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Uncertainty in Teacher Education Futures

Scenarios, Politics and STEM

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Foreword: Challenging Times in Teacher Education

This book is timely. The authors have thoughtfully captured some of the headline issues that need to be addressed in teacher education in these challenging times.

Importantly, Schuck, Aubusson, Burden and Brindley establish a forward focussed position that seeks to consider the possibilities, opportunities and tensions associated with what might be, rather than reflecting on the past—or remaining entrenched in the status quo.

There is little doubt that teacher education is under stress—or, as they have noted—caught (perhaps even mired) in a state of conflict. The demands on teacher education, the expectations and the superficiality of the shifting political landscape do little to set teacher education on a footing of certainty in terms of sense of purpose, policy and practice. It would be fair to say that amongst scholars of teacher education, that confidence has been slowly eroding due to the constant state of blame laid at the feet of teacher preparation programmes.

Just as the nature of teacher professionalism faces scrutiny, and as a consequence, increasing compliance and accountability, so too the same applies to teacher educators. Whatever perceived deficiencies are laid at the feet of teachers as a consequence of the outcomes of such things as international testing regimes (e.g. TIMMS, PISA), standardised tests (e.g. mandated high-stakes testing) and the need to produce citizens for jobs that do not yet exist, the simple response seems to be that teachers have not been properly prepared for such work. Hence, teacher education is at fault.

Sadly, much of that situation quite predictably hinges on simplistic views of teaching that largely involve an information dissemination process. Similarly, assessment of such teaching is conceived as equally simple and straightforward as propositional knowledge reigns supreme. The assumptions underpinning transmissive teaching inevitably lead to views of teachers and teacher education then as suppliers of information. However, those assumptions are able to be challenged in productive ways when teaching for understanding and learning for meaning take pride of place. It is with that shift in emphasis (through practice), that the authors offer their ideas and thinking about education for a different future.

As a beginning point, educational technology and learning with new media immediately creates new ways of conceptualising teaching and learning; new ways that need to be grasped in both schools and through teacher education. There is little point in the 'drip feed' information practices that tend to dominate an industrial world view of schooling when information is readily available and at the fingertips of anyone with an Internet connection. It is folly to think that a group of learners can all be 'moved along' at the same pace to achieve the same end point at the same time, when the world around them invites them to function as learners in their own ways, in their own time, driven by their individual interests, needs and concerns. Again, the authors pursue this shift in conceptualising learning as they contemplate the purpose of schooling and the important pedagogic moves associated with the 'how and why' as opposed to the 'what' of information or subject matter content.

When scenarios for educational development are based on learning—as opposed to the transmission of information (something that similarly haunts the nature and shape of school curriculum)—then new ways of envisaging a pedagogically meaningful future arise. The authors pursue the notion of backcasting as a way of opening up new possibilities for creating alternative futures and for considering the likely implications associated with different forms of educational exploration. Being intellectually freed to reframe practice (Schön 1983, 1987) opens the mind to different ways of seeing that become crucial in fostering future focussed thinking.

In many ways, teacher education then is an important catalyst for change, and as the authors illustrate through their work with the *Teacher Education Futures Forum*, new drivers for change offer different opportunities to conceptualise teacher education and to respond to purposes, expectations and ideals in ways that too easily are constrained by current structures, practices and assumptions. Clearly, to develop teachers for a different educational landscape requires preparation and planning that envisages (and accepts) that different educational landscapes can (and should) exist.

It is interesting to note that the authors draw on science education and mathematics education as curriculum areas through which change might be envisaged. Harshly, school science and mathematics are often described as the least adventurous areas for pedagogic risk taking and development, yet here, in a book that invites challenge, engages with learning and envisages scenarios that might foster new and different outputs and products, these subjects are viewed as contexts to support these very processes and products. In so doing, the authors thoughtfully challenge the status quo and again confront long-held assumptions about teaching and learning and about how these too can often be captured by perceptions that may not match reality.

The title of this book *Uncertainty in Teacher Education Futures: Scenarios, Politics and STEM*, invites the reader to rethink the nature of the relationships between teaching and learning, teacher education and schooling and the context in which they occur. Just as the development of expert teachers (Loughran 2010) requires a framework to inform theory and practice in concert, so too envisaging what is required in teacher education to offer a vision for what it means to be a teaching professional equally depends on an articulation of a framework that can

inform, shape and meaningfully influence the nature of practice. Through this book, Schuck, Aubusson, Burden and Brindley have done just that.

As I stated at the outset, this manuscript is engaging, thoughtful, forward-thinking and challenging. But beyond those laudable features, it also comes with an expectation that the ideas are useful and applicable. I trust that is exactly the outcome for you as a reader.

Melbourne, Australia

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Prof. Dr. Kevin Burden is a Professor of Educational Technology in the Faculty of Arts, Cultures and Education (FACE) at the University of Hull. In 2015, he was awarded a National Teaching Fellowship by the Higher Education Academy in recognition of his support for staff and students in using digital technologies to support innovation and change. He is currently the convener of the Technology Enhanced Learning (TEL) research group at the University of Hull where he leads a team focusing on the interface between learning and digital technology and he is particularly interested in exploring how educators use technologies to support and augment their own learning and that of their students. His recent work focuses on teacher education futures and the role of technology in these. He is currently leading a number of STEM-related projects funded by the EU and the British Council to investigate the impact of mobile technologies on learning, particularly for marginalised and difficult-to-reach communities.

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Chapter 1
Why the Future Is Important

Abstract We introduce our book on teacher education futures in this chapter. Teacher education is currently facing many challenges, arising from the societal changes and contexts in which it is embedded. These contexts include changes in political arenas, in the nature of knowledge that is deemed important and in the emergence of new technologies. The future is always uncertain but if we have a sense of the drivers that will influence society, schooling and teacher education, we can begin to imagine possibilities for teacher education futures and investigate the trajectories that may lead to desirable futures. In this chapter, we outline the reasons for investigating the future in teacher education, based on current trends and drivers. The chapter outlines the ways in which we grapple with possibilities for the future by focusing mainly on two futures methods, the development of scenarios and the use of backcasting. Examples of previous research in this area are used to illustrate the discussion, with a focus in these examples on STEM (Science, Technology, Engineering and Mathematics) education, given the current discourse on the importance of these areas for advancing society. Finally, the chapter provides a description of the structure of this book.

Keywords Teacher education · Futures research · STEM education
Future scenarios · Backcasting

Why Study the Future in Teacher Education?

Teacher education has undergone many changes, reviews and subsequent reforms. Yet the basic structures of teacher education have remained largely unchanged over the years. Numerous recommendations have arisen from reviews but the subsequent imposition on teacher education of these recommendations for reform is usually unsuccessful.

Currently, teacher education is attracting unprecedented attention from governments. Standards for teachers, accreditation and performance assessments are all under discussion and in the process of being developed by policy groups that often

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comprise governmental agencies and advocacy groups. Private concerns are consulted concerning the various structures and sets of priorities for teacher education. The numerous reviews of teacher education are often politically inspired and seldom initiated by teacher educators themselves. Teacher educators in public institutions are often excluded from the debates about reform. Sometimes teachers and teacher educators are seen as reactionary, and they have been described as 'enemies of promise' (Gove, 2013, online). It is therefore important for teacher educators to have the opportunity to discuss what futures they might want for teacher education, and to investigate the drivers and trends that might move us to those futures. They need a seat at the table at which such directions are being determined and they need unity in vision to strengthen their voices.

A way of creating a space to consider and debate the current context and trends and to imagine possible futures is through the use of futures methodologies. Such methodologies allow us to imagine different possibilities for teacher education and open these possibilities for discussion. This book provides such an opportunity for readers to be provoked and to engage in thinking about what is attractive, what scenarios might be sought after, and what should be avoided in teacher education. Agreement on these issues might then lead to the development of strategies for how we, as teacher educators, might go about getting what we want. The book seeks to engage teacher educators, teachers and policymakers in thinking about what is possible and desirable and to promote debate and discussion amongst all stakeholders.

This book helps us think about possible trajectories and possible futures for teacher education. It highlights current contexts, interrogates the drivers in these contexts and imagines scenarios which may be logical extensions of today's contexts given these trends and drivers. The chapters address changing contexts arising from interactive, inquiry-based and collaborative pedagogies; mobile and distributed learning; ubiquitous and pervasive computing; and augmented reality. In this book, we consider these changing contexts and their implications for education, including discussion of designs for future schools and teacher education programmes; the development of alternative educational institutions outside and beyond current systems; and new approaches to teaching and learning. The book draws on international discussions and studies and focuses on research conducted by the authors across two continents. We investigate sociopolitical, technological and pedagogical changes and drivers and their implications for teacher education.

There is now a considerable body of literature, stemming from research into Millennials (the school students of the twenty-first century), teacher education and applications of technology in formal and informal learning settings, all of which suggest frameworks to predict future developments. For example, much of the discussion about twenty-first-century learning considers a framework that focuses on the 4 Cs instead of the 3 Rs. There are many suggestions for what these 4 Cs need to be, ranging from community to creativity. When learning and innovation skills are discussed, the 4 Cs emphasised tend to be creativity, communication, collaboration and critical thinking (see, for example, P21, 2007). There is a great deal of rhetoric about the different learning and schooling that Millennials might

experience to achieve these 4 Cs. Understandings about these different ways of learning ought to be harnessed to reshape teacher education if the next generation of teachers are to lead our learning futures. This book offers the opportunity for teachers, teacher educators and policymakers, amongst others, to pause and contemplate whether we are moving in directions that will take us where we want to go. It brings together powerful ideas and new developments from internationally recognised scholars to provide theoretical and practical knowledge to inform teacher education.

Exploring Possibilities for the Future

To help us achieve our aims of shaping the future through changing the present, we employ futures research using futures methodologies. Such methodologies are used extensively in a variety of disciplines and areas. They are used to provide economic forecasts and help with planning for population increases or decreases in a society. Futures research seeks to provide insights that might help to change the present and direct the future. These insights, gained from investigating the trends and drivers that currently operate, may lead to the creation of possibilities that are either enticing or terrifying, or they have elements of both. Futures research allows us to develop understandings that provide guidance on how to achieve the futures we want. When we understand these possibilities, we can use our understandings to change actions, policies and practice.

In this book, we consider futures research in the educational context and focus on teacher education for the reasons indicated in the first section of this chapter. There are numerous futures research methods used to gain understandings of possibilities in teacher education. Other futures methods help us to investigate how to then use these understandings to modify practices and policies. We will focus in this book on the use of five of these methods, specifically horizon scanning, driver analysis, Delphi panels, scenario production and backcasting. The first three methods—horizon scanning, driver analysis and Delphi panels—have been used in our research to lead to scenario building or production, which involves us in building visions of what teacher education may look like in ten or more years' time. The method of backcasting suggests ways of working out how to change policy and practice to allow us to arrive at a particular future. It entails choosing a future scenario and considering what needs to be modified to get from the present to the future. Analysing the drivers that may need to change or may need to be strengthened provides a possible trajectory to that future. There are many other methods that are used in futures research, such as forecasting, but in this book, we restrict our discussion to these methods, as these are ones we have employed in our research in educational arenas.

No futures methods are easily executed. All require long-term thinking and a capacity for accepting uncertainty. Consultation and sharing of ideas are essential. Developing scenarios that are internally consistent and provocative is challenging.

Working out threats and opportunities is central to the process. We cannot provide evidence for what has not yet happened so we have to accept that what is proposed is speculative.

Futures methods often include extensive consultation, the presentation and sharing of alternative futures, and discussion about the value of alternatives and what might be done to transform the future. Futures research also includes specific methods that are specifically designed to not just inform but also to bring about specific changes in a system to alter the future.

As the methodologies for forward thinking in education remain underdeveloped, there is much to be done in building up a 'toolbox' of such approaches to inform the policymaking process. The methods discussed in this book assist us in doing this. The aim of this work is to ensure that the present is not allowed to dictate the future. Rather, we offer the opportunity for teachers, teacher educators and policymakers to collaborate in developing the futures that we agree are most desirable.

Our Previous Research

One of the first groups to start using scenarios to open debate in education was the Centre for Educational Research and Innovation (CERI) that is part of the Organisation for Economic Co-operation and Development (OECD). In a publication titled *Schooling for tomorrow: What schools for the future?* (CERI/OECD, 2001), the group developed six scenarios for learning systems aimed at provoking and disrupting teachers, teacher educators, policymakers and the public more generally. This was followed by a special issue of the *European Journal of Teacher Education* (2003), which was developed from the work of one of the Research and Development Centres (RDCs) of the Association for Teacher Education in Europe (ATEE). Under the leadership of Marco Snoek, RDC 19 concluded a 3-year project on the future of teacher education in Europe with a special issue in which scenarios were developed and discussed for teacher education in different European countries.

Our book has been highly influenced by both of these projects. Chapter 9 discusses the OECD project and provides an analysis of current thinking juxtaposed against the scenarios presented in 2001. Chapter 7 describes how Snoek's work influenced our future work on scenario development. Prior to meeting Snoek and learning about his methods for scenario creation, two of the authors of this book prepared a conceptual study that built on the OECD scenarios and considered what these scenarios might look like in a context in which use of the Internet was almost ubiquitous and Web 2.0, with its heightened capacity for collaboration and interactivity, might be impacting learning. Subsequent to the discussion with Snoek, the authors embarked on a programme of research that used Delphi methods to collect the views of leaders in science education and in teacher education about how teacher education might look in the future. Delphi methods typically involve the establishment of expert panels whose views are collected on particular questions or trends. The methods can be quantitative, or, as in these studies, qualitative.

Questions around technology, knowledge and forms of teacher education were included in interviews with these leaders in projects focusing on different aspects. The first project with teacher educator leaders, who were invited to participate from eight countries, examined their views about teacher education drivers and then built scenarios from the data (Aubusson & Schuck, 2013a). The subsequent project, with teacher education leaders from Australia and England, examined areas that appeared to be central to current teaching but on which the leaders in the previous project had been largely silent. The two areas of focus were technology and knowledge. Again, after data from the interviews had been analysed, a series of scenarios were created, and these were presented at conferences and seminars to gain feedback from the audience.

Conference forums in which we shared and discussed this futures work were: a symposium 'Creating and critiquing teacher education futures', at the CAL 2011 conference in Manchester (convened by Burden, May, 2011); an invitation-only forum of teacher educators, Teacher Education Futures Forum (TEFF), convened by Schuck and Aubusson in Amsterdam in September 2011 (which is further discussed in Chap. 7); and a symposium on Teacher Education Futures at the European Conference on Educational Research (ECER) in Cadiz in September 2012, by selected members of the TEFF (convened by Schuck, 2012). Two presentations on scenarios in teacher education were also presented and workshopped at annual conferences of ATEE in Halden, Norway (Aubusson & Schuck, 2013b) and in Braga, Portugal (Aubusson, Schuck, Burden, & Brindley, August 2014) and at the spring conference of ATEE in Riga, Latvia (Aubusson & Schuck, May 2017). Finally, a science education futures workshop was convened by Aubusson in February 2016 in Sydney. Each presentation dealt with similar themes, and each was used as an opportunity to test findings from our research projects. Some of the scenarios discussed are now coming into fruition whilst others have not changed much.

The authors have also published in academic journals on topics related to futures work. These articles include a focus on the impact of digital access on future school learning (Schuck & Aubusson, 2010); a special issue on teacher education futures edited by Schuck and Aubusson and including two articles on our research in this area (Aubusson & Schuck, 2013a; Brindley, 2013); and a publication on the authors' ongoing research in this area (Burden, Aubusson, Brindley, & Schuck, 2016). As noted above, the scenarios presented in these articles had usually been tested in conferences and then amended on the basis of the critique of audiences largely comprised of teacher educators.

The research published and presented by the authors has developed our thinking further, and this book is the culmination of this work. However, we would hesitate to call this our final thoughts on the subject. We have learnt that the future is unpredictable, constantly changing and surprising—a state of affairs that may well stimulate further investigations. Our main purpose for this book, though, is to stimulate and provoke discussion on this important topic. We have developed futures narratives to present potential futures. We acknowledge, however, the difficulty of making clear that we are not favouring a particular prediction in this book,

but rather we are seeking to explore, imagine, and, by using those explorations and imaginations, provoke our readers to call for action.

Outline of This Book

This book is divided into three sections. In the first section, Chaps. 2, 3, 4 and 5 discuss the various drivers and trends currently existing in education. Chapter 2 considers the key drivers of teacher education. Here, we examine some of the tensions and paradoxes that exist within the field of education and the impact these have on determining the future trajectories of teacher education. Chapter 3 concerns the politics of teacher education. It examines the relationship between politics and professionalism for teachers and teacher educators, particularly the micro-, meso- and macro-levels of this relationship, and then interrogates their impact and influence on teaching and teacher education. Chapter 4 investigates the trends in technology-enhanced learning. We consider the 4 Cs mentioned above, with respect to their connection to emerging technologies. We examine current trends in educational technology and affordances of emerging technologies for their effect on teacher education, particularly with respect to the time and space continua in which teacher education occurs. This chapter builds on the authors' research on mobile learning and associated constructs, such as the Mobile Pedagogical Framework (Kearney, Schuck, Aubusson, & Burden, 2012) and mobile learning in the Third Space (Schuck, Kearney, & Burden, 2017). Finally, Chap. 5 considers the way knowledge is used, created and understood and how its changing nature might influence changes in society. Knowing 'how' as opposed to knowing 'what' is becoming more important in a knowledge society. Interdisciplinary knowledge and knowledge of processes are in tension with subject content knowledge. Purposes of schooling continue to change emphases.

The second section (Chaps. 6, 7 and 8) concerns the futures methods we used to develop insights into teacher education and provide tools for shaping the directions in which we might go. In Chap. 6, we discuss and explain the purpose of futures research, the methods that are used in such research and the focus on the use of scenarios and backcasting as tools for this book. The chapter uses examples of scenarios within and outside education to elaborate on ways that scenarios provide visions of alternative futures and then explores the implications of such futures. Chapter 7 describes the work of the Teacher Education Futures Forum, the reasons for the creation of this Forum and the ways that the Forum embarked on the journey of scenario creation. Examples of how the scenario creation method was used at this Forum are described and illustrated. In Chap. 8, we unpack the process of backcasting and outline some cases in which we have used backcasting to promote thinking to contemplate the feasibility of alternative futures in teacher education by asking, what might have to occur to bring them about?

The third section (Chaps. 9–13) provides illustrations of our research and thinking about the future, using a STEM perspective in most of these chapters.

There is an international interest in increasing uptake and engagement in STEM, which is an acronym for Science, Technology, Engineering and Mathematics. Governments in most Western countries view STEM as the building blocks for a productive and future-oriented society and are concerned that students are insufficiently engaged with these disciplines. Three of the authors teach and research in the STEM area. Consequently, given the interest of educators and policymakers and our expertise in these disciplines, the examples of futures research chosen to illustrate the futures work are taken mainly from STEM teacher education. In this section, we tend to use the terms scenario production, scenario creation or scenario building in preference to scenario planning because this is in keeping with our projects. Scenario planning is often associated with the development of a specific plan for or response to a potential future scenario. However, we acknowledge that the distinction in the education futures literature is neither agreed nor clear. In order to respect the modes of expression used by some sources, the term scenario planning does appear in some chapters.

Chapter 9 revisits the OECD scenarios of 2001 and interrogates them in the current context. It examines the implications of the findings for teacher education and proposes an updated version of the scenarios to continue the discussion initiated by the OECD. Chapter 10 reports on the key concepts of knowledge and technology and draws on the views and opinions of international postgraduate students studying a module on educational technology as part of a full-time Masters' programme in the UK. Chapter 11 examines the implications for STEM learning of the emerging influence of mobile learning. It reports on a study of mobile learning in mathematics and science, considers the use of a pedagogical framework for mobile learning as a scaffold for teaching with mobile devices, and culminates in analysis and discussion of implications for teacher education, in areas such as preparing teachers and upskilling teachers in maths and science. Chapter 12 examines science education futures to explore the ways in which a specific discipline area seeks to shape its future(s). It first outlines some underlying challenges in present and past science education and describes the ways in which experts have proposed ideal or better ways to go about science education. The work reported here draws on data from Australia but is located in an international context. Finally, Chap. 13 describes how student teachers view the future of mathematics teacher education, using scenarios and backcasting to gather their views. This chapter uses the students' voices to discuss possible futures, which allow us to revisit current contexts and plan for the future. It suggests the use of new trajectories and pathways rather than allowing our current experiences to dictate our future ones.

The final chapter of the book, Chap. 14, elaborates the benefits of building, analysing and working with futures that might never come to be. Scenarios and backcasting are used to inform us about the present and our journey to the future. They identify critical points of potential change and test the viability of alternative futures. Turning points are discussed to highlight key differences between futures that might simply arise from current trajectories as opposed to futures we choose to design. This chapter also serves as a conclusion to the book and highlights insights that result from futures thinking.

Conclusion

This book will not only highlight successes and failures; hindrances and affordances; and social, political, historical and economic dimensions that impinge upon our teacher education futures, but also foreshadow exciting developments for further research. Accordingly, we hope this book will instigate dialogue and expand inquiry that will have significant impact shaping teacher education for the next generation, and also speak to a wide audience of stakeholders in government, higher education and education broadly. The chapters explore the strongly reflexive relationship between what gets taught at school and societal mores, norms and visions. We investigate this relationship and the kinds of teaching practices, learning environments and alternative forms of schooling—and hence teacher education—that might be appropriate now and in the future. We examine teacher learning in changing environments and new approaches to educating young people in ways that are relevant, equitable and sustainable. We provide insights into learning and we critique current and new directions for schooling and teacher education to test their alignment with and potential contribution to radical changes in twenty-first-century societies.

We invite the reader to engage with the debates and questions that arise from this book, consider ways of applying its new insights and suggest ways forward to a strong and healthy future in teacher education.

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Chapter 2
Key Drivers of Teacher Education

Abstract In this chapter, we explore the ways in which education and schooling have been shaped by demands of policy and industry. These drivers of education are often characterised by conflict with the values, beliefs and behaviours of teachers and teacher educators. Through an investigation of contexts that allow examination of some of the tensions present in education, we illustrate how powerfully education is now constructed by forces outside of the schooling system itself. However, the chapter ends by drawing attention to the place of teacher educators to act as agents of change precisely through identification of existing drivers, recognising this opportunity for the creation of new drivers which reflect the values of the school system.

Keywords Globalisation · Professionalism · Knowledge · Technology
Drivers of education

Introduction

Education is in conflict. Characterised by competing demands, beliefs and purposes, education nevertheless is the means whereby future societies are shaped and the economic success—or otherwise—of those societies are determined. In this chapter, we examine some of the tensions and paradoxes that exist within the field of education and the impact these have on determining the future trajectories of teacher education.

What Is Education for?

The simplicity of the question belies the complexity of the issues that lie beneath. Any response carries within it a set of ideologies, societal and individual values and ambitions relating to purpose. Within purpose, there resides, whether articulated or

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silent, beliefs about the legitimacy of an educational system relating to scope, significance, teacher role, engagement with society and legitimate ownership of educational outcomes. These variously place the global versus the local, autonomy versus centralisation, knowing how versus knowing what, technology as democratisation and technology as control, at opposite ends of a spectrum undefined and unbounded, as the frenetic pace of current demands in education jostle with attempts to read likely future policy imperatives. Within this, teachers and teacher educators attempt to deal with both the extant and the possible, and yet retain a sense of integrity about their working lives.

Unpicking any answer to what education is for therefore has to reveal a positioning on a range of issues, which we term drivers, serving to shape the needs and actions of teachers and teacher educators. Exploring some of the drivers will enable an understanding of the ways in which these stand alone and intersect one with another to compound already complex sets of expectations, and illuminate the decision processes which reside within these drivers.

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It would be unlikely to ask this question and not receive the answer 'students'. Yet students stand as a marker of the demands of a future society, as yet unknown and to some extent unimaginable. What we do know however is that the reach of the global is already a reality for students and the employment market is constructed to reflect this. Education and educators have to anticipate the global—a construct which requires a projection of future economic and societal needs, sensed rather than secured. Two key concerns emerge in relation to the global imperatives. One, outlined above, is the relative unknowability of future global needs; the second is that education, in the Western world at least, is largely constructed as responsive to individual needs and inevitably, therefore, has to be cast as 'local' rather than global.

Unknowability

Unknowability does not mean that the future cannot be to some extent imagined. Industry, and indeed society, projects and tests constructs which create possible scenarios, and from there backcast systems and resource needs to answer those scenarios. As these inevitably change and mutate, these systems are amended or replaced to accommodate new events. Education is part of that wider system and subject to the same shifting sands of response and change. However, there are also differences. Industry has many outcomes but an overriding and shared expectation in the capitalist world is that of profit. All other concerns are subservient to profit-making and global needs are constructed around this imperative. Education,