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Technology Education for 21st Century Skills**

Primary Design and Technology: Perceptions and practice

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Abstract:

Design and technology is recognised in many countries as a valuable subject in developing children's knowledge and skills about materials, as well as decision making through creative design processes. As such it makes a unique contribution to a child's general education and provides a foundation for future work with all forms of technology across professional and personal lives.

However in England and Wales, the countries where the subject was first conceived, following educational policy change and the subject's exclusion from the English Baccalaureate, design and technology is persistently required to justify its place within the curriculum (DATA 2011). Amid concerns that primary teachers are insufficiently trained to teach design and technology (DATA 2015) and set within the context of primary education and building upon findings from earlier research (Bell et al. 2016), which sought to establish the range of design and technology work currently being undertaken in primary schools, this paper presents next phase research findings.

Constructivist grounded theory (Charmaz 2006) is the adopted method, and drawing upon empirically grounded data, this paper explores the attitudes and perceptions of primary school teachers.

Participants were encouraged to reflect upon their own experience, to establish if they believe they received sufficient subject specific training. Work then explores their perceptions, to determine if they perceive that their personal subject knowledge has a direct impact upon the breadth and quality of work undertaken. Emergent findings are discussed in relation to the value placed upon of design and technology, and findings suggest that curriculum delivery is compromised where teacher confidence is low.

Future work will seek to investigate teacher perceptions further, aiming to explore the correlation between teacher's personal subject knowledge and the quality and creativity of work undertaken in design and technology, with a particular focus upon how knowledge is constructed and understanding developed.

Introduction:

There is little empirical evidence available that makes clear primary school teachers' beliefs and perceptions in relation to the subject of Design and Technology in England and Wales. In light of recent curriculum change (DfE 2013a) it is important to investigate the impact that policy change has had on classroom practice. Set within the context of primary age phase education in England and Wales (Ages 5 – 11 years old), amid concerns that primary school teachers are insufficiently trained to teach design and technology (DATA 2015; Benson and Lunt 2011), and anecdotally limited formal opportunities for teachers to undertake subject specific professional development. This paper presents findings from research which initially

sought to establish the range of design and technology work currently undertaken in such settings, before exploring the perceptions and practice of primary school teachers, and primary teachers in training, to establish if they perceive that their personal subject knowledge has a direct impact upon the depth, breadth and quality of work they undertake in design and technology.

The evolution of the primary design and technology curriculum:

Design and technology is a valuable subject (Barnes et al. 2002; Middleton 2005; Barlex 2007; DATA 2011; Owen-Jackson 2013; Hardy 2015) which makes a unique contribution to a child's education, yet in the country where the amalgamated 'new' subject of design and technology was arguably conceived (DCSF 1989), it faces a constant challenge, battling to position itself as a subject of worth within the curriculum within both the primary and secondary age phase.

After almost three decades of curriculum reform (DfE 2013a; 2013b) design and technology has been persistently marginalised (Bell 2016; Green 2014). Within primary education in England and Wales a child's entitlement to receive design and technology's remains, whilst the quality assurance mechanisms have been removed. Subject specificity is no longer reported as a discrete outcome under the latest iteration of the inspection framework (Ofsted 2015), indeed it is sometime since separate subject reporting was a feature of educational quality assurance in England and Wales (Elliott 2012). Quality assurance of school phase education in England and Wales is directed by the Department for Education (DfE) and enacted by the Office for Standards in Education, Children's Services and Skills (Ofsted). Thus there is no centralised mechanism that reports findings which relate to the quality of primary age phase design and technology provision.

Methodological approach and research methods:

The approach adopted for this study aligns with constructivist grounded theory (Charmaz, 2006). Underpinned by an interpretivist ontology, this approach adopts an abductive methodology, which combines both inductive and deductive theory generating procedures. The resultant being that theoretical concepts are constructed, rather than being 'discovered', with reasoning being undertaken after analysis of the data. In this study both qualitative and quantitative research methods were utilised, so it could be said that a mixed methods (Cohen et al. 2013) approach was an underpinning factor in the research design. Data was collected using a combination of multimodal questioning, an online survey and semi-structured interviews.

The research sample:

Convenience sampling (Cohen et al. 2013) was utilised for participant selection during the initial research phases which engaged two hundred and fifty one participants (n=251). During this initial phase of the study, participants were either primary age phase qualified serving teachers, or student teachers, (both undergraduate and postgraduate), currently training to teach within primary age phase settings located across England and Wales.

Subsequent research phases adopted purposeful and finally theoretical sampling techniques, and engaged 18 participants, who were all primary age phase qualified teachers. Participants were drawn from a wide range of educational settings, and selected to ensure diversity of experience, personal attributes and demographic characteristics.

Procedures for data analysis:

In line with this study's chosen methodological approach concurrent data generation and analysis occurred, with emergent outcomes from each research phase informing subsequent ones. Utilising methods advocated by Bryant and Charmaz (2007) and Charmaz (2014) care was taken to ask exploratory, rather than interrogative questions, with coding analysis procedures advocated by Glaser (1992) and Charmaz (2014) being employed. Data gathering occurred until saturation of the theoretical conceptual categories was deemed to have happened by response replication.

Ethical considerations:

Prior to participant engagement, the aims were explained to all participants and informed consent obtained. Interviews took place in a neutral setting, at a time convenient to the participants, within the ethical guidance framework as described by the British Educational Research Association (BERA 2011). Semi-structured interviews utilised procedures advocated by Bowden and Green (2005) and Charmaz (2006, 2014), and were recorded and transcribed verbatim, with care taken to accurately record responses in order to avoid misrepresenting the false attribution of meaning to comments and phrases. This ensured researcher neutrality prevailed and the data was not tainted or influenced by the pre-conceived ideas of the research team.

Presentation of findings:

Initial research sought to establish the range of design and technology work currently being undertaken in primary age phase settings. This phase engaged the full research cohort of participants (n=251), who were either qualified teachers or students training to become primary age phase teachers within England and Wales.

Using multimodal data collection methods at this a stage of the study participants were asked;

1. What is being taught?

This question sought to establish the breadth of work currently being undertaken within primary schools in England and Wales by asking participants what is actually being taught in the classroom, as such the responses for both groups of participants were combined. Figure 1 illustrates the range of projects identified by the study as currently being undertaken. As this was an open ended question, the definition of what *is* a primary age phase design and technology project was open to participant interpretation, and yielded the following responses;

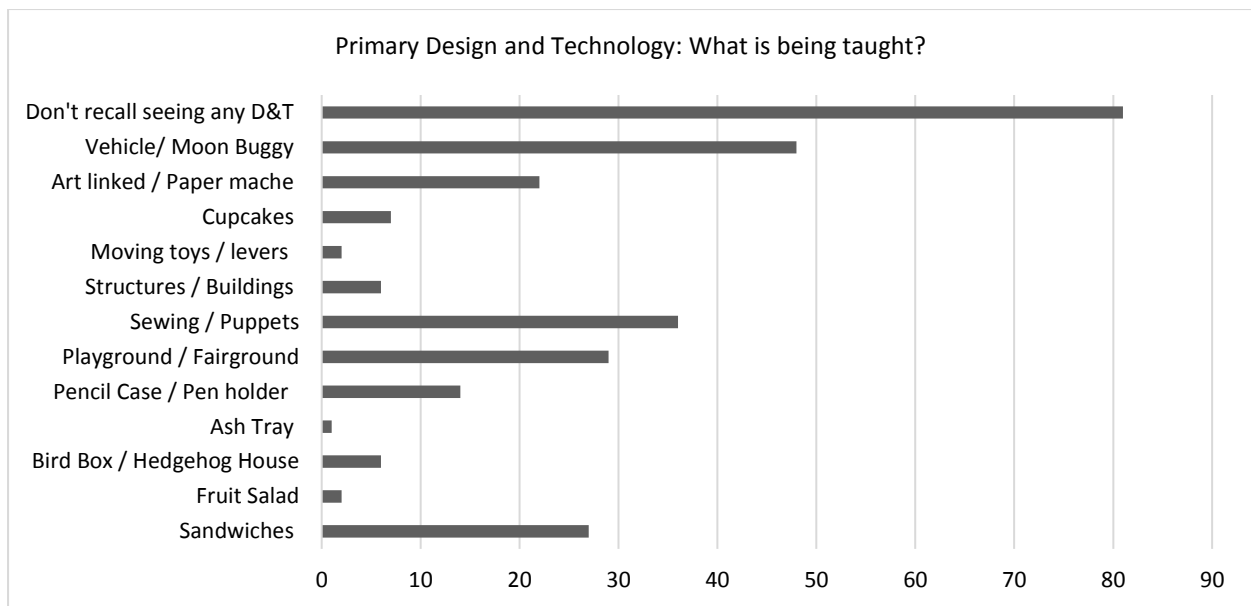


Figure 1: Primary design and technology; what is being taught?

Summary and discussion of initial research findings:

Outcomes of analysis from findings gleaned during this initial phase informed the development and direction of subsequent phases. First phase findings indicate, as could be predicted, that there is a range of activity perceived to be design and technology currently being undertaken in primary schools across England and Wales. However of the 251 participants 32.2% (n=81) reported that no design and technology activity was undertaken within their educational setting.

This statistic could be attributed solely to student teacher responses, as they may not have witnessed any design and technology activity within their setting whilst undertaking their professional placement. This is not to say that schools in which these students were placed were failing to provide the statutory design and technology curriculum entitlement for their students, rather the very short time schools spend on primary design and technology have not been coincidental to the timing of the individual students placement. However this in itself raises concerns in relation to the number of students currently training to teach, who may not have the opportunity to gain practical experience of subject delivery during their training in a school setting.

This is something which has not gone un-noticed. In expert witness testimony to a cross party education select committee, the assistant chief executive of the national subject association, The Design and Technology Association (DATA) drew policy makers' attention to the statistic that primary age phase teachers in training could actually be expected to deliver primary design and technology with as little as four hours subject knowledge input as part of their teacher training course. (Mitchell 2016).

In terms of the work undertaken 8.8% (n=22) of participants cited art linked/ papier-mâché work as some of the projects which they observed taking place. Within the primary Key Stage 1 and Key Stage 2 national curriculum (DfE 2013a) this would not usually be considered to fulfil the design and technology requirement for subject knowledge. Popular work identified as being undertaken in schools included food related tasks [sandwiches, cupcakes and fruit salad] which when combined accounted for 14.3% (n=36) of responses and the creation of vehicles / moon buggy's which accounted for 19.1% (n=48) of responses.

Underrepresented activity within the confines of the curriculum (DfE 2013a; 2013b) included those areas which could be considered to be more technical in nature with project work including the delivery of levers and structures accounting for only 3.1% (n=8) of responses.

Identification of Phase 2 Participants:

In line with the study’s methodological approach, findings from analysis of the first data phase informed the direction of the next phase. Analysis was supported by the use of theoretical memos, and work focused on how aspects of the study related to participants experiences of their practice, and represented some of the challenges found within participants’ working environments.

Data collection methods included multimodal survey techniques, with follow up interviews. This phase focused on 18 participants, all of whom were qualified, serving primary age phase teachers, rather than teachers in training.

Participants were selected in accordance with Geertz’s (1973) methodology for determining a purposeful and theoretical sample from an identified cohort. It was anticipated that this would yield the most representative sample of participants who in turn could provide a rich and varied account of their experience (ibid).

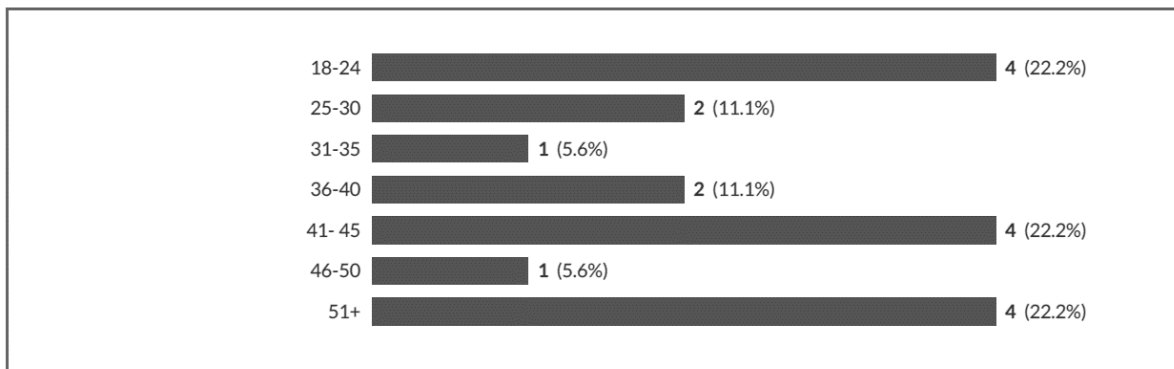
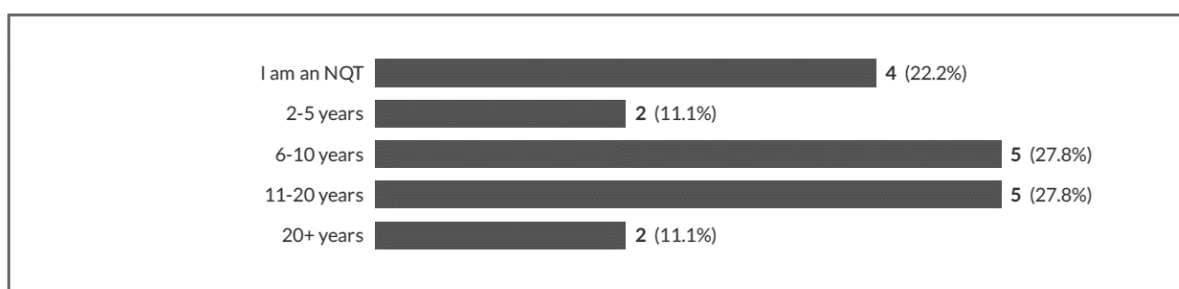


Figure 2: Age demographic of the second phase participant cohort.



Note: A Newly Qualified Teacher (NQT) is someone in their probationary year following the successful completion of their teacher training course.

Figure 3: Length of service of those in the secondary phase cohort.

Findings from the second phase:

During this second phase participants were asked a series of questions relating to their experience of design and technology curriculum arrangements in their own context, aspects of; planning, preparation, delivery and confidence were all investigated. Initially the study sought to establish *‘How often / how many hours is design and technology taught within your*

school / setting?' participants reported the following responses in a pre-coded matrix of options:

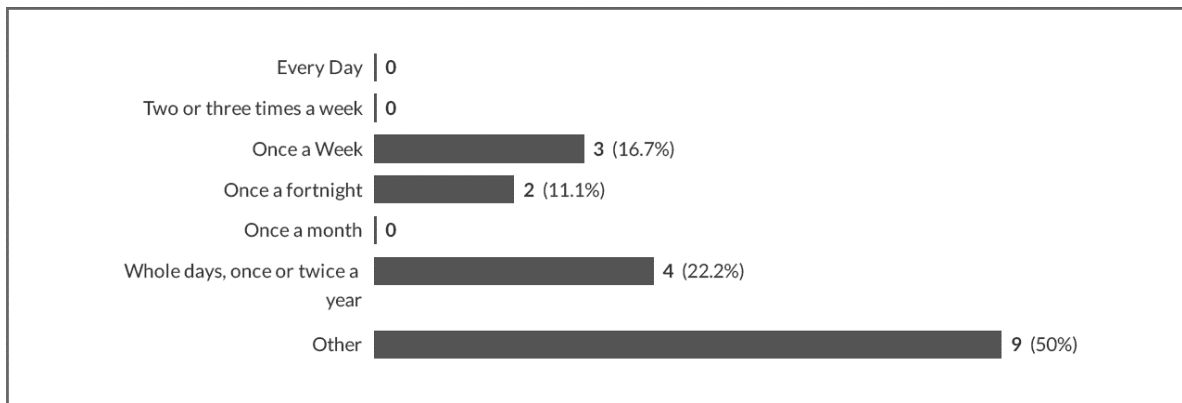


Figure 4: Frequency of design and technology teaching

Following this, the next question sought to establish if the participant perceived they had received any specific training, or they held any specialist qualification, in order to enable them to plan for and deliver design and technology:

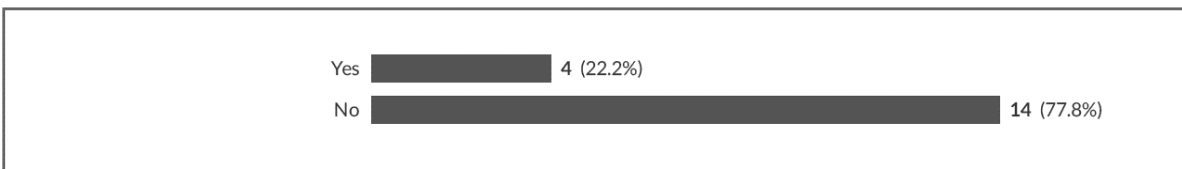


Figure 5: Participants experiences of their own design and technology training and qualification

This was followed with a question designed to explore participant's confidence and readiness for the delivery of design and technology in the classroom.

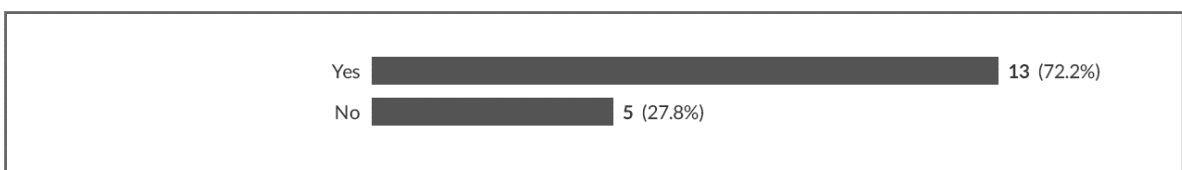


Figure 6: Participant confidence in their own ability to deliver design and technology.

Given that the study has already sought to investigate training and confidence, the research team felt it important to also look at the levels of resourcing and support for teachers of design and technology in the primary age phase classroom. A pre-coded set of alternatives were open to respondents, however, they were free to select as many options as they desired. Consequently the 18 participants provided a cumulative total of 33 responses, making the response rate to the question to be 1.83 responses per participant.

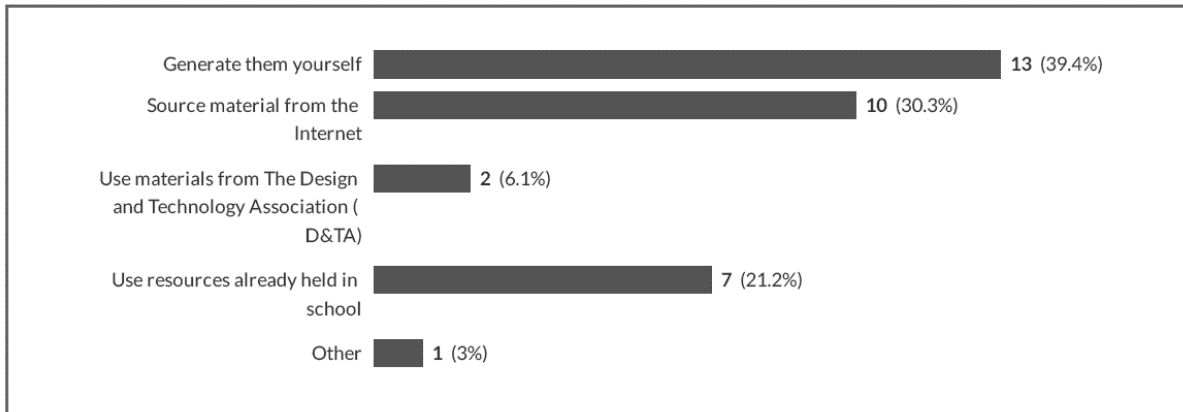


Figure 7: Data showing sources participants used to source support materials for their design and technology lessons.

A follow up question was asked about the setting in which the participants worked, and it sought to establish if any participant or their school held membership of DATA. No one indicated that either they or their school (100%, n=18) were affiliated to DATA.

To conclude participants were asked to contribute any other relevant information not previously covered. 38.9% (n=7) of participants responded to with the majority highlighting limited curriculum time and the impact of financial restrictions on both equipment and resources:

It's a real shame to think that 20 years ago, my classroom had a workbench and simple tools. There is no such facility in any primary school anymore.

Participant Four

Schools do D&T as a treat at the end of a unit of work if applicable and it is not respected as a standalone subject in the curriculum.

Participant Eighteen

Analysis of second phase findings:

Analysis of the second phase findings revealed that in the majority of primary age phase settings (72.2%, n=13) design and technology activity took place over the space of whole days for no more one or two times per year, with only 16.6% (n=3) of participants indicating that design and technology was taught within their scheduled school curriculum once a week. Where participants had cited delivery during blocks of time, further analysis illuminated some creative approaches to content delivery, frequently linked to whole school cross-curricular project and topic work.

The two questions which looked at training and qualification when compared to the one that explored teacher confidence show a direct correlation. The numbers of participants who identified that they had no qualification or training (77.8% n=14, Figure 5) was reflected in a seemingly linked lack of confidence in their own ability to deliver the subject (72.2% n=13, Figure 6). Interestingly, one participant self-determines that they have the confidence to deliver the subject effectively but they have no training or qualification to underpin this.

In considering the planning and preparation of design and technology lessons, one participant said they not generate or use resources. The majority of participants (72.2% n=13, Figure 7) said they either generated their own resources, or acquired resources from the Internet (55.6% n=10, Figure 7). As previously mentioned, this question allowed users to record multiple options, so collectively, from all of those selected this represents 69.7% (n=23) of responses against a total of 33.

Statistical information acquired from DATA (Adam 2015) indicates that the subject association has supplied 1,382 design and technology primary project resource packs in support of the primary age phase curriculum. It should be noted though, that these are only available to purchase and there is no cost free option. As previously highlighted, in this study no one indicated that their school held a subject association membership. However, 11.1% (n=2) of participant's indicated they did utilise some DATA primary resources which could mean that they borrowed resources or obtained them whilst working at a previous school.

In January 2015 there were 24,317 primary schools and academies in England (DfE 2015), and 1,330 in Wales (Welsh Government 2015) which would account suggest only 5.4% of primary schools have purchased the DATA resources to support the delivery of design and technology in their schools.

Discussion and conclusion:

Findings from this study make clear that there are pockets of excellence in the delivery of primary phase design and technology education, however analysis of findings suggests that in the majority of instances a restricted primary design and technology curriculum is in operation, if it exists at all.

Nascent patterns from the data would suggest that in addition to the lack of training to deliver design and technology aligned to teacher self-confidence and belief in their intrinsic ability to deliver the subject. This confidence level could be impacted by the non-uniform method of delivery in schools, and consequently the infrequency of regular lesson planning, preparation and delivery will be a contributory factor in the quality of design and technology work undertaken.

It is also worth drawing attention to the clear correlation between participants' responses from the second phase of the study to determine if they perceived that they had received any specific training, or held a qualification to support them in the delivery of design and technology. The number of respondents who commented positively here saying that they had undertaken this training (22.2%, n=4, Figure 5) almost identically mirrors the number of participants who said they felt confident to plan and teach design and technology (27.8%, n=5, Figure 6) which would suggest that the training they undertook was valued.

A worrying outcome from the study is that from the original 251 participants engaged in the initial phase 32.2% (n=81, Figure 1) indicated that they did not recall seeing any projects they would consider to fall within the design and technology curriculum. This raises the question do respondents have the ability to determine exactly what a design and technology project is? If the data from phase 2 showing those who have not received any subject specific training (22.2%, n=4, Figure 5) is considered alongside this it is reasonable to assert that a number of participants in this study have neither knowledge, confidence or training to determine when a project aligns with the design and technology curriculum.

The latest national curriculum revision (DfE 2013a) goes someway to trying to develop a suitable and fitting curriculum for pupils to undertake suitable classroom activities in order that they can effectively develop 21st Century Skills for their future studies and ultimately their intended careers. However, having concluded this initial study it shows a worrying

landscape of disparate provision across the primary sector, championed by enthusiastic but ill equipped teachers, doing their best within the circumstances they find themselves; struggling against budgetary constraints and limiting facilities, in addition to the issues of training and teacher confidence

It is clear that further work should be undertaken in this area. Of interest is the assertion that many non-subject specialist teachers are engaged in specialist subject delivery (Mitchell 2016) which undoubtedly will be having a significant impact on the quality of design and technology teaching in the primary classroom. The research team involved in this initial study is already seeking to investigate further teacher perceptions, in order to explore the correlation between teacher's personal pedagogical subject knowledge and the quality of application in practice.

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