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Problem-based, research-led learning for our times: The case of Vertically Integrated Projects in higher education

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Abstract

Vertically Integrated Projects (VIPs) are a novel method to embed problem-based research education in the curriculum in higher education. Students become part of student and staff research teams working on long-term research projects led by University Principal Investigators. The aim of this paper is to provide a description of how VIPs have been developed at the University of Galway and to explore student experiences of participation. Two semi-structured focus groups were conducted with nineteen undergraduate students who had completed their first VIP module. Interviews were transcribed verbatim and analyzed to identify key themes. Four key themes were developed: Increased understanding and awareness of research skills, approaches and resources; enhanced communication skills; improved organizational and project management skills; and becoming more "work ready". This study demonstrates the value of VIP in enhancing research knowledge and skills and supporting students to develop broader skills that are transferrable to their future careers.

Keywords: *Vertically Integrated Projects; Self-efficacy; Innovative Undergraduate Learning; Research Skills; Experiential Learning.*

1. Introduction

According to Kloeg (2023) "problem-based learning is not quite in its young years anymore: as an innovative approach to education, it stands to reason that it should continue to develop in response to our ever-changing world and the challenges that come with it" (p.93). An innovative project within the University of Galway has been working to introduce a new problem-based learning initiative, called Vertically Integrated Projects (VIPs), as part of its undergraduate

provision. The VIP approach was developed at Purdue University in 2001 within the Engineering Department. VIPs have a number of key components (Coyle et al, 2006; Sonnenberg Klein et al., 2017, Strachen et al., 2019). These are that the projects are based in active research projects currently ongoing by university staff, that the projects are running over a number of years, that they involve a reasonably large team of staff, that the teams are multi-disciplinary and that students work together in teams regardless of their year in college. Students also receive credit within their curriculum for their work. Finally, students can take part over a number of semesters in different roles so that they get a full, rounded experience The term "Vertically Integrated" refers to VIP team compositions, which can include undergraduate, postgraduate (taught) and research students in addition to university staff.

The opportunity to implement the VIP initiative in the University was made possible through the awarding of national funding for five years, (2020-2025), through the Human Capital Initiative (Higher Education Authority, 2020). The VIP programme has been developed to enhance the employability of university graduates by offering additional practical and creative teaching, learning and skills development alongside traditional degree studies.

VIPs in Galway are credit-bearing modules where students work in teams with academic researchers on multidisciplinary, longitudinal research projects to address grand challenges. This project represents the first time the VIP teaching approach has been deployed in an Irish context. As part of the implementation process, the University has become a member of the international VIP Consortium led by Georgia Institute of Technology, USA[1]. This paper provides an overview of the key features of how the VIP programme is being implemented at present at the University of Galway. This paper also aims to explore student experiences of participating in the introductory VIP module during the first year of VIP implementation at the University. Our findings will then be contextualized within relevant teaching and learning literature.

2. Methods

2.1. Description of the VIP Programme at the University of Galway

The VIP programme at the University of Galway has initially been set up to target 2nd and 3rd year undergraduate students. Two 5ECTs modules are available to students. VIP 1 is the introductory module where students join VIP for the first time. Students have the option then of completing a further VIP module which is focused on developing students' research leadership skills. Within this paper, we are describing students' experiences of participating in our VIP1

[1] For more information , see VIP Consortium Website

module in the first two semesters that we ran this module. The learning outcomes of the VIP 1 module are as follows:

On successful completion of this module the learner will be able to:

1. Describe the VIP programme and its relevance to your development.
2. Plan workload in order to deliver research tasks on time and within budget.
3. Interact with others to understand their research-related requirements.
4. Record work in a way that meets professional research standards.
5. Present research in a variety of forms to a professional standard.

In VIP1, students had three sets of regular commitments to make up the contact hours for this course. Each week, a one-hour lecture on research methods and approaches is delivered by the VIP coordinator. Secondly, students arrange up to six hours contact time with the Principal Investigator (PI) of their assigned research project. Thirdly, the group of students working together on the VIP project arrange separate times to meet up and progress assigned group work. The assessment requirements has three aspects. Students have to develop a group presentation based on their work, (10%); each research team have to complete a 1200-word research report on their project, (40%) and each individual student is asked to complete an individual personal reflection documenting the skills and dispositions they developed during VIP1, (50%). A number of core topics are taught in weekly classes including VIP module orientation, introduction to research design, preparation for teamwork, presentation skills, academic and literature reviewing. Specific topics were also introduced where there was a need to support particular work that project teams were doing.

2.2 Overview of VIP Projects

A recruitment campaign was undertaken to identify academic research projects within the university who would like to engage in this VIP initiative. The VIP coordinator circulated an all-staff e-mail, provided newsletter and website updates and set up individual meetings with potential PIs. The outcome of this process was the setting up of 13 VIP projects which are available to view on the University of Galway Designing Futures VIP website. During the first two semesters of VIP1 we allocated students to seven of these projects. The projects ranged from those focused-on data and artificial intelligence, cardiovascular health, perceptions of environmental sounds, mathematical education in the community, neuropsychology, medical device development and enhancing sustainability in small to medium enterprises. These projects also entail collaboration with the wider community, business, and enterprise. Prior to module commencement, students filled in an expression of interest form to match them to a project that suited their interests best. Student teams ranged in size from three to six students.

2.3 Evaluation method

We invited all students who participated in the two introductory VIP modules in 2023 to take part in semi-structured focus groups at the end of each semester to share their experiences of participating in the module. Focus groups were conducted by a postdoctoral researcher who was independent of the VIP teaching team. Focus groups were transcribed verbatim and analyzed using a thematic approach by two researchers who were independent of the students' teaching team (Bruan and Clarke, 2022). The data was analysed thematically in line with the focus group questions which captured student feedback in relation to their experiences whilst participating in the module, what they learned, what they enjoyed and suggestions for improvements. Ethical approval for this study was gained from the University of Galway Research Ethics Committee (Reference Number - 22.08.015). Pseudonyms were used and participants volunteered freely and were reassured that their feedback would be anonymized.

3. Results

19 out of the 34 invited students took part in the end-of-semester focus groups (56% response rate). This included seven males and 12 females. Five of the students were registered on courses in the College of Science and Engineering, 12 were registered on courses with the College of Arts Social Science & Celtic Studies and one was registered on a course with the College of Business, Public Policy and Law. 15 students were in the third year of their degree and four were in the second year of their course. Overall, the students reported that participating in the module was a very positive experience, that it was significantly different from other modules that they had experience of in college and that they would recommend the module to other students. Student feedback is summarised under four key thematic areas below with supporting quotes.

3.1 Increased understanding and awareness of research skills, approaches and resources

A core learning outcome for students was their increased understanding and awareness of research skills, approaches and resources. The students reported that this module did actually increase their skill level in this area as opposed to other more classroom-based modules involving research topics. Some students noted in particular specific skills they practiced such as interviewing skills, online researching, visiting research laboratories. They felt informed and knowledgeable about research resources that would be very useful to them in their future college and work careers. Aisha in recommending VIPs to other students highlights the research skills she has acquired from her participation.

"I would definitely recommend it as one of the better courses into research, writing and learning all that just because like there is no specific course to actually teach you how to do that. Some courses … say they're teaching you how to reference and research and they actually don't. Yeah,

so now I have a nice list of stuff that I can use now for like researching and compared to what I've heard from other courses. In terms of advice for other students, I'd say just go for it". (Aisha)

3.2 Enhanced communication skills

Students reported that participation in the VIP also provided them with many opportunities to improve their communication skills, whether through interacting with team members, researchers, in delivering presentations or in working with external community members. Across the feedback there was a recognition that this module enhanced student confidence and skills in working with people from different backgrounds and perspectives. Tara explains how she found having to speak in public 'daunting' yet it turned out to be a good experience and 'surprised' herself;

"I think for like speaking publicly like for example with the brain week, that we did that was something that I never thought that I could do. For me that was really daunting but it ended up being a really good experience. So far people like me, they like saw that as something that they were going to do that they shouldn't think that. Oh, I can't do that because you actually have surprised yourself. Like you learn new things in that way". (Tara)

3.3. Improved organizational and project management skills

A benefit of the cross disciplinary approach was the requirement that students develop their organisation and project management skills in order to complete group tasks and meet deadlines. As such, improved project management skills were identified by students as an outcome of their participation in the VIP. Jason explains how this was his first group work experience in university was challenging but rewarding

"I really enjoyed this well the group work aspect of the project. The fact that you know for three or four years, whatever you're working on your own, everything all the time and you get into an environment, we're spending the whole semester trying to work through challenges that come with that. It's sort of like a job environment to an extent, you know. So, I think it's really good just to experience on that side of things". (Jason)

3.4 Becoming more "work ready"

Finally, students reported that this module required them to develop their "work ready" skills, such as business etiquette, time management, being prepared for meetings, etc. The nature of the project work where students had to represent their work to external stakeholders required them to be aware of presenting as a "worker" rather than in a student role. These opportunities for learning which would benefit them as they transitioned into the workplace after college included practical tasks such as setting a meeting agenda, taking minutes so everyone know

what they are doing and the importance of turning up on time for meetings as Paddy and Surya explain;

"Set the agenda for every meeting. Oftentimes, when you meet the person, things can derail. It's better to set an agenda beforehand and make sure everyone knows in advance". (Paddy)

"Write up a plan or like make sure you take notes during the meeting so that you know who's doing what task and you're not confused as to what to do so". (Surya)

4. Discussion

This paper aimed to provide an overview of the initial implementation of VIP at the University of Galway, provide context for those wishing to adopt similar approaches in their universities. It also aimed to provide an insight into student experiences of participating in our introductory VIP module. Students reported that participation supported them in four key ways – by increasing their understanding and awareness of research skills, approaches and resources, enhancing their communication skills, improving their organisational and project management skills and supporting them to become more "work ready". These findings will be discussed now in relation to relevant teaching and learning literature.

The VIP model resonates well with the central tenets of adult learning. According to Knowles (1980), the adult learner has: increasing desires to be self-directed; significant life experiences which shapes their learning and may attach more meaning to experiential learning; are more likely to be motivated to learn when they can see how learning applies to their own life context; and are more inclined to be performance-orientated in their learning. On the VIP programme self-directedness is encouraged from the outset. Prior to starting the module, students fill in an expression of interest form to indicate their VIP project preferences. This element of choice supports self-determination. Students are encouraged in their expression of interest forms to indicate what skills/experience they bring to the projects, affirming their previous life experiences and supporting them to recognise how they can add value to the project teams. To keep learning as relevant as possible, students are asked on their expression of interest form to note any skills/topics they would like to develop in weekly classroom sessions and the class topic list through conversations and anonymous class surveys.

It is clear from the focus group analysis that students highly value the experiential, practical or problem-based approach to learning which facilitated them to deepen their understanding of research skills, approaches and resources. In the design of student assessments on the VIP programme, we have also tried to provide an opportunity for students not only to demonstrate the research-related work they have competed (in the team project report) but to reflect on what skills and dispositions they have developed and how this learning will support them in future (in their individual reflection assignment). Therefore, throughout the module, students are

encouraged to think about their adult experiences and the skills that will be relevant to their future lives and development. Their ability to reflect on the skills and dispositions they have developed is particularly evident in the themes in our analysis focused on how students felt they developed communication skills, project management and organisational skills and recognized how the module had helped prepare them for their future professional careers.

VIP modules resonate quite strongly with Barnett and Coate's (2005) conceptualisation of the three core components of curriculum: 'knowing', 'acting' and 'being'. Students are supported to gain knowledge on how research works with their VIP lecturer and PI's, to act as a researcher themselves in a research team; and to reflect on how their experience would support their 'being' in their future lives/careers through the skills and dispositions they have developed. O'Neil and McMahon (2005) outline three components of student focused learning – promoting interaction, allowing choice and devolving power. In VIP, interaction is promoted in lectures by trying as much as possible to flip the classroom and start with discussions on how teamwork is going and then focusing on any content aspects. Students spend 12 hours of the semester in team meetings with their student teammates and PI's. Within project teams, PIs are also encouraged to match the team activities to students' interests and previous skills/experiences. This also helps to devolve power and further supports the personalization of the student's learning experience.

5. Conclusion

VIPs provide a valuable pedagogical approach for integrating research and teaching in Higher Education. Coate, Barnett, and Williams (2001) advocate for research-based teaching because of the synergies derived of integrating research and teaching. Engaging students in research can ensure their learning experience remains current and compelling, focusing on important contemporary issues in science and society; while teaching offers an important context for the communication, discussion, and development of research. Furthermore, the composition of the VIPs, where students and faculty work shoulder-to-shoulder on research projects embodies Mann's (2007) reconceptualisation of the lecturer-student dyad, where the relationship becomes one of solidarity, rather than hierarchy. Fung's (2017) model of the *connected curriculum* advocates for research-based education that engages with key contemporary issues and interacts with the wider community. The innovative VIPs that have been developed at University of Galway are helping to support a whole new approach to student learning, predicated on their interests and engaging them in compelling and dynamic learning about key contemporary issues in science and society.

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