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Traditional and progressive orientations to teaching: new empirical evidence on an old debate

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Traditionalists argue that teachers should carefully sequence the best knowledge from their subject area and deliver it directly to the whole class. Progressives argue that teachers should instead facilitate pupils' exploration of their individual interests, thereby nurturing curiosity and thinking skills. We test these claims using fixed effect models applied to data on 1,223 pupils (age 11-14) in the German National Educational Panel Study. We find few links between pupil outcomes and their teachers' orientation. The one exception is that - contrary to progressive claims - pupils develop greater interest in learning when taught by teachers with a traditionalist orientation.

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Highlights

- For centuries, educationalists have debated the relative merits of the traditional and progressive approaches to teaching.
- Using a variety of fixed effect models, we provide the first wholistic empirical assessment of the claims made by both camps.
- We find little support for the arguments made by either side, suggesting that the debate has largely been an unhelpful distraction for the field.
- The one exception is that — contrary to progressive — claims pupils develop greater interest in learning when taught by teachers with a traditionalist orientation.

Why does this matter?

For centuries, progressives have argued that the traditionalist approach to teaching risks undermining students' interest in learning. Contrary to this, we find that the traditionalist approach supports pupils interest in learning.

Traditional and progressive orientations to teaching: new empirical evidence on an old debate

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Traditionalists argue that teachers should carefully sequence the best knowledge from their subject area and deliver it directly to the whole class. Progressives argue that teachers should instead facilitate pupils' exploration of their individual interests, thereby nurturing curiosity and thinking skills. We test these claims using fixed effect models applied to data on 1,223 pupils (age 11-14) in the German National Educational Panel Study. We find few links between pupil outcomes and their teachers' orientation. The one exception is that - contrary to progressive claims - pupils develop greater interest in learning when taught by teachers with a traditionalist orientation.

Keywords: traditional teaching, progressive teaching, meta-cognition

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Introduction

In his 1938 book *Experience and Education* John Dewey remarked that "*The history of educational theory is marked by opposition between the idea that education is development from within and that it is formation from without*" (1938). Those who favour *formation from without* assume that pupils initially lack the motivation, dispositions and sense of direction necessary for learning. On this account, it falls to teachers to instil these qualities in their pupils and then teach them the most valuable curricular content. By contrast, those who favour *development from within* assume that each pupil possesses interests and curiosity that will naturally propel them toward learning. The teacher's role is thus to provide experiences that allow for the unfolding of pupils' inner potential. In summarising this debate, Dewey noted that "*so far as practical affairs of the school are concerned [this] tends to take the form of a contrast between traditional and progressive education*" (Dewey, 1938).

Dewey describes progressive education as a response to the traditionalist approach, which was apparently widespread in the 1800s. However, notable examples of progressive primary schools can be found as far back as the 18th century in Germany and Switzerland (Koops, 2012). In America, a wide variety of progressive approaches to schooling emerged in the 1890s as part of a broader cultural movement (Cremin, 1959), many of which were documented in Dewey's (1915) influential book *Schools of Tomorrow*. Progressive ideas first gained a foothold in the UK in the 1920s before rising to prominence in the 1960s (Peal, 2014). In particular, the influential *Plowden Report* of 1967 advocated for the *development from within* approach, encapsulated in its famous declaration that "*at the heart of the educational process lies the child*" (p. 7). More recently, traditionalist approaches appear to have made a comeback (Claxton, 2021), in part due to a number of influential publications arguing for the importance of knowledge-rich curricula and direct instruction (Christodoulou, 2014; Deans for Impact, 2015; Willingham, 2009).

Over a century after Dewey began writing about progressive education (Dewey, 1915) the debate between traditionalists and progressives continues unabated. For example, *The American Scholar* recently published a long essay by Natalie Wexler called *Why so many kids struggle to learn,* which criticised progressive ideas for harming pupils' education (Wexler, 2021). Around the same time, Guy Claxton released his book *The future of teaching and the myths that hold it back,* which systematically critiqued many of the central tenets of contemporary traditionalist thinking (2021). Although representative data is hard to come by, a recent poll of 1,800 teachers in England found that 65% of respondents identified as either ('somewhat' or 'very') traditional or progressive, with only 35% not identifying with either group (Teacher Tapp, 2018). Educators' ongoing interest in this debate is not surprising, given its wide-ranging implications for how we should educate children, including how we should think about discipline, select curricular content, design pedagogy, and even the fundamental goals of education.

Despite the long running and often vociferous nature of this debate, very few empirical studies have addressed it directly. Related research has studied the efficacy of interventions which reflect certain aspects of the traditional or progressive orientations (e.g. Furtak et al., 2012; Rittle-Johnson et al., 2015). Empirical research from cognitive science is also relevant to the debate in that some of the findings are argued to have implications for effective pedagogy (e.g. Claxton, 2021; Sweller et al., 2019). However, as we will set out below, these empirical studies address only part of the debate. In particular, by focusing almost exclusively on pedagogy, such research misses several important aspects of the traditional/progressive debate relating to behaviour, curriculum and the aims of education (Kohn, 2015; Peal, 2014). In order to provide a more holistic empirical test of the broader traditional/progressive debate, we take a different approach, using questionnaire data on teachers' *overall* traditional or progressive orientations across this set of issues. We then

model how this relates to the outcomes of the pupils that they teach. This is the first empirical research to address the question in this way.

A second shortcoming of existing literature is that it tends to focus solely on test score outcomes. These studies are silent on other outcomes that are of central importance to progressive educators, such as pupils' interest in the world around them, and general (cross-subject) thinking skills. A balanced empirical assessment requires data incorporating these other outcomes. We address this limitation of the existing literature by analysing a particularly rich educational cohort study from Germany. As well as the questionnaire data on teachers' traditional and progressive orientations, this data includes repeated (value added) measures of pupil tests scores, interest in learning, and domain general metacognitive skills. This wide range of outcome measures allows us to evaluate the two schools of thought on their own terms. This is the first published research to address the question in this way.

We begin the paper with a detailed exposition of the traditional and progressive schools of thought, from which we derive our four research questions. This is a followed by a description of the National Educational Panel Study data, including descriptive analysis of the questionnaire data that we use to measure teachers' traditional and progressive orientations to teaching. Next, we describe our analytical approach, including the two fixed effects specifications that we employ to deal with potential confounders. Then we present our empirical findings, including tests for a number of alternative explanations for our results. The article concludes with a discussion of how our findings extend the existing literature and the limitations of our approach, before drawing out implications for educators and researchers.

The traditional orientation

In line with the idea of formation from without, traditionalists argue that teachers have to model and then inculcate in students the right approaches to study and behaviour (Bennett,

2020; Peal, 2014). This draws, in part, on Aristotelian ideas about virtue as habitual right behaviour (Curren, 2010). The challenge for educators is therefore to develop good habits in their students through the "*externally guided repetition of certain sanctioned actions*" (Cochran, 2018, p.675). In doing so, their students will in time come to feel pleasure in acting rightly and rationally-endorse studious behaviour, based on a learned understanding of its value (Sanderse, 2015). Thus, teachers are justified in establishing orderly routines in the classroom and consistently enforcing rules. Once an orderly learning environment has been established, traditionalists aim to share specialised knowledge with pupils (Hirsch, 1997; Young, 2007). Since the best knowledge is universal, traditionalists aim to convey broadly the same cannon to all pupils (Ballinger, 1959). This desire to equalise knowledge is sometimes framed in democratic terms – to "*establish between all citizens an equality of fact*" (Cordorcet, quoted in Duge, 1971 p.277). Elsewhere, it is framed in economic or instrumental terms. For example, that teaching pupils disciplinary knowledge will help pupils go on to make useful discoveries in science and technology (Avery, 1997; Baker, 2004).

With respect to pedagogy, traditionalists have turned to cognitive psychology to help achieve their educational aims. In particular, many traditionalists have turned to *Cognitive Load Theory* which derives implications for instructional design from a particular view of 'human cognitive architecture' (Sweller et al., 1998). This architecture includes working memory, which deals with information currently held in mind, and has a strictly limited capacity, and long-term memory, which is thought to be unlimited in capacity (van Merrinboer & Sweller, 2010). The instructional implications of this are that new information should be presented to learners in small doses in order to avoid overwhelming the limited capacity of working memory and, conversely, that our ability to engage in new learning or problem solving depends on having considerable quantities of relevant information stored in our more capacious, long-term memory. This line of reasoning weighs heavily against

minimally guided instruction, which is likely to present information in a quantity or sequence that is not conducive to the retention of new information (Kirschner, Sweller, & Clark, 2006). Hence, cognitive load theory can be used to justify the traditionalists' view that teachers should carefully sequence and control instruction to avoid these pitfalls. Cognitive load theory also implies that problem solving depends on existing knowledge related to the specific problem, rendering domain general 'problem solving skills' inert (Tricot & Sweller, 2014). Again, this can be used to justify traditionalists' view that curricula should be rich in knowledge from specific academic disciplines.

In summary, traditionalists argue that teachers should carefully select and sequence the best knowledge from their subject areas and then deliver it directly to the whole class, while maintaining order. Note that the aims and methods of the traditionalist orientation have a natural coherence. If the purpose of education is to empower, then there is a moral imperative to provide pupils with the knowledge necessary to protect their interest and influence the world around them. Since pupils begin their education in a position of ignorance, this knowledge must be selected by teachers expert in certain curricular areas. Moreover, mastering this large body of knowledge requires efficient methods of instruction, enabled by an orderly learning environment. The teacher is therefore also central in carefully designing and sequencing instruction to this end. Further, since the most powerful knowledge is the same for all pupils regardless of background, and all pupils share the same basic cognitive architecture, this supports standardised, whole-class instruction.

What does existing empirical research suggest about the traditionalist school of thought? There is now considerable evidence about the importance of habits in explaining human behaviour (Webb & Sheeran, 2006). However, the empirical literature on improving pupil behaviour in schools remains small and does not directly address traditionalist arguments (Korpershoek et al., 2016). With respect to traditionalist pedagogy, empirical

evidence has accumulated for cognitive load theory (Sweller et al., 2019). However, while relevant, this evidence relates to specific cognitive 'effects', such as the worked example effect, rather than traditionalists pedagogy in the round. Research that is more directly classroom-based comes from evaluations of training programmes aimed at helping teachers to use particular pedagogical approaches. For example, meta-analyses have found that science teacher training programmes focused on promoting more teacher-directed pedagogy (which reflects the traditionalist approach) tend to have greater impact than those promoting a more student-led approach (Furtak et al., 2012).

The progressive orientation

In line with the idea of development from within, progressives argue that teachers should aim to nurture the natural curiosity and interests of each child (Koops, 2012; Oelkers, 2002). This implies a very different way of structuring education (Oelkers, 2002). In particular, progressives worry that a routinised approach to learning will smother children's natural inclination to learn: "of what use would reading be to him after he had been disgusted with it forever?" (Rousseau quoted in Israel, 2012, p.7). In any case, such an approach is unnecessary for progressives because they do not aim to pass on a large cannon of knowledge inherited from the past. Instead, they prefer to focus on providing student with authentic problems that more closely mirror those they will encounter in the world outside of school, thus nurturing pupils "intelligent in the pursuit of the activities in which they will engage" (Cremin, 1959; Dewey & Dewey, 1915, p. 249). Since this future is inherently uncertain, progressives argue that teachers should focus on the development of domain general critical capacities, metacognitive skills, and experimental attitudes, that will equip them to deal with whichever novel challenges they might go on to face (Darling & Nisbet, 2000; Dewey, 1897; Kohn, 2015; Robinson & Aronica, 2015).

To achieve this, progressives argue that children should be supported to pursue their natural inclination to explore their environment, thus helping to foster independent, inquiring minds (Darling, 1993). This implies that the teacher's role is to facilitate such experiences through presenting children with relevant stimuli, supporting learning through engaging problems in the environment, or interactions with others. In concrete terms, this often takes the form of project-based learning, in which pupils explore practical problems (Blumenfeld et al., 1991). Progressives thus ascribe to a constructivist view of learning in which children build their own knowledge of the world through "the continuing reconstruction of experience" (Dewey, 1897). This experiential, student-directed approach to learning also ensures that what is learned is suited to the child's developmental stage (Plowden, 1967). Indeed, in the progressive view "development accounts for learning much more than the other way round" (Piaget, quoted in Almy, Chittenden, & Miller, 1966).

In sum, progressives argue that teachers should focus on facilitating individualised learning experiences in which pupils can explore their natural inclinations, thus nurturing their interests and developing general thinking skills. As with the traditionalists, the aims and methods of progressive thinking have a natural coherence. If there is a moral imperative to prepare the child for an uncertain future, then it is necessary to nurture their abilities to explore and solve problems. Since pupils naturally tend toward curious exploration of their environment, the educator's role must in turn be to nurture the unfolding of that capacity through facilitating such experiences. The apparent inefficiency of this error-prone, experiential method of learning is not a concern for the progressive since, unlike the traditionalist, they are not attempting to transmit a body of knowledge. Rather, for the progressive, the development of the inclination and capacity to investigate, test and adapt is the goal.

What does existing empirical research suggest about the progressive school of thought? There is now a sizable empirical literature suggesting that providing choice and autonomy to students helps support their motivation for learning (Cheon et al., 2020; Reeve & Cheon, 2021; Vasconcellos et al., 2020). There is also some empirical support for the claim that less guided, more experiential forms of learning are related to increased pupil interest in learning - though the literature is small and often employs weak research designs (Lamnina & Chase, 2021; Potvin & Hasni, 2014; Swarat et al., 2012). In contrast, the extant literature on metacognitive skills suggests that these are best developed using explicit instruction rather than unguided experiential learning and tend to be domain-specific rather than domain general (Fleur et al., 2021; Muijs & Bokhove, 2020).

The present study

The overarching aim of this study is to empirically test the claims made by the traditionalist and progressive schools of thought. In contrast to prior studies, we do so by measuring teachers' traditional and progressive orientations using questionnaire data and then using this to model teachers' influence on their pupils' learning and development. We define these orientations as clusters of beliefs - psychologically held proposition thought to be true (Philipp, 2007) - that are aligned with the two schools of thought. This novel approach allows us to provide a more holistic and direct test of the underlying theory.

Having said that, our novel approach also requires us to make certain assumptions. In particular, we do not directly observe teachers' classroom practice in our dataset. Instead, we rely on the plausible assumption that teachers with a more traditionalist or more progressive orientation will in practice adopt different approaches to teaching (see Ernest, 1989). We believe that this assumption is justified for two reasons. First, empirical studies consistently find positive correlations between teachers' espoused beliefs on the one hand and both their self-reported classroom practice (Saadati et al., 2019; Wilkins, 2008; Whitley et al., 2019;

Yang et al., 2020) and observed classroom practice on the other hand (Bray, 2011; Buehl & Beck, 2015; Stipek et al., 2001). Second, we provide indirect empirical support for this assumption by showing that teachers' traditional and progressive orientations do indeed feed through into their *self-reported* classroom practice in the way that our theoretical framework would predict.

Using this approach, we set out to provide new empirical evidence on the following four specific research questions (RQ):

- **RQ1**: Do pupils make faster progress in academic subjects when they are exposed to teachers with a more traditionalist orientation? This RQ is motivated by the traditionalist argument that their approach to teaching is more efficient than that of progressives.

- **RQ2**: Do different pupils make more equal progress in academic subjects when they are exposed to more traditionalists teaching? This RQ is motivated by the traditionalists commitment to spreading knowledge more equally and their commitment to using standardised curricular and whole-class pedagogical approaches suited to this task.

- **RQ3**: Do pupils display greater interest in learning when they are exposed to more progressive teaching or more traditionalist teaching? This RQ is motivated by progressives' contention that pupils are naturally curious, and that routinised approaches to instruction undermine this.

- **RQ4**: Do pupils make faster progress in developing domain-general metacognitive skills when they are exposed to more progressive teaching? This RQ is motivated by the progressive argument that student-led experiential learning helps develop domain general thinking and problem-solving skills.

Setting and Data

To answer these questions, we draw on the National Educational Panel Study (NEPS): a family of six cohort studies based in Germany (Blossfeld, von Maurice, & Schneider, 2011). NEPS is uniquely appropriate for our purposes because it includes measures of pupil achievement over time as well as rich parent, pupil and survey data capturing the other key

constructs (e.g. pupil interest) present in our research questions. Compulsory schooling begins at age 6 (Grade 1) in most German states and the vast majority of pupils attending state schools are allocated to elementary schools based on geographic proximity, with no opportunity to express preferences over schools within their area (Berendes et al., 2019). At age 11 (Grade 5), state-school pupils are allocated to one of four types of lower-secondary school depending on their academic achievement at the end of elementary school (Fabian et al., 2019). All pupils then remain at lower secondary school until age 14 (Grade 9), at which point some progress to further academic study and others move into vocational training (Fabian et al., 2019). We use NEPS Cohort 3 data (lower-secondary school, age 11-14) because, unlike the other cohorts, it measures teachers' traditional/progressive orientation in every survey wave.[i] We estimate all our models using variation within schools, in order to account for selection of pupils/teachers into lower-secondary schools.

NEPS is based on a complex sample design (Aßmann et al., 2011) in which strata were first defined based on geographic regions within Germany, then educational institutions were sampled from within each stratum with probability proportional to size. The original Cohort 3 sample contained 11,563 pupils in 378 lower-secondary schools, of which 6,112 pupils (52.9%) gave their permission to participate in the study (Zinn et al., 2020). In the third wave (Grade 7) the sample was boosted through inviting a further 3,944 students from the same schools to join the sample, of whom 2,205 (55.9%) gave consent to participate. Our final analytic sample is somewhat smaller than this because we can only use data for pupils who yield a pre-test and post-test and also have teachers who respond to the 'orientation to teaching' items in the teacher questionnaire. Wave specific response rates for pupils are between 76% and 95% (Zinn et al., 2020) and 89.1% of teachers provide a usable response to the teacher questionnaire.

Dependent variables

Answering RQ1 and RQ2 requires us to employ measures of pupil academic achievement in particular subjects as our dependent variable. NEPS Cohort 3 includes regular assessment of pupils across a range of subjects. We focus on maths and German, on the grounds that (unlike in science) both maths and German teachers respond to the questionnaire measuring their traditional/progressive orientation to teaching. Pupils in Cohort 3 were tested on maths and German in Grade 5, 7 and 9. Tests were administered in groups using pencil and paper or, in more recent waves, on computers. Each assessment lasts for around half an hour and is based on a mix of multiple choice, matching, and numerical answer formats (Pohl & Carstensen, 2013). These tests have been shown to have good reliability, with EAP/PV reliability of 0.81 and WLE reliability of 0.79-0.81 in Grade 9 (Ham, Schnittjer, & Gerken, 2018; Scharl et al., 2017). An important advantage of this test data is that the scores are derived using item response theory and equated across assessment waves, using either common items or through separate linking studies in which pairs of assessments are both administered to a separate sample (Fischer et al., 2016). This allows us to measure absolute growth in pupil achievement across waves, as opposed to just changes in pupils ranking within their cohort.

Answering RQ3 requires us to employ measures of pupils' interest in learning. In grade 6 and 9, the pupil questionnaire included four items assessing the respondents subject-specific interest in reading e.g., "I really enjoy learning more about myself and the world from reading books" and "It is very important for me to become more familiar with the German language and literature" (McDonald's Omega = 0.8). Likewise, in grade 6 and 9, the pupil questionnaire included four items assessing the respondent's subject-specific interest in math e.g., "I am willing to use my free time to learn more about math" and "I enjoy puzzling over a mathematical problem" (Omega = 0.81). We argue that these four items capture

individual interest, comprised of pupils' relatively stable affective ("I enjoy") and evaluative ("important for me") orientation toward each of the two subjects (Schiefele, 2009). We use confirmatory factor analysis to create two quasi-continuous variables capturing pupils' subject-specific interest in each of German and maths. The distribution of these variables can be seen in panel 1 and panel 2 of Appendix Figure 1.

Answering RQ4 requires us to employ measures of metacognition, which is often defined as 'thinking-about-thinking' and can be traced directly back to Piaget's theory of child development (Fisher, 1998). More specifically, we focus on metacognitive knowledge, which consists of "…beliefs about what factors or variables act and interact in what ways to affect the course and outcome of cognitive processes" (Flavell, 1979, p. 907). This can be decomposed into knowledge about person (e.g., I tend to forget dates), task (e.g., it is easy to miss important information in an exam question) and strategy (e.g., creating a plan improves the quality of my subsequent writing). This is operationalised in NEPS using a 15-minute scenario-based metacognitive knowledge test in which pupils are asked to rate different approaches to solving age-appropriate, subject-general problems (Händel et al., 2013). More specifically, students are presented with eight scenarios, each of which is accompanied by six strategies for approaching the scenario. Students were then asked to rate each of the strategies on a four-point scale ranging from 'not useful at all' to 'very useful'. Scores were then generated by comparing pupils' responses to answers generated by a panel of metacognition experts (Händel et al., 2013). This test was administered to Cohort 3 pupils in Grade 6 and Grade 9. The distribution of these variables can be seen in panel 3 and panel 4 of Appendix Figure 1. Table 1 provides descriptive statistics on the NEPS sample and Appendix Table 1 summarises the outcomes measures for each research question in each wave of the data collection.

<< Table 1>>

Measuring traditional and progressive orientations in NEPS

Our main variable of interest is the extent to which teachers report a traditional or progressive orientation. We measure this using eight items from the Teacher Orientation scale, which was administered to pupils' German and maths teachers in each of the first five academic years of the study (Grade 5-Grade 9). Column 1 of Table 2 lists the eight items, some of which capture aspects of the traditionalist orientation and some of which capture aspects of the progressive orientation. All eight items are gauged on a four-point response scale ranging from "completely disagree" to "completely agree". The columns of Table 2 include four aspects of the traditionalist orientation to teaching, as set out in the previous section. A `+` symbol in a cell indicates that the questionnaire item in that row is conceptually aligned with the aspect of traditional teaching in that column of the table. For example, Item 1 "It is better when the teacher – and not the student – decides what needs to be done" is conceptually aligned with the first aspect of the traditionalist orientation "Teachers should carefully select and sequence [knowledge]" and the third aspect "and deliver it directly to the whole class". Conversely, a `–` symbol in a cell indicates that the questionnaire item in that row runs contrary to the to the aspect of traditional teaching in that column of the table. The presence of either a `+` or `–` symbol in every column of the table indicates that, taken together, the questionnaire items do a good job of capturing the various aspects of the traditional/progressive debate about teaching.

<< Table 2 >>

Figure 1 is a diverging stacked bar chart, showing the distribution of responses to each of the eight items measuring traditional/progressive approaches to teaching. Each vertical bar represents 100% of responses to a specific item, with the proportion giving each of the possible responses represented by a different shaded region within the bar. Responses above the horizontal line reflect a traditionalist orientation; responses below the line reflect a

progressive orientation. The figure reveals that some items are more sensitive to the traditionalist/progressive distinction than others. For example, almost all respondents agree to some extent with the traditionalist-oriented statement 'Quietness in the classroom is absolutely necessary for effective learning' (item 7). The most divisive statements are the traditionalist-oriented "Classes should be based on problems with clear-cut and correct answers as well as on concepts that are quickly understood by the students" (item 4) , "It is better when the teacher – and not the students – decides what needs to be done" (item 1) and "The question of how much students will learn depends on their background knowledge - therefore the teaching of facts is vital" (item 5). These three items will likely be responsible for a large proportion of the variation in our latent variables capturing traditionalist/progressive orientation to teaching. Appendix Table 2 shows that the four traditionalist-oriented items are positively associated with each other (top left quadrant). Likewise, the four progressive-oriented items are positively associated with each other (bottom right quadrant).

To explore this further, we reverse scored the progressive-oriented items and conducted an exploratory factor analysis. A parallel analysis (Appendix Figure 2) suggested that there are indeed two separate latent variables underlying the eight items. Following an oblique rotation, the factor pattern matrix (Appendix Table 3) shows a clean structure in which the four progressive-oriented items load (>0.3) on the first factor and the four traditionalist-oriented items load (>0.3) on the second factor. This is consistent with the idea that teachers beliefs do in fact cluster into two groups that are aligned with the way that we have theorised the traditional and progressive orientations to teaching. Thus, we operationalise a teacher having a more traditionalist orientation as when they more strongly agree with our four traditionalist-oriented statements. Likewise, we operationalise a teacher having a more progressive orientation as when they more strongly agree with our four

progressive-oriented statements. The internal consistency of the scales is not particularly good, with a McDonald's omega of 0.61 for the progressive and 0.55 for the traditionalist factor. Test-retest correlations for teachers who respond in consecutive waves is 0.57 for the progressive scale and 0.58 for the traditionalist scale (see Appendix Figure 3). In order to maximise our usable sample and improve the reliability of our measures, we average teachers' scores across all waves in which they respond to the underlying survey items.

<< Figure 1 >>

Methods

We answer our research questions by running two types of value-added regression models. In Model 1, we are leveraging within-school variation in pupils' exposure to teachers with differing traditional and progressive orientations:

Model 1 (M1): $Y_{ikl} = \beta_0 + \beta_1 Trad_{kl} + \beta_2 Prog_{kl} + \beta_3 Y_{ikl-1} + \beta_4 School_l + \beta_5 Pupil_{ikl} + \epsilon_{ikl}$

Where:

- *i* indexes pupils, *k* indexes teachers, *l* indexes schools
- Y_{ikl} is a (quasi-)continuous variable (standardised to have mean of zero and standard deviation of one) representing one of our outcome variables for pupil *i,* in teacher/class *k,* in school *l*
- $Trad_{kl}$ and $Prog_{kl}$ are quasi-continuous variables (standardised to have mean of zero and standard deviation of one) representing the teachers' traditionalist and progressive orientation to teaching, respectively
- Y_{ikl-1} is the same outcome variable for the same pupil but in a prior wave
- $SchoolFE_l$ is a school fixed effect
- $Pupil_{ikl}$ is a vector of pupil characteristics: special educational needs, German as an additional language, gender, year of birth
- ϵ_{ikl} is the error term

A crucial point to note about Model 1 is that we enter the traditional and progressive orientation variables separately into the model. This allows us to test for the possibility that both the traditionalist and progressive orientations are beneficial for pupils. We do not assume a binary situation in which at least one group is wrong.

One concern with Model 1 is that pupils might get allocated to teachers with specific progressive/traditional orientations based on characteristics related to their future learning growth, which we do not observe in our dataset e.g. personality type (Von Stumm et al., 2011). For example, pupils with high levels of curiosity might be allocated to the classrooms of teachers with a more progressive orientation on the grounds that they will be more able to explore their interests in these classes. Alternatively, pupils that tend to misbehave may be allocated traditionalist classrooms on the basis that they would benefit from the more orderly environment. This could create a spurious association between a teachers' orientations and pupil outcomes.

In Model 2, we replace the school fixed effect with a narrower pupil point-in-time fixed effect. Hence, we are leveraging within pupil, within year, across teachers/subject variation in pupil exposure to teachers with differing traditional and progressive orientations. To put it another way, we ask the question: does a particular pupil experience better outcomes in maths compared to German when their math teacher has a more traditional/progressive orientation then their German teacher? This specification rules out a wide range of potential confounders, including unobserved pupil characteristics (e.g. IQ, personality type) and pupil-specific unobserved shocks (e.g. changes in family income, or stress in the home):

Model 2 (M2): $Y_{ijkl} = \beta_0 + \beta_1 Trad_{jkl} + \beta_2 Prog_{jkl} + \beta_3 Y_{ijkl-} + PupilFE_{il} + \epsilon_{ijkl}$

Where:

- j indexes subject (German or maths)

- Pupil's exposure to teachers with traditionalist and progressive orientations now varies across subjects (j) as well as across teacher (k)
- $PupilFE_i$ is a pupil point-in-time fixed effect

In our models, standard errors are clustered at the level of the primary sampling unit (schools). This accounts for the clustered sampling procedure underlying our data, meaning it is not necessary for us to use multi-level models (McNeish, Stapleton, & Silverman, 2017). We do not apply survey weights in our analysis as this would be incompatible with our fixed effect modelling approach.

Results

Table 3 provides the results of our empirical analysis addressing RQ1: Do pupils make faster progress in academic subjects when they are exposed to more traditionalist teaching in that subject? The first four columns report findings using Model 1. Note that the number of groups falls in columns (3) and (4) because the German teachers are one third less likely to respond to the teaching orientation questions compared to maths teachers. Columns 5-6 report findings using Model 2. Odd columns report findings from two separate regressions, with the traditional and progressive variables entered independently. Even columns report findings from a single regression, with the traditional and progressive variables entered simultaneously. Both the dependent and independent variables have been standardised, meaning that all coefficients can be interpreted as the standard deviation (SD) change in test scores associated with a one SD change in exposure to a teacher with either traditional or progressive orientation. Across all the specifications in Table 3, we consistently observe small coefficients, which are generally not statistically distinguishable from zero. In our preferred specification (M2), which incorporates our pupil point-in-time fixed effects, these null findings are precisely estimated, with standard errors between 0.023 and 0.025. In

sum, we find no support for the claim that pupils exposed to teachers with a traditional orientation make more progress on average.

<< Table 3 >>

Figure 2 reports the results of empirical analysis addressing RQ2: Do different pupils make more equal progress in academic subjects when they are exposed to more traditionalists teaching? We do this using quantile regression, with results estimated at the 20th, 40th, 60th and 80th percentile of the outcome distribution. Since the math and German results showed little difference in Table 3, we pool the data here to maximise power. The 95% confidence intervals all overlap substantially across percentiles. In sum, we find no evidence that pupils exposed to teachers with a more traditionalist or progressive orientation make different levels of progress depending on their position in the achievement distribution.

<< Figure 2 >>

Table 4 reports our empirical analysis addressing RQ3: Do pupils display greater interest in learning when they are exposed to more progressive teaching or more traditionalist teaching? The format of the table and interpretation of coefficients is identical to Table 3. The coefficients in the progressive row are generally small and none of them are statistically distinguishable from zero ($p > 0.05$). In the traditional row, the coefficients in columns 1-2 (Math) are negative but are not statistically significantly different from zero. In columns 3-4 (German) the traditional coefficients reveal a positive association with pupils' interest in learning (0.27-0.45 SD). In our preferred specification (columns 5-6) the coefficients remain positive and statistically significant. In sum, we find qualified support for the claim that pupils exposed to teachers with a traditional orientation display greater interest in learning.

<< Table 4 >>

Table 5 reports our empirical analysis addressing RQ4: Do pupils make faster progress in developing domain-general metacognitive skills when they are exposed to more progressive teaching? The first column reports findings from two separate regressions with the traditional and progressive variables entered independently and the second column reports findings from a single regression, with the traditional and progressive variables entered simultaneously. Coefficients have the same interpretation as in prior OLS tables. In column 1, traditionalist teaching shows a small negative association with metacognitive skills and progressive teaching shows a small positive association. However, neither coefficient is statistically significant at conventional levels. In Column 2, the magnitude of these coefficients increases slightly and the *p* value on the traditional coefficient falls below 0.1. Unfortunately, we are unable to test whether this result holds using Model 2, since our measure of metacognitive skills are not subject-specific, meaning we cannot compare across subjects/teachers within pupils. In sum, while we find some suggestive evidence that pupils' exposure to a teacher with a more traditionalist orientation is associated with a small reduction in growth in meta cognitive skills, we do not find clear support for the progressive claim that exposure to a teacher with a more progressive orientation improves metacognitive skills.

<< Table 5 >>

Alternative explanations for our null findings

The large number of null findings relating to pupil achievement above raise questions about whether our traditionalist and progressive latent variables are capturing meaningful variation in approaches to teaching. For example, perhaps teachers express strong views about their orientation when asked about their attitudes in the abstract, but this bears little relation to their actual classroom pedagogy.

We investigate this by looking at the relationship between teachers' traditionalist/progressive orientations and their self-reported use of pedagogical techniques closely associated with each of the two schools of thought. First, we look at teachers' self-reported use of direct lecturing to the class. This is closely aligned with the traditionalist orientation in that it involves direct transmission of the same information from the teacher to the whole class (Hirsch, 1997; Kirschner et al., 2006; Peal, 2014). Second, we look at teachers' self-reported use of project-based learning, which involve pupils exploring authentic problems (Blumenfeld et al., 1991). This is closely aligned with the progressive orientation in that it involves pupils pursuing their interests with a higher degree of autonomy, inquiring about a real-world problem, and working in a manner that more closely reflects how adults might operate in the workplace (Kohn, 2015; Robinson & Aronica, 2015).

The frequency with which teachers' use lecturing or projects is captured in NEPS using teacher self-report on a six-point scale running from 'Never' to 'Almost every lesson'. In Table 6, we report pairwise associations (odds ratios) between these two variables and the questionnaire items from our teaching orientation scale. The results show a clear pattern, with the traditional items showing a negative association with use of project-based learning, and the progressive items generally showing a fairly strong positive association with project-based learning. The converse pattern holds for the use of lectures. We interpret this as reassuring evidence that our null findings above are unlikely to reflect teachers' traditionalist or progressive orientations not feeding through into their classroom practice.

<< Table 6 >>

A second, measurement-related concern is that the individual traditionalist and progressive survey items may have a relationship with our outcomes, but these relationships differ in sign, meaning they cancel each other out once they are combined in our factor

scores. We investigate this in Table 7 by including each of the traditionalist items (column 1) and each of the progressive items (column 2) as separate predictors in our models. In line with our previous results, we find no evidence of a relationship at the item-level.

<< Table 7 >>

A third alternative explanation for our null findings is that traditional (or progressive) approaches to teaching may be more effective in a school that has higher levels of teachers with more traditional (or progressive) orientations to teaching on average. This is plausible, since pupils may be more adept at learning using the e.g., progressive approach, if they are already experienced with this approach. Our final empirical analysis, in Table 8, tests this by interacting a measure of the school-wide average traditional (or progressive) orientation with the focal teachers' own traditional (or progressive) orientation. Once again, we find no statistically significant relationship between test scores and traditional/progressive teaching orientations, regardless of school-wide teaching orientations.

<< Table 8 >>

Discussion

For centuries, educationalists have debated the relative merits of the traditional and progressive approaches to teaching. Over the years, theorists have spilt a great deal of ink over this debate. However, very little empirical research has directly addressed the claims made by each camp. In this paper, we set out to redress this imbalance between theory and evidence. Our findings advance the existing literature by providing the first ever empirical evidence on the relationship between teachers' traditional and progressive orientations and pupil outcomes. Crucially, this is the first paper to analyse the distinctive sets of outcomes that traditionalists and progressives argue educationalists should strive for, thus evaluating the two schools of thought on their own terms.

Perhaps our clearest results relate to research question 3, where we found that pupils exposed to teachers with a more traditionalist orientation in a given subject showed greater interest in that subject. However, this is not totally consistent across model specifications. Nevertheless, this finding runs counter to the progressive argument that direct instruction risks undermining children's interest in learning. By contrast, we found no relationship between exposure to a teacher with a more progressive orientation and pupil interest in learning.

This finding might appear to contrast with existing research. For example, several empirical studies have found that pupils show more interest when given meaningful choice or allowed to conduct their own hands-on inquiry (Linnenbrink-Garcia et al., 2013; Schraw et al., 2001; Swarat et al., 2012; Potvin & Hasni, 2014). Both of these approaches are hard to square with the traditionalist approach in which teachers sequence the curriculum and prove knowledge directly to students. However, our results can be reconciled with the existing literature when we consider that our research is focused on persistent, individual interests. By contrast, the studies supporting the use of meaningful choice and hands-on inquiry tend to focus on short-run situational interest (Schiefele, 2009; Hidi & Renninger, 2006).

Taking this into account, our findings advance the existing literature by suggesting that, while less progressive approaches might generate pupil interest in the short run, traditionalist approaches may be better at promoting sustained interest. While we can only speculate as to why this might be the case, our findings are consistent with the argument that traditionalist teachers may be able to use their control of curriculum sequencing to 'unfold' a subject in such a way that prior learning combines to suggest intriguing puzzles, which motivate future pupil learning. Existing research suggests this may play an important role in generating sustained pupil interest in a subject (Hidi & Renninger, 2006; Knogler et al., 2015; Rotgans & Schmidt, 2014).

With respect to research questions 1 and 2, we found no support for the traditionalists' claim that exposure to a teacher with a more traditionalist orientation will result in faster or more equal pupil progress. In our preferred specification, these null findings are precisely estimated, ruling out even a small association. These null findings relating to pupil learning appear to run counter to a considerable body of empirical research on cognitive load theory, which is often invoked to support a more traditionalist orientation (see Sweller et al., 2019 for a recent review). Many, if not all, of the items in our measures of traditional and progressive teaching reflect cognitive load theory in one way or another. It is worth noting, however, that cognitive load theory - like most theory - is an attempt to construct a coherent explanatory account for a series of empirical findings e.g., the split-attention effect, worked-example effect and the guidance-fading effect (Paas & van Merriënboer, 2020). It is notable that these well-established empirical effects have a much weaker conceptual relationship with the items from which we construct our measure of teachers' traditional orientation. For example, the role of worked examples is not directly reflected in any of these items. Thus, while our findings are in tension with the explanatory account provided by cognitive load theory, they are not in direct tension with the empirical effects around which cognitive load theory has been built. Our findings in relation to pupil achievement shed new light on the debate between traditionalists and progressives by highlighting that empirical finding from cognitive science do not provide a whole-scale justification for the wider traditionalist approach to education.

With respect to research question 4, we found no positive relationship between teachers' progressive orientation to teaching and pupils' growth in domain-general metacognitive skills. This does not support progressive arguments about the importance of independent exploration for the development of higher order thinking skills. Having said that, we do find a small negative association between traditionalist orientations to teaching and

pupil metacognitive skills. However, we are somewhat cautious about this result because we are not able to use our preferred model specifications for RQ4. Our findings here are broadly consistent with the existing literature. In particular, a recent review points to the need for explicit instruction in metacognitive strategies to help pupils improve their metacognitive skills (Muijs & Bokhove, 2020). Indeed, teaching of metacognition is more effective when it relies on scaffolded activities conducted after the substantive learning activity, rather than during the substantive learning activity (Michalsky et al., 2009; Muijs & Bokhove, 2020). This runs counter to progressive's claims that such skills will emerge from pupils' self-directed explorations. In sum, while our research is the first to directly test the relationship between teachers' orientation and growth in pupils' metacognitive skill, our findings largely serve to corroborate related research.

Limitations

These finding should, of course, be interpreted in light of the limitations of this study. Four in particular stand out. First, while our pupil point-in-time fixed effects approach can account for a wide range of potential confounders, it still falls short of the ideal experimental test. Second, our data relate to a single country. Germany shares many important characteristics with other more economically developed nations. However, as with all data collected within a single country, caution is called for when drawing implications for other countries. Third, some of our outcome measures represent multi-faceted latent variables, which are hard to measure. For example, there is a sizable literature debating how best to conceptualise and measure student interest (e.g., Mazer, 2013; Schiefele, 2009; Weber et al., 2005). We acknowledge that our questionnaire-based measures likely have some limitations.

Fourth, as previously discussed, we might be concerned that teachers' self-proclaimed teaching orientation does not feed through into their classroom practice in a way that is faithful to the underlying theory. This would lead us to underestimate the effects of the two

different approaches on pupil learning. While we were able to show that teachers' self-reported orientations are associated with the self-reported frequency with which they use traditional and progressive teaching methods, we do not have access to researcher-collected classroom observations allowing us to independently verify that their orientation feeds through into classroom practice. A conservative interpretation of our findings would therefore be that pupils do not learn more when they are taught by a teacher that *professes* to be either traditionalist or progressive in their orientation.

Implications

Notwithstanding these caveats, we believe that this finding has implications for educators. At the very least, it suggests that teachers with a traditionalist orientation are unlikely to 'put off' students. Assuming that teachers' orientation is indeed affecting pupil interest via their classroom pedagogy, our data suggests that carefully sequenced teacher-led instruction may actually help to nurture pupils' interest in a subject. More specifically, teachers should think carefully about the potential to use curriculum sequencing to ensure that prior learning prompts interest in new learning, thus creating sustained students' interest in their subject (Rotgans & Schmidt, 2014). Careful curriculum design ties a sequence of lesson together to ensure that it is more interesting than the sum of its parts (e.g. Knogler et al., 2015; Harackiewicz et al., 2016).

More generally, this paper serves as a reminder that educators should be cautious about broad-brush explanatory accounts such as those offered by the traditionalist and progressive schools of thought. Despite the longstanding and often vociferous nature of this debate, we find really quite limited support for the claims made by either side. Theory development in the social sciences is a highly error prone process and all theories incorporate some elements that are less well supported by the data they seek to explain (Broers, 2021). Instead, educators might be better off focusing on narrower, more reliably established

empirical findings that have direct implications for teaching and learning (see Willingham, 2017). For example, educators would be better off discussing the worked example effect than the traditionalist approach to teaching.

Conclusion

Progressive arguments that traditionalists risk undermining pupil interest in learning appear to be misplaced. Indeed, a traditionalist approach in which teachers carefully sequence the best content appears to better support pupils' interest in learning. Besides this, however, the arguments made by both traditionalists and progressives appear to have little support in our data, suggesting the debate has been somewhat misleading for the field. Teachers would likely be better served by focusing on more granular, less broad-brush debates about how to approach the job of teaching.

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Tables

Table 1
Descriptive statistics on the teachers and pupils

	%
Female	48.5
German as an additional language	9.7
Born:	
1998	2.1
1999	40.3
2000	55.9
2001	1.7
Special Educational Needs	2.5
Parents highest qualification:	
Other	11.8
Upper secondary	31.0
Any degree-level	57.2
N =	1,223

Note. Percentages may not sum to 100 due to rounding or because low frequency categories are not reported. N is the number of complete case unique pupils observed during lower secondary school.

Table 2

Operationalising traditional/progressive teaching using items from NEPS

Traditional approach:	Teachers should carefully select and sequence…	…knowledge from their subject areas…	…and deliver it directly to the whole class…	…while maintaining order.
Item 1: It is better when the teacher – and not the students – decides what needs to be done.	+		+	
Item 2: My role as a teacher is to make it easier for the students to investigate and explore things.	-		-	
Item 3: Students will learn best when they try to find solutions to problems independently.			-	
Item 4: Classes should be based on problems with clear-cut and correct answers as well as on concepts that are quickly understood by the students.	+		+	
Item 5: The question of how much students will learn depends on their background knowledge - therefore the teaching of facts is vital.		+		
Item 6: Students should be given the possibility to reflect on solutions themselves before the teacher shows the approach to the solution.			-	
Item 7: Quietness in the classroom is absolutely necessary for effective learning.				+
Item 8: Thinking and reasoning processes are more important than specific content of the syllabus.		-	-	

Notes: A `+` symbol indicates that the item in that row is conceptually aligned with the aspect of traditional teaching in that column of the table. A `-` symbol indicates that the item in that row runs contrary to the aspect of traditional teaching in that column of the table.

Table 3

OLS fixed effect regressions: pupil achievement

	Math		German		Pooled	
	(1)	(2)	(3)	(4)	(5)	(6)
Traditional	-0.014	-0.038	0.089*	0.081	-0.025	-0.032
	(0.05)	(0.055)	(0.050)	(0.050)	(0.024)	(0.025)
Progressive	-0.063	-0.075	0.050	0.016	-0.028	-0.034
	(0.052)	(0.052)	(0.065)	(0.075)	(0.023)	(0.023)
N Obs.	1,163	1,163	787	787	1,552	1,552
N Groups	107	107	80	80	776	776
Trad/Prog separate	✓		✓		✓	
Trad/Prog together		✓		✓		✓
School FE (M1)	✓	✓	✓	✓		
Pupil P.I.T. FE (M2)					✓	✓

Notes: Each odd numbered column shows the results from multiple models, in which Traditional and Progressive variables are entered separately. Each even numbered column shows the results from a single model in which Traditional and Progressive variables are entered together. * = p<0.1 ** = p<0.05 *** = p<0.01. Standard errors are clustered at the school level and shown in parentheses. Obs = pupil-by-subject observations. FE = fixed effect. P.I.T. = point in time. M1 = Model 1. M2 = Model 2. All models control for prior achievement in Grade 5. Models 1-4 also control for: special educational needs, German as an additional language, gender, year of birth.

Table 4

OLS fixed effect regressions: pupil interest in subject

	Math		German		Pooled	
	(1)	(2)	(3)	(4)	(5)	(6)
Traditional	-0.13	-0.130	0.266**	0.453**	0.152*	0.152*
	(0.097)	(0.102)	(0.120)	(0.180)	(0.087)	(0.087)
Progressive	0.036	-0.006	0.082	-0.148	-0.003	0.006
	(0.085)	(0.096)	(0.091)	(0.104)	(0.067)	(0.065)
N Obs.	431	431	229	229	249	249
N Groups	56	56	28	28	127	127
Trad/Prog separate	✓		✓		✓	
Trad/Prog together		✓		✓		✓
School FE (M1)	✓	✓	✓	✓		
Pupil P.I.T. FE (M2)					✓	✓

Notes: Each odd numbered column shows the results from multiple models, in which Traditional and Progressive variables are entered separately. Each even numbered column shows the results from a single model in which Traditional and Progressive variables are entered together. * = p<0.1 ** = p<0.05 *** = p<0.01. Standard errors are clustered at the school level and shown in parentheses. Obs = pupil-by-subject observations. FE = fixed effect. P.I.T. = point in time. M1 = Model 1. In Model 1, groups are schools. M2 = Model 2. In Model 2, groups are pupils. All models control for prior interest in subject in grade 6. Models 1-4 also control for: special educational needs, German as an additional language, gender, year of birth, parents' highest qualification.

Table 5

OLS fixed effect regressions: metacognition

	Metacognitive skills	
	(1)	(2)
Traditional	-0.043	-0.057*
	(0.029)	(0.024)
Progressive	0.021	0.045
	(0.044)	(0.043)
N Obs.	606	606
N Groups	69	69
Entered separately	✓	
Entered together		✓

Notes: All columns use Model 1. Each odd numbered column shows the results from multiple models, in which Traditional and Progressive variables are entered separately. Each even numbered column shows the results from a single model in which Traditional and Progressive variables are entered together. * = p<0.1 ** = p<0.05 *** = p<0.01. Standard errors are clustered at the school level and shown in parentheses. All models control for prior metacognitive test scores, special educational needs, gender, year of birth.

Table 6

Pairwise correlations (odds ratios) between traditionalist/progressive orientation and teachers' reported use of project- or lecture-based pedagogical methods

		Project based learning	Teacher direct lecture
Progressive Items	Teachers' role is to help students investigate/explore	1.327***	0.952
		(0.128)	(0.114)
	Students learn best when search for solution independently	1.484***	0.735***
		(0.135)	(0.083)
	Thinking and reasoning are more important than curriculum	1.212**	0.753**
		(0.110)	(0.086)
	Students should think about solutions themselves first	1.609***	0.753**
		(0.176)	(0.086)
Traditional Items	Learning depends on prior knowledge, so facts are vital	0.821**	1.710***
		(0.068)	(0.180)
	A quiet classroom is necessary for learning	0.802**	1.500***
		(0.076)	(0.173)
	Best if the teacher decides what gets done is the lesson	0.716***	1.460*
		(0.064)	(0.159)
	Classes based on concepts that are quickly understood	0.971	1.460***
		(0.076)	(0.159)
No. of teacher-by-year observations		≥1,013	≥1,020
Entered separately		✓	✓

Notes: Each column shows the results from multiple models in which the predictor variables are entered separately. * = p<0.1 ** = p<0.05 *** = p<0.01. Standard errors are shown in parentheses.

Table 7

OLS fixed effect regressions: pupil test scores

		(1)	(2)
Progressive Items	Teachers' role is to help students investigate/explore	-0.031	
		(0.046)	
	Students learn best when search for solution independently	-0.002	
		(0.043)	
	Students should think about problems themselves	-0.015	
		(0.063)	
	Reasoning more important than curriculum content	-0.042	
		(0.048)	
Traditional Items	Best if the teacher decides what gets done is the lesson		0.059
			(0.046)
	Classes should be based on clear cut problems		-0.029
			(0.033)
	Prior knowledge aids learning, so teaching of facts is vital		-0.049
			(0.047)
	A quiet classroom is necessary for learning		-0.032
			(0.035)
N Obs.		1,718	1,602
N Groups		859	801
Entered together		✓	✓
Pupil P.I.T FE (M2)		✓	✓

Notes: Each column shows the results from multiple models in which the predictor variables are entered separately. * = p<0.1 ** = p<0.05 *** = p<0.01. Standard errors are shown in parentheses.

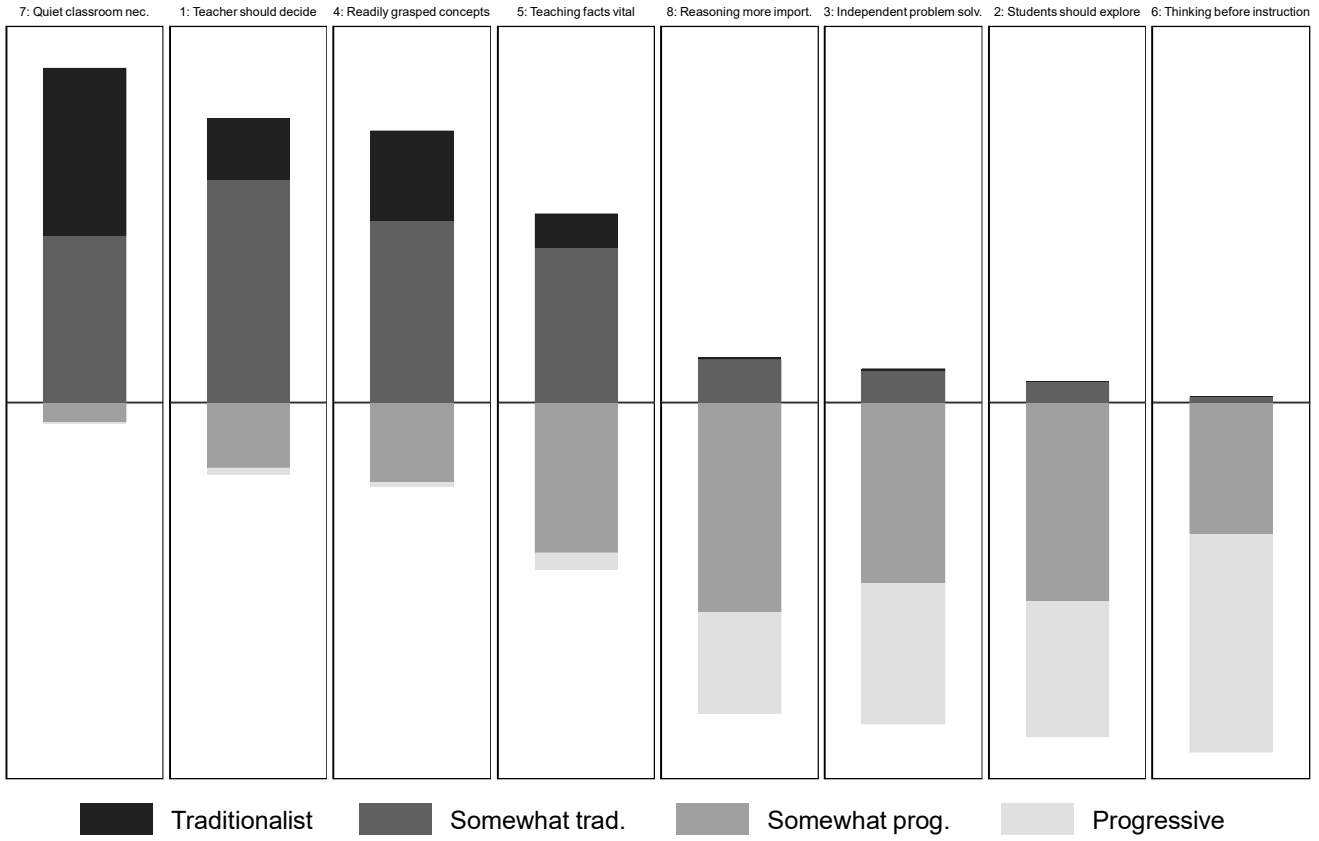
Table 8: OLS regression: pupil test scores

	(1)
Individual traditional orientation	0.019
	(0.023)
School traditional orientation	-0.016
	(0.042)
Individual traditional x School traditional	-0.031
	(0.021)
Individual progressive orientation	-0.024
	(0.022)
School progressive orientation	0.037
	(0.042)
Individual progressive x School progressive	0.002
	(0.028)
N	1,975

Notes: Column 1 shows the results from a single regression model in which all variables are entered simultaneously. * = p<0.1 ** = p<0.05 *** = p<0.01. Standard errors are clustered at the school level and shown in parentheses. Obs = pupil-by-subject observations.

Figures

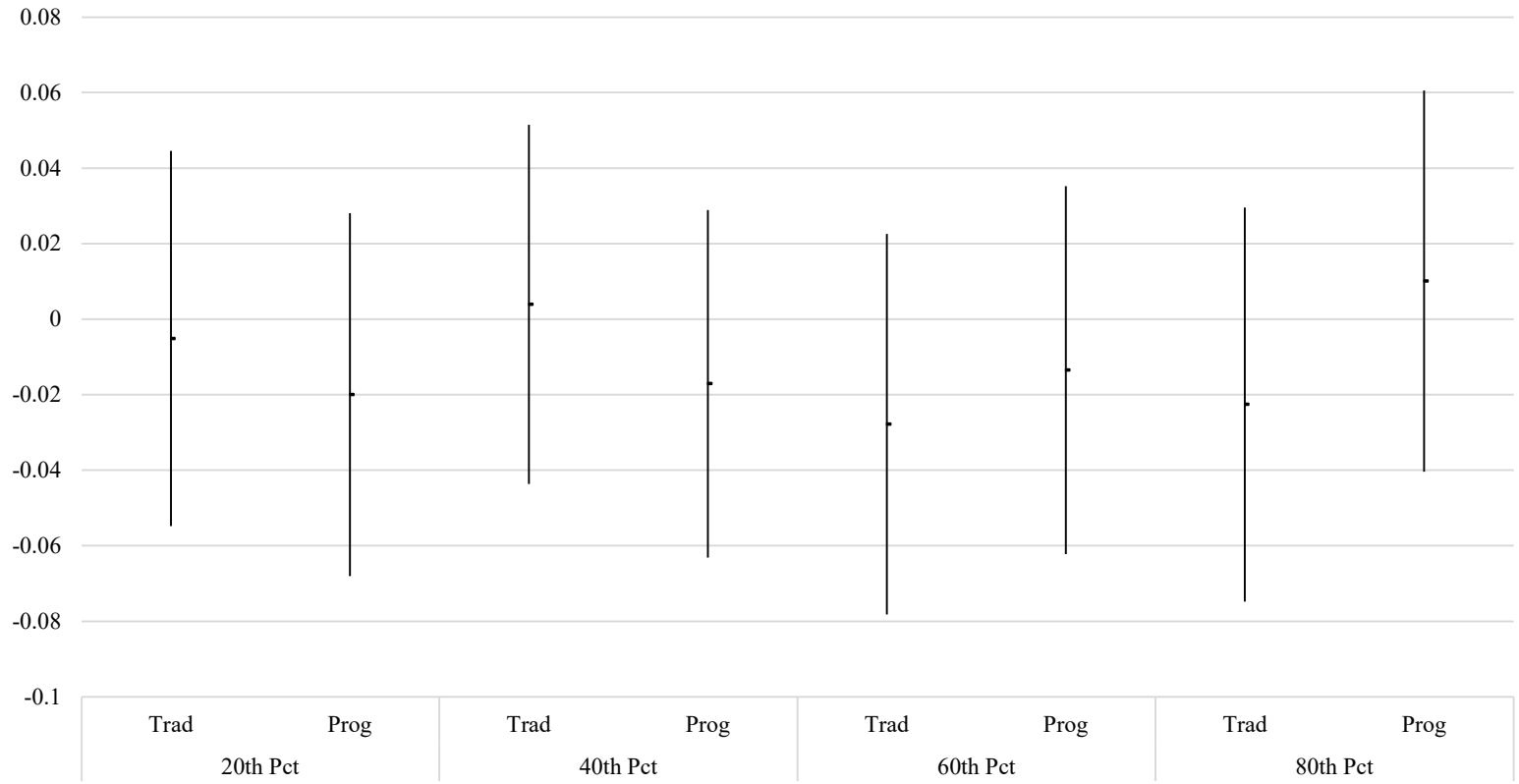
Figure 1. *Distribution of responses to the eight items measuring traditional/progressive orientation*



Note. Each vertical bar represents 100% of responses to a specific item, with the proportion giving each of the possible responses represented by a different shaded region within the bar. N=2,953 teacher-by-year observations.

Figure 2.

Quantile regressions: pupil achievement

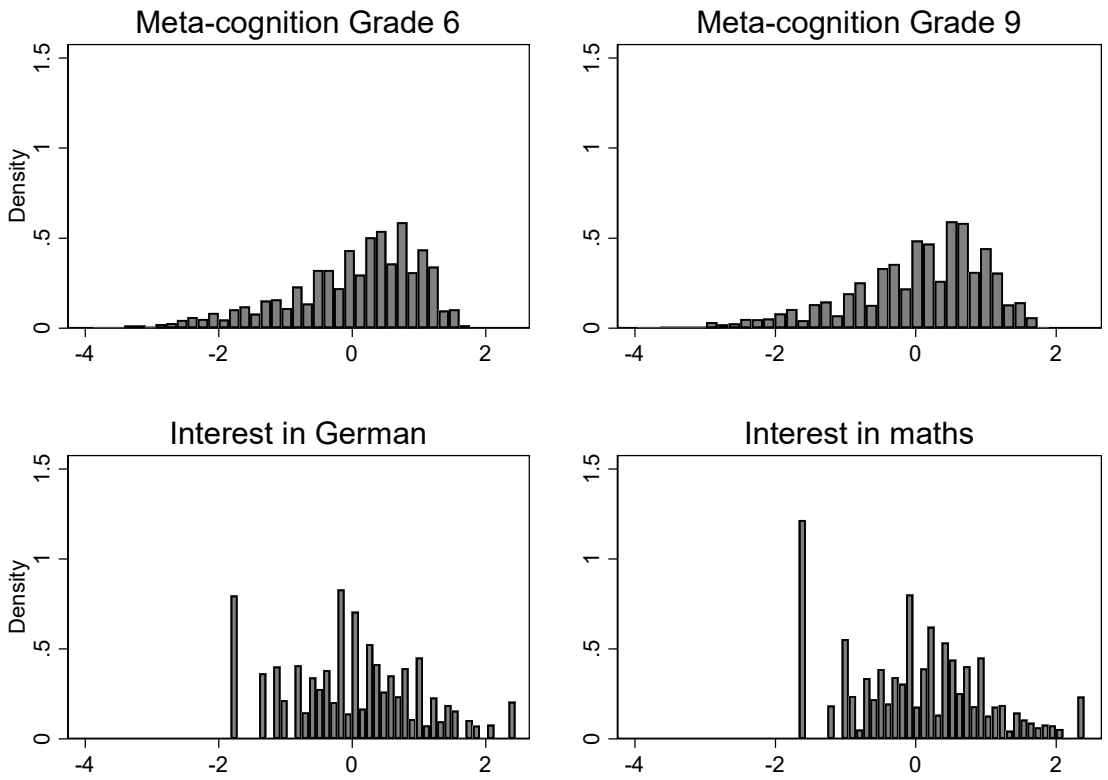


Note. Pct = percentile. Trad = traditionalist orientation. Prog = progressive orientation. Vertical bars represent 95% confidence intervals. N=2,708 pupil-by-subject observations. All models control for prior achievement in Grade 5, special educational needs, German as an additional language, gender, year of birth.

Appendix

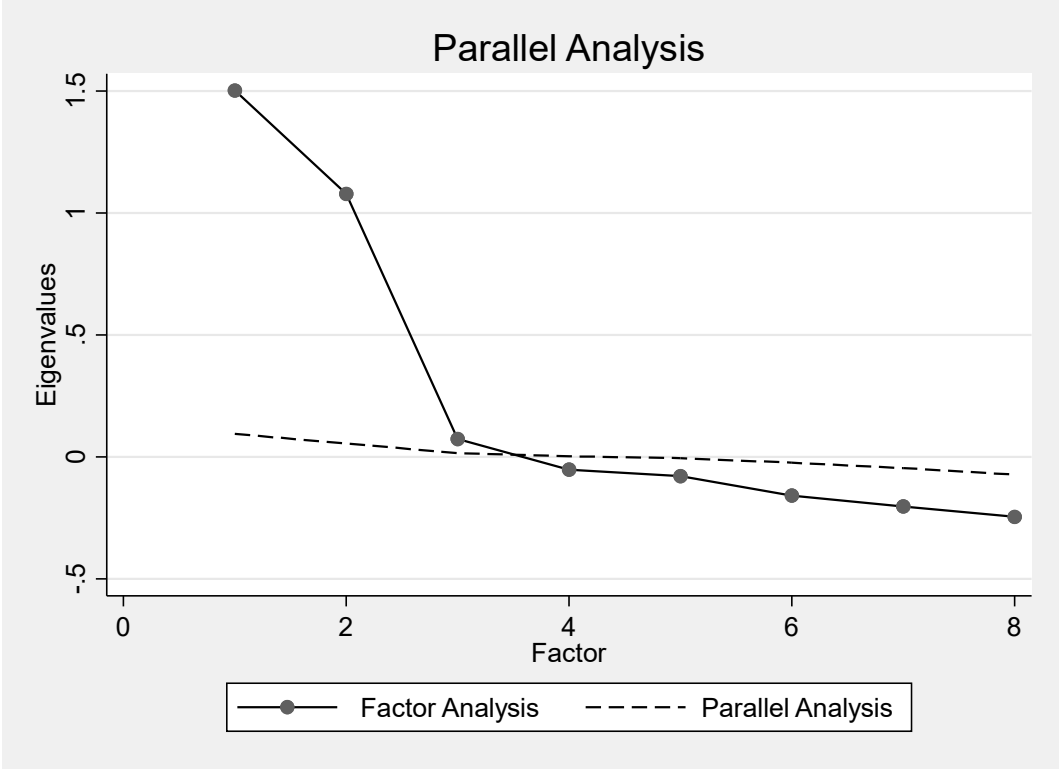
Appendix Figure 1

Distribution of the non-test score outcome measures



Appendix Figure 2

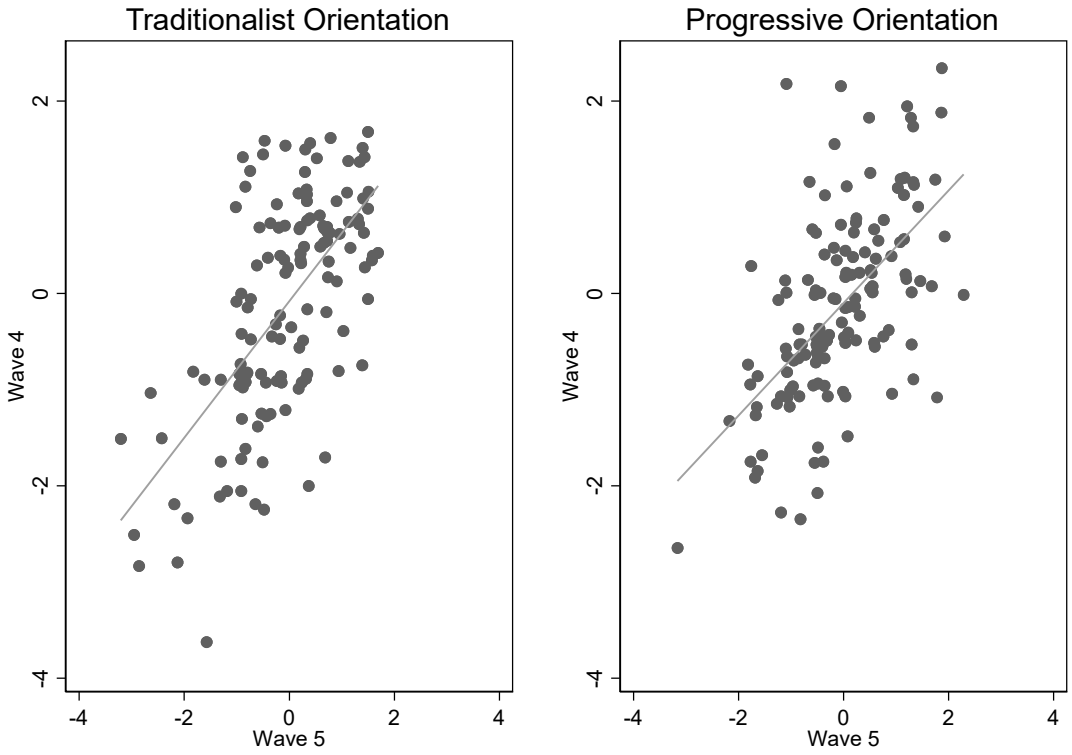
Parallel analysis of the traditionalist/progressive items



Notes. N=2,730 teacher by wave observations.

Appendix Figure 3.

Traditional and progressive scores for a given teacher, measured in two consecutive waves



Notes: Solid grey line is a line of best fit.

Appendix Table 1

Summarising the research questions (RQs), outcome measures, and waves

RQ	Variable	2010/11 Grade 5	2011/12 Grade 6	2012/13 Grade 7	2013/14 Grade 8	2014/15 - Grade 9	
		Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6
All	Trad/prog	Ger/mat Teach quest.	Ger/mat Teach quest.	Ger/mat Teach quest.	Ger/mat Teach quest.	Ger/mat Teach quest.	
RQ1/ RQ2	Maths	Test		Test		Test	
RQ1/ RQ2	German	Test		Test			Test
RQ3	Interest in learning (German/math)		Pupil quest.				Pupil quest.
RQ4	Metacognition		Test				Test

Appendix Table 2

Pairwise polychoric correlations for the traditionalist/progressive items

		Traditionalist items				Progressive items			
		Item 1	**Item 4**	**Item 5**	**Item 7**	**Item 2**	**Item 3**	**Item 6**	**Item 8**
Traditionalist items	**Item 1**	1.00							
	Item 4	0.22	1.00						
	Item 5	0.32	0.32	1.00					
	Item 7	0.32	0.29	0.27	1.00				
Progressive items	**Item 2**	0.05	0.20	0.07	0.05	1.00			
	Item 3	-0.23	0.03	-0.12	-0.05	0.32	1.00		
	Item 6	-0.14	-0.02	-0.08	0.03	0.33	0.55	1.00	
	Item 8	-0.06	-0.01	-0.15	0.02	0.21	0.37	0.38	1.00

Notes. Full wording for each of the numbered items can be found in Table 1. None of the items have been reversed scored. N=2,730 teacher by wave observations.

Appendix Table 3

Factor pattern matrix following oblique rotation

Item	Short item content	Factor 1: Progressive orientation	Factor 2: Traditionalist orientation	Uniqueness
1	Teacher should decide		0.52	0.71
2	Students should explore	0.47		0.75
3	Independent problem solving	0.69		0.51
4	Readily grasped concepts		0.52	0.73
5	Teaching facts vital		0.53	0.70
6	Student thinking before instruction	0.69		0.53
7	Quiet classrooms necessary		0.51	0.75
8	Reasoning more important	0.50		0.75
	McDonalds's Omega:	0.61	0.55	

Notes. Loadings < 0.3 blanked out. N=2,730 teacher by wave observations.

[i] NEPS Cohort 2 (elementary school, age 6-11) and Cohort 3 are both theoretically well-suited to our research, since both cover pupils during the period in which traditionalist and progressives dispute the best teaching methods. In the progressive formulation, pupils of this age are yet to reach 'developmental maturity' (Darling, 1993) and in the traditionalist formulation, have not yet developed 'virtue' (Curren, 2010) or 'expertise' (Sweller et al., 2003). However, an important limitation of NEPS Cohort 2 for our purposes is that it only measures teachers' traditional/progressive orientation in two survey waves (Grade 1 and 3). This makes it harder to isolate the relationship between the approach of a given teacher and subsequent changes in pupil outcomes.

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