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Exploring Curricular Reform in Science Education and Practitioner Pedagogical Transitions-Seeking Solutions to Policy and Practice Dichotomies

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Abstract

This paper is based on a case study of a large science department in a middle class, academic Irish school. It explores the processes, challenges and perceptions that combine to influence a science teacher's selection of pedagogical approach to science teaching. This study was conducted using a multi-methods approach which incorporated focus group and one to one interviews alongside open ended questionnaires. This study specifically examines the factors highlighted by the participants as being pivotal to their willingness to shift from a didactic whole class approach to a cooperative learning approach, in order to facilitate greater opportunities for inquiry based learning and skill development. The findings highlight that a teacher's sense of identity, core values and beliefs are significant determinants to whether change to existing practice is welcomed or feared. A number of issues impacted on the teachers' willingness to shift from a predominantly didactic approach. These factors included finding time to attend appropriate continuous professional development (CPD), inadequate resources to teach groups through inquiry, workload, age and constraints of a content driven examination system.

In addition, the policy requirements issued from state bodies requiring teachers to adopt a range of diverse teaching approaches are not perceived as impactful. Teachers perceived irregular 'snapshot' inspections as being an insignificant influence on their pedagogy and valued their practitioner pedagogical autonomy as an accepted norm in Irish science classrooms. With the emergence of significant curricular reform at Junior Cycle level in Ireland and with science being the next subject to be implemented as a skills driven, student led specification, the issue of teachers' use of effective pedagogical approaches to teaching, learning and assessment is more urgent than ever. Yet, industrial relations issues and teacher reluctance to engage with this reform has meant a delay in implementation of the new science specification.

Recommendations emerging from this research may illuminate a way forward by generating discussion in response to the challenges raised in this study. These recommendations include the need for greater collaboration within subject departments and the support of school management in supporting and facilitating change. Time to meet and share resources and ideas alongside access to effective CPD that continues on return to school were highlighted. Additionally, the forging of greater links with third level institutions and other schools were cited as potentially positive supports to changing pedagogical practice. The reform of Junior Cycle Science in Ireland offers great opportunities for science education but only if policy and practice can merge to accommodate teachers' fears and needs, alongside the state's management of such change and reform. This paper, despite being contextualised to the Irish context, has policy and pedagogical change management relevance for teachers, teacher educators and policy makers.

1. Introduction

The pedagogy discourse has yielded extensive research, at various levels of education and in many disciplines. However, learners are a group with diverse needs who are susceptible to societal challenges throughout their educational experience [1]. As research on pedagogy, learning and assessment has progressed in recent years, the traditional 'chalk and talk' approach has been reconsidered in light of the emergence of more active, collaborative and inquiry based methodologies [2]. Policy makers internationally are supportive of flexible classroom strategies with technology perceived as increasingly beneficial for the diverse learners accessing science education [3]. Active learning and inquiry approaches are acknowledged as being effective within science education [4]. The development of national vocational qualifications alongside the academic 'A' levels in England

and Wales were successful in highlighting the need for more flexible approaches to teaching [5]. In Ireland, there have been calls for teachers to move away from a teacher-led, examination driven focus and to adopt more varied assessment methods [2]. Group work has also been acknowledged as having value in developing the teamwork skills required by employers [5]. However, research suggests that change from teacher-led methodologies is challenging [6]. Irish research indicates there are still too few opportunities for students to participate actively in groups [7]. This is significant in light of the new Junior Cycle reform in Ireland which centralises the constructivist approach to student learning [8]. Learning outcomes related to the Nature of Science are underpinning content strands, with the hope that teachers will adopt a student-led and skill focused approach, as opposed to a teacher-led, content driven pedagogy [8].

2. Rationale

This paper investigates post-primary teachers' attitudes and beliefs around their classroom teaching approach. If we understand why some teachers remain reluctant to adopt varied teaching approaches, or establish why others readily experiment with different methodologies and strategies in their classrooms, we can gain valuable insights into pedagogical practice. Such insights provide a stimulus to initiate the sort of professional reflection amongst practitioners, which enhances the educational experience for students. The focus in this study is on teachers' use of whole class teacher-led instruction (WCI) and cooperative learning (CL). WCI is identified as the dominant teaching approach in this case study sample. CL is considered as an alternative as it facilitates the structuring of greater groupwork, inquiry and argumentation opportunities in the science classroom and could act as a bridge for teachers to move towards greater use of inquiry based approaches [5, 7]. How teachers select a teaching and learning approach may be influenced by a number of factors such as exposure to CPD [9], inspectorate advice or curricular and policy requirements [10]. A longstanding familiarity with a certain approach discourages teachers from re-evaluating their teaching approach, as does a lack of regular professional conversation around classroom practice [11]. CL has value as an alternative to exclusive use of whole class instruction resulting in greater achievement, motivation, skill development and provides a higher level of interaction between students, enhancing social development [12]. Many teachers are still relying on their preferred teacher-led approach [12]. This paper provides insights into this phenomenon following an investigation of a science department's attitudes and perceptions to their pedagogical approaches.

3. Research Design

This is a qualitative case study using a multi-method approach. Open ended questionnaires, semi-structured one to one interviews and observation of teaching comprise the three methods used for triangulation. The site for this research is a large post-primary school. Sampling was purposeful to the case and there was a gender and age representation across the department of eight science teachers researched. The principal and laboratory technician were also interviewed to enable participant triangulation. The analysis approach mirrors the Miles and Huberman [13] general framework which is particularly useful in case studies. The data is categorised into three key themes with sub-themes. These themes arose from a categorising exercise where data was systematically indexed and a topic flow was used to establish the interactions in the data. The emergent themes are discussed below.

3. Discussion and Conclusions

3.1 The teachers 'self'

Teachers in this study were categorised into three types. Firstly, the 'conformists' are the most conservative with regard to diversity of teaching approach, adhering mainly to WCI. Secondly, the 'realists' are individually freer and do sometimes adopt newer methodologies into their classrooms, but still predominantly use WCI, as they believe this approach is the most effective for students achieving good grades. Finally, the 'overwhelmed' are newly qualified teachers who adopt WCI in favour of newer ideas due to a lack of knowledge of where to begin, fear of classroom management issues with group work and the prevailing culture of the department's dominant approaches mitigating against change. The teachers 'self' influences choices of teaching approach based on intrinsic beliefs and values about science education [14]. The younger teachers do not perceive their teacher role to be focused on the didactic delivery of content, but struggle to use inquiry or CL due to them prioritising their fitting in with existent norms, as new members of a school and science department. The

'overwhelmed' are more active in accessing continued professional development to enhance their knowledge of pedagogical approaches. Yet, if dominant teaching approaches of senior staff are didactic, this makes the implementation of different teaching approaches challenging. The experienced staff in this study are content with an approach they believe is effective and see little reason to change. The preferred approach for all teachers' in the sample was WCI, with the structuring of limited groupwork only during practical experimentation and never for 'theory' classes. In addition, practical classes would often consist of teacher demonstration rather than groupwork. However, the reasons for pedagogical choice varied among participants, based on experience and circumstances such as positionality in the science department. The cultural reproduction of dominant pedagogies is a duality which intersects the teacher's personal practices and the institutional practices. The institutional pedagogical norms influenced a general resistance to pedagogical change.

3.2 Constraints to change

The Irish examination system is cited by all the participants as the greatest single deterrent to offering a more diverse and student-led classroom approach. The teachers' claimed that time to cover lengthy syllabi and the pressure of a results orientated system mitigated in favour of the transmission model, perceived as ideal for delivery of large amounts of information. The teachers also believed that students preferred this arrangement to achieve good grades in their exams. Although teachers' agreed that CPD was important to challenge existing perceptions about effective teaching and learning, there were a number of concerns. Teachers cited the lack of availability of good substitute staff, the increased workload, 'to catch up', the day after training and guilt at missing classes with exam groups, as barriers for staff attendance at training. They also mentioned that infrequent CPD led to idea overload which they felt was counterproductive. Temporary staff highlighted that school release to attend in service was not always forthcoming, particularly if substituting for another permanent teacher. Attempts to address these deterrents could improve teacher attendance at CPD and positively influence attitudes towards change. The traditional classroom layout and some management expectations in favour of a silent classroom, as well as limited resources for group work were also cited as barriers to adopting CL methodologies in the classroom. Teachers can be fearful of losing control in their classes and the disruption that is perceived to accompany the incorporation of CL methodologies is a deterrent [12]. If schools became more cooperative, led by management, this could enable the sharing of ideas around teaching methodologies, much greater communication between management and staff, and a support system that respects all staffs needs and circumstances. Team teaching, greater sharing of resources, and a cross curricular approach to teaching could feasibly reduce the exam system pressures and address the scarce resources which deter teachers from embracing pedagogical change. However, time to plan and meet would be a prerequisite to such an approach. In addition, forging greater links between teacher training institutions and schools could be effective at supporting the new teacher in their first real teaching positions. This is the aim of 'Droichead' the Teaching Council [15] initiative aimed at inducting and probating newly qualified teachers and creating a bridge between initial teacher education and in-career practice.

3.3 Exploring Dichotomies

Although the state bodies and policy reformists reiterate the need for diverse classroom approaches [1, 2] and a need for schools to plan programmes which facilitate this, they can fail to maintain the support financially to enable continuity. The significant cuts to school capitation grants, vocational programmes and provision for students with additional needs are not helpful in facilitating a culture and morale which encourages teachers to embrace curricular or pedagogical reforms. In addition, teachers perceive the increased accountability with incidental inspections and an increase in subject and whole school inspection to be an added pressure. Teachers did not perceive the role of the inspector as supportive or valuable. They cited issues with inconsistencies around what is required by the inspectors of schools and teachers, leading to contrived 'show classes' by teachers. The principal cited the failure of the inspectorate to address enquiries around policy implementation challenges. This left a dichotomous divide rather than a shared vision between the two groups. Teachers may be more willing to embrace new teaching approaches if more supportive links could be forged between staff and inspectors. It is through collaboration that groups can come together in an attempt to solve problems for student educational experience. Changes to assessment which centralise learning beyond preparing exclusively for the terminal examination and reducing the current overuse of summative approaches would also encourage teachers to incorporate a more diverse range of pedagogies. The Junior Cycle reform could offer a way forward [8]. However, issues of resourcing,

teacher morale, and a confidence to move from the pedagogical status quo are important mitigating factors for the success of this potentially transformational turn in Irish science education.

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