within the prison system (e.g., vulnerable prisons). We have previously also worked with young people in London who have experienced homelessness. However, your specific point of working with Mother and Baby units within prisons is a good one – we have been working on funding to provide family education for women who have been released from prison, allowing mothers and children/parents to learn together. We have also applied for funding to take this work to overseas prisons and to refugee camps (no luck... yet).

Technical

The UK prison system is not a whole system. Scotland and Northern Ireland have devolved criminal justice systems, therefore this should perhaps be made more clear in line 26 perhaps refer to England rather than UK.

Yes, this is an excellent point and one we don't go into. We will change UK to England in the following line to make it clear that we didn't work on other devolved areas:

*In this short commentary, we discuss a framework put in place to build student confidence during the teaching of a STEM course in **English** prisons in 2019 (Heron, 2019, 2020).*

Line 16 should multi-factorial be multifactorial?

We can change this.

Line 103 "the impact on this on student's" should read "the impact of...."

We can change this.

Line 113 "really interesting" is perhaps a little bland can this be expanded or explained in a more vibrant way?

Agree! We can modify this line to read:

*Incidentally, by setting a task to express their thought process, rather than 'testable' questions, the work submitted **not only reflected upon the subject matter, but also their personal experiences with the topic.***

Please also note the supplement to this comment:

<https://egusphere.copernicus.org/preprints/2022/egusphere-2022-16/egusphere-2022-16-AC1-supplement.pdf>