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14- to 19-year-olds everyday and school science understandings of genetics in the context of health and disease: Translating research findings into classroom practice.

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Background

An understanding of genetics, lifestyle influences, and their interactions in relation to family and personal health and disease, is important in an era of access to increasingly personalised medicine, and to support engagement in public consultations related to the applications of biomedical advances. However, science education researchers report that most secondary school students have a poor understanding of the processes by which genetic information is transferred, with widespread uncertainty and confusion recorded (Lewis & Wood-Robinson, 2000; Venville, Gribble & Donovan, 2005). Alternative conceptions exist and a key publication argues that there is a widespread lay knowledge of inheritance that conflicts in various ways with scientific explanations and inhibits learning (Richards & Ponder, 1996). These alternative conceptions are developed and sustained through day-to-day social interactions. Furthermore, research evidence in medical literature suggests that lay understanding about inheritance may conflict with contemporary medical models (Walter, Emery, Braithwaite & Marteau, 2004).

In an attempt to engage students, the newly introduced GCSE 21st Century Science Curriculum has repositioned genetics and inheritance firmly in the context of health and disease, and introduced opportunities for students to participate in debates about current and controversial genetic issues (such as genetic testing and reproductive choices). However, there are gaps in (both past and current) education research into 14- to 19-year-olds' understanding of genetics in the context of health, and disease, lifestyle choices and gene-environment interactions. Moreover, much of the recent research into student understanding of controversial genetic issues, tends to focus on level and patterns of argumentation rather than the development of students' scientific content knowledge (Sadler & Fowler, 2006).

Research Questions

The initial phase of this study focussed on two key areas: students' everyday and school science understandings of genetics and inheritance in the context of health and disease, and the barriers to the development of students' school science understandings. Findings from this empirical work and previous research were used to support the development, implementation and assessment of a targeted teaching intervention.

Methods

A quasi-experimental approach was used in the participating school, the same teacher taught both the intervention and comparison classes. A sequence of four intervention lessons (designed to address GCSE science students' identified learning needs) were integrated within the students' GCSE programme. The intervention teaching and learning activities include explicit opportunities for students' to think and talk with each other about the connections between everyday and scientific understandings. Collaborative modes of group work (Howe, Tolmie, Thurston, Topping, Christie, Livingston et al.), dialogic teaching and learning were promoted (Alexander, 2008; Mercer, Dawes, Wegerif & Sams, 2004). The teacher and researcher met regularly during the planning phase to discuss the intervention lessons, the teaching and learning processes, each lesson's content, structure and resources. The comparison classes were taught according to the teacher's usual lesson plans. A number of different tools were used to investigate the students' and teacher's classroom interactions. For each lesson, both systematic classroom observations, and audio-recording of the teacher's modes of communication and students' talk were completed. Additionally, students completed a pre- and post-test, and a sub-sample of students participated in a follow up

semi-structured interview. Furthermore, a semi-structured interview was used to investigate teacher perceptions of teaching and learning pre- and post-intervention.

Frame

The analyses completed were part quantitative and part qualitative. Quantitative analyses were used to analyse data collected in the pre- and post- tests, and structured observations (according to Howe et al., 2007; Mortimer & Scott, 2003). Transcriptions of audio-recorded classroom and interview data were analysed using a mix of qualitative and quantitative methods consisting of discourse analysis, concordance analysis methods (as outlined in Mercer, 2007), and the categorisation of conceptual levels of scientific talk according to a ranked scheme developed by the researcher.

Research findings

The findings from the analyses will be discussed in terms of: student-student and teacher-student(s) classroom interactions, pre- to post-test learning outcomes and teacher perceptions.

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