RESEARCH DIRECTIONS

Use of Portfolios to add Generative AI Resilience to Chemistry Final Year Literature Projects: Staff Perceptions

Laura Hancock

School of Chemistry, University of Birmingham, Edgbaston, Birmingham, B15 2TT, United Kingdom.

*Corresponding author l.hancock@bham.ac.uk

Keywords: *Chemistry*; *Generative AI Resilience*; *Literature Projects*; *Portfolio Assessment*

Abstract

Concerned about the vulnerability of final year literature projects to Generative AI (GAI), a portfolio assessment to document a students' project is described. Students are required to record all aspects of the project including critical reflections of the literature and reflections on meetings with their project supervisor. A qualitative evaluation of supervisor feedback has been carried out revealing that alongside GAI resilience, supervisors perceive the portfolio assessment enhances staff and student experience, promoting enhanced student attainment and engagement, allowing staff to better monitor student progress, increase staff-supervisor meeting efficiency and increase the overall robustness of the supervisor generated mark.

Introduction

Portfolio assessment comprises a collection of work that documents and supports a learner's development and progress towards specific learning outcomes (Adamchik Jr, 1996 & Nahady et al., 2022). As well as providing a robust body of evidence for summative assessment grading, portfolios are an effective method of formative assessment allowing student reflection on their learning journey. In chemistry, portfolio-based assessment is commonly used as a record of professional practice and development, for example in teaching training at both school (Abell and Sevian, 2020) and university level (Richards-Babb et al., 2014). It has also emerged as a way to chronicle and assess laboratory skills development. (Wright et al., 2018 & Hyde, 2025). Boyce and Singh (2008) converted an analytical chemistry course to problem-based learning and replaced the final exam with portfolio assessment to record their workshop outcomes, laboratory report, learning resources and reflections.

A significant literature review, either as a standalone project (at BSc level) or as part of a larger experimental research project is commonplace in UK chemistry degrees. However, students can struggle with the composition of these reviews, especially those who are non-native speakers. (Krishnan and Kathpalia, 2002) Research on academic writing reveals that both native and non-native speakers find it challenging to synthesise information from multiple sources and paraphrase to write a distinct account (Dubois, 1988). This leads to a range of coping strategies being used and may ultimately result in deliberate or inadvertent plagiarism. Tools such as Turnitin allow educators to identify 'traditional' plagiarism. However, the emergence of GAI poses a real challenge if students have used it to generate content. (Batista et al., 2024) Whilst there are some indicators, such as hallucinated references (Gravel et al., 2023), it is often difficult to identify, or indeed prove, that content has been generated using GAI (Peres et al., 2023) As a result, educators may need to transform

assessment practices. This could involve embracing GAI to facilitate literature searches and effective academic writing, whilst supporting students to develop an understanding of appropriate and ethical use of GAI. It also may be appropriate to devise alternative assessment strategies to ensure key learning outcomes are met.

To this end, the assessment for literature projects in the University of Birmingham (UoB) BSc chemistry degrees have been modified to introduce a portfolio for students to record the progress of their research project. In this paper, details of how the portfolios have been implemented alongside the perceptions of project supervisors of the usefulness of the portfolios, are described.

Introduction of Portfolio

Students completing a BSc chemistry degree at UoB have the option to complete a 40-credit literature project in the final year of their degree. Prior to 23-24 academic year, the final report (a literature review in a specific research area) comprised 60% of the summative assessment for this module. Concerned by the vulnerability of this type of assessment to plagiarism through use of content generation through GAI, we revised the assessment scheme (**Table 1**) to focus on aspects we believed were more resilient to inappropriate use of GAI. The most significant changes were a significant reduction in weighting of the final report and increase in weighting of the supervisor mark. As part of reducing the weighting of the final report, we also made a slight increase to the weighting of the presentation.

Table 1 Revisions to component weightings of literature projects from 2022/23 to 2023/24.

Component	Weighting	
	22/23	23/24
Report	60	40
Supervision	10	25
Viva	20	20
Presentation	10	15

As part of this supervisor mark, a Microsoft OneNote portfolio to chronicle student progress through the project was introduced. Students were provided with specific guidance over what to include in their portfolio, both via written instructions and in an introductory lecture at the beginning of the module. Students were advised that the portfolio should include:

1. Records/reflections on supervisor meetings (at least 6 meetings over the year):
    a. Links to specific papers discussed
    b. What was learnt from the meeting
    c. Plans as a result of the meeting

2. Record of papers read including:
    a. Where paper was found (e.g. Web of Science, reference in other paper)
    b. Short summary
    c. Comment about significance
    d. Highlighted/annotated papers (optional)

3. Analysis: grouping papers with comments about similarities/differences

4. Linked working copy of final report

Students were required to share the OneNote portfolio at the beginning of the project with their supervisor so both parties had access to it throughout the project. It should be noted that integration of OneNote into the UoB virtual learning environment was not possible at the time of introduction, but this would be preferred to allow other staff (such as module leads) to have easy access to all portfolios for moderation purposes. The supervisor assessment criteria updated to explicitly reference the

portfolio. The assessment breakdown for the supervisor mark is shown in **Table 2**.

Table 2 Individual components that contribute to supervisor mark with details of how the portfolio contributes to each component.

Component	Weighting	Portfolio Contribution
Intellectual Input and Initiative	25	
Organisation and Planning	20	Specific number of contemporary meeting reflections
Communication Skills	10	
Commitment and Motivation	20	Detailed and contemporary account
Ability to Source Literature	25	All sources provided

Three out of five components of the supervisor mark scheme refer to the portfolio hence expectations are clearly outlined to the students. Example assessment criteria for the *Organisation and Planning* component are shown in **Figure 1**.

Organisation and Planning (20)

– Fully prepared for meetings with clear plan for project. At least 6 contemporary portfolio entries for supervisor meeting reflections providing a detailed account of meetings.	**16-20**
– Significant preparation for meetings with a generally clear plan for project. At least 6 contemporary portfolio entries for supervisor meeting reflections providing account of meetings but lacking some details.	**12-15**
– Some preparation for meetings with some indication of a plan for project. Entries for supervisor meeting reflections are lacking significant details OR are not contemporary OR up to two entries are missing.	**8-11**
– Limited preparation for meetings with very little plan for project. Entries for supervisor meeting reflections are limited AND/OR multiple entries are missing AND/OR are not contemporary.	**4-7**
– Little or no preparation for meetings with no plan for project. Entries for supervisor meetings are entirely missing OR contain no useful information AND are not contemporary.	**0-3**

Figure 1 Assessment criteria for *Organisation and Planning* component of supervisor mark (comprising 20% of total mark).

Method

The study aimed to address the following research questions:

1. *What are project supervisors' perceptions of portfolios for assessment?*

2. *Do project supervisors perceive student portfolios to increase generative AI resilience of final year projects?*

This project obtained ethical clearance through the University of Birmingham's Science, Mathematics, Engineering and Technology ethics committee (Project Number: ERN_2444-Apr2024). All participants in this research project were chemistry academics supervising third year literature projects in chemistry at University of Birmingham. There were nine literature project supervisors in 2023/24. All data was collected by semi-structured interviews (N = 6) and analysed by thematic analysis using the method described by Bree and Gallagher (2016), which was based on the thematic analysis method described by Brenner (1985). Thematic analysis was selected for its flexibility, enabling a comprehensive and nuanced exploration of the data. (Braun & Clark, 2006) A theme represents a significant aspect of the dataset, directly linked to the research question, regardless of how often it appears. However, it is important to note that the quotations used to support emerging

themes serve as illustrations, rather than originating from a single data point.

Results and Discussion

Upon analysis, five major themes were emergent: *attainment and engagement*; *progress monitoring*; *meeting efficiency*; *assessment robustness* and *GAI resilience*. **Table 3** shows the key themes, separated into subthemes with illustrative staff quotes.

Table 3 Themes raised by staff in portfolio interviews

Themes	Illustrative quote
Attainment and Engagement	
Supports achievement of higher order learning outcomes	*might possibly encourage them to think a little deeper about the papers, because what my students tended to do was to write a critical reflection on each of the papers*
Aid to structure report	*makes it easier for them to know where everything is going to be when they need to go back and write the report*
Promotes effective time management	*none of them really panicking at the end*
Box-ticking exercise	*show that they have done something that's not necessarily useful for them*
Distraction from final assessment	*If the student doesn't naturally fall into the habit of keeping it up to date, then it becomes a bit of a distraction*
Monitoring Progress	
More accurate gauge of progress	*for the first time ever I've been able to monitor fully the engagement of my students on their projects*
Easier to monitor multiple students	*I can imagine when you have 4 or 5, it's gonna make life much better*
Highlights support students require	*it can help to identify where intervention is needed. It's kind of helped me identify where to put most effort in in terms of supporting students*
Meeting Efficiency	
Scaffolding discussion	*Supervisor meetings are more efficient, covering the aspects that are genuinely useful for the students*
Allowed staff preparation	*I checked the portfolio in advance…which allowed the discussion to be informed. This was a good thing for the weaker/less confident students who would frequently come without anything specific to discuss*
Assessment robustness	
Evidence for supervisor mark	*The students I supervised this year didn't use the portfolio entirely effectively, but I found that this gave appropriate evidence as to why my supervisor mark was low – it felt more robust.*
Resilience to staff absence	*we did need to generate supervisor marks for a supervisor who is away. I was able to…make a judgment of whether…[the] class of those marks was correct.*
Generative AI resilience	
Difficult to use GAI to generate portfolio	*it stops them from generating an AI essay at the end, which I think is what I was worried about this year*
Opportunity to train in ethical GAI use	*Teach them to use it ethically, and to use judgement on what's being spat out from it in terms of is that a reasonable thing to say.*

https://doi.org/10.29311/ndtns.vi20.4982

Attainment and Engagement

In general, staff were extremely positive about the portfolios for increasing attainment and engagement with the literature projects. From the data it is apparent that the portfolio is facilitating the process of critical reflection that already may have been anticipated in final year projects by explicitly telling students to comment upon the significance of specific papers and reflect upon supervisor discussions. Hence students may be able to access higher order learning outcomes. One participant stated that they thought '*a couple of them would have made quite a good job at it, but I think they ended up making a very good job of their project'.* It was also highlighted that the portfolio better prepared students for writing their report at the end of the project. It was perceived that it had facilitated better time management due to the requirement to update the portfolio regularly hence students had a good record of the literature read alongside a critical commentary. It also provided a good basis to structure the report. Krishnan and Kathpalia (2002) note that students generally don't understand what critical analysis is and need to be trained in this. It may be that the portfolio allows for this by promoting less formal (and possibly more subjective) critical thinking (Cadman, 1997) which can be refined into a more appropriate style with supervisor input as the project progresses.

Despite the advantages outlining above, participants highlighted that the portfolio was not a panacea for disengagement. Some students treated the portfolio as a '*box-ticking exercise*' rather than engaging in the critical reflection required. For students who didn't update the portfolio regularly, they needed to add multiple entries towards the end of the project when they should have been focussing on their report. Having the portfolio visible to the supervisor should mean that intervention can take place earlier to avoid this (as noted in the *Monitoring Progress* theme below). However there needs to be motivation for both staff and students, which could take the form of a nominal interim portfolio grade.

It was noted by one participant that one student was '*a little less tech savvy. He had a few problems [setting up OneNote] for some reason'*. It is not clear whether this student did not engage with the support and instructions provided to set up the OneNote portfolio, but this is something to monitor, and supervisors should ensure the portfolio is created and shared by a deadline to ensure effective use.

Monitoring Progress

Use of the portfolios allowed supervisors to monitor engagement and progress of students on their projects in a way not previously possible. Having a record of activities made it difficult for the student to '*pull… the wool over your eyes'.* Nicholson (2018) noted that online portfolio assessment for an academic skills module allowed tutors to monitor students' progress but results also indicated that tutors thought students were encouraged to make more timely progress because they knew tutors were able to check. It was also noted that the portfolio allowed more effective supervision of multiple students. At University of Birmingham, a relatively small number of students complete literature projects but this highlights that this approach is transferable to larger cohorts. The portfolios were identified as an effective student support mechanism as it was obvious if the student had fallen behind and intervention could be taken. Previously this may not become apparent until the student was writing the report, at which point, it was too late to mitigate.

Meeting Efficiency

Participants were notably positive about how the portfolio had transformed the supervisor meetings held regularly with students. This was particularly true for students who struggled to communicate their progress in meetings as supervisors could use specific questions to prompt students. It was also noted that if a student had engaged with a paper in an '*area of chemistry I wasn't that comfortable with or familiar with, so I could do some thinking about ahead of the meeting'.* As well as increasing the efficiency of the meeting, this also provides a better student experience as the supervisor can directly discuss the paper rather than the content being unknown. Despite checking the portfolio in advance creating extra work for the supervisors, nobody commented that this was particularly onerous. One supervisor did acknowledge that '*it wasn't like I was looking on it to see what questions they were going to ask me in the upcoming meetings'*. This indicated the need for clearer staff

expectations to ensure all students are having an equitable experience.

Assessment Robustness
Overall, the portfolio was perceived to increase the robustness of the supervisor mark, especially for lower achieving or less engaged students. Where supervisors have multiple students, it allows supervisors to better keep track of each student to award an accurate and transparent mark. It also allowed for more effective moderation. Another advantage of the portfolio was the ability to award a more accurate supervisor mark if, for some reason, the supervisor is unable to provide the mark (e.g. staff illness).

Generative AI Resilience
Given that the initial motivation for introducing portfolios was to add GAI resilience to literature projects, it was pleasing that participants agreed that this was effective. The general feeling seemed to be that the portfolio made it very difficult for a student to complete minimal work all year then use GAI to write their report at the end of the year (or if they did do this with the new assessment structure, they would not obtain good marks). It was also felt that there would be some level of suspicion where there were limited portfolio entries, a lack of working report draft and then one suddenly appeared. (Of course, plagiarism would still be hard to prove). It was acknowledged that GAI could be used to create individual portfolio entries and hence '*use AI to fill up the portfolio'.* However, at this point, it could be argued that this would require significant willing deceit by students and plagiarism more often arises unintentionally (Krishnan and Kathpalia, 2002). Kumar (2023) identified that the lack of personal perspective was a weakness of GAI. Hence it would seem that (at this point) there is GAI resilience for the reflections on supervisor meetings. Acknowledging that judicious use of GAI is becoming an important employability skill, (Reddy, 2024) it was also raised that the portfolios could be used to train students in appropriate use of GAI.

Conclusion and Limitations

An electronic portfolio has been introduced to chronicle the progress of final year literature projects with the intention of adding GAI resilience. Project supervisors perceive that portfolios are an effective way of adding resilience to literature projects, especially in relation to recording and reflecting upon supervisor meetings. Moreover, supervisors perceive portfolios to have a range of other advantages for both staff and students. The portfolio prompts students to critique papers and provides a scaffold for the final report, potentially increasing overall student attainment. It allows supervisors to monitor student progress facilitating earlier intervention and hence also increases the efficiency of student-supervisor meetings, allowing supervisors to better support students with their literature project.

It is recommended that educators in higher education consider the introduction of portfolio assessment to final year projects, especially those with a significant literature review element. However, it is important to provide clear guidance to staff and students relating to expectations about portfolio use to ensure an equitable experience. Portfolios may also be an effective way to chronicle the progress of an experimental research project, using the same principles outlined in this article. Indeed, portfolios have been incorporated into third year laboratory-based research projects at University of Birmingham and future work should focus on whether the advantages outlined extend to experimental projects.

The limitations of this study are that this is a small sample size of supervisors over one year at a single university. In addition, this article only discusses supervisor perceptions. In future, it would appropriate to gather student perceptions about the portfolios and also detailed insight into how they are using them to support their research projects.

References

Abell, T. N. and Sevian, H. (2020). Analyzing Chemistry Teachers' Formative Assessment Practices Using Formative Assessment Portfolio Chapters, *Journal of Chemical Education*, 97(12) pp.4255–4267.
https://doi.org/10.1021/acs.jchemed.0c00361

Adamchik Jr., C.F. (1996). The Design and Assessment of Chemistry Portfolios, *Journal of Chemical Education*, 73(6), pp.528 - 531.
https://doi.org/10.1021/ed073p528

Batista, J., Mesquita, A. and Carnaz, G. (2024). Generative AI and Higher Education: Trends, Challenges, and Future Directions from a Systematic Literature Review, *Information*, 15 (11), 676. https://doi.org/10.3390/info15110676.

Braun, V. and Clarke, V. (2006). Using thematic analysis in psychology, *Qualitative Research in Psychology, 3*, pp.77– 101.
https://doi.org/10.1191/1478088706qp063oa

Bree, R. T. and Gallagher, G. (2016). Using Microsoft Excel to code and thematically analyse qualitative data: a simple, cost-effective approach, *AISHE-J.*, *8* (2), pp.2811-2819.
https://doi.org/10.62707/aishej.v8i2.281

Brenner, M., Brown, J. and Canter, D. V. (1985). The Research Interview: Uses and Approaches; Academic Press: London.

Cadman, K. (1997). Thesis writing for international students: A question of identity? *English for Specific Purposes*, 16 (1), pp.3-14.
https://doi.org/10.1016/S0889-4906(96)00029-4.

Dubois, B. L. (1988). Citation in biomedical articles, *English for Specific Purposes*, 7 (3), pp. 181-193.
https://doi.org/10.1016/0889-4906(88)90015-4.

Hyde, J. (2025*).* A New Perspective on Chemistry Foundation Level Students Laboratory Skill Development using Reciprocal Peer-Teaching, Laboratory Simulations, and Practical Skills Portfolio (PSP) during COVID-19 and Post-Pandemic in 2024, *Journal of Chemical Education*, 102 (3) pp.984-1003. https://doi.org/10.1021/acs.jchemed.4c01124.

Krishnan, L. A. and Kathpalia, S. S. (2002). Literature reviews in student project reports, *IEEE Transactions on Professional Communication*, 45 (3) pp.187-197.
https://doi.org/10.1109/TPC.2002.801637

Kumar, A. H. S. (2023). Analysis of ChatGPT tool to assess the potential of its utility for academic writing in biomedical domain, *BEMS Reports*, 91, pp.24–30.
https://doi.org/10.5530/bems.9.1.5

Nahadi, Siswaningsih, W., Purnawarman, P., Indriani, A., Lestari, T. and Nuryana, Nur Albar, C. (2022). Development of Electronic Portfolio-Based Assessment Strategies in Chemistry Learning to Assess Students' Concept Mastery, *Moroccan Journal of Chemistry*, 10(1), pp.1-12.
https://doi.org/10.48317/IMIST.PRSM/morjchem-v10i1.31714

Nicholson, D. T. (2018). Enhancing student engagement through online portfolio assessment, *Practitioner Research in Higher Education*, 11(1), pp.15-31.

Peres, R., Shreier, M., Schweidel, D. and Sorescu, A. (2023). On ChatGPT and beyond: How

generative artificial intelligence may affect research, teaching, and practice, *International Journal of Research in Marketing*, 40, pp. 269–275.
https://doi.org/10.1016/j.ijresmar.2023.03.001

Reddy, M. R., Walter, N. G. and Sevryugina, Y. V. (2024). Implementation and Evaluation of a ChatGPT-Assisted Special Topics Writing Assignment in Biochemistry, *J. Chem. Educ*.,101 (7), pp.2740– 2748.
https://doi.org/10.1021/acs.jchemed.4c00226

Richards-Babb, M., Penn, J. P. and Withers, M. (2014). Results of a Practicum Offering Teaching-Focused Graduate Student Professional Development, *Journal of Chemical Education*, 91(11) pp.1867–1873.
https://doi.org/10.1021/ed500134d

Wright, J. S., Read, D., Hughes, O. and Hyde, J. (2018). Tracking and assessing practical chemistry skills development: practical skills portfolios, *New Directions in the Teaching of Natural Sciences*, 13.
https://doi.org/10.29311/ndtps.v0i13.2905