Hydrol. Earth Syst. Sci. Discuss., 9, 629–669, 2012
www.hydrol-earth-syst-sci-discuss.net/9/629/2012/
doi:10.5194/hessd-9-629-2012

Hydrology and Earth System Sciences Discussions

Competence formation and post-graduate education in the public water sector in Indonesia

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Received: 13 December 2011 – Accepted: 2 January 2012 – Published: 11 January 2012

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Published by Copernicus Publications on behalf of the European Geosciences Union.

Abstract

A framework is introduced, describing three aggregate competences for technical issues, management and governance, and a meta-competence for continuous learning and innovation, for the water sector. The four competences are further organised in a T-shaped competence profile. The framework and an assessment methodology were tested in a case study on post-graduate water education for professional staff in the Directorate General Water Resources (DGWR) in Indonesia.

Though DGWR professionals have a firmly "technical" orientation, both the surveys and interviews show strong interest in the other competences: in particular the learning meta-competence, as well as the aggregate competence for management. The aggregate competence for governance systematically scores lower. A discrepancy appears to exist between the competences that staff perceive as needed in daily work, and those that could be acquired during post-graduate water education.

In both locally-based and international post-graduate water education, the aggregate competences for management as well as governance are reportedly addressed modestly, if at all. With only little competence in these disciplines, it will be difficult for professionals to communicate and collaborate effectively in an interdisciplinary way. As a result, the horizontal bar of the T-shaped profile remains weakly developed. In international post-graduate education, this seems partly compensated by the attention for continuous learning and innovation. The exposure to a different culture and learning format is reported as fundamentally formative. The policies of DGWR have gone through three distinct phases. In the first phase (1970–1987) technical competence and learning were valued highly and training was arranged effectively; in the current phase the need to develop new competences is raising new challenges.

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1 Introduction

Many of today's water challenges are of such complex nature that they involve multiple disciplines and often need several organisations to collaborate (Alaerts and Dickinson, 2007; Bourget, 2008; Loucks, 2008; Nash et al., 1990; Wagener et al., 2007, 2010). It is a safe prediction that water problems are likely to become more serious, certainly in developing country contexts, and that water resources use, management and governance will continue to be a politically contested terrain (Mollinga, 2009).

To face this situation, water professionals should be specialist in their particular discipline, but increasingly conversant in other relevant disciplines. An engineer should not only have an operational knowledge of theories and principles of mathematics, physics, chemistry, engineering economics and statistics, but also have an understanding of behavioural processes, systems analysis and computer modelling, laws and regulations, history, sociology and ethics (Loucks, 2008). Water professionals should be able to cross boundaries: disciplinary boundaries, but also boundaries in society.

In this study we consider a framework with three aggregate competences, for technical issues, management and governance, together with a meta-competence for continuous learning and innovation. The latter is a prerequisite to obtain and keep improving the other aggregate competences. Each of these aggregate competences consists of a cognitive-explicit, a cognitive-tacit, functional, personal, and values or ethical component (Sultana, 2009). The aggregate competences can subsequently be organised in various T-shaped competence profiles with the vertical bar representing a specialisation in one discipline, and the horizontal bar representing competence in adjacent disciplines, a meta-competence for continuous learning and innovation, to enable the professional to act and collaborate across boundaries.

The framework and the analytical methodology are field tested in a case study comparing the aggregate competences acquired in locally based post-graduate water education (LPE) and international post-graduate water education (IPE), for professional

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staff of the Directorate General of Water Resources (DGWR) in the Ministry of Public Works (MPW) in Indonesia.

Section 2 presents a framework based on the concepts of knowledge and competence, followed by the research strategy and method in Sect. 3. Section 4 briefly describes the case study and context for the research. Section 5 elaborates on the results and discusses the competences acquired in post-graduate education in relation to the needs as perceived by the water professionals. We conclude in Sect. 6 with suggestions for research practical recommendations for human resources management and for education.

2 Conceptual framework

2.1 Knowledge and competence

There is substantial debate in literature concerning the concept of "competence", and it is impossible to identify a conclusive theory, or to arrive at a definition capable of accommodating and reconciling the different ways that the term is used (Delamare Le Deist and Winterton, 2005). However, approaches that were developed relatively independently, in the United States (McClelland, 1976, 1998; Prahalad and Hamel, 1993; White, 1959), the UK (Cheetham and Chivers, 2005), Germany and France (Bohlinger, 2007/2008) have given way to frameworks that see competence as a multidimensional holistic concept (Delamare Le Deist and Winterton, 2005), including (i) a cognitive-explicit component, that involves the use of objective and replicable theory and concepts, as well as (ii) an informal cognitive-tacit component, which is gained experientially; (iii) a functional component (skills or "know-how"), i.e. those things that a person should be able to apply when functioning in a given area of work, learning or social activity; (iva) a personal component, involving attitudes and knowing how to conduct oneself in a specific situation; and (ivb) a values or ethical component involving the possession of certain personal and professional values (Sultana, 2009). We

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regard the personal and ethical component as one, as personal attitude is largely the consequence of one's norms and values.

The concept of knowledge can be defined in a similar manner. Drawing on epistemological analysis, knowledge can be both explicit (that which can be articulated and transferred in written form, for example, and formally taught) and tacit, referring to knowledge embedded within a person (such as the ability to ride a bike) (Nonaka and Takeuchi, 1995; Polanyi, 1966; Sveiby, 2001b; Tsoukas, 2002; Weggeman, 1997). Tacit knowledge is typically created by socialization and mimicking, if the source of knowledge is tacit, or by internalization, when the source is explicit (Nonaka and Takeuchi, 1995).

The concept of knowledge and the competence approach come from different intellectual roots but they consist of the same ingredients: information equals the explicit part of cognitive competence, skills are similar to functional competence, experience is similar to cognitive, tacit competence, and attitude is comparable to personal and ethical/values competence. Furthermore, in the context of international development, these two concepts are also intimately related to that of "capacity", which refers to the ability of organisations or individuals to be effective in their endeavours (Alaerts and Kaspersma, 2009). In this article we choose to use the word competence, because in the context of education this is the most commonly used term.

2.2 Aggregate competences

Firstly, the technical aggregate competence is required to analyze and solve those problems that are of technical nature. For instance, all sector agencies need to regularly acquire new technical knowledge on an array of subjects from geo-technology and construction techniques to climate change mitigation and adaptation. Second, organizations need to have an adequate management aggregate competence, usually embodied in their senior staff. In many developing countries sector agencies may score well on technical and civil engineering aspects, but often the competence to manage personnel and organizations, as well as the water resource itself, is modest. Finally,

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an effective and performing water sector requires professionals that are competent to foster and apply principles of good governance, such as working towards effective institutions, dialogue with stakeholders, resource allocation within policy frameworks that aim for equity and poverty alleviation, transparency and accountability.

Next to these aggregate competences, capable individuals are those who, by deliberate decision, keep learning and innovating. Learning and innovation do not come naturally but require financial resources and dedicated personal and managerial procedures to foster knowledge generation and sharing. This learning can be incentivized by an acquired attitude or natural inquisitiveness, by financial and career opportunities, or after being held accountable for poor performance (Alaerts and Kaspersma, 2009). Figure 1 shows an overview of the three aggregate competences and the meta-competence for continuous learning and innovation, the four components, and practical examples. The competence for continuous learning and innovation is called a meta-competence because it exists beyond the other competences and enables individuals to monitor and develop other competences (Cheetham and Chivers, 2005). We have displayed the meta-competence for continuous learning and innovation as an umbrella over the other three competences because it is a prerequisite for every professional, whether he or she specialises in a technical, management or governance subject. The professionals working in these organisations will need aspects of the technical, management and governance competence to a certain degree, together with the competence for continuous learning. The mere possession of knowledge and expertise in the professional's own field is in most cases no longer sufficient. It is now necessary to have a basic knowledge – though not necessarily an operational grasp – of adjacent and connecting fields in order to work in interdisciplinary ways, be a good discussion and collaboration partner, both within and outside the organization (Oskam, 2009). The combination of essential aggregate competences can be visually presented in a T-shape. A professional with a T-shaped competence profile has specialist knowledge in his own field (the vertical leg of the T), plus a broad knowledge base with elementary knowledge or insight of adjacent water fields or more general disciplines such as

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business administration (the horizontal leg of the T) and soft-skills enabling him or her to communicate with other disciplines (Oskam, 2009). In Fig. 2 we provide a possible profile for a technical water specialist. As example, a hydrologist will need cognitive explicit competence in mathematics, physics, hydrology, water resources management, and similar "basic" disciplines. He/she will furthermore need a broad understanding of the technical context in which he/she is working (cognitive tacit competence), such as, e.g. river or flood management. Next to these, he/she needs functional competence or skills such as hydrological modelling. These all belong to the technical aggregate competence. Of the aggregate management competence, a hydrologist will at least need understanding of the organisational context in which he/she works such as an operational, regulatory or research establishment (cognitive tacit component), some project management skills, mentoring skills for junior staff (functional competence) and a knowledge sharing attitude and commitment to his cause (personal/ethical/value component). Similarly he/she will require a willingness and ability to effectively work in teams across disciplinary boundaries for higher goals (aggregate governance competence). The hydrologist should furthermore develop his/her learning style, ability to think critically, and openness for continuous learning (meta-competence for continuous learning and innovation). Depending on the specialism and the water sector context, other components of the technical, management and governance competence may be important. Still, the competence mix ("capacity") of the organisation is what matters most, with some staff being highly specialized and mono-disciplinary, but with a growing majority equipped with shallower but broad Ts. Those with broader T's can ensure team cohesion and overall effectiveness. This paper does not discuss the specific competences needed for given situations or the optimum ratio of specialization and breadth. Different mechanisms exist to develop these competences. Typical instruments are formal education and training, which are suitable for acquiring the cognitive-explicit component, whereas the tacit component can best be transferred through one-on-one interaction between junior and senior, apprentice and mentor. Also networks – both formal and informal associations and "communities of practice" – are important mechanisms

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for professional improvement for many water professionals (Alaerts and Kaspersma, 2009). Depending on socio-economic conditions in a country, some mechanisms are more prominent than others. In less developed countries, post-graduate education often fulfils a key role to generate competence and access specialized knowledge, as other mechanisms to access this type of knowledge (professional associations, high-quality seminars, etc.) are less abundantly available Finally, the perception of what competences are most needed, and how they should be acquired and enhanced, depends on policies and procedures in the sectoral institutions, and in those of the "enabling environment" (Alaerts and Kaspersma, 2009). Competence valuation and acquisition, therefore, depend strongly on external factors of policy, administrative and cultural nature.

3 Research strategy and methods

A case study approach was chosen to field test the concept presented above and a method to assess the need for, and acquisition of competence. The DGWR of the MPW of Indonesia was chosen as a case, because of (a) its track record as one of the largest, professional water organisations in Asia, for the past half century, (b) the availability of large groups of professionals who have completed postgraduate water education either in industrialized countries or at Indonesian universities, (c) the availability of a large body of study and information regarding the development that the country's water sector has gone through in recent history, and (d) it being the largest employer for water professionals in Indonesia, and therefore, offering the most representative sample of sector professionals.

To take into account the contextual factors of water resources management in Indonesia, we have distinguished three paradigmatically different phases that influence the need and preference for certain competences and they way they are acquired. A description of these phases is provided in Sect. 4.

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We adopted a two-pronged method in the case study, with first a sequence of 38 semi-structured interviews (hereafter referred to as interviews), followed by a quantitative survey.

The primary target group for the interviews and the survey was the professional staff of the DGWR, i.e. those holding at least an MSc or equivalent degree in a civil engineering or water resource related discipline. The interview respondents from the DGWR were selected to form a representative sample on the basis of two main criteria: (i) the type of education they had enjoyed in the water field, that is, a locally-based (LPE) or international post-graduate education (IPE), and (ii) their involvement in the MPW during one of its three paradigmatic phases in the recent history of the Indonesian water sector (defined by year of recruitment). For the semi-structured interviews, the secondary target group included people external to the DGWR, yet involved in water management in Indonesia from 1980 to the present day, with a good overview of the water sector. Respondents from the latter group are henceforth termed resource persons. In total, the respondents can be categorized into seven strata (Table 1). All interviews and surveys were anonymised.

The first six questions concern the key biographical information of each respondent. Subsequent questions concern the main tasks and activities of respondents, the characteristics of their education, their opinions on the utility of the aggregate competences acquired during their education and their reflections on the aggregate competences needed in water management in Indonesia. The semi-structured interviews were undertaken in Indonesian and in English in the period from November 2008 to January 2010. Each interview lasted between one and two hours. The interviews were recorded, transcribed within a day and then checked for accuracy with the respondents. Following the completion of the interviews, Atlas TI version 6, a qualitative data analysis software package, was used for interview analysis. Each interview was coded thematically according to the method proposed by Saldaña (2009) using codes based on theory. In addition, open coding was used to identify topics that emerged during the interviews and that could not adequately be classified using the thematic

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codes. By cross-referencing the thematic and open coding with the seven strata, a rich and composite understanding of the evolution of the three aggregate competences and the meta-competence within the DGWR in relation to post-graduate education was obtained.

The survey was designed to gain quantitative insight in the phenomenon, and to test the reliability of survey results in a case-study where contextual factors are considered. The survey used random stratification as a sampling method. Seventy-one questionnaires were administered, guided by the primary author and categorized in the same sub-groups (Table 2). The choice for guided questionnaire sessions was made to accommodate the need of respondents for clarification of the questions, and to safeguard the time respondents would allot to filling out the questionnaire.

The survey questions were designed based on the results emerging from the interviews. Respondents were asked to rate the aggregate competences acquired during post-graduate education, and the aggregate competences necessary to execute daily tasks, on a scale ranging from 1 to 5, where 1 = not at all, 3 = to some extent, and 5 = extensively. To better specify the possible meanings of the aggregate competences, all questions were split up in a number of sub-questions referring to sub-competences (e.g. aggregate management competence comprising project management, organisational management, etc). The results were analysed per stratum, using SPSS software (version PASW Statistics 18). To analyse the extent to which variation between groups of respondents can be attributed to real differences instead of random fluctuations in the sample, tests of difference and analyses of variance (ANOVA) were performed. Differences between cohorts or between LPE and IPE that are statistically significant at a confidence level of 10 %, are indicated with an asterisk. Regarding the other items it cannot be excluded statistically that observed differences are attributable to chance; however, they can indicate patterns. Large differentials in the outcome of the surveys should not be likely, as everybody is likely to value each of the aggregate competences and meta-competence to a relatively high degree and the response options were not mutually exclusive. Mutually exclusive questioning (e.g. by forcing

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respondents to prioritize options) was expected to lead to predictable outcomes – for sure, both for the individuals and for their organisation, the technical competence would have the first priority, and management the second. Also, Indonesian respondents may tend to equalize ratings because of cultural sensitivity; hence small differences around the median do matter.

4 Analysis of the recent history of water management in Indonesia

In the recent evolution (1970–2011) of the Indonesian water sector, three separate phases can be distinguished. The first phase, 1970–1987, is characterised by a strong focus on construction of infrastructure. Building roads, canals, reservoirs and flood protection works was essential to start the economic development of the nation and for food security. The principles of water resources and irrigation sector management in this phase were based on Law 11 of 1974 on water resources development. Good governance in the form of public transparency, accountability and public participation were not yet reflected in the law (Herman, 2007) and in this period, staff were appreciated for their technical competence and loyalty to the organisation.

The second phase can be considered to start with the introduction of the Irrigation Operation and Maintenance Policy (IOMP) in 1987 (Herman, 2007). Although the IOMP responded to the need for more decentralisation and collection of user fees, this policy did not change the top-down, construction-focused irrigation development because the government continued its role as an operator, directly implementing activities and staying in charge of the operation and maintenance. In 1992 the first initiatives were taken to introduce Integrated Water Resources Management (IWRM) policies. But since the society was still controlled by an authoritarian state, initiatives such as first IOMP and later IWRM, were counteracted in favour of the strong construction paradigm and very centralised decision-making. Over time, construction contracts had also become a means for well-connected persons to enrich themselves, and it had become increasingly important to be loyal to the regime than to be competent. Only in

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1998, when the Suharto regime ended after 30 yr, the time was ripe to initiate effective institutional reforms in ways which could go beyond lip service (Mollinga and Bolding, 2004). This is the onset of the third phase. The new government embarked on an ambitious programme of decentralizing tasks and responsibilities (Alaerts and Herman, 2005). However, problems arose due to the limited management capacity and financial abilities at provincial and district level. In 2004 the government revised the water law, which emphasizes IWRM but reflects an administration system that has been partly re-centralised (Schwartz, 2008).

This brief overview suggests that water management in Indonesia has been very technically oriented until the end of the nineties, with consequent demands for technical education. A transition is slowly taking place since 1998, towards appreciation of management and governance of water resources. For an elaborate description, see Kaspersma (2012).

5 Discussion

5.1 Three aggregate competences and the learning meta-competence

The aggregate management and governance competences receive a much higher appreciation than would be expected considering the strong technical orientation and history of the DGWR and the respondents (Figs. 3 and 4). It is to be noted that the aggregate competences and the learning meta-competence are mutually non-exclusive response options, allowing higher scores on more than one option. Both LPE and IPE respondents attach lower weight to the aggregate technical competence (Fig. 3). These results are at odds with the outcomes of the interviews, and also with the historical and current incentive system and the expectations at the DGWR, which both tend to stress the aggregate technical competence. Across the board, the interviews stress that professional staff at the DGWR know that the other aggregate competences

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should become part of the overall set of aggregate competence of the DGWR, however, in practice, the orientation has remained overwhelmingly technical thus far.

Respondents with IPE experience tend to rate the need for competence across the board higher than the respondents with LPE experience (Fig. 3). It seems they have stronger opinions about the need for and value of competence than LPE respondents. The interviews confirm the general value attributed to learning, but indicate, in addition, that the need for learning is highly appreciated especially by IPE respondents, and are generally seen as key to personal and organisational advancement, in an environment where the number of individuals with a post-graduate education is still limited.

Respondents who represent the phases II and III all tend to under-value the aggregate technical competence (Fig. 4). This is again in stark contrast with the reality at the DGWR. Furthermore, the meta-competence for continuous learning and innovation is valued strongly especially by respondents from phases I and III. Although the differences are statistically not significant, the interview outcomes underscore the same trend. In phase I DGWR was characterised by a strong *esprit de corps*, and focus on technical competence and development, also of skills, whilst phase III respondents are much younger and are likely to recognize the necessity to fast improve on their specialization.

The majority of the LPE programs is reported to not yet strongly reflect the paradigm shift from "construction" to water resources management and to a new set of resulting competences (Fig. 5) (Ministry of Public Works – Directorate General of Water Resources, 2010). This observation is confirmed by the survey and the interviews. During the interviews, all respondents confirmed the technical orientation of locally-based post-graduate education, but they add that this is the most directly appreciated educational background in the DGWR.

For IPE respondents, the interviews and the survey show the same tendency (Figs. 5 and 6) with high scores for the aggregate technical competence, and the meta-competence for continuous learning and innovation, compared to the other aggregate competences. Both interview and survey respondents report that the IPE experience

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was particularly effective for specialised new skills such as computational techniques, as well as for the cognitive-tacit component of competence. Still, the assumption that IPE would notably stress the non-technical competences more, seems not borne out. It is, furthermore, surprising that in the survey the aggregate management and governance competences were scored higher by LPE than IPE respondents. This does not necessarily mean that LPE is more effective than IPE in absolute terms, as respondents cannot compare the effectiveness of IPE and LPE, because each respondent has had only one such experience. In fact, the interviews, where the interviewer as outsider is able to assess better both types of education, and the analysis of documentation, do not the support the perception of the respondents in this case.

Phase I respondents plausibly emphasise their acquisition of the aggregate technical competence as water governance and water management concepts such as IWRM were not widespread, let alone incorporated in curricula in that period (Fig. 6). We would expect this to be similar for phase II, but the survey results do reflect a lower level acquisition of technical competence. A much higher appreciation for aggregate technical competence is again reflected among the young respondents from phase III, whereas in phase III there are more educational programmes available with an IWRM orientation. This apparent contradiction can be explained by a possible path-dependency that makes people choose a familiar subject, of which they know it is appreciated in their organisation. As mentioned earlier, the interviews indicate that many people are aware that the DGWR needs expertise in fields other than water engineering but in practice, engineering is still the basic and, perhaps too often, singularly appreciated education background. Moreover, in phase III, apart from the increasing attention for aggregate competences other than the technical there is a new need for increasing the technical competence after a long period of erosion of this expertise, first in the aftermath of phase II and then during the financial crisis at the onset of phase III. Therefore, strictly technical subjects will remain a popular choice for students enrolling in an IPE or LPE. The lower score in phase II could, as is portrayed in the case study description in Sect. 4 and in the interviews, be a consequence of the required loyalty to

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the regime to the detriment of technical competence. The interest in obtaining technical competence in education may have been a relatively low priority.

Both the aggregate governance and management competence are rated low in Fig. 6. For phase I, this is plausible considering the dominant construction paradigm in that period. This would also be expected for phase II, but the survey results do not bear this out. The interview results and literature confirm that in phase II, despite attempts to introduce the concept of IWRM and the IOMP, the organisational focus was still heavy on construction and infrastructure development.

The IPE interviewees employed in phase III furthermore indicated that they consciously chose for a water governance or water management orientation, stating that they have acquired the aggregate technical competence during their BSc degree or from acquisition in the organization itself. However, as explained before, having an aggregate technical competence is a core priority of the MPW, and for post-graduate water education a technical subject may still have the preference of many staff.

The difference between the aggregate management and governance competences as acquired from post-graduate education and the aggregate competence as required for daily tasks is relatively large, when we compare Figs. 3 and 4 with Figs. 5 and 6. For the aggregate management competence, the need in daily work is explained by the fact that work at the DGWR consists for a large part of administrative tasks, which is part of the aggregate management competence. This is mentioned in all interviews. This suggests that a discrepancy exists between what is needed in daily work and the orientation people choose in their post-graduate education. For the aggregate management competence, the explanation may be that people expect to obtain the management competence through on-the-job training. Management training is indeed available for staff of DGWR, although this type of training has a strong focus on the functional component of the competence, i.e. skills, only.

For the aggregate governance competence, the IPE respondents score higher for the extent to which an aggregate competence is needed in daily work, whereas the LPE respondents surprisingly score higher on the extent to which they obtained this

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aggregate competence in school. The latter is not confirmed by the interviews. Interviews with resource persons and LPE as well as IPE respondents raise the issue of the gap between the aggregate governance competence in the organisation and the extent to which it is obtained during an LPE or IPE. We can conclude from these results that for the aggregate management and governance competences an apparent imbalance exists between the aggregate competences required in daily work vs. what is obtained during post-graduate water education, be it local or international. This is confirmed by both the survey and the interviews.

5.2 Technical competences

The aggregate technical competence consists of three components. The cognitive-explicit component, e.g. specialised theoretical knowledge; the cognitive-tacit component, e.g. a broader understanding of the technical context; and a functional component, e.g. design or modelling skills (Fig. 7). The personal/ethical/values component is non-existent for the aggregate technical competence.

The results for LPE and IPE respondents show higher scores for IPE, for each component. The LPE programmes for water management show a slight preference for the cognitive-explicit component of the aggregate technical competence. This is also confirmed in the interviews with LPE respondents. For IPE respondents, the cognitive-tacit component is perceived higher than the others. It is confirmed by the interviews that IPE pays more attention to the cognitive-tacit component by for example creating broader understanding of the technical context, and for technical problem solving. Further comparative analysis of the specific sub-competences did not reveal additional information, other than already discussed in Sect. 5.1.

5.3 Management competences

A need exists for each component of the aggregate management competence (Fig. 8). The need for the cognitive-tacit component is valued slightly higher than the others.

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The cognitive-tacit component includes competences such as a broader understanding of how organisations and their staff are managed. Phase III respondents rated the need in daily work of the cognitive-explicit component (e.g. theoretical knowledge about organisational management and people management) as, lower than respondents of the other two phases; the reason of this low rate is unclear. This component of the competence, though essential, would automatically also become tacit, i.e. it is internalized when people start applying it in work situations they encounter. This may explain why the cognitive-tacit component is rated higher than the cognitive-explicit component.

The breakdown in components for the management competence as acquired during post-graduate water education (Fig. 9) shows that the explicit component is not reportedly strong, and actually much lower than the other components. Phase III respondents emphasised that the education seemed to favour the functional component, constituted by competences such as written communication skills and project management; and the personal/ethical/values component, such as the willingness to share knowledge. The components, and especially the cognitive explicit component, appear insufficiently addressed in the curricula of both IPE and LPE. The cognitive-explicit component is imperative in post-graduate education, and should then be internalised to become tacit, when it is combined with the personal experience gained on-the-job.

5.4 Governance competences

As was mentioned in Sect. 5.1 an apparent imbalance is appearing between the high rates for aggregate governance competence as required in daily work vs. the markedly low rates for acquisition during post-graduate water education, be it local or international (Figs. 10 and 11). The cognitive-tacit component, however, such as for example the understanding of political consensus building, is rated low in both figures, especially by phase I respondents. This can be explained by the fact that in phase I a strong *esprit de corps* existed because of the shared goal of the development of the nation, albeit under a highly centralised administrative and political system. There was only limited space for political consensus building as decisions were made by the top management

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and as these were the years where the power and successes of the MPW were at their peak. Therefore there was no high need for formal governance in daily work, and no reason to acquire this component in education.

The acquisition of the personal/ethical component, e.g. the ability to achieve ethical objectives, is scored higher by respondents of phase III (Fig. 11). Considering the more open atmosphere in phase III, and more attention for accountability and transparency in the DGWR, it is to be expected that the personal/ethical component scores higher, but this would naturally also be expected in Fig. 10. The results from the interviews indicate that the younger generation of phase III tends to appreciate the personal/ethical/values component, and the organisation also provides more space for that.

Inter-disciplinarity

The ability to think and work in an inter-disciplinary fashion is an aspect of the aggregate competence for governance that merits special attention. The documentation on existing local water curricula shows that in most water-related MSc curricula the connections between the different disciplines are made insufficiently, and interdisciplinary thinking is limited to the technical disciplines. The survey results point out that interdisciplinary thinking acquired during education is rated significantly lower for LPE than for IPE, although the score for LPE is not extremely low. In the interviews, though, no evidence is found pointing to interdisciplinary working skills as obtained in LPE. In IPE the situation is slightly different. Even though aggregate competences such as management and governance are not taught sufficiently intensively according to the survey and interviews, and consequently connections between these topics and technical disciplines are weak, interview respondents stated that they were encouraged to look over the boundaries of their discipline and learn how to communicate with colleagues from other disciplines. However, for both IPE and LPE opportunities for improvement exist.

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5.5 Meta-competence for continuous learning and innovation

Graduates of both IPE and LPE rate the need for the meta-competence for continuous learning and innovation in daily work as very high in comparison with the other competences (Figs. 3 and 4), and slightly higher for their acquisition of this competence during education (Figs. 5 and 6). Phase I respondents pointed out the DGWR policies during phase I, which stressed the continuous learning concept and had in place mechanisms to rotate staff, provide mentorship and junior-senior learning arrangements, and careful selection of IPE candidates (during this period, no LPE was on offer yet). On the other hand, phase II respondents rate this need decidedly lower, probably because in phase II competence and learning were sometimes subordinated to loyalty, when it came to incentives and careers. Yet, also in this phase DGWR had suitable policies in place albeit possibly less well enforced. The cognitive-explicit component (for example, intercultural sensitivity) of the meta-competence is rated lowest of the four components, for the need in daily work (Fig. 12) as well as the extent to which it is acquired in postgraduate education (Fig. 13). The perceived low need in daily work is remarkable as intercultural sensitivity is important in the Indonesian context, considering the diverse ethnical backgrounds of the staff of the DGWR.

Explicit attention for this meta-competence is only marginally available in the water curricula of LPE and IPE, and this is confirmed by both survey and the interviews. This means that the cognitive-explicit component of this meta-competence is not taught. The other components of the meta-competence, i.e. the cognitive-tacit (for example, the ability to reflect on oneself); the functional (such as critical thinking); the personal/ethical/values (for example, creativity) are implicit in the curricula; they can, to some extent, be acquired while working on the other aggregate competences.

The interview outcomes, contradicting the survey results, confirm the acquisition of the meta-competence for continuous learning and innovation from education for IPE only. For example, all phase III interview respondents with an LPE stated that the meta-competence for learning is a personality trait and exists independent of what one

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learns in school; they furthermore thought that they did not acquire this competence in school. IPE alumni, on the other hand, unanimously stated that acquiring the meta-competence for continuous learning and innovation while abroad was synonymous with fundamental attitude change.

All IPE interviewees, together with 13 out of 14 resource persons confirmed the hypothesis that the most important aspect in IPE is acquiring the meta-competence for continuous learning and innovation, and the attitude change that happens simultaneously. This has been termed socialisation of tacit knowledge (Nonaka and Takeuchi, 1995). The socialisation happens because the participants are in a totally different habitat for a substantial period. In the assignments they have the chance to mingle with different cultures and patterns, and they are encouraged to discuss with lecturers and professors and ask questions, which is a new experience for many participants. The aspects of the education that catalyze the socialisation are summarised in Table 3. Learning is encouraged by group work, role plays, debates, and through a working culture with smaller power distances in human relations, facilitating easier interaction between professors and students. Typical statements from the interviews confirm this picture: *The very fact that you are in a different country changes the experience. You are told things you wouldn't accept from someone in your home country*, and *Receiving critical comments from teachers was difficult. They would tell you that you need to do certain things differently, but not how you should do it. You have to find out yourself but they help you getting started.*

The one resource person who doubted the attitude change among alumni from international post-graduate water education suggested that MPW staff should learn together with NGO staff, civil society representatives and university staff. Indeed, the large majority of participants in international programmes have a government background. Creating a more heterogeneous mix of backgrounds and opinions in the educational programmes would help increase the learning opportunities.

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6 Conclusions

A framework was introduced, describing three aggregate competences for technical issues, management and governance, and a meta-competence for continuous learning and innovation for the water sector. The framework was tested in a case study on post-graduate water education for staff in the DGWR of the MPW in Indonesia. Though DGWR and the sector professionals have a firmly "technical" default orientation, both the surveys and interviews provide a surprisingly strong interest in the other competences: primarily the meta-competence to learn and innovate, as well as the aggregate competence of management. The aggregate competence of governance systematically scores lower, however, it is still regarded as reasonably important. A discrepancy appears to exist between the competences that staff perceive as needed in daily work, compared to those that could be acquired during post-graduate water education. Respondents also indicated that the DGWR needs a wider palette of competences beyond the strictly technical ones, but these competences seem not to be intensively acquired from the post-graduate education, even though some international courses do offer them. Thus, it can be assumed that the DGWR is still located in a primarily mono-disciplinary technical paradigm. This situation may for the moment be inevitable under the pressure of the current need to rebuild and expand the existing infrastructure and the comparative staff shortage, but it is likely that in the coming decade this discrepancy will increasingly call for a new human resource policy at DGWR. It could be expected that international post-graduate education would help fill the need for the aggregate management and governance competences, but this is not the case, possibly because respondents hail from three different phases in the development of the sector and international courses did not yet offer such competence building prior to, say, 1990.

The LPE in Indonesia has a relatively singular cognitive-explicit and technical orientation. With this set of knowledge, a part of the vertical bar of the T-shape is filled. The aggregate technical competence is not complete, as the personal and ethical

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component, together with the cognitive-tacit component (understanding, practical experience), tend to receive relatively less attention. IPE programmes, on the other hand, seem to have a relatively strong technical focus as well, but, in particular in phase III, pay more attention to the cognitive-tacit component, in addition to the cognitive-explicit component.

In both LPE and IPE, the aggregate competences for management as well as governance are reportedly addressed modestly, if at all. With only little competence in these disciplines, it will be difficult for professionals to communicate and collaborate effectively in interdisciplinary settings and in the water policy and political discussions that characterize the Indonesian water sector since the onset of phase III. As a result, the horizontal bar of the T-shaped profile remains weakly developed. In IPE, this seems partly compensated by the (implicit) attention for continuous learning and innovation. The exposure to a different culture and learning format is reported as fundamentally formative. An important aspect of IPE is the tacit knowledge the students acquire through socialisation.

However, for both IPE as well as LPE, the responses in this study cover a substantial period and the study is not able to make statements about the performance of current post-graduate water education. Especially since 2000, also the Indonesian water curricula are becoming more responsive to the new demands of the sector.

The methodological differentiation of respondents as a function of their LPE or IPE experience, and of the administrative and political context in the country and sector, has proven useful to generate relatively detailed insight in the development of the competences in the Indonesian water sector, over a long span of time, and as defined by the evolving economic, administrative and political context. However, the combined utilization of guided surveys, semi-structured interviews and analysis of reports and policy papers proved essential to provide more accurate and meaningful interpretation; survey results alone were often insufficient and proved hard to interpret. Importantly, surveys reflect perceptions of individuals, and as many respondents have had only one and a very personal experience with LPE or IPE, these perceptions are not necessary

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mutually compatible; the presence of the interviewer/analyst offered the possibility to set more robust assessment benchmarks.

The findings of this research are considered representative for the water sector in Indonesia, and hold valid conclusions pertaining to the water sector in other developing and emerging economies. More research is suggested to further refine the analytical framework and investigative methods for data collection. The framework cannot resolve decisions on the details of the required T-shaped competence profiles and skills mixes for specific water specialisations of individuals and organisations (e.g. on the relative importance of "broad" competence versus "in-depth" expertise) but it can help in outlining requirements that subsequently help guide MSc-level water curricula improvements.

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Table 1. Interview respondents in seven sub-groups.

Degree type	Recruited in phase I	Recruited in phase II	Recruited in phase III
LPE	3	1	5
IPE	12	1	2
Resource persons	14	–	–

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Table 2. Survey respondents per sub-group.

Degree type	Recruited in phase I	Recruited in phase II	Recruited in phase III
LPE	14	11	9
IPE	20	7	10

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Table 3. Most important aspects of international education, as perceived by interview respondents.

Aspect	How many times mentioned in interviews
Learning how to learn, encouragement of curiosity	10
Intercultural sensitivity	7
Being exposed to new concepts	10
Discussions with peers	7
Discussion with professors	5
International networking	7
Encouragement of critical thinking	10
Working in an interdisciplinary fashion	6
Team building	6
Being away from home/living in a different country	5
Working independently	4
Exercises for self-reflection	1
Learning to plan ahead	6
Different working culture	8
Connecting theory to practice	6

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	Meta-competence for continuous learning and innovation			
	Cognitive - explicit component	**Cognitive - tacit component**	**Functional component**	**Personal /ethical/ value component**
	Knowledge about learning and learning styles	Experience with and awareness of your learning style	Critical thinking, self-discipline, ability to concentrate	Availability for training and education in new knowledge, readiness to critically reflect on one's own performance, desire to 'keep learning', creativity, self-confidence, non-individualistic attitude
Aggr. Competence:				
Technical	Regularly updated technical knowledge	Understanding of the broader technical context, application insight, intuitive understanding	Design skills, modelling skills	
Management	Regularly updated knowledge about management	Understanding of broader organisational context, Application insight, intuitive understanding	Project mgt skills, financial mgt skills, people mgmt, negotiation Mentoring, Ability to 'deliver', Leadership	Willingness to involve staff in decision-making, Knowledge sharing attitude
Governance	Regularly updated knowledge on governance, such as participation stakeholder involvement	Ability to apply inclusiveness, Understanding of procedures and institutional structures, Understanding of political consensus building Application insight, intuitive understanding Ability to cross disciplinary boundaries	Policy formulation skills, Working in a participative manner	Achieving ethical objectives: non-corruption, transparency, etc. Willingness to cross disciplinary boundaries (Mollinga, 2009)

Fig. 1. Three aggregate competences, and one meta-competence for continuous learning and innovation, for professionals in the water sector, based on Alaerts and Kaspersma (2009), Sultana (2009).

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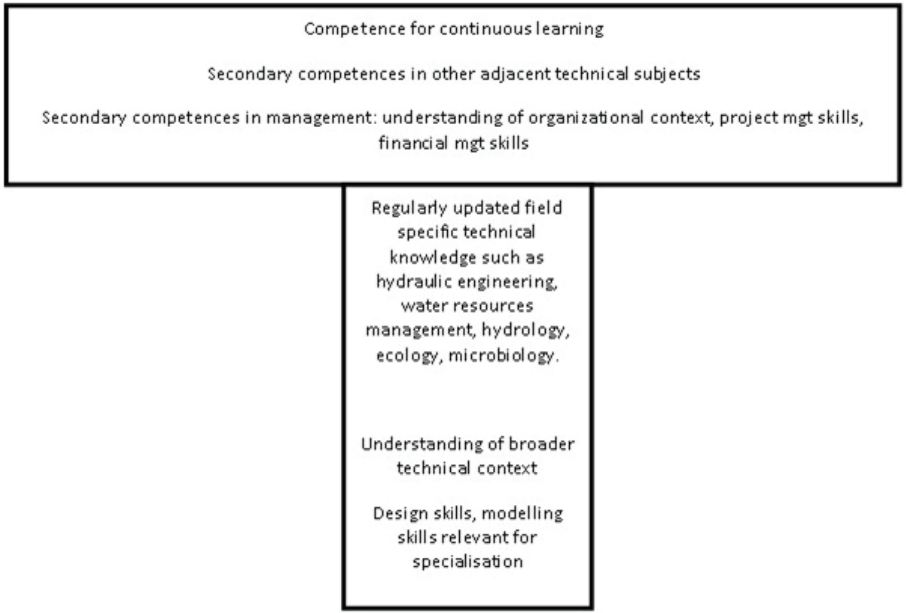

Fig. 2. Hypothetical T-shaped competence profile for a technical water specialist.

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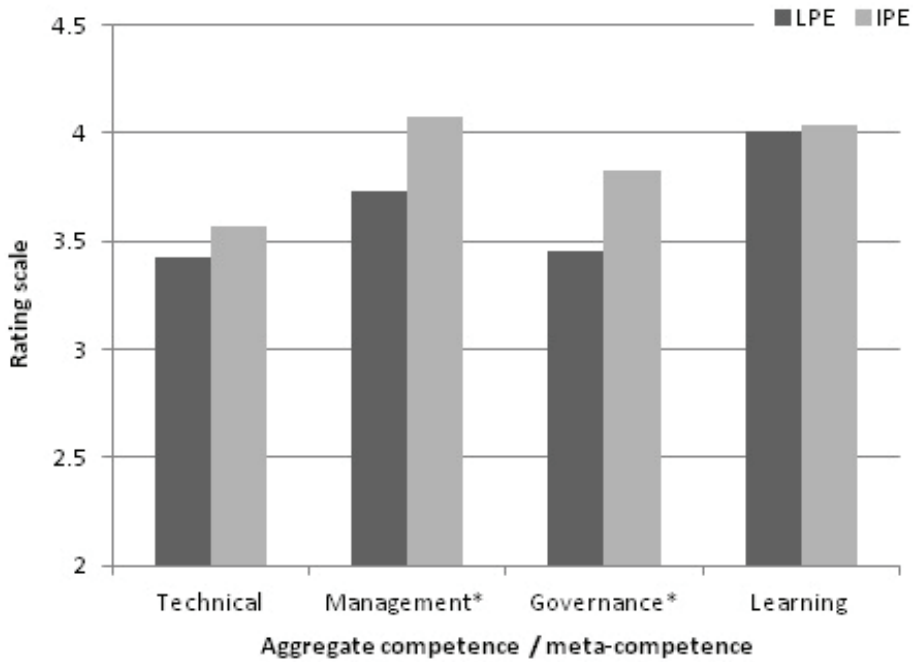

Fig. 3. Aggregate competences and meta-competence perceived to be required for daily tasks in the DGWR as rated by LPE alumni and IPE alumni.

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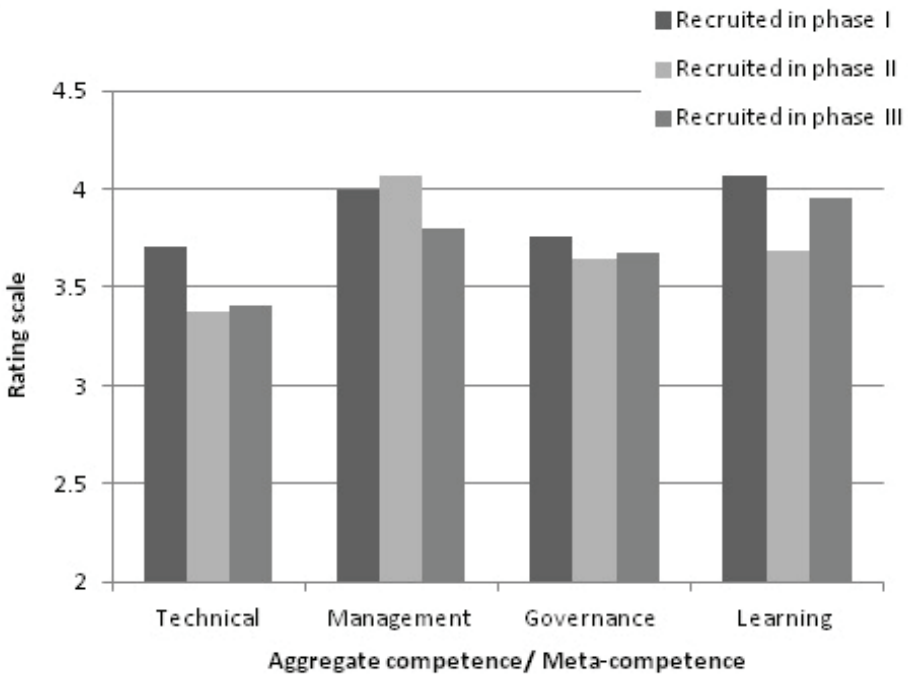

Fig. 4. Aggregate competences and meta-competence perceived to be required for daily tasks in the DGWR, in phase I, II and III.

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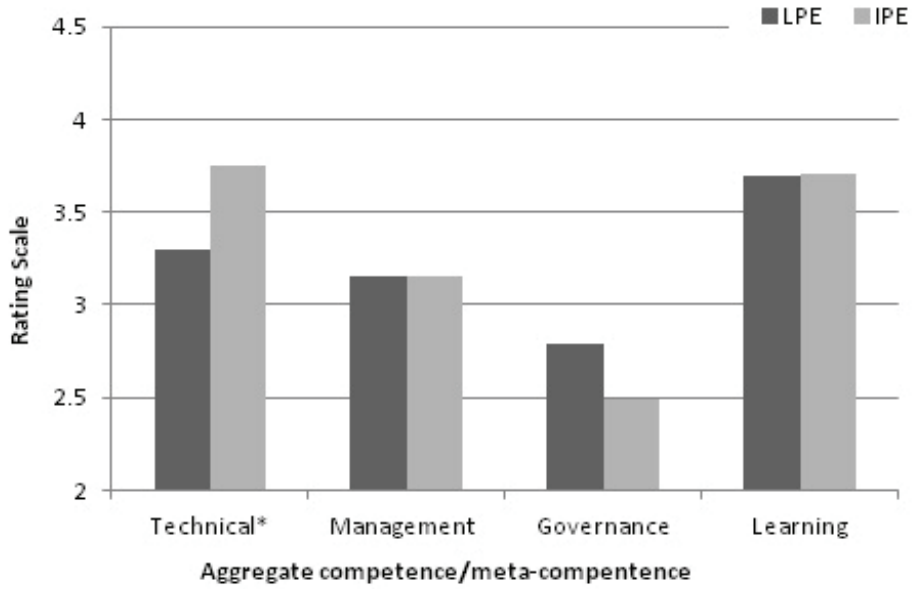

Fig. 5. Aggregate competences and learning meta-competence perceived to be acquired during LPE and IPE.

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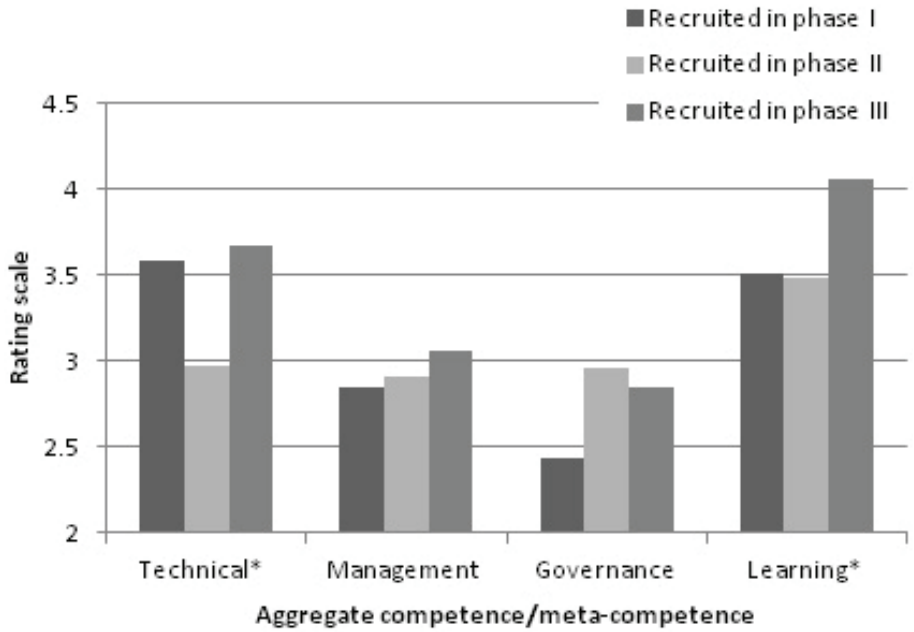

Fig. 6. Aggregate competences and meta-competence perceived to be acquired during LPE or IPE in phase I, II and III.

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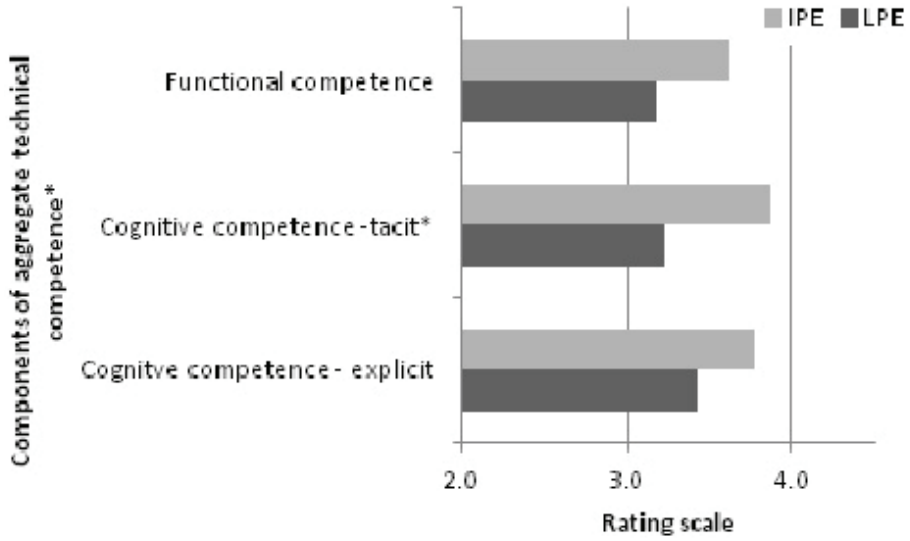

Fig. 7. Components of aggregate technical competence perceived to be acquired during LPE and IPE.

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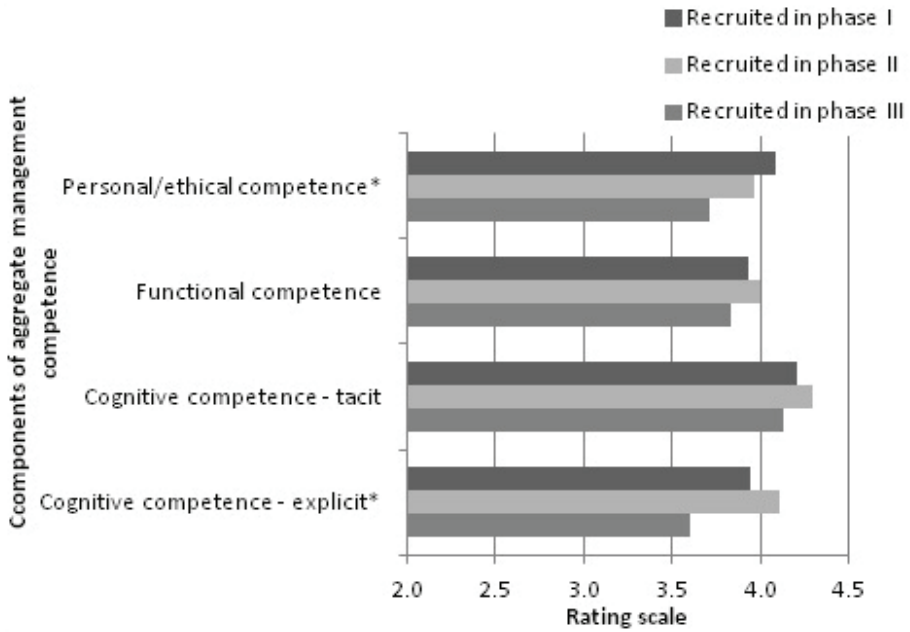

Fig. 8. Components of the aggregate management competence perceived to be required in daily work in phase I, II and III.

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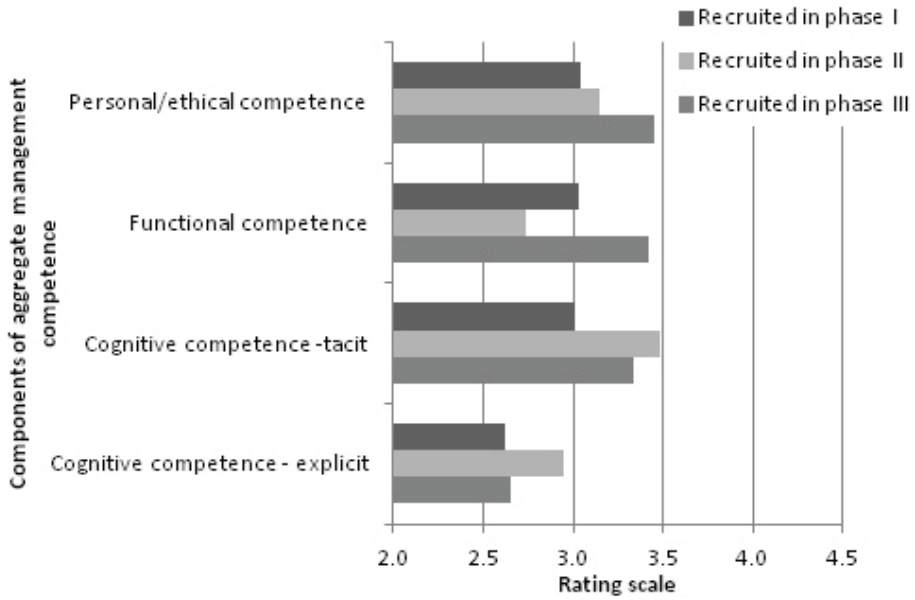

Fig. 9. Components of the aggregate management competence perceived to be acquired during LPE and IPE in phase I, II and III.

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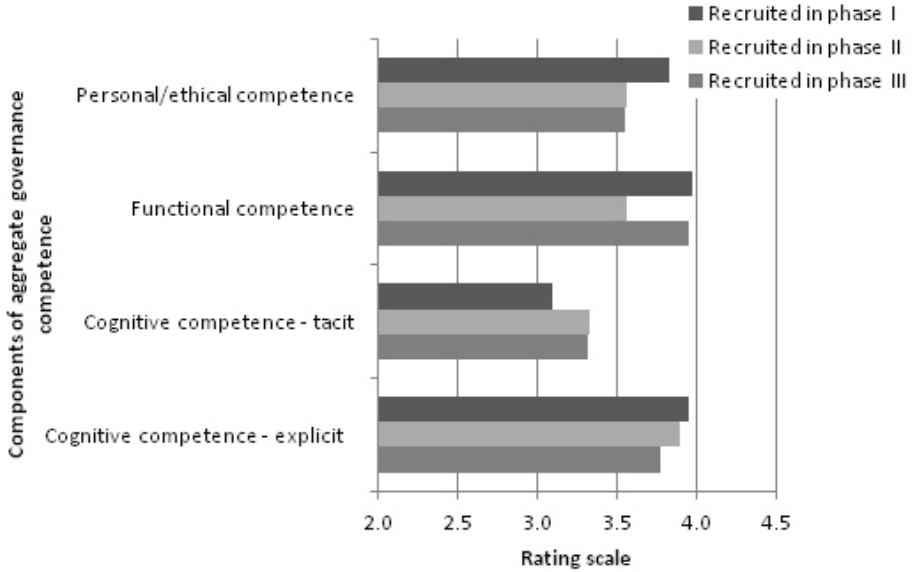

Fig. 10. Components of aggregate governance competence perceived to be required in daily work, in phase I, II and III.

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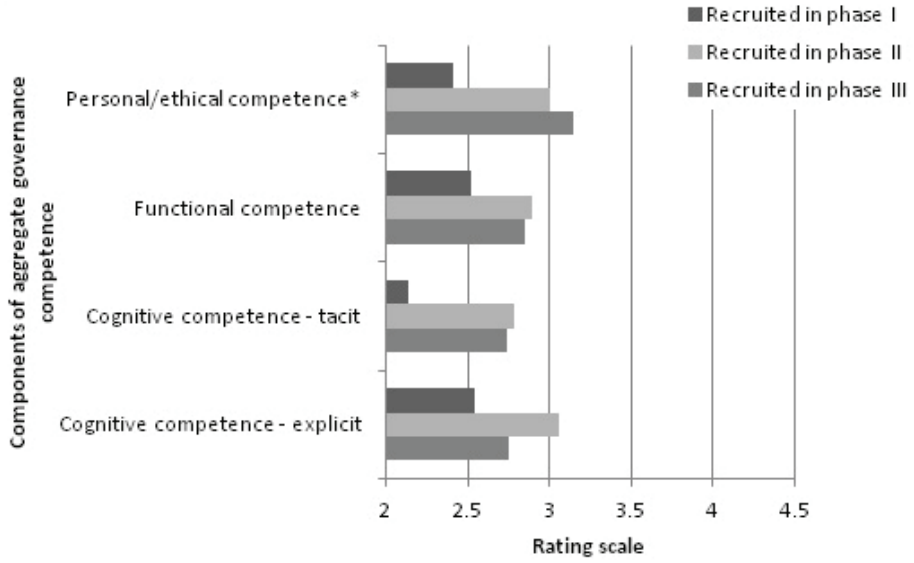

Fig. 11. Components of the aggregate governance competence perceived to be acquired from LPE and IPE, in phase I, II and III.

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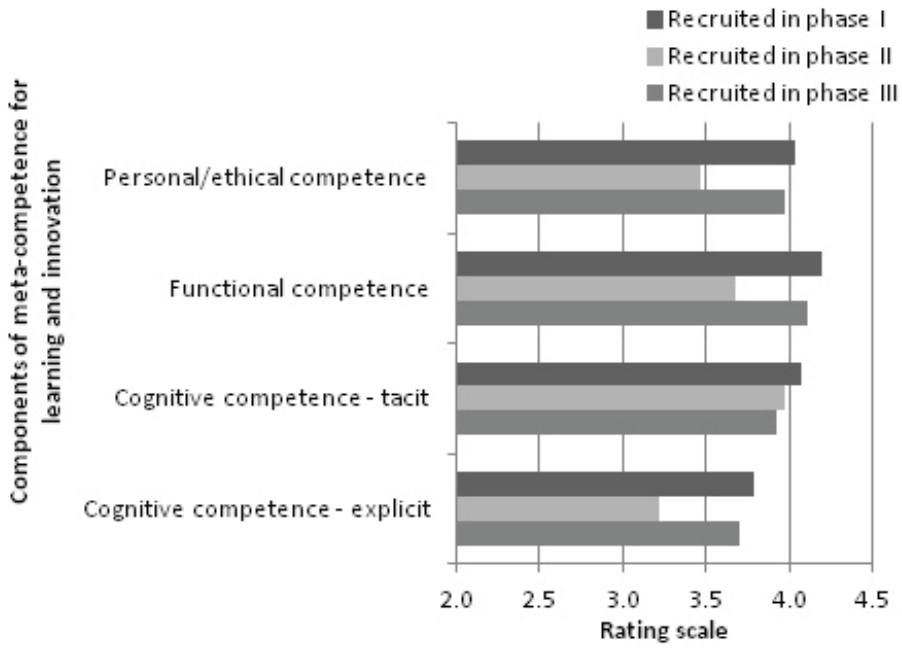

Fig. 12. Components of the meta-competence for continuous learning and innovation perceived to be required in daily tasks, in phase I, II and III.

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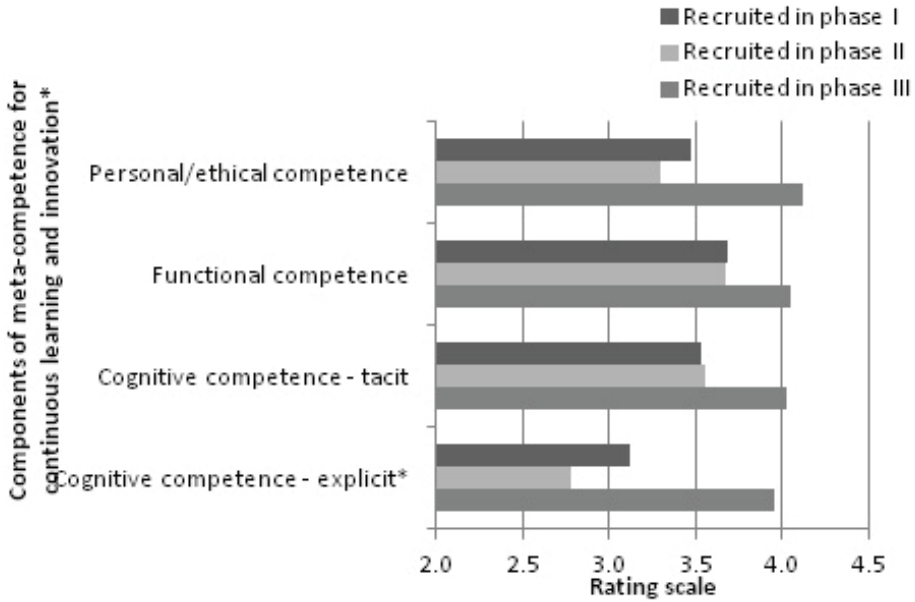

Fig. 13. Perception of components of the meta-competence for continuous learning and innovation perceived to be acquired from IPE and LPE, in phase I, II and III.

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