

Student
Teachers Learning
Through Inquiry:
International
Perspectives

Edited by: Pete Boyd
Agnieszka Szplit

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The use of creative, contextualised, subject specific teaching approaches within primary teacher education

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Abstract

This chapter describes the use of a creative teacher education methodology to facilitate study on a one-year postgraduate initial teacher education programme. It outlines how student teachers can be supported in their aspiration to become highly accomplished educators by inclusion within an active research orientated teaching programme. The chapter is illustrated with a concrete example of how student teachers can be motivated to engage with the acquisition of their own subject specific pedagogical knowledge within primary science. Arguments are made regarding the significance of fostering student teacher learning within a relevant social context in order to fulfil the aspirations and needs of student teachers, as both learners and evolving pedagogues. The self-deterministic approach consists of initial modelling during taught university sessions followed by reflection on student teacher classroom based inquiry. The attitudes of student teachers to this type of professional learning is examined alongside a critical reflection of the efficacy of this mode of learning. The conclusion includes an exposition of the potential of student inquiry within initial teacher education.

Key words: initial teacher education, science specific pedagogy, curriculum subject knowledge, contextualised learning, social change.

Introduction

During initial teacher education in England, many primary school teachers undertake a double stranded training programme consisting of university study combined with school-based learning. A popular route for teacher education is that of a one-year post-graduate course in education, following a three-year degree programme. At the culmination of this yearlong training programme, primary teachers must be confident and competent to deliver effective lessons across a broad curriculum, including the core (mathematics, literacy and science)

and foundation (geography, history and art) subjects. They are also responsible for raising children's awareness of personal, cultural, social and religious beliefs. This is a challenging remit given that trainee teachers must concomitantly refresh their own curriculum subject knowledge and develop a deep understanding of how children learn. They must also be able to cross boundaries between training settings (university and multiple schools) as well as perform as effective teachers and learners simultaneously.

This chapter puts forward a simple subject specific model for a component of postgraduate teacher education which draws on the seminal work of Shulman (2004) of how and what teachers must learn, fused with an appreciation of adult learning (andragogy) from the perspective of self-determinism theory. The model affords student teachers opportunities to acquire subject mastery by testing their competence to teach within a purposeful framework. The specific example used, is student teachers facilitating children's learning about human bodies as a means to support them in making positive lifestyle choices as part of the primary science curriculum. Government policy makers, health care and social service professionals have argued that maintaining child health is a significant challenge in the current climate. Childhood obesity has been termed a "world-wide epidemic" over the last decade and a half, and is projected to be a significant contributor to early death and economic decline. This risk has an underlying social element in the U.K. where studies indicate the incidence of obesity is linked to social class (HSCIC 2012).

Discursive elements of the chapter are illustrated by a four year empirical research study carried out during teacher education sessions using a creative drawing based methodology. This methodology is inspired by the pivotal work of Osborne et al (1992) who used annotated drawings to interrogate children's ideas about human bodies during the extensive Science Processes and Concept Exploration (SPACE) study in the 1990s. In an approach resonating with the current creative methodologies endorsed by Stuart (2015), student teacher drawing was used as a means of facilitating active learning through inquiry. Data from the student teacher drawings is supplemented by their narratives of teaching this topic before and after school based placements, in order to assess the efficacy of the approach. The impact of student teachers' practice on children's developing conceptions of human life processes is monitored using a variety of methods including observation of role play and drawings. Student teachers' perspectives of the challenges of teaching this topic within primary classroom are examined alongside an exploration of their confidence for promoting healthy lifestyles.

The chapter concludes with an assertion that inquiry based subject specific teacher education within a meaningful context is a valuable tool in fostering teaching excellence in the next generation of primary teachers. Given the current governmental agenda of promoting the training of teachers exclusively within

schools rather than within the existing ITE partnerships, suggestions are made as to how the findings from this study may inform future practice in teacher education.

The complexity of teacher education

Student teachers on one year postgraduate teacher education programmes in England have a complex learning remit within their intensive one year course. Primarily they are situated as learners in both academic (at university) and professional (school) contexts. At the onset and early stages of the course they see themselves as learners who will be taught how to become teachers. They imagine that their university mentors will confer copious amounts of knowledge on them which they will assimilate, enabling them to pass the course requirements and become inducted into the profession. They also appreciate that they will be given opportunities to refine their teaching skills within schools to prove their mastery. However further exposition of their learning situation reveals that the system is multifaceted and a composite of many intercalating processes. During their study student teachers begin to understand that whilst they are teaching in a school they are learning at least three different levels; namely learning from their class teachers how to teach children, learning about the needs and cognitive abilities of their pupils and learning from themselves in the form of critical reflection of their practice.

Superimposed upon this triad of learning influences is student teachers' recollection of material they have been taught during university study in terms of pedagogic knowledge and subject knowledge. Many student teachers describe the learning process as "overwhelming" and "over complicated". In the case of primary school student teachers (who teach children aged 3-11 years old) the teaching and learning arena is further complicated in England by the requirement of student teachers to teach across a broad curriculum. The majority of primary schools will require teachers to be familiar with knowledge (subject specific and pedagogic content) pertaining to at least nine different curriculum subjects. Given these obligations it is not surprising student teachers report being overwhelmed.

The overriding complexity of the situation that student teachers find themselves in during the one-year postgraduate programme is that their learning takes place in multiple settings. It is not unusual for student teachers to learn in at least four different locations within a space of nine months (three different schools and a university setting). In all these locations they must develop effective learning relationships with their peers, class teachers, school supervisory tutors, leading school mentors, school senior management and most importantly children. They are also rapidly evolving their own professional

identity as a teacher which we know is significantly impacted by the situations teachers find themselves in (Day et. al., 2013).

It is no wonder that this nomadic learning existence can in some cases cause student teachers to exhibit a degree of uncertainty with respect to what they are meant to be learning and or teaching at any one place or time.

Adult learning

What measures can be taken to support student teachers in their professional and academic learning? It is argued that effective “signposting” of learning opportunities within a meaningful context will assist student teachers to understand what they are learning and support them in the metacognitive process. If the signposting of learning opportunities is explicit, it is envisaged that student teachers will know what they know, how they came to know it, and what should be done with that knowledge. Explicit signposting will also enable them to “package” learning experiences into manageable “parcels” which can be re-explored during the course and at later stages during their early career. Critics of this view will assert that this strategy risks student teachers seeing professional and academic knowledge as being disparate components which can be haphazardly “bundled” together, rather than a deep, meaningful and holistic appreciation of the knowledge required to become an effective teacher (Boyd, Hymer & Lockney, 2015). However given the complexity of their learning situation and the fact that during their formative first two decades (during which they have spent approximately 15,000 hours in schools), learning has already been to a large degree packaged into curriculum subjects and associated assessments, there would seem no easy alternative.

A multi-layered approach

To combat this dislocation of learning components and foster a degree of student teachers taking control of their learning, it is argued that student teachers may benefit from being made explicitly aware of the underlying design of the learning opportunities afforded them within their training. To be most effective these opportunities need to draw on adult learning theory as outlined by Knowles (1990), who asserts that adult learners bring a great deal of experience to their learning situations, expect a high degree of influence over what and how they are taught and need to be made aware of how their evolving knowledge may be best used. As powerfully observed by Burns (1995, p. 233)

“By adulthood people are self-directing. This is the concept that lies at the heart of andragogy...andragogy is therefore student-centred, experienced based, problem orientated and collaborative”

This premise draws highly on the seminal work by Ryan and Deci, (2013) from a perspective of Self-Determinism Theory. The three main basic psychological needs that self-determinism caters to are:

- (a) A need to develop a high degree of competence.
- (b) A need to understand the relatedness of knowledge acquisition.
- (c) A need to assume a degree of autonomy over learning.

All three of these requirements can be specifically addressed within a postgraduate teaching course conferring qualified teacher status in England. The first is explicit within the course in that the goal of the vast majority of students on this course is to become an accomplished primary school teacher and hence master the multiple competencies this role necessitates. Student teachers understand the need for secure curriculum subject knowledge aligned to the necessary pedagogical competence required to teach effectively. As they progress through the course they become more aware of the reciprocity which acts between learners and teachers and the need for productive learning relationships between both parties.

The second need that of relatedness is realised within this teacher education strategy by affording student teachers the opportunity to work together in small groups, in order to learn from each other in co-constructional shared learning context. In this way they can experience how knowledge may be synthesised through social constructivist mechanisms and equally importantly, how teachers may work together symbiotically to design and evaluate subject specific pedagogical approaches.

The final need, which this author argues is the most compelling, is that adult learners need to adopt a measure of independence during their learning. All student teachers registered on a postgraduate teacher education course are proven learners by virtue of having previously completed an undergraduate degree and some have extensive life experience and or professional learning qualifications. It is not unreasonable to expect that having been proven successful they find it desirable to be afforded opportunities where they can exert some choice in the modality of their own learning. However melded within this successful learning profile it is often apparent that student teachers yearn for a highly time efficient formula to attain qualified teacher status, whilst it can be argued what they actually need is to develop to the point where they realise that self-regulated learning is the most constructive way forward.

Research orientated learners

The third need provides an excellent opportunity for student teacher led inquiry where teacher inquiry is defined as focussing:

“on the concerns of teachers (not outside researchers) and engages teachers in the design, data collection, and interpretation of data around their question.”

Dana 2002

Obviously the research question will differ according to the individual contexts teachers find themselves. As opposed to traditional research where often external university based academics explore classroom practice in a research mode, the inquiry will be voiced by those who are making themselves familiar with children’s learning. It has also been argued that this approach is likely to result in educational change since the student teacher has a leading voice in the research process. In the case of student teachers at the early stages of their professional development, it can be argued that it is necessary to provide a basic framework for teacher-led inquiry. This can be achieved in many different ways but a classic route is through what is termed subject specific pedagogy. Shulman (2004) asserts that in addition to central subject knowledge, different curriculum subjects have specific pedagogy associated with them, he terms this pedagogic content knowledge.

Conversely opponents of this view argue that it is more important that student teachers master core practices and pedagogies which can then be applied across the entire curriculum (McDonald, et al. 2013 & Forzani, 2014). In the case of primary science many experts have concurred with the former view that there are elements of science teaching that do in fact require specific pedagogical approaches within the discipline (Allen, 2014). For example the relative motion of the planets and moons within the solar system is conceptually challenging for young learners and warrants the introduction of specific concrete prompts and models to facilitate deep learning. Perkins (2006) adds to this debate by highlighting what he terms as troublesome knowledge where ideas are sometimes counter-intuitive (effects of gravity on bodies of different masses) or alien (for example aspects of electricity). It is argued that student teachers may become empowered to teach these science topics by accepting they are troublesome and embracing the challenge of enlightening their learners.

One way they can be encouraged to tackle this may be by formulating their own teacher inquiry during their school-based training. A focus on student teachers as a participant researchers in a classroom-based context, suggests that this strategy can work towards closing the perceived gap between “theory and practice”. As eloquently reasoned by Cochran-Smith (1991)

“As a teacher-inquirer in charge of your own learning, you become a part of a larger struggle in education—the struggle to better understand, inform, shape, reshape, and reform standard school practice.”

The second route for supporting the conceptualisation of student teacher inquiry is through a pertinent social context, in which the learning takes place. If student teachers feel they are addressing a learning need of significance for both themselves and their young learners, according to self-determinism theory they will be more motivated to increase their teaching efficacy.

A framework for student teachers inquiry was formulated during university based study by looking initially at student teachers' knowledge surrounding a biology topic which then became a stimulus for further individual inquiry in the classroom. In an endeavour to emphasise the assertion that "the central element of becoming a teacher is to learn to see teaching from the perspective of the learner" (Boyd, 2015, p. 57), explicit modelling of appropriate pedagogical strategies is used as a provocation for student teachers to engage with an inquiry based teaching approach. In this way congruent teaching in university sessions is used to encourage student teachers to re-construct modelled activities and evaluate their teaching (and hence learning) strategies in this conceptually challenging area of the curriculum.

Social context

It is important for student teachers to see the relevance of their evolving pedagogy in terms of social context. For them to see children make sense of their scientific ideas and apply their knowledge to everyday experience is critical to their sense of evolving self-efficacy. Children may use their knowledge and skills to explore scientific phenomenon, challenge the ideas of others or change their own perspective. One science curriculum area in which children's understanding can impact significantly on their personal choices is that of healthy living.

Of particular prominence is the question of healthy eating, with recent studies suggesting that childhood health is significantly compromised by poor lifestyle choices. Public Health England undertook the National Child Measurement Programme (involving over a million children) which revealed that over one fifth of 4 - 5 year olds were overweight or obese, rising to one third of 10 - 11 year olds. In the case of children defined as clinically obese the incidence was shown to double between these age groups. Of further concern were the findings that the incidence of obesity in children in areas of high socioeconomic deprivation were double those of their more advantaged peers.

In order to combat this significant threat to the health of children in England, both adults and children need to understand how making well informed lifestyle choices can impact positively upon personal physical condition. Children specifically need to understand what constitutes a healthy diet, how their bodies process food and what effect exercise has on the maintenance of healthiness. It has been argued

that teachers may have a role in helping children understand the importance of nutrition and exercise in maintaining a healthy body (Yager & O’Dea, 2005).

National Curriculum requirements

The National Curriculum (N.C. 2013) which is taught in the vast majority of schools in England supports this area of learning. By the end of key stage 1 (children aged up to seven years old), statutory requirements state that children should be taught to *“describe the importance for humans of exercise, eating the right amounts of different types of food, and hygiene.”* (Department for Education, 2013, p.11). This is expanded on in the next year of their study, requiring children to *“identify that animals including humans, need the right types and amount of nutrition”* (Department for Education, 2013, p.17). On completion of their primary science study, year 6 (children aged up to 11 years old) are required to *“recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function.”* Department for Education, 2013, p.31). If children can develop their scientific knowledge and conceptual understanding of these specific elements of human biology then it can be argued that they will be able to make more informed choices about their own life styles and the impact they might have on their well-being and health.

Key to understanding these scientific concepts is the knowledge of what constitutes a human body in terms of the tissues, organs and biological systems that coordinate together to ensure a functional human. If children can be encouraged to see themselves as a biologically functional entity which has needs in terms of exercise, balanced diet and healthy lifestyle they may be able to use their understanding to make sense of information they are given, for example dietary advice or fitness initiatives.

Fostering subject mastery

To facilitate children’s understanding of these key scientific concepts it is vital that their teachers should have an in-depth knowledge of basic human biology. There is a tendency for adults to believe they are knowledgeable in this area of the curriculum, just by the fact that everyone is in possession of a human body. Experience of working with student teachers as a teacher educator often confirms that their subject knowledge is somewhat inconsistent (Blackmore & Howard, 2013). To remedy these deficiencies in subject knowledge and encourage student teachers to view their evolving professional identity through a lens of social context, a research orientated teaching inquiry was undertaken with student teachers enrolled on the one-year post graduate course. The intention of the study was to adhere to the prerequisites of

research oriented study as described by Jenkins et. al. 2007 who defines this teaching approach as involving learners within the research based inquiry itself as participants and researchers. In this way student teachers are given the opportunity to co-design the research methodology, participate in data collection and analysis and assimilate the key findings. This approach is efficacious on two levels, as it makes explicit to student teachers the processes involved in research and encourages their reflections on their subject specific pedagogic knowledge. In other words they are aware of how to assess knowledge within a learning population and how to use that information to inform the construction of future teaching strategies.

Study methodology

The research was undertaken over a four-year period with approximately 40 student teachers per academic year. Ethical approval was granted in accordance with university policy and there was an underlying commitment to adhere to educational best practice during the study. Since student teachers are required during their training to complete a large amount of documentation often in the form of questionnaires and surveys it was decided to deploy a creative methodology which would not just “mine information” “for an own (organisational) benefit” but would encourage “reflection and playfulness” of the participants (Stuart et al, 2015, p. 134).

Student teachers were asked to work in small groups to create their own pictorial representation of a human body using one consenting member of the group as a template to draw around. The student teachers used their own knowledge and that of their peers, to depict how a human body works. They were encouraged by their mentor to consider how the various cells, tissues, organs and organ systems that constitute a human body work synergistically together. Students were given the freedom to portray their ideas in any form they chose, including cartoon drawings, annotations or anatomical approximations and in this way accessed the advantages of multisensory learning as advocated by Laird (1985). This activity prompted a large amount of discussion and science based academic argument between both student teachers and mentors and was seen as a real exemplar of social constructivist based learning.

In addition to their university based study, student teachers were encouraged to deploy their knowledge and pedagogic skills in schools during their eight week teaching placement to teach children about healthy human living. Student teachers undertook a variety of creative teaching approaches including role play, working walls and cross-curricular learning to facilitate children’s understanding of human living processes.

By the end of the research inquiry twenty-six group drawings were available along with annotated comments from one hundred and thirty student teachers.

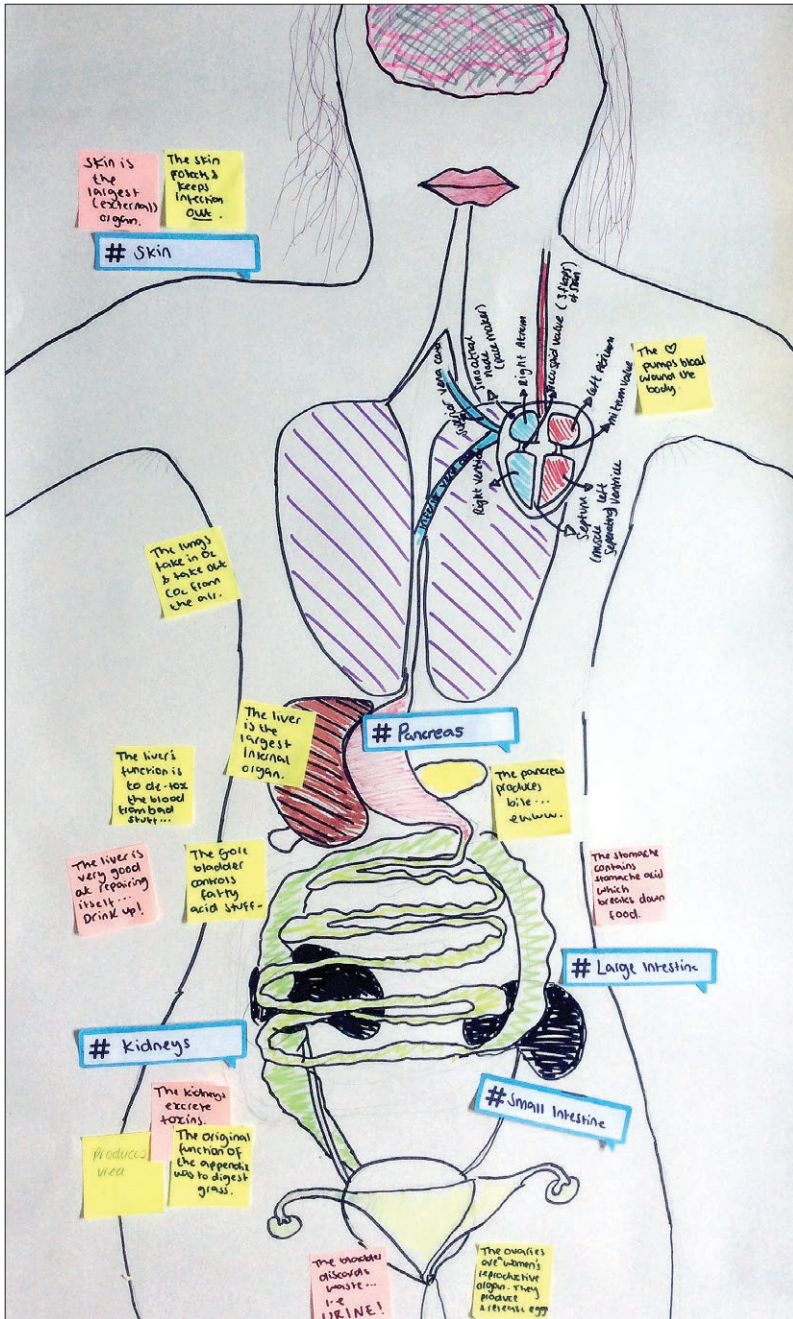


Figure 1: A diagram of the organ systems of the human body constructed by a small group of student teachers during a university session.

The drawings were photographed and collated using NViVO software for ease of analysis. The drawings were scored according to anatomical accuracy (position and relative size of organs) and an understanding of function. The reflective comments were analysed by a process of constant comparative analysis as originally defined by Miles and Huberman and further refined by Kolb (2012) and examined for emergent themes.

Findings of the study

Student teacher subject knowledge

Overall the analysis of the drawings with associated annotations revealed that the student teachers possessed a good level of subject knowledge, commensurate with that required to teach primary age children effectively (see figure 1 for a typical example). The diagrams were as a whole well informed and denoted a clear understanding of the six main organ systems in the human body. The best comprehended system was the digestive system with the majority (70%) of drawings demonstrating good knowledge. Student drawing groups were all judged to have attained reasonable, to good knowledge for the following organ systems: musculoskeletal, cardio-vascular, respiratory and genitourinary. The organ system least well portrayed was the central nervous system (CNS) where depictions seemed to be generally centred on a brain in isolation.

The vast majority of annotations were pertinent and signified a clear understanding of the functionality of the key components of the human body e.g.

"Epiglottis stops food entering trachea."

"Stomach starts digestion, enzymes and hydrochloric acid start to break food down. Stomach absorbs nutrients from food."

"In the small intestine nutrients are absorbed into the bloodstream."

"The liver detoxes and synthesizes vitamins."

"Pancreas produces insulin and glucagon."

"Kidneys filter blood for excretion in urine."

"The ovaries are women's reproductive organs, they produce and release eggs."

In the minority of drawings where the brain was depicted connected to the spinal chord and peripheral nerves there was a reasonable understanding of the CNS

"The brain is encased in the cranium and controls the CNS."

"The brain receives messages from the body, e.g. movement, sight, etc. and sends messages to body via electrical impulses."

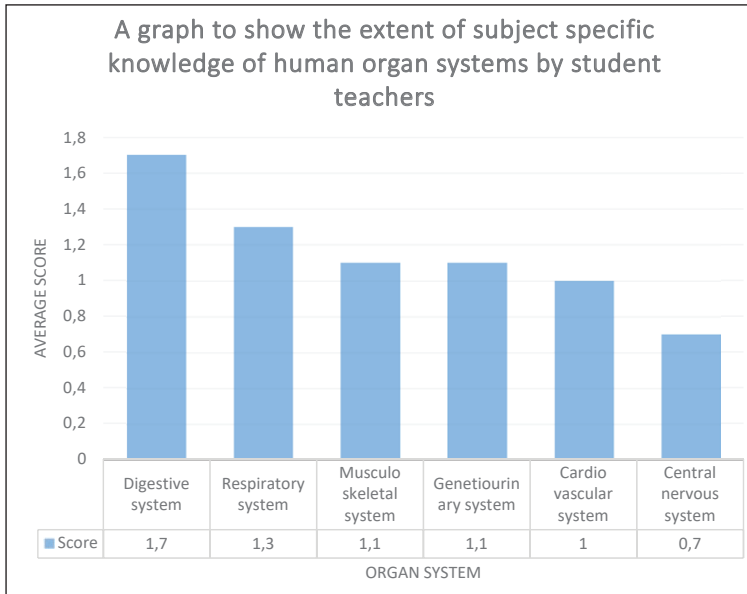


Figure 2: Analysis of the degree of understanding demonstrated by student teachers pertaining to human organ systems.

Figure 2 legend: Figure two shows the average score assigned to student teacher drawings of the main six human body organ systems (scoring as follows: 0 = nil to very little understanding, 1 = good understanding and 2 = very good to excellent understanding)

Figure 2 shows the number of correct conceptions for each organ system as judged by the accompanying annotations. This reinforces that the digestive system was by far the best understood organ system. Within the digestive system the roles of the stomach, liver and intestines were the best understood and portrayed with appropriate diagrammatic refinements e.g. villi to absorb nutrients in the small intestine. Annotations from drawings were amalgamated and analysed using Wordle software to reveal key word frequency use.

The Wordle (figure 3) for the respiratory system shows a good understanding of applicable key words pertaining to the respiratory organ system. This is encouraging as breathing and gas exchange are accessible topics for primary age children so it is heartening to see that student teachers are familiar with the key scientific vocabulary associated with this topic.

Of some concern is the fact that although the musculoskeletal system was represented to a good standard in 60% of the drawings only one pertinent comment was made signifying functional understanding, namely:

“Arm muscles are antagonistic and work in pairs.”

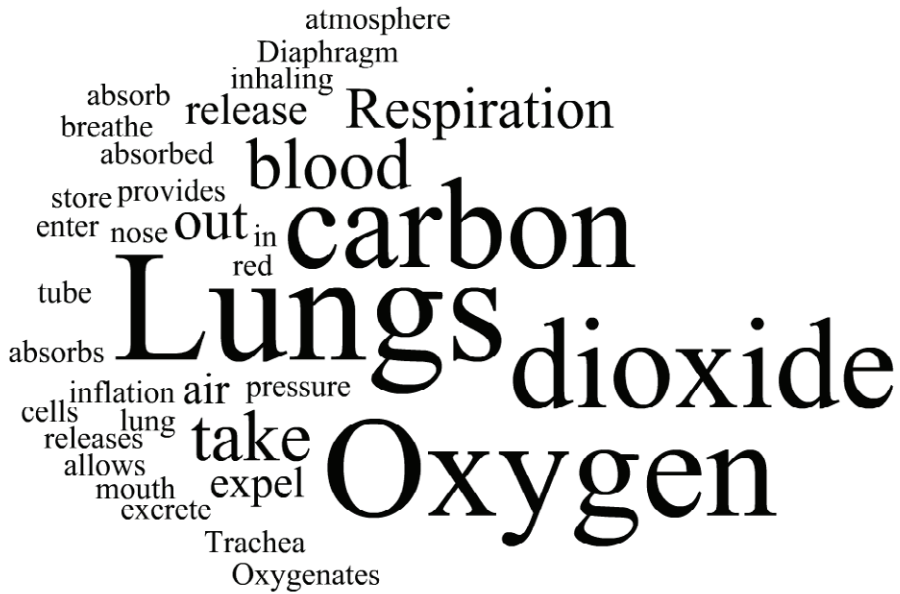


Figure 3: Key words used by student teachers to describe the functionality of the human respiratory organ system.

Figure 3 legend: A Wordle frequency diagram to show the most prevalent words student teachers associated with the human respiratory organ system.

This could however be due to a limitation in the methodology, in that it could be argued that it is easier to represent bones, joints and muscles pictorially rather than describe how they function together to give rise to movement. Since facilitating children's understanding of exercise involving movement is vital in terms of embracing a healthy lifestyle, this finding warrants further exploration.

Student teacher reflections

The efficacy of the modelling of the human body drawings at the beginning of the student led inquiry appeared to have been high with over 75% of student teachers choosing to reflect on this activity favourably after their school experience.

Initially the student teachers seemed to replicate the teaching activity they themselves had undertaken during university sessions with their classes. However it is clear that a degree of reflection and maturation of ideas had taken place as their teaching approaches showed elements of planning for the effective elicitation of children's existing ideas, co-construction of knowledge and exploratory learning.

"As part of a science day, my class were looking at the circulatory system and the effect of exercise on the heart rate. At the start of the day, I used the paper human

activity to assess the children's prior knowledge. The children drew the parts of the circulatory system that they knew and working in their groups, they had to also decide where they were located. The children also wrote questions around the body about things that they would like to find out by the end of the day. The children thoroughly enjoyed this task, it was fun and engaging. At the end of the day, we looked back at the drawings to discuss what we had found out and assess what we had learnt."

Student teachers were also seen to enhance their teaching differentiation strategies, enabling a more inclusive classroom learning environment to be generated:

"Mixed ability groups were needed as the organs could be difficult to identify, especially if the children had not been exposed to the anatomy of the body before. On reflection, this activity gave a good indicator where the children were in terms of their understanding."

The activity seemed to prompt reflection with respect to both student teacher subject knowledge and emergent pedagogic knowledge.

Two student teachers commented:

"I am confident when teaching year 6 science; whilst on my second school experience I had to teach about exercise and how it affects the body. I was able to provide children with enough information and use interesting resources to get them interested in learning. I felt confident enough in my own subject knowledge which allowed for the learners to learn sufficiently whilst also being challenged."

"Reflecting on my experience of the science teaching, I need to look at muscles and the circulatory system more, as well as human and animal fertility and the various cells."

It was interesting to note that whilst student teachers consistently reported increased confidence with respect to teaching human processes they still looked for external validation from those they perceived as experts. This resonates heavily with Banduras theory of self-efficacy, which in this case is in part derived from an estimation on the behalf of the student teacher of what others (more senior teachers) know (Tschannen-Moran et al., 1998).

"I taught two science lessons in a mixed year 5/6 class about the effects that exercise and diet can have on our bodies and heart. I realised how important it was for me to have secure subject knowledge. I was able to answer children's questions which then allowed them to have a deeper understanding of their learning which also encouraged them to become more independent learners, promoting critical thinking skills. Both times the observers commented on how well the children engaged with their tasks and it was clear that they were excited to learn."

Analysis of this narrative also reveals a growing awareness of the student teacher with respect to the underlying learning needs of the children. They highlight the importance of giving opportunities for children to attain independence and extend their critical thinking skills in order to foster deeper learning.

Student teacher attitudes

At the onset of the inquiry there was a slight degree of concern that student teachers would feel they were being used as part of a research project and therefore under a heightened degree of scrutiny. This might have compromised the ethicality of the inquiry, however keeping the research at a fairly informal level allowed student teachers to feel their perspectives were integral within the learning approach. Student teachers as a whole reacted positively to being part of a research orientated teaching inquiry, one remarked:

“I like to think of myself as part of a research project into teachers’ knowledge.”

Enabling student teachers to become part of an endeavour which facilitates many layers of inquiry would appear to be highly effective. Student teachers moved away from being passive recipients of knowledge to being actively involved in knowledge acquisition and collation. They appeared to derive a sense of empowerment in keeping with the strands of developing competency and determining relevance.

In addition there was a large amount of evidence that student had developed their critical evaluation skills, they had ceased to merely re-enact tried and tested classroom methodology but refined their own pedagogical approaches.

One student teacher reflecting on her practice during her first school teaching experience with a Year 3 class (learners ages 8 - 9 years old) reflected:

“I was able to teach three science lessons they were focused upon bones and muscles within the human body. A lesson which I felt worked really well, was where the children worked scientifically, being myth busters and attempting to prove or disprove certain myths about the human body. This included whether or not your ear is the same length as your nose. This lesson also had a cross-curricular link to maths as the children had to decide which measuring tool to use.”

There was some evidence that by focussing on the research elements of the inquiry and not merely their own teaching efficacy, this learning approach had a positive effect on some student teachers’ self-confidence. One student teacher on reflecting on her first school teaching experience stated:

“On reflection, initially I was nervous to teach science as it was something I had never experienced before and was a subject area that I found challenging. However after

my teaching, I was pleasantly surprised with how enjoyable teaching science can be for both myself and of course more importantly for the children.”

This comment suggests a growing conception of behalf of the student teacher of the reciprocity that exists between teachers and learners in terms of enjoyment and fulfilment during effective learning and teaching.

Impact on children’s learning

Student teachers were encouraged, after securing appropriate permissions, to bring back copies of children’s work to the university for further analysis and reflection on the teaching efficacy of the approach. The following descriptions of human processes were offered by a mixed ability Year 3 (8-9 year old) group of children.

“First you take a mouthful of your food your many teeth grind it up and mix it with spit. Your stomach churns food into a thick liquid.”

“Kidneys remove water and it extracts wee from your blood. Wee trickles down to tubes called ureters.”

“Heart pumps blood around body, this side pumps blood to the lungs.”

“Your brain is made up of billions of special cells called neurons.”

“The brain helps with moving, hunger, balance, touch, smelling, seeing and hearing with nerves.”

All these conceptions reveal an appropriate level of understanding of children in this age group as judged by comparison with the National Curriculum. Indeed several elements, for example “*special cells called neurons*” exceed the requirement at this key stage, as this phrase suggests that children understand that cells in the body are differentiated into many forms, which may have specialised functions.

Scrutiny of the work by student teachers also revealed that they felt children displayed a high degree of spatial and organisational awareness in some cases. Children were able to depict structures that were enclosed within organs in an appropriate manner. Figure four shows the children’s depiction of a liver, with a gall bladder quite clearly shown within this organ. The associated annotations by the children, and the detail within the drawing suggests a good level of understanding. It is clear the children understand that this is where bile is produced and stored in order to aid digestion. The drawing does show however that the children were incorrect in siting the organ in the second upper quadrant of the human body and probably indicates a lack of overall awareness in terms of anatomy.

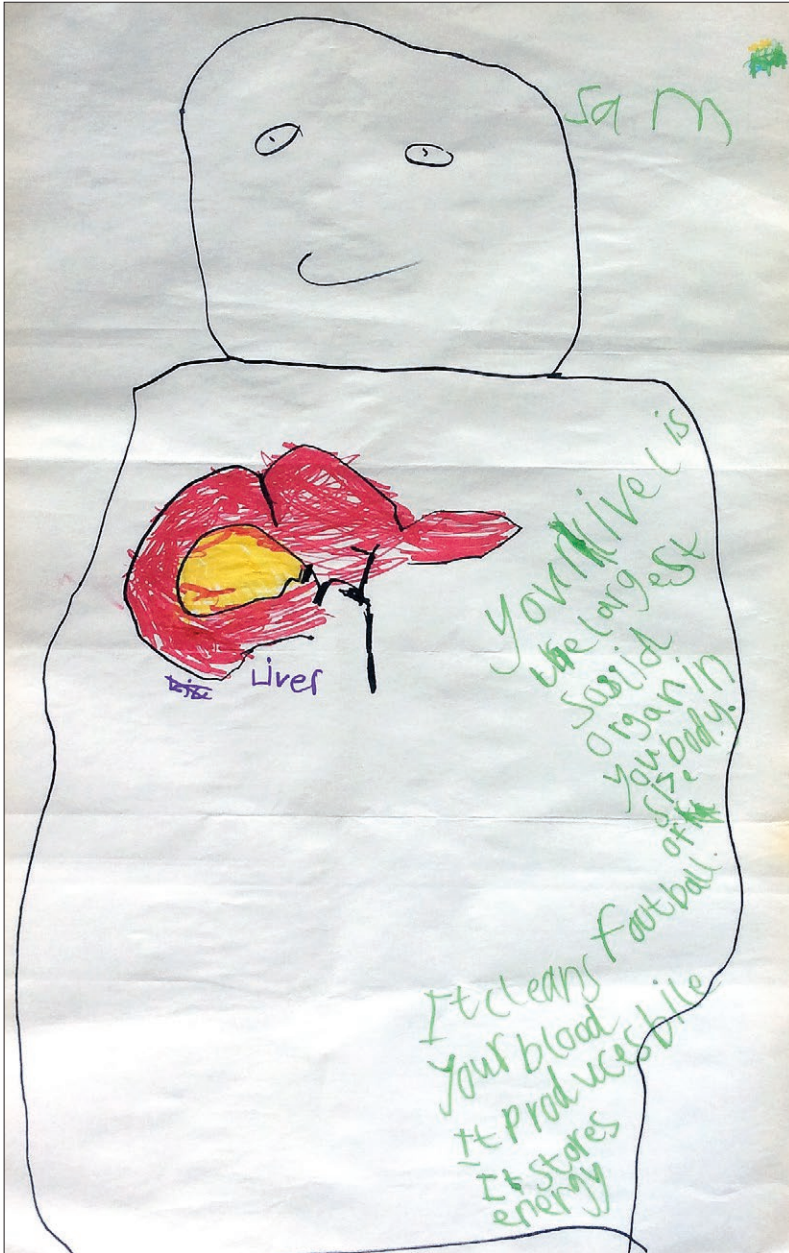


Figure 4: Children's conceptions of the function of human organs following student teacher inquiry.

Figure 4 legend: A drawing done by a small group of year 3 children focussing on the liver. Children's writing says "Your liver is the largest solid organ in your body. It's size of a football. It cleans your blood. It produces bile. It stores energy."

Conclusions and recommendations

It is quite difficult to carry out an unbiased judgement with respect to the inclusive nature of the drawing methodology as a tool to foster student teacher led inquiry. The vast majority of student teachers seemed to have found the approach engaging and an outlet for creativity. A large proportion (over two thirds) chose to deploy this methodology within their school teaching experience, which would suggest they found the approach of merit. With respect to learners who did not benefit from drawing based learning opportunities; it can only be said that during the four year project no student teacher has felt that this approach lacks merit in terms of raising awareness of science specific subject knowledge or associated pedagogy. However it could be argued that if a student teacher felt this way they are unlikely to voice that opinion due to perceived power relationships between student teachers and mentors. It would appear overall that this teaching approach is effective for a wide range of learner ages and abilities.

As a training vehicle for student teachers this type of drawing based inquiry would seem to have the following merits:

- Inclusivity
- Creativity
- Accessibility
- Ease of deployment
- High degree of engagement

Detractors from the methodology would point out that this type of inquiry based teacher education does take a significant amount of time when it is considered that student teachers need the initial stimulus to be taught within university based sessions, then deploy the methodology within schools, obtain evidence for subsequent analysis and return to that setting in order for reflection on their pedagogic practice. This author would argue that this perceived deficit, is in fact is a strength of the methodology. Deep learning can only be achieved as a result of sustained inquiry, extensive reflection on modes and efficacies of learning approaches and a significant engagement with appropriate bodies of knowledge (in this case learning theory and human biology). Whilst student teachers may be supported to design effective teaching and learning strategies, monitor and assess the resultant attainment of their young learners in their professional learning context, there is a dearth of opportunities for them to build upon these experiences, analyse and re-construct their developing pedagogies. Explicit modelling during initial teacher education within university sessions allows student teachers the opportunity to pilot and refine teaching approaches in collaboration with their peers and highly experienced teacher educators. In busy primary schools it is rare to be afforded the opportunity in terms of time, place and space to undergo these essential learning

processes. It is clear that student teacher led inquiry when deployed across academic and professional learning settings can lead to deep, critical learning and concomitant skill acquisition, ideally suited to initial teacher education.

Unfortunately, in the case of teacher education within England the proposed drive is to significantly increase the proportion of student teachers being exclusively trained in schools (DfE, 2016). Due to time constraints within schools and in the case of primary science, lack of expertise, this will essentially mean that student teachers will not be given the opportunity for sustained student led inquiry. Given the findings of this research and that of others in Scandinavia and Australasia (Hansen & Wasson, 2016 & Timperley, 2008) it is of significant concern that inquiry based student teacher learning may experience a demise.

In summary this study advocates a more extensive positioning of student teacher inquiry using creative methodology within teacher education programmes and school and university educational partnerships. It is only with the deployment of rounded, holistic research informed teacher education programmes within the international teaching community that teaching excellence will be achieved by future generations of teachers.

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