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Authentic research practices throughout the curriculum in undergraduate medical education: Student beliefs and perceptions

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ABSTRACT

Opportunities for students to participate in research practices promote student beliefs about the relevance of research for later work practices. Yet engaging undergraduates in learning activities that mirror the way in which research is used in practice settings is not that straightforward. This longitudinal study aims to assess the influence of authentic research practices in the learning environment on medical undergraduates' perceptions of research and their beliefs about the relevance of research. In total, 947 students completed the Student Perceptions of Research Integration Questionnaire. Our findings suggest that research practices promote student motivation for research and foster the belief that research is relevant to learning. We suggest that to foster student learning about research, it is beneficial to include elements of professional practices that stimulate students' enthusiasm for research and focus students' attention on the way research findings are produced. Furthermore, implications are given for further research and teaching practice.

KEYWORDS

Research-teaching nexus; undergraduate programme; student experience; authentic learning

Introduction

Findings from previous studies suggest that opportunities for students to engage in authentic research practices can promote student reflections on the meaning of knowledge construction in their field (Healey & Jenkins, 2009; Hu, van der Rijst, van Veen, & Verloop, 2014). Yet engaging students in authentic research practices through undergraduate teaching in a way that makes the research visible and accessible for students is not that straightforward (Brew & Mantai, 2017; van der Rijst, Visser-Wijnveen, Verloop, & van Driel, 2013). This study aims to further our understanding of student perceptions of research and beliefs about the relevance of research for learning and practice in relation to authentic research practices in the learning environment. A better understanding of student perceptions of research, beliefs and authentic research practices is important for higher education professionals who aim to strengthen the role of research in teaching.

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Authentic research practices

In this study 'authentic research practices' (ARP) as a term was chosen to emphasise that research incorporated in learning activities mirrors the way in which research is used in professional settings (Herrington & Herrington, 2006; Wald & Harland, 2017). The ARP as defined in this study take place in the context of an undergraduate curriculum, which differs from ARP in service learning or community based learning. Previous studies into authenticity of the learning environment indicate that learning activities refer to the real professional world by simulating the context of future use of knowledge (Barab & Duffy, 2000; Vos, 2011). Yet most learning activities will contain elements that are widely recognisable as originating from original professional practice (Vos, 2011).

Findings from Rule's (2006) review study have recently been used in university education to bridge a gap between student learning activities within the classroom and professional settings by revealing four factors that promote authenticity of learning activities (Diamond, Middleton, & Mather, 2011). First, authentic learning experiences are promoted by student engagement in real-world professional problems, targeting a real professional audience. Second, the learning activities should reflect the scientific process of knowledge construction and, therefore, foster student thinking skills. Third, authentic learning experiences enable discourse amongst a community of learners. Fourth, enhancing authenticity should encourage students to direct their learning in accordance with their own interests (Rule, 2006). In this study we focus our description of research practices on authentic aspects of the learning activities.

Most medical students will go on to work as practitioners rather than scientists; therefore, ARP can offer all students the opportunity to gain valuable insights into the use of research in work practices. The medical discipline was chosen as an example of a discipline in which knowledge construction can be characterised by a relatively high consensus on paradigms, research content and methods focusing on applied, patient-related problems.

Defining authentic research practices in the curriculum

Findings from studies into research integrated into undergraduate curricula indicate that fruitful integration lies in a well-considered variety of approaches (Healey & Jenkins, 2009; Fung, 2017). This study was conducted in the context of a curriculum change that aimed to strengthen the integration of research into teaching through ARP. The curriculum change involves all three years of undergraduate medical education at the Leiden University Medical Centre (LUMC) and is gradually implemented from the academic year 2012–2013 onwards starting with the first year of study.

In the three-year undergraduate programme students attend patient interviews in addition to predominantly theoretical classes augmented by learning activities in small groups. Students are taught by academic staff involved in medical scientific research, clinical care and teaching undergraduate courses. Every academic year 330 students, with an average age of 19 years, start studying medicine at the LUMC. The students participating in this programme were admitted through a weighted lottery procedure based on their grade point average in secondary education. Students with a high GPA are more likely to be admitted.

Only theesearch projects in the first and third year are developed within the changed curriculum. In the previous curriculum there were no research practices in the first and third year. The second-year project is a component of the previous curriculum and since it fits the aim of the curriculum change it has been kept. In the changed curriculum, first-year students participate in a small research project during an internship in nursing homes. Ethical approval for the first year students' research practice in nursing homes was granted by the ethics committee of the university medical centre. The second-year research practice is a course in which students assess the evidence base of drug advertisements in professional journals for general practitioners (GP). During the third-year student research practice students individually conduct a literature study, to formulate a piece of advice for treatment or diagnosis of an authentic patient problem, supervised by a specialist in training. Students eventually present their findings to professionals within their supervisors' department.

Throughout these practices students engage in real-world professional practice by doing an internship, assessment of the evidence base of drug advertisements as GP's would and by individually presenting a piece of advice to medical specialists based on a literature review. Learning activities aiming to foster a discourse among learners and reflection on knowledge construction include the formulation of a research question, presentation of findings to peers and teachers, critical appraisal of research literature in pairs, small group sessions or under supervision of a specialist in training. Within the practices, students direct their learning by their choice of variables in the context of nursing homes and by selecting a focus within the topic of the critical appraisal in specialist care. The practices build on each other by modelling the link between research and practice, as the year one practice focuses on practical research skills and the year two practice on the way in which research findings are communicated to a professional audience. The year three practice stimulates students to reflect on research findings and formulate practical implications for patient care.

The research practices put emphasis on student engagement with professional practices which should enrich their learning experiences. We, therefore, expect ARP to foster student motivation for research. Furthermore, immersing students in research practices in a professional setting may foster their beliefs about the relevance of research in practice. The research practices are incorporated as assignments for students to reflect a particular way of working and reporting that is similar to authentic professional practice in which clinicians reflect on research findings. For this reason we expect students to experience critical reflection on research findings. The ARP might provide opportunities to familiarise students with staff research, although this is not a primary goal of the curriculum change. We are thus mainly interested in student perceptions of participation in research, motivation for research, critical reflection on the way results are produced and beliefs about the relevance of research for practice.

Students perceptions and beliefs

Student perceptions of research in teaching can promote various learning outcomes such as research dispositions, research skills and student achievement (Vereijken, van der Rijst, de Beaufort, van Driel, & Dekker, 2018; Visser-Wijnveen, van Driel, van der Rijst, Visser, & Verloop, 2012). Undergraduates can perceive both benefits and disadvantages of research integrated into teaching (Healey, Jordan, Pell, & Short, 2010). Examples of benefits are

perceptions of staff's enthusiasm for research, participation in research and reflections on research products (Robertson & Blackler, 2006; Turner, Wuetherick, & Healey, 2008; Visser-Wijnveen, van der Rijst, & van Driel, 2016). On the other hand, a strong focus on the research interests of staff may lead to narrow representations of the discipline at the expense of students' own interests (Healey et al., 2010). Student perceptions of research in teaching may be influenced by their beliefs about the purpose of university teaching (Pajares, 1992; Robertson & Blackler, 2006) and beliefs about the importance of research to professional practice (Griffioen, 2018). In this study we, therefore, gathered data both on student perceptions of research integrated into teaching and student beliefs about the relevance of research for learning and professional practice including three cohorts of students in the context of a curriculum change.

Research aim

We aimed to describe the influence of a curriculum change, intended to foster ARP, on medical student perceptions of research and student beliefs about the relevance of research for learning and practice. Participants in this study are a cohort of medical students following the previous curriculum and two cohorts following the changed curriculum aimed to strengthen research-teaching integration. We focus on relations between ARP, student perceptions of research in teaching and student beliefs about the relevance of research for practice. Furthermore, this study provides a longitudinal perspective on student perceptions and beliefs about research by focusing on a three-year undergraduate medical education program.

Method

Study design

We conducted a longitudinal, quantitative study using questionnaires comparing two curricula. A comparison was made between a previous curriculum and a changed curriculum over a period of three years of undergraduate education. We included two cohorts following the changed curriculum to make sure that both students and academic staff gained some experience with teaching and learning in the changed curriculum before investigating potential effects of the curriculum change.

Participants

Three successive cohorts of students were invited to participate in this study, one following the previous curriculum and two following the changed curriculum. The students were enrolled in the medical programme as first-year students in the academic year 2011–2012, 2012–2013 or 2013–2014, respectively. We distributed hardcopy questionnaires to all first, second, and third year students during lectures at the end of the academic year, between April and June from 2012 until 2016. The questionnaires are explained further below. The students had completed their research practices in the months before. The students were asked to complete the questionnaire for all subjects they had been enrolled for up till then during lectures and handed these in to the

researchers. They were asked for permission to use their unique student identification number, so that we could send the questionnaire to the students not present at the lecture. Ethical approval was granted by the LUMC Research Ethics Committee. Not all students completed the consecutive questionnaires (see Table 1), which is typical for longitudinal educational studies (e.g., Shephard et al., 2014).

Ultimately, 947 students completed questionnaires at least once during the course of the undergraduate programme. Of these, 308 respondents followed the previous curriculum and 639 respondents followed the changed curriculum. 69% to 71.6% of all first-year students were women all three cohorts, which indicates that the sample is representative for the medical student population. Students were between 16 and 35 years old in the first-year of their study (n = 662; M = 19.5; SD = 1.66). Some of the students had previous experiences with research (n = 213), such as extracurricular research activities. Of all 947 students, 176 students completed the all three questionnaires. This sample of 176 students consisted of 81 students following the previous curriculum (response rate = 26.3%) and 95 students following the changed curriculum (response rate = 14.9%) (see Table 1).

Instrument and procedure

The first and fourth authors were involved in the development of student research practices in the changed curriculum and made a description of authentic elements per research practice. Table 2 summarises authentic elements (cf. Rule, 2006) of the student research practices per year of study in the changed curriculum.

To study undergraduate student perceptions of research in teaching we administered a version of the Student Perception of Research Integration Questionnaire (SPRIQ) in which the item wording was adjusted to medical education (Vereijken et al., 2018; Visser-Wijnveen et al., 2016). The scales included student perceptions of teaching through (1) *critical reflection* on the way research findings are produced; (2) student *research participation*; (3) *familiarity* with staff research; (4) fostering *motivation* for research and; (5) *student beliefs about the relevance of research for learning*; (6) *student beliefs about the relevance of research for practice* and (6) perceived *quality of the learning environment*. The scale *critical reflection* included items such as 'During this academic year the scientific process was an essential part of the curriculum'. Other sample items are described elsewhere (Vereijken et al., 2018). All 30 items were answered on a 5-point Likert-scale ranging from strongly disagree (1) to strongly agree (5). The quality scale was included because students' opinions on the general quality of teaching could influence their scores on the other scales. Cronbach's alpha per scale varied from .69 to .89 which indicates an acceptable to good reliability of the scales.

Table 1. Student numbers and response rates for all years of study in both curricula.

Time	Changed curriculum (n = 639)	Previous curriculum (n = 308)
Year 1	450 (70.4%)	246 (79.9%)
Year 2	270 (42.3%)	242 (78.6%)
Year 3	180 (28.2%)	153 (49.7%)
Year 1 to 3	81 (26.3%)	95 (14.9%)

Table 2. Description of authentic research practices in medical education per year of study (cf. Rule, 2006).

	Student engagement with real-world professional practice	Learning activities reflecting knowledge construction	Discourse among learners	Element of students' choice directing learning
First year: Nursing homes (Changed curriculum)	Students participate in internship; research element is 'add-on'	Formulating research question about elderly care; practical research skills	Students collaborate in pairs; two small group sessions	Variables in research question within limited set of variables
Second year: Drug advertisements (Previous & changed curriculum)	In 'ideal' professional practice; simulation	Practicing critical appraisal of research literature on effectiveness of drugs	Individual assignment; one small group session	Research papers are assigned to students
Third year: Critical appraisal of a topic (Changed curriculum)	Students indirectly contribute to real-world patient care	Critical appraisal of research literature on specific patient problems; scientific reasoning in a professional setting	Individual assignment; discourse between supervisor and student	Topics are assigned to students; students choose focus within topic

Analysis

We used a mixed model approach to repeated measures analysis of variance (ANOVA). This is based on the expectations regarding changes in particular student perceptions of research as a result of the ARP (see introduction-section). Furthermore, this method of analysis also includes the data of students who had completed the questionnaire once or twice during their undergraduate education to estimate missing scores (cf. Keselman, Algina, & Kowalchuk, 2001). The three time points, one per year of study, were used as repeated factor and student identification numbers were used as subjects in the analysis. The separate student perception and beliefs scales per curriculum were used as the dependent variables. A confidence interval of 95% was applied for all effects.

In order to compare student perceptions of research practices in the changed curriculum with the previous curriculum, additional t-tests for independent means were carried out. A confidence interval of 95% was applied for all effects. We calculated Cohen's *d* to indicate the size of the effects and for interpretation we used the following criteria; $.20 \leq d < .50$ = small effect, $.50 \leq d < .80$ = medium effect and $\geq .80$ = large effect (Cohen, 1988).

Results

The results of the repeated measures ANOVA are presented in Table 3. The effect sizes indicated mainly medium effects with regard to participation, motivation, familiarity and quality and large effects on critical reflection in year 2 and 3. The effect sizes of the beliefs scales were neglectable to small. Students following the changed curriculum perceived a stronger emphasis on *participation, motivation, current research* and *critical reflection* than students following the previous curriculum. With regard to *participation* students felt more involved in research during the course of the undergraduate programme, although scores were less than 3 on a 5-point Likert scale (see Table 3). Scores regarding *participation* were higher in the changed curriculum [$F(2,292.96) = 58.95$, 95% $CI_{yr3\text{-}yr1}$ [−.70, −.47], 95% $CI_{yr3\text{-}yr2}$

Table 3. Descriptive statistics per scale of the student perceptions of research integration questionnaire.

	Changed curriculum			Previous curriculum		
Scale	M_{year1} (*sd*) n = 450	M_{year2} (*sd*) n = 270	M_{year3} (*sd*) n = 180	M_{year1} (*sd*) n = 246	M_{year2} (*sd*) n = 242	M_{year3} (*sd*) n = 153
Participation	$2.31^{a,d}$ (.73)	2.30^{b} (.75)	$2.89^{a,b,e}$ (.83)	$1.95^{c,d}$ (.69)	2.28 (.81)	$2.33^{c,e}$ (.84)
Critical reflection	$3.32^{a,d}$ (.62)	$3.53^{b,e}$ (.58)	$3.66^{a,b,f}$ (.61)	2.99^{d} (.67)	2.86^{e} (.70)	2.98^{f} (.65)
Motivation	$3.03^{a,c}$ (.79)	$2.99^{b,d}$ (.87)	$3.29^{a,b,e}$ (.69)	2.74^{c} (.78)	2.80^{d} (.82)	2.87^{e} (.81)
Familiarity	$3.06^{a,d}$ (.63)	3.21^{e} (.61)	$3.24^{a,f}$ (.66)	$2.66^{b,d}$ (.68)	$2.89^{c,e}$ (.65)	$3.11^{b,c,f}$ (.63)
Quality	3.75^{a} (.56)	$3.52^{a,b}$ (.59)	$3.75^{a,c}$ (.59)	3.80 (.51)	3.85^{b} (.59)	3.84^{c} (.59)
Beliefs relevance for learning	3.06^{a} (.81)	$2.89^{b,c}$ (.85)	$3.31^{a,b,d}$ (.88)	3.04 (.80)	3.05^{c} (.82)	2.98^{d} (.88)
Beliefs relevance for practice	3.64^{a} (.73)	3.58 (.76)	$3.49^{a,b}$ (.79)	3.66 (.67)	3.62 (.73)	3.63^{b} (.72)

Means within the same row that share superscripts differ at $p < .05$

[−.71, −.48]] than in the previous curriculum [$F(2,187.38) = 19.42$, 95% $CI_{yr3\text{-}yr1}$ [−.50, −.24], 95% $CI_{yr3\text{-}yr2}$ [−.18, .08]]. The results on the participation scale in Table 3 indicate that students following the changed curriculum participated more strongly than they had done before, specifically in the first and third years.

Student *motivation* for research increased as they progressed through the undergraduate programme in the changed curriculum [$F(2,305.84) = 19.97$, 95% $CI_{yr3\text{-}yr1}$ [−.35, −.17], 95% $CI_{yr3\text{-}yr2}$ [−.40, −.19]] but not in the previous curriculum [$F(2,190.76) = 2.03$, 95% $CI_{yr3\text{-}yr1}$ [−.26, .00], 95% $CI_{yr3\text{-}yr2}$ [−.21, .05]]. Comparing the scale means between curricula, students following the changed curriculum reported a stronger *motivation* for research in medicine, in particular in the first and third years (Table 3).

The mean scores on perceived *critical reflection* in Table 3 show that students following the changed curriculum experienced a stronger focus on research processes than those following the previous curriculum from the first year onwards ($M_{difference\ yr\ 1} = 0.33$). Before the curriculum change, student perceptions of *critical reflection* in year one were similar to year three and dropped a bit in year two [$F(2,182.45) = 2.90$, 95% $CI_{yr3\text{-}yr1}$ [−.11, .14], 95% $CI_{yr3\text{-}yr2}$ [−.23, .00]]. In the changed curriculum perceived *critical reflection* increased slightly over the years [$F(2,327.28) = 34.88$, 95% $CI_{yr3\text{-}yr1}$ [−.42, −.25], 95% $CI_{yr3\text{-}yr}$ [−.22, −.03]].

Student *beliefs about the relevance of research for practice* dropped slightly from year one to year two in the changed curriculum and then increased, and student beliefs on the relevance of research for practice did not change towards their third-year [$F(2,291.02) = 4.81$, $CI_{yr3\text{-}yr1}$ [.05, .23], 95% $CI_{yr3\text{-}yr2}$ [−.01, .18]]. The data from the previous curriculum showed a somewhat similar result [$F(2,159.33) = 0.51$, 95% $CI_{yr3\text{-}yr1}$ [−.06, .12], 95% $CI_{yr3\text{-}yr2}$ [−.10, .08]].

Table 3 shows the descriptive statistics of all SPRIQ scales. Within the previous curriculum student *beliefs about the relevance of research for learning* decreased slightly over time [$F(2,117.11) = 0.69$, 95% $CI_{yr3\text{-}yr1}$ [−.07, .19], 95% $CI_{yr3\text{-}yr2}$ [−.05, .19]], while students following the new curriculum believed that research was more important for learning towards the end of the undergraduate program [$F(2,303.73) = 26.27$, 95% $CI_{yr3\text{-}yr1}$ [−.36, −.15], 95% $CI_{yr3\text{-}yr2}$ [−.53, −.30]]. Students placed the least relevance on research for their learning in year two.

Students who carried out the research activities in the changed curriculum felt more *familiar* with their teacher's research from their first to their third year [$F(2,308.04) = 10.85$, 95% $CI_{yr3\text{-}yr1}$ [−.27, −.08], 95% $CI_{yr3\text{-}yr2}$ [−.11, .07]]. In the previous curriculum perceived

familiarity with teachers' research grew gradually [$F(2,201.19) = 28.89$, 95% $CI_{yr3\text{-}yr1}$ [−.57, −.33], 95% $CI_{yr3\text{-}yr2}$ [−.34, −.11]].

Overall, the perceived *quality of the learning environment* was lower in the changed curriculum than before: scores on *quality of the learning environment* dropped somewhat in the second year compared to the first and third year [$F(2,341.66) = 19.18$, 95% $CI_{yr3\text{-}yr1}$ [−.08, .08], 95% $CI_{yr3\text{-}yr2}$ [−.32, −.14]]. In the previous curriculum the perceived *quality of the learning environment* from year to year was similar [$F(2,195.53) = 0.76$, 95% $CI_{yr3\text{-}yr1}$ [−.13, .06], 95% $CI_{yr3\text{-}yr2}$ [−.09, −.11]]. Still, in both curricula the perceived quality of the learning environment was relatively high ($M \geq 3.52$ on a 5-point Likert scale).

Conclusions and discussion

This study aimed to assess the influence of ARP in undergraduate medical education on student perceptions of research and student beliefs about the relevance of research for learning and practice. To this end, a comparison was made between a curriculum specifically developed to strengthen research integration through ARP and a previous curriculum over the course of undergraduate medical study programmes. Authentic elements within research practices in this study were described based on a framework for authentic learning (Rule, 2006). The data indicates that students' participation in research, motivation for research, perceptions of critical reflection on research findings and familiarity with staff research all increased after the curriculum change. The results suggest that student beliefs about the relevance of research for practice and learning remained stable over the course of their undergraduate education, regardless of the curriculum change. Analyses of the data revealed that students' sense of active involvement in research and their motivation for research increased modestly towards the end of their undergraduate medical education.

The perceived quality of the learning environments in both curricula was strong and did not create barriers for stimulating student perceptions of research. Furthermore, all students entered medical education through the weighted lottery system. On the one hand, differences found between curricula can be explained by the extent to which students are engaged in the ARP. On the other hand, this could be explained by the way teachers use research in their teaching. All ARP actively engaged students in either using or doing research in a professional setting. This is in line with findings from previous studies into research integrated into teaching which indicate that the students' role, on a dimension from observing to participating in research, is a defining characteristic of learning activities incorporating research (e.g., Healey & Jenkins, 2009). Our findings indicate that, in the case of the medical discipline, research integrated into student learning activities can benefit from connections with professional practice in diverse work settings. Furthermore, our results indicate that a curriculum including ARP can promote student motivation for research from the first undergraduate year onwards. The data also suggests that teachers found ways to familiarise students with their own research as well.

The findings suggest that the relevance placed by students on research is less malleable than their perceptions of research in teaching, which depend more strongly on the curriculum. Generally, student beliefs are relatively stable in nature and reflection on one's own beliefs can be fostered through, for example, reflection on previous learning

experiences (Pajares, 1992). To benefit student learning, it might be beneficial for future research and teaching to focus on learning activities which allow students to relate learning experiences to their beliefs about research in professional practices.

Limitations and implications

Questionnaires were used in this study to obtain information about student perceptions of research and beliefs about the value of research within a large-scale, three-year undergraduate programme. The use of a questionnaire in a longitudinal study design was considered most appropriate due to the scale of the study programme and the curriculum change. We suggest that future studies into student perceptions and beliefs about research could benefit from further, in-depth explorations of relations between beliefs, perceptions and student learning outcomes using qualitative and quantitative methods. In order to encourage more students to complete questionnaires in future longitudinal studies into higher education, it could be beneficial to feedback preliminary findings to students involved in fostering quality of the undergraduate programme (e.g., student council).

The description of authentic elements within research activities highlights student engagement in real-world professional practice in all undergraduate years. The description of all three research practices suggests that further exploration of discourse among learners either in the small group settings or informally in professional practice, can promote authenticity in research activities. Furthermore, student learning can benefit from providing students opportunities to follow their interests, for example, by engaging them in the selection of research papers and patient problems within the described research practices.

Our findings suggest that strengthening the role of research in teaching through ARP fosters student participation in research, stimulates students' enthusiasm for research and focuses their attention on the way research findings are produced. Our findings also indicate that ARP can offer ways for academic staff to familiarise students with staff research from the first undergraduate year onwards.

Disclosure statement

No potential conflict of interest was reported by the authors.

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