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Abstract: Demands that Initial Teacher Education (ITE) prepare teachers who can equip students to be agile real-world problem solvers are frequent. Guidance about ITE integrated curriculum approaches to achieve this aim is harder to find, a significant gap given increasing time and policy pressures for ITE educators. Drawing from an Australian context, this systematic review investigates how integrated curriculum is conceptualised and enacted in secondary schooling ITE courses. Three conceptions of integrated curriculum for ITE are highlighted – Interdisciplinary, Disciplinary Literacy, and Transdisciplinary approaches – alongside benefits and barriers to enacting integrated curriculum. Recommendations for further research and practice around integrated curriculum are proposed.

Keywords: integrated, interdisciplinary, ITE, school, teaching, transdisciplinary

Introduction

Visions for students to be agile problem solvers as evident in the OECD's 2030 learning futures agenda (OECD, 2018) highlight the importance of curriculum that focuses on interdisciplinary capabilities and problem solving. Concomitantly, schools and Initial Teacher Education (ITE) programs are experiencing a narrowing of curriculum driven through standardisation processes as part of accountability regimes. Highly prescribed discipline-specific curricula are a result of what Pasi Sahlberg called the Global Education Reform Movement (GERM). GERM has manifested in five globally observable trends in the name of improving quality in education: standardisation; an increased focus on core subjects; prescribed curriculum; transference of models from business into education; and high-stakes accountability (Sahlberg, 2011). While ITE may be a forum for reform and challenge about the purpose of education, ITE programs have been subject to declining support through shrinking budgets, casualisation of the workforce, and intensified workloads for teacher educators. There are ever-changing expectations about what high quality graduates ready for contemporary classrooms might entail (Bonner, Warren, & Jiang, 2018). ITE curriculum

design is occurring under rapid reform conditions, with little time for (re)conceptualisation about requirements for integrated curriculum.

These challenges for teacher educators are illustrated by the context of this study where a large Australian metropolitan university had to rapidly adapt to national legislation that required the one-year Graduate Diploma (Senior Years) be replaced with a two-year Master of Teaching (Secondary) degree. Previously, the Graduate Diploma (Senior Years) was offered with curriculum specialisations in English, Maths, Science, Geography, History, Art, Film and Media, Dance, and Drama taught in separate semester units, catering for the Australian Curriculum (AC) (Years 7–10) and the Queensland Senior Syllabi (Years 11–12). A major driver towards an integrated curriculum course in the Secondary Master of Teaching was concern about reduced student numbers. In this transactional space for curriculum design (Priestley, Alvunger, Phillippou, & Soini, 2021) teacher educators with backgrounds in specialisations were organised into shared units in response to pressures for economic viability and sustainability of the course. The new structure was not favoured by discipline-specific academic staff, as it was not a decision based on ideals, and they had not had professional learning about integrated disciplinary teaching. Despite this, discipline leaders committed to negotiate and develop an integrated approach that remained viable and sustainable. However, what became obvious quickly was that academics from specific disciplines thought differently and did not agree on much. The disagreements were not personal, but epistemic, related to preserving the integrity of disciplinary knowledge.

Integration of curriculum specialisations was not an approach enabled by the curriculum documents on which the ITE secondary units were based, as they favoured in-depth discipline studies. For example, the Australian Curriculum (AC) (Years 7–10) from the Australian Curriculum, Assessment and Reporting Authority (ACARA) states that 'The learning areas and disciplines from which they are drawn provide a foundation of learning in schools because they reflect the way in which knowledge has, and will continue to be, developed and codified' (ACARA, 2012, p. 15). Furthermore, state-developed curriculum documents for senior schooling (Years 11 and 12) are also discipline-specific.

However, whilst the AC and its locally developed counterparts are structured by disciplines, commentators such as Mockler (2018) highlight the integrative potential of the AC through compatible discipline areas. ACARA's *Shape of the Australian Curriculum* paper that informed curriculum writers, acknowledges that the disciplines are interconnected and dynamic, allowing for cross-disciplinary thinking to enrich students' learning (ACARA, 2012). The *Melbourne Declaration on Agreed Goals for Schooling* (MCEETYA, 2008) (updated to the *Alice Springs (Mparntwe) Education Declaration*; Education Council, 2019) which underpins the AC, not only highlights the importance of disciplinary knowledge, but also refers to active citizenship and creativity, concepts which lend themselves to integrated approaches.

While such integrated approaches are often used in primary or middle schools in response to curriculum and staffing priorities, they are less common for teaching secondary schooling and had never been adopted in the Faculty of Education at this university. This was a new transactional curriculum process for us as teacher educators. Our motivations, therefore, for undertaking this systematic review of the literature were in response to what we were experiencing in trying to integrate discipline areas within a coherent curriculum structure. We were grappling with multiple tensions and differences in opinion. We wanted to see what existed in the literature that would help us improve our practices and contribute to the professional learning of academics who similarly were considering integrated curriculum by choice or necessity. According to Mockler (2018), there is increasing importance in developing students (and pre-service teachers) who can navigate knowledge across

disciplinary boundaries. This increasing importance warranted further investigation into integrated curriculum approaches for teaching and learning for secondary students in ITE.

A History of Integrated Curriculum

While integrated curriculum was new to the teaching team, it is not new in education. One of the first proponents for integrated curriculum was John Dewey, in his book *Experience and Education* (1938). In this, he referred to subjects in schools as 'water-tight compartments' (p. 48) and disconnected from each other. In the 1960s, others followed such as Bruner (1966) in the USA (Man as a Course of Study, MACOS project) and Stenhouse (1968) in the UK (Humanities Curriculum Project, HCP) who also believed that knowledge should not be siloed. Many nomenclatures are often used for integrated curriculum approaches and are often classified into three broad categories – multidisciplinary, interdisciplinary, and transdisciplinary (Tambyah, 2012). These are briefly explored, highlighting how each is based on a different approach to curriculum design and showing that integration can occur in multiple ways.

Integrated Approaches

In multidisciplinary approaches, the disciplines are studied separately but students draw connections through a theme. Beane (1997) suggests that while multidisciplinary approaches contribute a range of perspectives on a theme, they fall short of authentic integration. Interdisciplinary approaches are similar yet according to Venville, Wallace, Rennie, and Malone (2002) disciplines are connected beyond a theme, with connections made explicit to students. The National Academy of Sciences (2005) maintains that where two or more disciplines work together, they "advance fundamental understanding ... beyond the scope of a single discipline" (p. 2). However, critics warn of the potential to undermine disciplinary-based knowledge (see Yates, 2017; Young & Muller, 2016). Transdisciplinary approaches work across disciplines (Quigley & Herro, 2016). The term was coined by Jean Piaget and colleagues who argued that discipline boundaries should be crossed to provide multifaceted understandings of a topic. According to Mockler (2018), "transdisciplinary approaches are forged around big questions, problems or ideas that drive the natural connections between subject areas or disciplines" (p. 129). For example, rather than Science or Geography being foregrounded, climate change as a problem is prioritised.

The next section outlines the method adopted to conduct the review, the formation of research questions and search parameters, the screening process and setting of inclusion/exclusion criteria, as well as how the final corpus of studies were synthesised.

Method

Systematic reviews are commonplace in public health and psychology and are gaining legitimacy in education. Using a pre-defined methodological approach and applying explicit inclusion/exclusion criteria, existing research around topics are identified, classified, and synthesised (Hofmann, Hinkel, & Wrobel, 2011). Systematic reviews provide a precise approach to enable replication (Moher et al., 2015). They are beneficial for identifying gaps and pointing to future research directions (Petticrew & Roberts, 2006). Here, the concept is integrated curriculum approaches to teaching and learning in ITE for secondary schooling.

For this review, the guidelines suggested by the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA; Moher, Liberati, Tetzlaff, Altman, & the PRISMA Group, 2009) were followed. The review involved three phases:

(1) the setting of questions and search parameters to identify relevant studies,
(2) the screening of studies at title, abstract, and full-text levels filtered through an *a priori* inclusion/exclusion criteria, and
(3) a synthesis of the final corpus of studies (Torgerson, 2007).

Phase 1: Research Questions and Search Parameters

Two key questions guided this review: (1) How are integrated curriculum approaches in ITE for secondary schooling conceptualised and enacted in practice in the education academic literature? and (2) What can be learned in terms of benefits and barriers for sustaining integrated approaches to teaching and learning in ITE? An adapted version of the SPIDER tool (Sample, Phenomenon of Interest, Design, Evaluation and Research Typology) (Cooke, Smith, & Booth, 2012) was used to identify search terms relevant to the key questions. The thesaurus in each of five databases used for this review (ERIC, Academic Search Elite, Education Source, A+ Education, and Scopus) enabled the identification of synonyms that could be included in the final search phrase. There was variation in search terms used for each database. However, the overall search strategy involved combining terms related to the broad areas of integrative education, secondary school, and ITE shown in Table 1.

Search term category	Individual terms searched
Interdisciplinary approach	AB (interdisciplin* OR integrat* OR transdisciplin* OR cross) AND AB (curriculum OR approach)
	AND
Secondary education	AB (“secondary education” OR “secondary school” OR “high school” OR “middle school”)
	AND
Initial teacher education	AB (“preservice teacher educat*” OR “teacher educat*” OR “teacher educator education” OR “teacher education programs” OR “student teach*”)
Search parameters	Publication year 1999–2019, English language, peer reviewed

Table 1: Database Search Terms (for ERIC)

Phase 2: Screening Process and Use of Inclusion/Exclusion Criteria

The five databases were searched for empirical and non-empirical research published in English between 1999 and 2019. Non-empirical papers were included due to low numbers of papers in this field. The twenty-year period captured the growth in integrated approaches that occurred at the turn of the millennium. The studies included also had to meet the following criteria:

- published as a journal article (peer reviewed) or book section;
- focused on some element of integrated approaches to teaching and learning;

- explicitly related to initial teacher education (ITE); and
- focused on secondary schooling (but not school-based).

The following were excluded from the review:

- Unpublished or non-peer reviewed documents including conference proceedings, reports/reviews, theses, editorials, book reviews; and
- Studies with a low degree of accessibility, i.e., not published in English.

Meta-analyses and systematic reviews were not included *per se*; however, they were scanned for studies meeting the search criteria. Furthermore, the authors followed up with colleagues and/or known publications in the field, but no further articles met the inclusion criteria.

The bibliographic details and abstracts of articles retrieved were exported to an Endnote library and duplicates removed. This resulted in 280 studies for further screening. Collectively, the authors reviewed the first 100 to determine eligibility for inclusion using the criteria. The remaining 180 records were divided among the authors who reviewed in pairs, applying the same inclusion criteria. This initial screening process resulted in 43 articles that met the inclusion criteria. Of the 237 excluded articles, 41 were not peer reviewed, 101 were not about integrated approaches, 84 were not focused on ITE, and nine were not about secondary school. A further two were excluded; one a systematic review, and one a duplicate.

Full-text versions of the remaining 43 studies were then reviewed by the team. During this process, a further 30 were excluded; two were not peer reviewed, 15 were not about integrated approaches, and 13 did not have an ITE focus. This selection process identified 13 studies included in the analysis. This is documented in Figure 1, the PRISMA diagram.

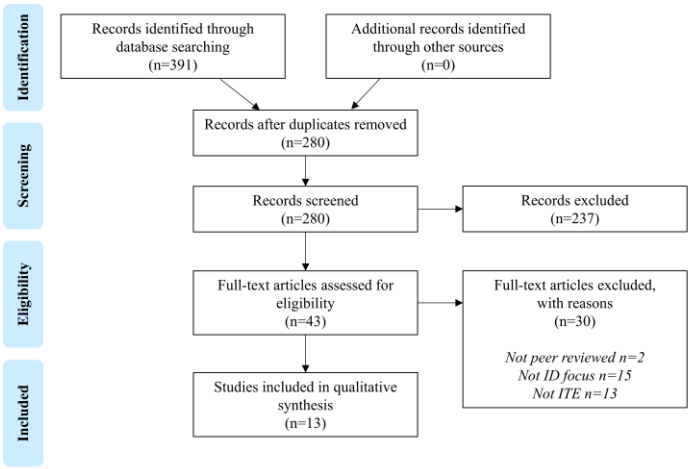

Figure 1: PRISMA flow diagram detailing identification, screening, and inclusion of articles. Adapted from Moher, Liberati, Tetzlaff, Altman, & the PRISMA Group (2009)

Phase 3: Synthesis of the Final Corpus of Studies

After identification of the final studies for full-text analysis and setting up the log as shown in Table 2, the papers were assigned one or more keywords in line with nomenclature around integrated approaches to teaching and learning. These were checked by three other

researchers which prompted further discussion, allowing the refining of these keywords until agreement was reached.

Findings

Before elaborating the approaches identified, first, Table 2 summarises the included studies in terms of location, type/name/quality of publication, research design, participants, disciplines involved, aims, findings, and benefits. For quality of publication, the Quartile index from Scimago was used. Scimago ranks journals according to quality, with Q1 the highest.

Approach 1: Interdisciplinary							
Authors and date	**Location**	**Publication type and name/quality index from Scimago**	**Method/research design**	**Sample**	**Disciplines**	**Aim**	**Findings/benefits**
Bullock, Park, Snow, & Rodriguez (2002)	USA	Journal article *Interchange* Q3	Non-empirical	N=4 teacher educators	Language, Literacy, Science, Math, Social Sciences	To document the re-conceptualisation of a preservice education course.	Positive, bridging integrated curriculum and critical pedagogy.
DiCamillo & Bailey (2016)	USA	Journal article *Social Studies* Not listed in Scimago	Non-empirical	N=2 teacher educators	English, History	To examine how pre-service teacher education in curriculum/methods classes worked in a school context.	Positive, effective interdisciplinary ways of working takes additional preparation time but should be enacted in embedded professional experiences for their pre-service teachers.
Donnelly et al. (2013)	Australia	Journal article *Ethos* Not listed in Scimago	Non-empirical	Not applicable	Geography, SOSE, History, Integrated Studies, English	To examine how issues/themes around global perspectives could be embedded across disciplines.	Highlighted challenges around time and getting educators to embrace Global Education philosophy.
Hooley & Moore (2005)	Australia	Journal article *Australian Journal of Teacher Education* Q2	Mixed method	N=14 pre-service teachers	Math, Science, IT	To evaluate an integrated approach to curriculum/ methods units combined with site-based teacher education.	Positive, pre-service teachers reported enhanced levels of preparedness or readiness to teach.
Moser, Ivy, & Hopper (2019)	USA	Journal article *Middle School Journal* Not listed in Scimago	Qualitative – Action research	N=14 secondary pre-service teachers	Examples of Soc Science, Maths, Science &	To examine the development of an interdisciplinary curriculum/methods	Positive, adopts a post-structuralist perspective to challenge the

					English Lang Arts	unit for secondary pre-service teacher preparation to teach to middle-school learners.	definition of disciplines and their boundaries.
Suriel, Spires, Radcliffe, Martin, & Paine (2018)	USA	Journal article *School–University Partnerships* Not listed in Scimago	Non-empirical report on research project	Pre-service teachers, teachers, Year 7 students (N not reported)	Social Studies, Science, Maths and Literacy	To examine a university/school collaborative exercise where Year 7 students attended all day workshops of interdisciplinary lessons designed and delivered by pre-service teachers in conjunction with teacher educators.	Positive, pre-service teachers benefitted from the interdisciplinary approach through hands on application of lesson design, teamwork and real world teaching experiences.
Szul, Moore, & Norris (1999)	USA	Journal article *The Delta Pi Epsilon Journal* Not listed in Scimago	Mixed method	N=3 teacher educators; N=25 pre-service teachers	Business, English	To provide perspectives on interdisciplinary methods units in ITE education.	Positive, pre-service teachers valued the interdisciplinary approach particularly in working as part of a team.
Approach 2: Disciplinary Literacy							
Authors and date	**Location**	**Publication type and name/quality index from Scimago**	**Method/research design**	**Sample**	**Disciplines**	**Aim**	**Findings/benefits**
Alvermann, Rezak, Mallozzi, Boatright, & Jackson (2011)	USA	Journal article *Teachers College Record* Q1	Qualitative – Interpretive case study	N=22 (11 pairs of pre-service and in-service teachers)	Science, Literacy	To examine the integration of reading strategies into concept-based science instruction.	Mixed, findings revealed contradictory discourses across disciplines.
Bintz (2004)	USA	Journal article *Middle School Journal* Not listed in Scimago	Qualitative – Reflective practice	N=1 teacher educator	Math, Science, Art, Social Studies, Literacy	To document how poetry was incorporated into	Positive, working with other discipline areas

						pre-service teacher education courses.	was valuable and productive.
Howard & Guidry (2017)	USA	Journal article *Literacy Research and Instruction* Q1	Mixed method	N=18 pre-service teachers	History, Social Studies, Literacy	To examine how teacher candidates in a practicum setting used literacy strategies learned in a co-taught course.	Positive, increased integration and emphasis upon methods and literacy leads to improved quality of teaching and anticipated school-student learning outcomes.
Shanahan, Shanahan, & Misischia (2011)	USA	Journal article *Journal of Literacy Research* Q1	Qualitative	N=6 (2 disciplinary experts; 2 teacher educators; 2 high school teachers)	History, Maths, Chemistry, Literacy	To describe educationally relevant differences in literary use among the three disciplines, specifically with reference to reading.	Positive, the teachers and teacher educators helped discipline experts describe their approaches and implications for reading. Differences between the three groups were evident.
Approach 3: Transdisciplinary							
Authors and date	**Location**	**Publication type and name/quality index from Scimago**	**Method/research design**	**Sample**	**Disciplines**	**Aim**	**Findings/benefits**
Feez & Quinn (2017)	Australia	Journal article *Teaching and Teacher Education* Q1	Qualitative – Action research	Pre-service teachers (N not reported)	Science education; Science literacy and writing in middle years	To design and test an initial teacher education pedagogy – an inquiry-based approach to science education integrated with discipline-specific literacy strategies.	Positive, pre-service teachers benefitted from portable curriculum resources and the teacher educators themselves gained valuable professional development.

Paige, Lloyd & Chartres (2008)	Australia	Journal article *Asia-Pacific Journal of Teacher Education* Q1	Non-empirical	Not reported/not applicable	Science, Math, Social Sciences	To outline conceptual framework focusing on transdisciplinary ways of working, the nature and importance of futures studies, and connectivity through place-based education.	Findings were not reported; however, authors emphasised the need for programs to be developed by tenured staff to ensure continuity of thinking and academic rigour. Challenges included time, need for collaboration between discipline experts, staffing, and timetabling.

Table 2: Details of Final Corpus of Studies

Three integrated curriculum approaches to teaching and learning in Initial Teacher Education (ITE) for secondary schooling were evident: (1) Interdisciplinary; (2) Disciplinary Literacy; and (3) Transdisciplinary. Each approach is elaborated providing an overview of the studies before each study is explicated in detail.

Approach 1: Interdisciplinary

Interdisciplinary approaches were the most prevalent (n=7). Five of the studies were based in the USA and two in Australia. Of the seven studies, five were not listed in Scimago. The two studies which were listed are Bullock, Park, Snow, and Rodriguez (2002) and Hooley and Moore (2005), Q3 and Q2 respectively. Four were non-empirical, the others using action research (n=1) and mixed methods (n=2). Participants included teacher educators, pre-service teachers, and secondary students ranging from one to 25 participants. Many different disciplines were included – Science, Mathematics, The Arts, Humanities, English, Business Studies, and Information Technology.

The common thread tying the studies together was a pedagogically purposeful reason for adopting an interdisciplinary approach in a teacher education course/program at university, and these can be further grouped into the subthemes of partnerships and role-modelling.

Partnerships

Four studies informed the first subtheme of partnership (DiCamillo & Bailey, 2016; Hooley & Moore, 2005; Suriel, Spires, Radcliffe, Martin, & Paine, 2018; Szul, Moore, & Norris, 1999). The study by Szul et al. (1999) reported on English and Business pre-service teachers planning work for high school students which they delivered at their university. The authors claimed that their pre-service teachers valued teamwork in terms of knowledge exchange, learning patience, creativity, and compromise, perceiving that they would adopt this interdisciplinary approach in their future classrooms. However, concerns about increased workload/stress levels and limited planning time were also voiced. Feedback outlined the need for more guidance for the interdisciplinary activity for the future.

The study by Suriel et al. (2018) also focused on pre-service teachers designing and delivering interdisciplinary lessons to middle school students (Year 7) attending the university campus. Guided by teacher educators from Social Studies, Science, Maths, and Literacy, interdisciplinary activities were based on the theme of water pollution in China. That study is not reported as a research paper, but findings claim how pre-service teachers benefit from hands-on lesson design, teamwork, and real-world teaching experiences.

The next two studies took place in schools. Hooley and Moore's (2005) Australian study of 14 pre-service teachers used both qualitative and quantitative data to show enhanced readiness to teach when curriculum/methods units were combined with site-based teacher education. Instead of foregrounding disciplines, an interdisciplinary approach based on knowledge, skills, and classroom practices was trialled. Mentors perceived no reduction in disciplinary knowledge, a criticism often cited (Yates, 2017). However, the findings are descriptive rather than analytical, focusing on partnership processes rather than outcomes.

The second school-based study by DiCamillo and Bailey (2016) outlined how two teacher educators in an urban school used an interdisciplinary approach for English and History. Based on their beliefs about culturally relevant teaching, the chosen theme was justice incorporating immigration, racism, and women's rights. Findings reported positive

responses from the secondary school students. It was argued that interdisciplinary approaches required additional preparation and collaboration time and should be enacted in embedded professional experiences.

Role-Modelling

In the second subtheme (role-modelling), there were two studies: Bullock et al. (2002) and Moser, Ivy, and Hopper (2019). Both studies involved the re-conceptualisation of subjects/units to incorporate interdisciplinary approaches. In Bullock et al. (2002), four teacher educators' redesign of discipline subjects into modules on multiculturalism, literacy, classroom learning environments, and inclusion were narrated. Interdisciplinary approaches encouraged collaboration and role-modelling for pre-service teachers. In their opinion, transcending disciplines allowed powerful teaching and learning, creation of new knowledges, and redefined power structures within classrooms. However, there were two barriers to conceptualising their courses this way: (1) a modular approach using integration was at odds with timetabling patterns within university structures; and (2) resistance from their pre-service teachers who preferred discipline-based thinking.

Moser et al. (2019) also believed in role-modelling interdisciplinary approaches for their secondary pre-service teachers. Instead of working in silos, collaborative projects based around standards, social issues (such as racism), and broader education ideas such as assessment/lesson planning were chosen as the focus of instruction. The findings were positive particularly in terms of collaboration, building trust and belonging, and connecting knowledge across disciplines. Whilst these findings present insights for teacher educators adopting interdisciplinary approaches, research methods were limited.

The last discrete study by Donnelly et al. (2013) examined how global perspectives could be embedded across disciplines including Geography, SOSE, History, Integrated Studies, and English. These writers offered a framework based on skills and values, useful for crossing disciplines in schools. Although not a research paper, these teacher educators believed that one discipline could not offer authentic, holistic experiences for developing active global citizens. That said, they highlighted challenges around time and getting educators to embrace global education philosophies.

In summary, in Interdisciplinary approaches, there were two dominant themes – partnership and role-modelling – and a discrete study centred on an interdisciplinary framework. Adopting this approach presents benefits but also some constraints that are explored more fully in the Discussion. Importantly, the approaches were driven by shared and crucial pedagogic priorities.

Approach 2: Disciplinary Literacy

The next approach focused on disciplinary literacy as the impetus for integrated curriculum design. According to Shanahan and Shanahan (2012, p. 8):

> disciplinary literacy … is an emphasis on the knowledge and abilities possessed by those who create, communicate, and use knowledge within the disciplines … [it] emphasises the unique tools that the experts in a discipline use to engage in the work of that discipline.

Literacy has been an education priority for decades, as governments respond to international literacy and numeracy test results, for example, PISA (reading test). Discipline-specific literacies stand in contrast to content or general literacy which advocates for common

reading strategies applicable with some adjustments to varied discipline areas (Shanahan & Shanahan, 2012).

Four papers drew on this approach – Shanahan, Shanahan, and Misischia (2011); Alvermann, Rezak, Mallozzi, Boatright, and Jackson (2011); Bintz (2004); and Howard and Guidry (2017). All papers are from the USA. Three of the studies are listed as Q1 in Scimago, the other is unlisted. All studies are empirical; three qualitative and one mixed method. Participants range from one to 22 and include teacher educators, teachers, and pre-service teachers across the discipline areas of Science, Mathematics, Art, Social Sciences, History, and Chemistry. What these four studies have in common is the embedding of literacy into discipline areas, specifically reading strategies. While only one discipline area was considered in one of the studies, this high-quality study featured in the search, showing how integration is being understood in the literature as integration of literacy and disciplinary knowledge.

Shanahan et al.'s (2011) study aimed to describe differences in literary use in high schools among three disciplines: History, Mathematics, and Science specifically with reference to reading. Using think-aloud protocols, interviews, and transcripts from focus groups, findings revealed differences in sourcing, contextualisation, corroboration, close reading and rereading, critical response to text, and use of text structure or arrangement and graphics. It was found that while all participants engaged in critique while reading, the nature of such critique differed by discipline.

Alvermann et al.'s (2011) study also focused on reading but rather than examining strategies used across disciplines, the study documented a prospective science teacher's struggle to make sense of an online literacy course. Specifically examined was the integration of reading strategies into concept-based science instruction. Findings revealed that the pre-service teachers had to navigate contradictory messages from the teacher educators involved; one more focused on conceptual clarity for science instruction, the other more inclined towards successful reading strategies. The contradictions highlighted by the pre-service teachers led the teacher educators to change their course so content and process skills could be fused more effectively.

Bintz's (2004) study was also connected to reading but took a broader view by examining how poetry could be incorporated into pre-service teacher courses. The purpose of this project was two-fold: (1) to help pre-service teachers learn how to develop meaningful curriculum by creating connections between literacy (reading and writing) and one (or both) of their two discipline areas, and (2) to support the teacher educator's own learning around this. The author claimed that working with other discipline areas was valuable and productive. She spelled out the importance of making discipline knowledge understandable through reading and writing strategies, specifically using poetry. Her pre-service teachers began to see reading as an integrative tool, rather than an isolated skill.

The final study by Howard and Guidry (2017) investigated 18 teacher candidates' literacy strategies in a practicum. These strategies had been learned in a co-taught course designed by a literacy teacher educator and a History/Social Studies teacher educator. Data from observations, videos, and surveys revealed that pre-service teachers modelled the practices from the co-taught course and recognised the importance of disciplinary literacy to engage students particularly in higher order thinking, document analysis, and using multiple texts.

In summary, these four studies point to the importance of disciplinary literacy where disciplines are recognised as having different discourses, vocabulary, and language choices (Shanahan & Shanahan, 2012). All the studies incorporated a pedagogic purpose for integrating literacy into discipline areas with two of the studies (Alvermann et al, 2011; Bintz, 2004) also including aspects of professional learning.

Approach 3: Transdisciplinary

The last approach with the least number of studies was Transdisciplinary approaches (n=2), defined earlier as designing curriculum around big questions that transcend the spaces between disciplinary boundaries. Both these Australian studies, a non-empirical study by Paige, Lloyd, and Chartres (2008) and action research by Feez and Quinn (2017), are published in top ranked journals. Science, Mathematics, SOSE, and English were the disciplines covered.

Paige et al. (2008) presented a critical reflection on the implementation of a transdisciplinary curricula for pre-service teachers across Science, Mathematics, and SOSE using the theme of ecological sustainability. The authors asserted the need for lateral rigor across disciplines and vertical rigor within disciplines. They maintained that to best prepare students for teaching, there was a need for *disciplinary* before *transdisciplinary*. The complexities of staffing and time for implementing transdisciplinary courses were highlighted. Specifically, the authors emphasised the need for programs to be developed by tenured staff for continuity of thinking and collaboration between discipline experts, staffing, and timetabling. The writers claimed that transdisciplinary programs required long-term vision, commitment, and investment by institutions.

Feez and Quinn's (2017) study reported on how a transdisciplinary model was used to design an initial teacher education pedagogy in which pre-service teachers experience how an inquiry approach to science education might be augmented with a sequence of discipline-specific literacy activities. Using action research cycles, teacher educators, who usually taught in their own discipline areas (Science and English), revamped their instruction during a fieldtrip based on biodiversity. Through observations and student evaluations, the writers reported increased enthusiasm and engagement from their pre-service teachers. They reported how the collaborative nature of the project made the teaching of both subjects more purposeful. Pre-service teachers benefitted from portable curriculum resources and the teacher educators themselves gained valuable professional development.

In summary, teacher educators were able to design transdisciplinary pedagogical and professional learning experiences based around themes of place and biodiversity. The latter study by Feez and Quinn (2017) reported many benefits from using a transdisciplinary approach; the study by Paige et al. (2008) was much more critical, identifying the need for long-term staffing partnerships before rigour was possible in transdisciplinary curriculum.

Discussion

Over 20 years ago, Venville, Wallace, Rennie, and Malone (2000) maintained that integrated curriculum is superior to discipline-based, compartmentalised ways of working. Their contemporaries elaborated how purpose, reason, and relevance to instruction may be enhanced when disciplines are connected (Hargreaves & Moore, 2000). These claims are powerful drivers for integrating curriculum, yet in the initial teacher education context, this became a struggle. To find out about integrated approaches to curriculum in ITE for secondary schooling, we set up two lines of inquiry. A summary of what we found is shown in Table 3.

1	The scoping out of the conceptual research revealed three approaches used in ITE: Interdisciplinary, Discipline Literacy, and Transdisciplinary approaches (RQ1).
2	Enacted practices for sustaining integrated approaches were based on collaboration – teamwork, partnership, role-modelling, and reflective professional learning (RQ1).
3	Benefits of using integrated approaches include new knowledge and student focused (including pre-service teachers as students) benefits including motivation/improved learning outcomes, improvements in dispositions such as compromise, patience, and trust, or skills such as higher order thinking (RQ2).
4	Barriers to integrated teaching include workload/time, inflexible timetabling, anxiety, and resistance from students who prefer discipline-specific teaching and learning (RQ2).

Table 3: Summary of Findings

The first line of inquiry – How are integrated curriculum approaches in ITE for secondary schooling conceptualised and enacted in practice in the education academic literature? – led to three identified approaches. Studies were organised around Interdisciplinary, Disciplinary Literacy, or Transdisciplinary approaches. Other nomenclatures evident at the onset of this paper, such as multidisciplinary or cross-disciplinary, returned no studies using the selected search terms.

In terms of the enactment of integrated approaches, the most common practices found were partnerships, role-modelling, and professional learning exercises. The amalgam of these practices revealed pedagogical and professional learning purposes and the need for collaboration to take learning forward in the integrated space. Partnership was predominant in interdisciplinary (DiCamillo & Bailey, 2016; Hooley & Moore, 2005; Suriel et al., 2018; Szul et al., 1999) and transdisciplinary (Feez & Quinn, 2017) approaches, where collaboration centred on pre-service teachers and teacher educators' teamwork, with different disciplines working together and learning from each other. Commentators such as Venville et al. (2000), although referring to school contexts rather than ITE, emphasised that enhanced teamwork skills change competition to cooperation and responsibility. There was a common belief that learners and educators all benefitted from working together in authentic real-world experiences for improving learning and informing practices in ITE. However, comments about improving learning were not always underpinned by robust research findings.

Role-modelling was another practice for Interdisciplinary approaches where pre-service teachers were given opportunities to emulate integrated practices enacted by teacher educators (Bullock et al., 2002; Howard & Guidry, 2017; Moser et al., 2019). It was hoped that such collaboration would encourage pre-service teachers to adopt integrated approaches when they entered the profession for the benefit of their students.

The final common practice was reflective professional learning, evident in Disciplinary Literacy (Alvermann et al., 2011; Bintz, 2004) and Transdisciplinary approaches (Feez & Quinn, 2017). Teacher educators in these studies reported gains in confidence and enjoyment of the process which enhanced creativity and led to changes in teaching practices.

The USA was the country where most of the studies occurred (n=9). There were no large international studies around integrated approaches to teaching and learning in ITE for secondary schooling. Rather, studies were localised with, for the most, small participant numbers, perhaps convenience samples. Regarding quality of papers, six of the 13 studies were not listed in Scimago. However, five were rated as Q1 publications. These studies related to Disciplinary Literacy and Transdisciplinary approaches. This points to a need for more high-quality studies in this research field, particularly in Interdisciplinary approaches, given the search returned only 13 papers in total. This finding echoes Lindvig and Ulriken's (2019) systematic review on interdisciplinarity about the 'lacuna' of empirical examples for interdisciplinary teaching. Other studies have reached similar conclusions, for example Haynes and Leonard (2010) and Rhoten, O'Connor, and Hackett (2009). There is still a

dearth of studies in this research area, with not much progression within the last decade. There also appears to be a lack of consensus on how some integrated approaches are defined. For example, some of the interdisciplinary studies with themes such as water pollution, social justice, or multiculturism could be labelled as transdisciplinary. Clarity is needed if teacher educators are to find ways to design an integrated, coherent curriculum.

The second line of inquiry – What can be learned in terms of benefits and barriers for sustaining integrated approaches to teaching and learning? – points to productive areas for research as well as practice.

Benefits

Two main benefits emerged from this systematic review, namely: new knowledge, and student focused benefits.

New Knowledge

Across all three approaches, new knowledge was the dominant benefit, albeit different in each approach. The studies in Interdisciplinary and Transdisciplinary approaches pointed out the importance of knowledge creation as connections were made across the disciplines (Bullock et al., 2002; Feez & Quinn, 2017; Moser et al., 2019; Paige et al., 2008; Suriel et al., 2018; Szul et al., 1999). For disciplinary literacy, the notion of knowledge in the included studies was different from the other approaches. This is explained aptly by Shanahan and Shanahan (2012) when they note, "disciplines differ extensively in their fundamental purposes, specialised genres, symbolic artefacts, traditions of communication, evaluation standards of quality and precision, and use of language" (p. 9). Therefore, even though disciplinary literacy is an integrated approach, it foregrounds discipline-specific knowledge and practices for the inclusion of disciplinary literacy.

What is noteworthy is that one of the main critiques of curriculum integration has been around the depletion or *dumbing down* of disciplinary knowledge in higher education (e.g., Venville et al., 2002). However, in the study by Hooley and Moore (2005), no reduction in discipline-specific knowledge was reported by supervising teachers.

Student Focused Benefits (Including Pre-Service Teachers as Students)

The second benefit from using integrated approaches was focused on students, specifically their motivation and engagement with subject matter, potentially leading to improved learning outcomes and enhanced higher order thinking skills (Suriel et al., 2018). This aligns with thoughts from McBee (2000) who contended that integration increased student motivation and interest in subject matter leading to higher levels of performance. Other writers, for example, Moser et al. (2019) and Applebee, Adler, and Flihan (2007), contend that middle school students in particular benefit from integrated approaches. These students could explore topics through collaborative projects, multiple lenses, and modes of inquiry.

For pre-service teachers as students, benefits included improved dispositions such as patience and compromise (Szul et al., 1999), trust and belonging (Moser et al., 2019), as well as increased engagement and enthusiasm for teaching (Feez & Quinn, 2017). It would be hoped that these dispositions would make them better teachers in the future.

Barriers

Two main barriers emerged – workload/time (and associated stress and anxiety) and resistance from staff and students to enacting integrated approaches.

Workload/time

Studies by Szul et al. (1999), DiCamillo and Bailey (2016), and Donnelly et al. (2013) reported that to implement integrated approaches effectively, a considerable amount of planning and preparation time was needed. Related to time, Bullock et al. (2002) and Paige et al. (2008) commented on rigid timetabling structures which did not allow flexibility for innovation. Paige et al. (2008) specifically emphasised the need for committed tenured staff working collaboratively with timetabling and institutional leaders. Related to these time requirements, pre-service teachers reported stress from the workload involved (Szul et al., 1999).

Resistance

Two studies reported resistance as a barrier. In Bullock et al. (2002), this came from pre-service teachers' preferences for concentrating on their own discipline areas that they saw as more relevant, and in Donnelly and colleagues' (2013) study, secondary teachers were averse to using a global perspectives framework. In summary, whilst integrated approaches reveal several potential benefits, there are also barriers which need to be addressed.

Conclusion and Recommendations

This systematic review has reported on 13 studies that met the inclusion criteria for integrated approaches to teaching and learning in Initial Teacher education (ITE) for secondary schooling. The limited number of studies were small scale with no evidence of any larger scale collaborations across borders. Benefits were outlined including new knowledge and enhanced student motivation and achievement using practices such as authentic school-based teaching and learning experiences, role-modelling, and embedded professional experiences. However, barriers such as time, staffing, and students' mindsets were also identified. This review provides guidance for teacher educators who seek to do, or are required to do, the demanding work of integrating curriculum when there is little previous work to guide them. This work also highlights an important gap in the research, an explicit aim of a review. That is, it identified a distinct lack of empirical research into how higher education contexts, with their attendant constraining factors and economic, institutional and ideological characteristics (Marginson, 2016; Sahlberg, 2011), which differ markedly from that of schools, can provide high quality integrated ITE programs.

The context that led to this review was driven by fiscal decisions, and the good will of teacher educators who wished to maintain discipline integrity using an integrated curriculum approach for secondary pre-service teacher preparation. It is clear from this literature review that there are some benefits (Mockler, 2018) in designing integrated curriculum for pre-service teachers, but little research-based guidance to do the work. Building on this literature review, we make a number of assertions/recommendations for practitioners and researchers:

- Coherent integrated disciplinary courses can go well beyond what is required by policies concerned with standardisation, and contribute to a genuinely transformative

agenda especially when based around a shared theme or uniting experience such as literacy or partnerships.

- Professional development of teacher educators to use integrative approaches such as those outlined in this review are needed as part of curriculum integration designs.
- More flexible tertiary education structures, such as timetables and support for partnerships, are needed to enable integration.
- Flexibility beyond existing school-based curriculum is needed to experiment and be inclusive of integrated approaches that might differ from what is offered in schools.
- More and better-quality research on a larger scale into integrative approaches in secondary pre-service teacher education and disciplinary structures within overarchingly integrated curriculum frameworks in ITE.

Support for integrated secondary ITE curriculum relies on the work of research-informed teacher educators working as a collaborative community of practice to break down silos and acknowledge different epistemologies. The emerging structures of research-only or teaching-only staff workloads is an example of one of the risks to this type of important work. The observable trends from GERM (Sahlberg, 2011) outlined earlier, such as a narrowing of curriculum reinforced by accountability regimes, makes the work of ITE educators who venture into integrated curriculum even more important as they prepare innovative teachers ready to teach in uncertain times.

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