








PROGRAMME DESCRIPTION

Description of a practice-focused research skills curriculum for a master's in pharmacy programme

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Abstract

Background: To describe a research skills curriculum across the five years of a Master's in Pharmacy (MPharm) programme whereby students designed, undertook, and disseminated Practice of Pharmacy (PoP) research projects. **Methods:** In years 1 to 3, students developed foundational research skills through workshops in academic writing, critical appraisal, presentation, database searching, and information gathering. The research training received by students was a comprehensive journey from learning the theoretical principles of research through idea generation, planning, application, execution, and dissemination. PoP research skills were developed in years 4 and 5, via taught components, by undertaking an individual capstone research project in year 4 and a team-based PoP research project in year 5. Team-based projects were included to emulate the working of a research group. The year 5 project was performed while students completed experiential learning placements in patient-facing settings. **Results:** As of 2023, 100% (n = 236) of students commencing year 5 completed the MPharm programme. Despite the challenge of COVID-19, 33 groups successfully produced high-quality research project reports at the end of year 5, three (9%) of which have been published in international peer-reviewed journals. **Conclusion:** The MPharm research curriculum expanded learning across all programme years. The personal, interpersonal, and research skills developed could place graduates at a distinct advantage for continuing their professional development across their careers and becoming involved in research projects as qualified pharmacists.

Introduction

Pharmacy curricula require adaptation to accommodate expanding pharmacist roles, including advanced clinical roles and involvement in patient-centred research (Hudson *et al.*, 2007; DiPiro, 2011). Pharmacists must keep updated with research findings and treatment guidelines, diversify roles as government policies and legislation allow, and be innovative in care delivery (Rouse, 2004). Developing the knowledge, skills, and competence to undertake Practice of Pharmacy (PoP) research could considerably enhance the future development of pharmacists and the profession as a whole.

Pharmacy practice research education is still a developing area, particularly in Europe. A 2014 survey of European pharmacy schools indicated that 47%

lacked an education and research methods course (Kostriba *et al.*, 2014). To address pharmacists' low involvement in research (Awaisu & Alsalmiy, 2015), the Royal Pharmaceutical Society (RPS) launched a 'Research Ready' self-accreditation programme in 2013 to facilitate the involvement of community pharmacists in research across the United Kingdom (UK) (Ferguson, 2016). The RPS evaluated programme engagement during the first three years of its operation. Of 72 accredited pharmacies surveyed, all were actively involved in research, including recruitment (21%), study signposting (29%), and raising awareness of research (27%). A small number of pharmacies were engaged in medication provision as part of clinical trials (5%) and carrying out interventions (4%) (Garner *et al.*, 2017).

No equivalent programme exists for pharmacists in Ireland. However, recent changes in undergraduate pharmacy education in Ireland presented an opportunity to enhance the development of pharmacy students' knowledge, skills, and competence in PoP research.

Students studying pharmacy in Ireland complete a newly revised five-year "integrated" Master's in Pharmacy (MPharm), with experiential learning dispersed throughout. Students complete a statutory four-month placement in year 4, which may be either clinical or non-clinical (e.g. industrial, academic, regulatory, etc), and an eight-month placement in year 5, which must be undertaken in a clinical setting, i.e. community or hospital. Students also complete a non-statutory two-week clinical placement in year 2, i.e., one not required by law. This programme is underpinned by a Core Competency Framework (CCF), a detailed set of competencies expected of pharmacists upon qualifying (Pharmaceutical Society of Ireland, 2013; Ryan et al., 2019).

The Pharmaceutical Society of Ireland (PSI) accreditation standards stipulate that the curriculum provides comprehensive training in research skills (Pharmaceutical Society of Ireland, 2019). In line with Trinity College Dublin (TCD) University requirements, students in year 4 also undertake a capstone research

project module of 15 European Credit Transfer and Accumulation System (ECTS) (aligning with one-quarter of the academic credit for the final year of an honours degree) and an additional research project in the MPharm year, which must equate to 30 ECTS (aligning with one-third of the academic credit for a one-year master's) (Trinity Education Project, 2019; Trinity College Dublin, 2020).

This study aimed to describe a research skills curriculum across the five years of an MPharm programme whereby students designed, undertook, and disseminated a PoP research project.

Description of programme

The curriculum developed foundational research skills and research skills across pharmaceutical sciences (pharmaceutical chemistry, pharmacognosy, pharmacology, pharmaceutical microbiology, pharmaceutical formulation) and PoP. The PoP domain encompassed pharmacoepidemiology, medicines management, patient education, social and administrative pharmacy, and principles of pharmacotherapy. Research skills were developed throughout the MPharm programme (Figure 1).

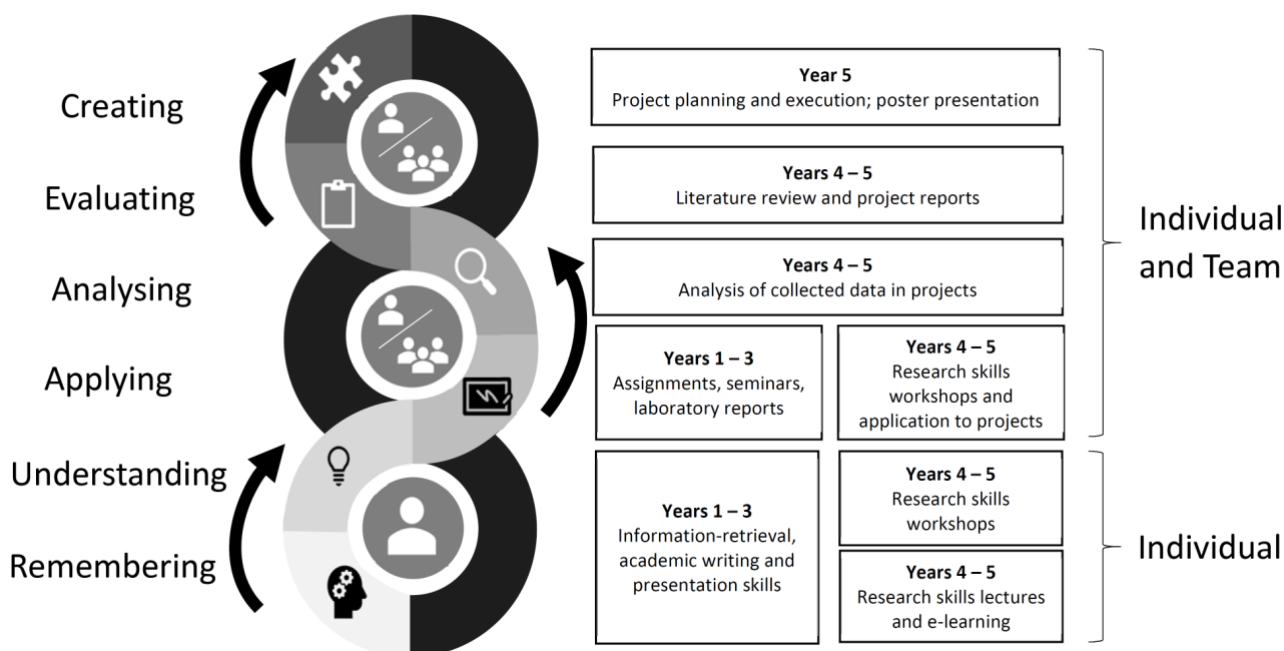


Figure 1: Trajectory of research skills development through Bloom's Taxonomy (Anderson & Krathwohl, 2001)

The trajectory of research skills was developed using a stepwise approach and was reflective of Bloom's

taxonomy (Anderson & Krathwohl, 2001). In year 1, students developed foundational research skills

through workshops in information retrieval, academic writing, and presentation skills. Students worked in teams to research and present information about the treatment of pain and inflammatory conditions, taking an integrative approach across pharmaceutical sciences. Year 2 students completed assignments that required engagement with literature searching. In year 3, they developed literature research and presentation skills by participating in a student-led seminar on natural products. Students also gave an oral presentation on a clinical therapeutics research paper. They developed protocol and scientific writing skills throughout the programme by completing laboratory reports.

In year 4, students conducted an individual research project in any area of the pharmaceutical sciences under the supervision of an academic staff member, all

of whom were international experts in their respective fields. These projects were completed over four weeks, during which students were required to produce (i) a research paper for a specified target journal and (ii) an oral presentation demonstrating a comprehensive understanding and critical interpretation of methodologies and data. The projects were assessed by the supervisor and a panel of two academics. During the project period, students did not have other coursework, so time was protected for the project.

Before and during these projects, lectures and workshops enabled students to learn good research practice, data handling, storage, statistical analysis, report writing, and presentation skills. Table I presents the allocation of marks for the assessed components in the year 4 module.

Table I: Contribution of the assessed components to final grade in year 4 module (15 ECTS)

Component	Individual/group mark	Contribution to module grade
Research methods		
Written Examination on Research Methods	Individual	20%
E-learning Continuous Assessment	Individual	10%
Research project		
<i>Marks are broken down as:</i>		
• Attendance, commitment, engagement, and quality of work: 20%		
• Project write-up: 20%		
• Understanding and presentation of data: 20%		70%
• Conclusion and recommendations: 10%		
• Oral Presentation: 20%		
• Discussion: 10%		

With regard to PoP research skills, students learned how to undertake research studies from idea generation to results dissemination. They developed the ability to critically appraise study designs that contribute to evidence-based practice, including cohort studies, randomised controlled trials, case reports, and case series. They also learned how to design questionnaires and use qualitative and quantitative research methods.

In year 5, students completed team-based PoP research projects. They received an introductory session explaining the process, along with a project handbook and e-learning podcasts. These resources covered topics such as the General Data Protection Regulations (GDPR), research ethics, literature review, and data management and analysis. All learning materials provided in year 4 remained available to students in year 5.

Appendix A displays the learning outcomes for the year 5 project, which are mapped to the PSI Core Competency Framework (Pharmaceutical Society of Ireland, 2013).

Students were assigned to groups based on their geographical location to facilitate face-to-face meetings. Project supervisors (School PoP academic staff) provided the title and background of the project to their group. Each group typically received guidance from two supervisors. Year 5 projects were carried out primarily during students' experiential learning placements in practice settings (community or hospital pharmacy).

The research project involved six distinct stages. In the first stage, students developed the research protocol in line with appropriate guidelines based on the study type. If necessary, an application was submitted to the relevant Research Ethics Committee (REC) with supervisor assistance. As students conducted their

research project during their experiential learning placement, preceptors were informed if data collection was planned on-site (e.g. through patient surveys) as opposed to off-site (e.g. non-empirical reviews).

In the second stage, each student independently completed a literature review to enhance their understanding of the topic. Supervisors allocated literature review titles, then students designed their search strategy and completed searches, screening, data extraction, and critical appraisal independently. Students submitted one draft of their literature review to their supervisor(s) for feedback prior to final grading.

The third stage focused on data management and analysis and spanned eight weeks. During this period, students could pilot study material, undertake data collection, develop experience in using databases for storing data, and transcribe qualitative research

findings. This process was followed by the fourth stage, where students prepared the first draft of their research paper. In the fifth stage, students produced a poster and delivered a 5-minute presentation. The sixth stage involved the finalisation of the research paper. Authorship could be led by the supervisor, by an individual student, or with joint first authorship of students.

Assessment was both formative and summative, involving individual and group assessment. Rubrics were based on those developed by the Association of American Colleges and Universities (Rhodes, 2010). Year 5 projects were assessed by both supervisors and additional academic assessors. The allocation of marks for project components in the year 5 module is presented in Table II.

Table II: Contribution of project components to final grade in year 5 module (30 ECTS)

Component	Individual/Group mark	2019/20	2020/21	2021/22	2022/23
Protocol	Group	10%	12%	22%	20%
Literature review	Individual	25%	33%	33%	33%
Data management & analysis	Group	7.5%	7.5%	7.5%	14.5%
Poster	Group	10%*	7.5%	7.5%	7.5%
Research paper	Group	40%	40%	30%	25%
Peer assessment	Individual	7.5%	Formative	Formative	Formative

*Due to COVID-19, the Poster Session was cancelled, and marks reallocated pro-rata to the other elements of the project.

A prize sponsored by a large pharmacy chain was awarded to the best project group based on the sponsor's evaluation. The prize bursary, amounting to up to €5,000, was intended to support further educational or research initiatives.

Year 5 students conducted two peer evaluations, assessing their colleagues on communication, involvement, support, use of skills, adaptability, leadership, and organisational capability. Module coordinators processed these evaluations confidentially. Feedback was provided on a case-by-case basis to any students requiring additional support with engagement.

Results

All students who commenced year 5 in 2019, 2020, 2021, and 2022 (n = 236) successfully completed the

PoP research project. Each year, students completed projects in six to thirteen groups, with 5–10 students per group and an average of seven students per group. Students were supported by twelve academic supervisors. In total, 33 projects have been completed, three of which (9%) have been published in peer-reviewed international journals.

The first year of the year 5 projects faced the challenge of the emergence of COVID-19. The University advised against face-to-face data collection involving human participants for student projects. Three projects required amendment to continue while ensuring compliance with these restrictions, maintaining the aims of the original study (Table III). Deadlines were modified to allow flexibility, and contingency plans were put in place should students be required to self-isolate. The 2019/20 poster session was cancelled due to COVID-19, and marks were reallocated to other project components (Table II). The projects encompassed various study types, as shown in Table III.

Table III: Project titles and group sizes for the first three iterations of the year 5 research project

Year 5 2019/20 research projects Group size (n = 54)	Year 5 2020/21 research projects Group size (n = 57)	Year 5 2021/22 research projects Group size (n = 50)	Year 5 2022/23 research projects Group size (n = 75)
A survey of family carers on medication saving behaviors in older adults* n = 9	A survey of family carers on medication saving behaviors in older adults n = 9	Pharmacy students' resilience during the COVID-19 pandemic and factors affecting it: a questionnaire study n = 9	A scoping review of practice readiness among healthcare professions: pharmacy, dentistry and nursing n = 7
Quality of counselling resources for direct oral anticoagulants* n = 8	Development and evaluation of novel, personalisable, electronic counselling aids for patients starting "Direct" or "Non-Vitamin K Antagonist Oral Anticoagulants" (DOACs/NOACs) Phase 1 n = 8	Personalised electronic counselling on direct oral anticoagulants: a pilot study in community pharmacies n = 8	Identification of knowledge gaps to guide and target personalised education in patients with atrial fibrillation n = 9
Exploring the knowledge and educational needs of pharmacy students in providing pharmaceutical care to older adults with intellectual disability* n = 8	An anonymised questionnaire to explore the knowledge and educational needs of pharmacists in providing pharmaceutical care to older adults with intellectual disability n = 9	The adverse effects of long-term exposure to antipsychotics among older people with intellectual disabilities: a scoping review† n = 8	Adverse outcomes of polypharmacy in older adults with intellectual disabilities: a scoping review n = 5
Pharmacy practice in the newspapers n = 5	Pharmacy practice in the newspapers during the COVID-19 pandemic in Ireland n = 6	Patients' and carers' perspectives of interprofessional working in medication management before and since the COVID-19 pandemic: a secondary analysis of interview data n = 7	A scoping review to examine the impact of community pharmacist-led contraception services n = 6
Rating scales to measure adverse effects of medications in people with intellectual disability: a systematised review† n = 8	Defensive pharmacy practice: A survey of Irish pharmacists n = 9	Paediatric influenza vaccination in community pharmacy: a study on demographics and parents' perspectives n = 10	Vaccination services in community pharmacy practice: a scoping review n = 7
Demonstrating community pharmacist activities in Ireland: An observational study on interventions characterised by pharmacist-to-prescriber contact n = 8	Health services research in pharmacy in Ireland: a scoping review n = 8	Effectiveness of pharmacist-led interventions for patients with asthma in primary care: systematic review and meta-analysis n = 8	Deprescribing for older adults with intellectual disability: a scoping review n = 5
Travel vaccination and pharmacy: a content analysis of recent newspapers n = 8	A questionnaire study investigating the Irish public's attitude towards pharmacogenomic testing† n = 8		"Happy pharmacist, happy patient" A qualitative study investigating the barriers and facilitators to job satisfaction in both community and hospital pharmacy n = 5
			Advanced community pharmacy services in the United Kingdom and Ireland: a scoping review n = 5
			Medication self-management interventions in the domiciliary setting for people experiencing cancer and using oral anticancer medication: a systematic approach to a scoping review n = 5
			A scoping review of pharmacist-led interventions targeting the prescribing and use of antidepressants

Year 5 2019/20 research projects Group size (n = 54)	Year 5 2020/21 research projects Group size (n = 57)	Year 5 2021/22 research projects Group size (n = 50)	Year 5 2022/23 research projects Group size (n = 75)
			n = 5 A scoping review of pharmacist-led interventions targeting the prescribing and use of antipsychotics n = 5
			Professional role orientation-validation of a pharmacy-specific professional role orientation inventory (PROI) n = 5
			Evaluation of a mole scanning service in community pharmacy n = 6

*These projects were amended to ensure completion following the emergence of the COVID-19 pandemic. † These projects have been published in international, peer-reviewed journals

Each year, the supervisory team reviewed the module to determine whether any changes were necessary, including the weighting of each project component. Over time, the contribution of the protocol increased from 10% to 20% to encourage students' early engagement in the project. Additionally, peer assessment was changed from summative to formative to promote early identification of issues with teamwork and allow time for remediation (Table II).

Discussion

The research skills training received by students enrolled in this MPharm Programme is a comprehensive journey along Bloom's taxonomy, from learning the theoretical principles of research through idea generation, planning, application, execution, and dissemination (Figure 1).

The research training component of the TCD MPharm programme shares similarities with pharmacy programmes worldwide. For example, at Southern Illinois University Edwardsville, the University of California San Francisco, and the University of Utah, these programmes included research training that spanned years 3 and 4 of the courses, and the final output included both a research paper and a presentation to faculty (Wuller, 2010; Kao *et al.*, 2011; Henchey *et al.*, 2020). While students in San Francisco and Edwardsville could undertake individual or team-based projects, those in Utah completed individual projects. A separate programme at another institution offered an optional research programme that students across years 1–4 could apply to complete, with training in research skills provided (McLaughlin *et al.*, 2015). At

the postgraduate level, structured research projects have also been integrated into residency programmes (Barletta, 2008; Swanoski *et al.*, 2012). The TCD MPharm incorporates the characteristics of these approaches and expands the learning across all years of the course.

Completing the year 5 research project in teams allows students to gain practical experience of working on a research team while they are academically more mature (Linca & Matei, 2023). Teamwork skills are essential for efficient practice in the health sciences (Rosen *et al.*, 2018), and exposure to research in practice during the years of study may encourage continued engagement in research after qualification (Laustsen *et al.*, 2021).

Both staff and students can be motivated by the potential for publication of the project. Staff can pilot projects before making grant applications or rolling out on a larger scale while adding to their publication record. Students may be motivated by the career progression opportunities resulting from the publication of their work in an international peer-reviewed journal (Griffin & Hindocha, 2011). Additionally, the availability of a research prize bursary adds to the research environment, as dissemination activities (e.g. conferences) are of high relevance for an active researcher (Haus, 2020).

Practice research has numerous challenges. Data collection may be delayed due to amendments and responses to REC comments (Mrisho & Essack, 2021). Research activities can be time-consuming, with competing tasks and workloads posing additional difficulties. Limited financial resources and issues with data access can cause difficulty (Cullati *et al.*, 2016). By offering students practice research experience during

their MPharm, they are potentially better prepared to address these effectively during their careers.

PoP research has expanded in recent years, with outcomes aiming to improve healthcare processes. Subsequently, there is a need for a higher level of engagement from practising pharmacists (Awaisu & Alsalmiy, 2015). As the lack of training is often cited as a barrier to pharmacists' participation in research (Awaisu & Alsalmiy, 2015), this MPharm programme potentially narrows the gap and increases the potential of future pharmacists to undertake practice research projects (Kehrer & Svensson, 2012; Krass, 2015). The programme introduces students to different types of PoP research topics of national health interest, including communication between health professionals, pharmaceutical care for specific patient categories (e.g., older adults, individuals with intellectual disability, and those receiving anticoagulants), PoP in the media, pharmacogenomics, and vaccination.

Future research could focus on evaluating the programme by analysing student feedback on their experience, assessing its impact on other modules and grades, and examining correlations between performance in different module components.

Overall, the authors hypothesise the innovative curriculum design facilitates the development of a research culture for MPharm graduates by fostering research skills and enthusiasm towards active involvement in research activities. The programme could be further enhanced by integrating projects across the modules of years 4 and 5, streamlining the development of one larger project while maintaining exposure to various pharmaceutical sciences.

Conclusion

During the academic years 2019/20, 2020/21, 2021/22, and 2022/23, all students successfully completed the research component of their MPharm training. Graduates of this programme are expected to demonstrate higher adherence and commitment levels to PoP research projects.

Ethics approval and informed consent

This paper was deemed exempt from requiring ethical approval by the School of Pharmacy and Pharmaceutical Sciences Research Ethics Committee, Trinity College Dublin.

Conflict of interest

The authors declare no conflict of interest.

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During the revision of this article, the principal author used the free versions of Grammarly and QuillBot to check and improve grammatical correctness. These tools were not used to write, rewrite, rephrase or modify the article content beyond basic grammatical checks.

References

- Anderson, L. W., & Krathwohl, D. R. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives*. Longman.
- Awaisu, A., & Alsalmiy, N. (2015). Pharmacists' involvement in and attitudes toward pharmacy practice research: A systematic review of the literature. *Research in Social & Administrative Pharmacy*, *11*(6), 725–748. <https://doi.org/10.1016/j.sapharm.2014.12.008>
- Barletta, J. F. (2008). Conducting a successful residency research project. *American Journal of Pharmaceutical Education*, *72*(4), 92. [https://doi.org/10.1016/S0002-9459\(24\)00449-2](https://doi.org/10.1016/S0002-9459(24)00449-2)
- Cullati, S., Courvoisier, D. S., Gayet-Ageron, A., Haller, G., Irion, O., Agoritsas, T., Rudaz, S., & Perneger, T. V. (2016). Patient enrollment and logistical problems top the list of difficulties in clinical research: a cross-sectional survey. *BMC Medical Research Methodology*, *16*(1), 50. <https://doi.org/10.1186/s12874-016-0151-1>
- DiPiro, J. T. (2011). Preparing our students for the many opportunities in pharmacy. *American Journal of Pharmaceutical Education*, *75*(9), 170. <https://doi.org/10.5688/ajpe759170>
- Ferguson, R. (2016). Get started with research in community pharmacy. *The Pharmaceutical Journal*, *296*(7885), 296. <https://doi.org/10.1211/PJ.2015.20200163>

- Garner, S., Patel, P., Duggan, C., & Joynes, R. (2017, 15th and 16th May). *Royal pharmaceutical society 'Research ready' accreditation scheme evaluation*. Annual National Health Service Research and Development Forum, Manchester. Retrieved 2021, 15 April from <https://annualrdforum.org.uk/wp-content/uploads/formidable/5/D3-Sonia-Garner.pdf>
- Griffin, M. F., & Hindocha, S. (2011). Publication practices of medical students at British medical schools: experience, attitudes and barriers to publish. *Medical Teacher*, **33**(1), e1–8. <https://doi.org/10.3109/0142159x.2011.530320>
- Hauss, K. (2020). What are the social and scientific benefits of participating at academic conferences? Insights from a survey among doctoral students and postdocs in Germany. *Research Evaluation*, **30**(1), 1–12. <https://doi.org/10.1093/reseval/rvaa018>
- Henchey, C., Keefe, K., Munger, M. A., & Witt, D. M. (2020). Fostering PharmD student research and quality improvement with mentored projects. *American Journal of Pharmaceutical Education*, **84**(9), ajpe7940. <https://doi.org/10.5688/ajpe7940>
- Hudson, S. A., Anaw, J. J. M., & Johnson, B. J. (2007). The changing roles of pharmacists in society. *International e-Journal of Science, Medicine & Education*, **1**(1), 22–34. <https://doi.org/10.56026/imu.1.1.22>
- Kao, D. J., Hudmon, K. S., & Corelli, R. L. (2011). Evaluation of a required senior research project in a doctor of pharmacy curriculum. *American Journal of Pharmaceutical Education*, **75**(1), 5. <https://doi.org/10.5688/ajpe7515>
- Kehrer, J. P., & Svensson, C. K. (2012). Advancing pharmacist scholarship and research within academic pharmacy. *American Journal of Pharmaceutical Education*, **76**(10), 187. <https://doi.org/10.5688/ajpe7610187>
- Kostriba, J., Alwarafi, A., & Vlcek, J. (2014). Social pharmacy as a field of study in undergraduate pharmacy education. *Indian Journal of Pharmaceutical Education and Research*, **48**(1), 6–12. https://www.ijper.org/sites/default/files/ijper_48_1_2.pdf
- Krass, I. (2015). Ways to boost pharmacy practice research. *The Pharmaceutical Journal*, **295**(7883), 295. <https://pharmaceutical-journal.com/article/opinion/ways-to-boost-pharmacy-practice-research>
- Laustsen, C. E., Petersson, P., Westergren, A., & Haak, M. (2021). Involvement of professionals in research: knowledge integration, development of practice, and challenges: a group concept mapping study. *Health Research Policy and Systems*, **19**(1), 115. <https://doi.org/10.1186/s12961-021-00763-5>
- Linca, F. I., & Matei, F. L. (2023). Teamwork efficiency of students: does the university environment contribute to the development of this competence? *Review of Psychopedagogy*, **12**(1), 81–86. <https://doi.org/10.56663/rop.v12i1.60>
- McLaughlin, M. M., Skoglund, E., Bergman, S., & Scheetz, M. H. (2015). Development of a pharmacy student research program at a large academic medical center. *American Journal of Health-System Pharmacy*, **72**(21), 1885–1889. <https://doi.org/10.2146/ajhp150042>
- Mrisho, M., & Essack, Z. (2021). Understanding constraints and enablers of turnaround time for ethics review: The case of institutional review boards in Tanzania. *Journal of Empirical Research on Human Research Ethics*, **16**(5), 514–524. <https://doi.org/10.1177/15562646211026855>
- Pharmaceutical Society of Ireland. (2013). *Core competency framework for pharmacists*. Retrieved 2020, 25 June from https://www.thepsi.ie/gns/Pharmacy_Practice/core-competency-framework.aspx
- Pharmaceutical Society of Ireland. (2019). *Accreditation standards for the five-year fully integrated masters degree programmes in pharmacy*. Retrieved 2022, 18 August from https://www.thepsi.ie/Libraries/Education/5Yr_Prog_Accreditation_Standards.sflb.ashx
- Rhodes, T. (2010). *Assessing outcomes and improving achievement: Tips and tools for using rubrics*. Association of American Colleges and Universities. <https://www.aacu.org/publication/assessing-outcomes-and-improving-achievement-tips-and-tools-for-using-rubrics>
- Rosen, M. A., DiazGranados, D., Dietz, A. S., Benishek, L. E., Thompson, D., Pronovost, P. J., & Weaver, S. J. (2018). Teamwork in healthcare: Key discoveries enabling safer, high-quality care. *American Psychologist*, **73**(4), 433–450. <https://doi.org/10.1037/amp0000298>
- Rouse, M. J. (2004). Continuing professional development in pharmacy. *Journal of the American Pharmacists Association*, **44**(4), 517–520. <https://doi.org/10.1331/1544345041475634>
- Ryan, T. J., Grimes, T., Henman, M. C., Sheachnasaigh, E. N., O'Dwyer, M., Roche, C., Ryder, S. A., Sasse, A., Walsh, J. J., & D'Arcy, D. M. (2019). Design and implementation of an integrated competency-focused pharmacy programme: A case report. *Pharmacy (Basel)*, **7**(3), 121. <https://doi.org/10.3390/pharmacy7030121>
- Swanoski, M. T., Akers, M. F., Amaro, M. L., Huot, K. L., & Lutfiyya, M. N. (2012). Incorporating research into a postgraduate year 1 pharmacy residency. *American Journal of Pharmaceutical Education*, **76**(9), 175. <https://doi.org/10.5688/ajpe769175>
- Trinity College Dublin. (2020). *Calendar part III graduate studies and higher degrees*. Retrieved 2021, 15 April from <https://www.tcd.ie/calendar/graduate-studies-higher-degrees/complete-part-III.pdf>
- Trinity Education Project. (2019). *Capstone project: Definition and criteria*. Retrieved 2021, 15 April from <https://www.tcd.ie/teaching-learning/ug-regulations/Assets/A.5%20TEP%20-%20Capstone%20Project%20-%20Definition%20%20Criteria.pdf>
- Wuller, C. A. (2010). A capstone advanced pharmacy practice experience in research. *American Journal of Pharmaceutical Education*, **74**(10), 180. <https://doi.org/10.5688/aj7410180>

Appendix A: Learning outcomes for year 5 PoP research project

Learning outcome	Mapped to Core Competency Framework
Developing, within the research team, a research protocol, using appropriate research methodologies for a research topic assigned to the team by the research supervisor	2.1 Leadership skills 2.2 Decision-making skills 2.3 Team working skills 2.4 Communication skills 5.3 Research skills
Demonstrating an understanding of GDPR 2016/679 and Health Research Regulations 2018, if required by the chosen methodology	5.3 Research skills
Developing, within the research team, an application for attaining Research Ethics Committee Approval, or for a waiver, or by demonstrating/establishing why an application is not required	1.4 Practises ethically 2.1 Leadership skills 2.2 Decision-making skills 2.3 Team working skills 5.3 Research skills
Preparing an individual in-depth literature review on the research topic	2.4 Communication skills 5.3 Research skills
Collecting and collating original data from individual placement sites or other vehicle as dictated by the research methods	5.3 Research skills
Analysing and interpreting data systematically and appropriately within the research team	2.1 Leadership skills 2.3 Team working skills 5.3 Research skills
Presenting, within the research team, the research project in the form of a research paper and poster presentation	2.1 Leadership skills 2.3 Team working skills 2.4 Communication skills
Collaborating as an effective member of a research team throughout the research project	2.1 Leadership skills 2.2 Decision-making skills 2.3 Team working skills 5.3 Research skills