Education – world of work mismatch: a multidimensional competence gap analysis for reorienting the fisheries vocational education system in India

Reshma Gills[1,*], C. Ramachandran[1], V. P. Vipinkumar[1], Manish Kumar[2,3], Eldho Varghese[1], Jayaraman Jayasankar[1], Shelton Padua[1], R. Narayana Kumar[4], Pooja Krishna[1] and T. V. Ambrose[1]

[1]ICAR-Central Marine Fisheries Research Institute, Kochi 682 018, India
[2]National Skill Development Agency, New Delhi 110 019, India
[3]StatsInk Consultancy Pvt Ltd, New Delhi 110 019, India
[4]Madras Research Centre, ICAR-Central Marine Fisheries Research Institute, Chennai 600 028, India

India's New Education Policy 2020, which is in tune with SDG 4 (quality education) and SDG 8 (decent work and economic growth), has stressed the redesigning of vocational education (VE) to equip the youth for the world of work, considering the window of opportunities available till 2040. Though the competence gap is being pronounced as the foremost hurdle in the 'education–world of work' transition in every sector, its precise measurement and quantification remain elusive. In this context, we have develop an innovative methodological framework and a composite index (η) to measure the competence gap of the vocational higher secondary education system (VHSES), taking marine fisheries and seafood processing courses offered under the VHSES in Kerala, India as a case study. This study demonstrates that the educational gap, delivery gap, propensity to normalize with general education and inadequate learning ecosystem are responsible for the 'education–world of work mismatch' in VE. The findings of the present study point to specific areas of VE that need pedagogic and pragmatic reconstruction. It also shows strategic policy considerations to place the learners' aspirations, gender and vocational opportunities in a balanced manner for a better vocational teaching–learning ecosystem.

Keywords: Competence gap, composite index, gender, marine fisheries and seafood processing, vocational education.

INDIA ranks fourth in the world for the export of fish products, contributing 7.7% of the global fish production[1], with an export income of Rs 4137 crores in 2020–21 (ref. 2). In addition, it offers a basket of livelihood and entrepreneurial opportunities across the value chains[3,4]. Though the marine fisheries sector in India is a sunrise sector, the benefits of commercial fishing, processing and value chain development are not sufficiently diffused. Similarly, the young generation is not adequately encouraged to engage in fishing and related activities, like in many other nations where small-scale fishing is the norm[5]. The 'competence deficit' in attracting, exploring, adapting and leveraging cutting-edge technology options is the reason for the slow expansion of capture fisheries along its value chain in India, in terms of human capital turnover and economic growth rate[6]. Although Indian fishermen are well known for their diligence and capacity to work under challenging conditions, a severe competence gap has been cited as the cause of the apprehended employability rate[7]. It can be overcome through skill matching, skill upgrading and relevant societal skills[8,9]. While viewing the fisheries sector through an 'individual–economic–social–development' sense, vocational education (VE) plays a critical role in the formal skilling of people, similar to the other primary sectors[10–12].

Though attempts at a structured VE system in India's maritime fisheries sector have been made during the British era[13] to teach 'fishery' as a vocational subject and to produce 'educated fishermen', it could not keep abreast of the technological changes unleashed by globalization, thus resulting in an 'education – the world of work' competence mismatch. India's New National Education Policy 2020 (NEP-2020) emphasizes a redesign of VE in the primary sector, such as fisheries, to address this problem[14]. Similarly, VE found a special mention in India's National Fisheries Policy, 2020, to improve the competence of fishery personnel and workers[15]. Nevertheless, the most critical question is: to what extent will the students be vocationally educated so that they will be able to meet the labour market expectations of the marine fishing sector? In recent years, there have been a few attempts to conduct a macro-level analysis of the education–workplace mismatch in India's primary and secondary sectors[16,17]. However, there is limited

*For correspondence. (e-mail: reshma1818@gmail.com)

empirical research conducted at the micro-level, especially on fisheries VE in India, due to the lack of a quantitative analytical framework to measure the competence gap. Hence, the present study focused on (i) developing a methodological framework to quantify the competence gap; (ii) quantifying the current level of competence gap among vocational students and (iii) exploring appropriate policy options to improve the marine fisheries VE in general.

Methodology

As in any other sector, quantifying the competence gap in fisheries is critical to achieving one of the sustainable development goals (SDG), namely quality education for a decent job. However, general confusion about the conceptual understanding of knowledge and skill versus competence is observed in VE research[18]. Taking into consideration the significant arguments about the definition and measurement perspectives[19,20], competence is defined in this study in terms of the knowledge, technical skills and soft skills/traits explicitly considered necessary for enhanced employability and job performance[21,22]. The data collection tool was prepared with questions for the quantitative measurement of demographic variables and a validated Likert scale to measure the competence gap. The reliability of the scale was tested and the coefficient of internal consistency (Spearman's rho) of this scale was 0.843. Each item on the scale has two dimensions that can be measured. One measures the perceived importance of each item in securing meaningful employment in the current job market using a three-point continuum. The other dimension evaluates each student according to the perceived level of competence attained on a five-point continuum. Students of the vocational higher secondary education system (vocational higher secondary education system (VHSES); +2 level; $N = 477$), teachers ($N = 22$) of marine fisheries and seafood processing (MF&SP) course and potential employers of the MF&SP sector ($N = 20$) from three zones of Kerala (North, Central, and South), India, participated in this study. All 13 schools that offer the MF&SP courses were surveyed (Figure 1). The same measurement tool was given to teachers and students with a slight tweak. Students were asked to rate how they placed themselves for employable competence, and the teachers were asked to provide a rating of competence of their students.

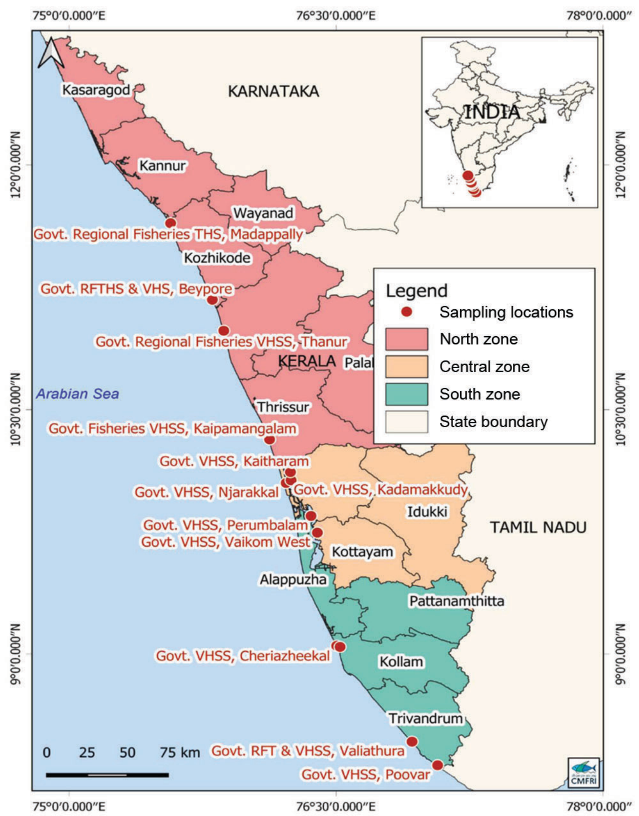

Figure 1. Map showing the study location.

Analytical framework

Since the previous works lacked a quantitative analytical framework or a programmed ready-reckoner to quantify the competence gap[22,23], we proposed a theoretical and procedural headway (competence gap analysis approach; CGAA). CGAA has four pillars with different actors, i.e. job market, educational institutions, students and teachers (Figure 2). It measures four different levels of competence, i.e. C_R is the required level of competence in the labour market.; C_E the expected level of competence for students in the education system; C_P the perceived level of competence by students themselves in the learning ecosystem; and C_M the measured level of competence of students by the evaluator/teacher.

The gaps in each continuum are defined as follows: The satisfaction gap measures the difference in competence as expected from the students by the education system and the perceived competence level (by self-evaluation) of the students. The market demand gap is the difference (±) between the measured level of competence of students in educational institutions and the competence demand of the job market. The education gap (±) is observed between the two social institutions, i.e. the market and the education system. It might be due to the deficiency of the education system in translating the competence demand of job markets while drafting the curriculum, or due to the conscious emphasis given on the pedagogical domain of curriculum to ease the vertical and horizontal mobility of the students. Similarly, the competence gap observed in the evaluator–student continuum is the delivery gap. It might be due to the failure of the teaching systems to translate the competence demand as designed in the course among the scholars, or the incapability of the students to express their competence potential in the given learning ecosystem. The delivery gap and education gap are intervening variables, and their

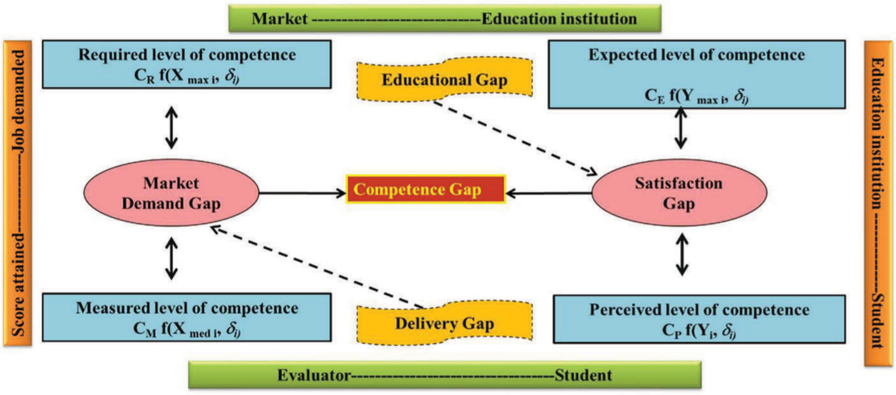

Figure 2. Competence gap analysis approach.

effects are measured along with the market demand gap and satisfaction gap respectively.

Based on the conceptual framework, we developed a composite indicator (competence gap index, η) to quantify the real competence gap of each student (eq. (1)). We assumed equal importance for all three dimensions (knowledge, technical skill and soft skill) instead of performing principal component analysis (PCA) to assign weightage. Thus, the composite indicator (η) developed in this study shows the weighted sum of knowledge gap index (KGI), skill gap index (SGI), and trait gap index (TGI) represented by eqs (4)–(6) respectively.

$$\eta = \sum_{i=1}^{k} \delta_i \{| x_{\max,i} - x_{\text{med},i} | \; + \; | y_i - x_{\text{med},i} |\}, \tag{1}$$

Maximum η could be

$$\eta_{\max} = \sum_{i=1}^{k} \delta_i \{x_{\max,i} + y_{\max,i}\}, \tag{2}$$

where $x_{\max,i}$ is the maximum level of η assigned to a subject group (of n_3 students) by the experts (of n_2 teachers) for the ith dimension. (Since responses are recorded in a 5-point continuum (0 to 4) the maximum for each dimension will be 4.)

$x_{\text{med},i}$ is the median of the scores assigned by the experts group (of n_2 experts) to a subject group (of n_3 students) for the ith dimension.

$y_{\max,i}$ is the maximum level of η a subject group (of n_3 students) can have for the ith dimension. (Since responses are recorded in a five-point continuum (0 to 4), the maximum for each dimension will be 4.)

y_i is the level of competence of the individual in a subject group (of n_3 students) for the ith dimension according to self-evaluation.

n_1 is the number of experts chosen to assign weights for each dimension of η.

n_2 is the number of teachers chosen to evaluate each dimension of η of a subject group.

n_3 is the number of individuals/students in a subject group.

k is the number of dimensions (i) through which η has been assessed.

δ_i represents the weight assigned to each dimension by the experts (importance of each dimension on the employability it could offer).

$$\delta_i = \frac{\sum_{j=1}^{n_1} x_{ji}^*}{\sum_{i=1}^{k}\sum_{j=1}^{n_1} x_{ji}^*}, \tag{3}$$

where x_{ji}^* is the rating given by the jth expert for the ith dimension of η.

$$\text{KGI} = \sum_{i=1}^{k} \text{kwd}_i \{| x_{\max,i} - x_{\text{med},i} | + | y_i - x_{\text{med},i} |\}, \tag{4}$$

$$\text{SGI} = \sum_{i=1}^{k} \text{sd}_i \{| x_{\max,i} - x_{\text{med},i} | + | y_i - x_{\text{med},i} |\}, \tag{5}$$

$$\text{TGI} = \sum_{i=1}^{k} \text{td}_i \{| x_{\max,i} - x_{\text{med},i} | + | y_i - x_{\text{med},i} |\}, \tag{6}$$

where kwd_i, sd_i and td_i represent the weight assigned to each item under knowledge, skill and trait dimensions respectively, by the experts. We also developed an R-language computer program to calculate η (Annexure 1).

Remark 1: It must be noted that η will be the lowest when $x_{\max,i}$ is equivalent to y_i.

Remark 2: Equation (2) is attainable when the median score ($x_{\mathrm{med},i}$) is zero.

Results and discussion

Demographic information about the participants

Most MF&SP students (62.1%) hail from the fishing community, with a gender composition of around 3 : 1 (male (n) = 325 and female (n) = 152). Around 98% of them are in the age group of 15 to 18 years (Table 1). Most MF&SP vocational teachers (59.1%) who participated in this study were graduates. About 86.4% of them were selected for services through the Public Service Commission (PSC) of the state (Table 2).

Competence imparted in fisheries VE and its perceived importance in employability

The rating given by the teachers and students on the importance of each item under knowledge competence significantly varies in all aspects (Figure 3). Teachers consider that knowledge about the physical features and morphology of commercial fishes (mean rank = 8.30), navigational equipment and deep-sea fishing methods are crucial factors determining employability. However, they consider knowledge about chilling/freezing, quality requirements for processing, and the chemical and physical composition of the products to be the least contributing knowledge elements to employability. The most critical knowledge items as perceived by the students for gainful employment are those related to navigational equipment (mean rank = 7.17), deep-sea fishing methods (mean rank = 6.92) and the knowledge of various fish preservation methods (mean rank = 6.76).

In the case of technical skills, the primary fish post-harvesting skills such as chilling/freezing of fish, aptitude to distinguish fin and shellfish species, and quality testing by vision, touch and smell are perceived as crucial for obtaining gainful employment by the students. Although the teachers recognized the value of open-sea fishing proficiency (mean rank = 4.60) and the capacity to recognize and use a variety of crafts and equipment (mean rank = 5.20) for producing educated fishermen, the rating given by the students revealed that teachers gave less emphasis and topics exposure to the students in these because of their inexperience (Figure 4).

The abilities of self-assurance, initiative, functioning in difficult circumstances, decision-making and resource management capacity received the highest rating from students in the case of soft skills (Figure 5). In contrast, skills like problem identification (mean rank = 11.75) and constructive modification of the work based on suggestions were perceived with minimum scores by the students. The capacity to plan and develop projects as well as healthy working behaviour are essential employability traits (mean rank = 14.95) in the opinion of teachers (Figure 5).

Perceived and measured levels of competence attainment of students

The students consider that they are less knowledgeable about the commercial significance of fish size in marketing (mean rank = 5.60) and quality aspects of fish filleting (mean rank = 5.97). At the same time, they perceive themselves as more competent in their knowledge of different methods of fish preservation and the various navigational equipment (Figure 6). Though teachers agree with the opinion of the students on many aspects of fish processing, they think the students lack sufficient knowledge about deep-sea fishing methods (mean rank = 4.89) and filleting techniques (mean rank = 5.09).

Similarly, students assessed themselves as proficient in distinguishing different crafts and gears (mean rank = 5.00) and identifying fin and shellfish (mean rank = 4.91). However, according to the teachers, compared to other skill aspects, the students demonstrated skills to assess fish quality and to distinguish fin and shellfish more efficiently in practical classes (Figure 7).

Table 1. Demographic attributes of marine fisheries and seafood processing (MF&SP) student participants in the study

Attributes	Sub-attributes	Percentage (n = 477)
Occupation of parents	Capture fisheries and allied activities	62.1
	Agriculture	30.2
	Service and other sectors	7.8
Age (years)	15–16	33.1
	17–18	65.6
	19–20	1.3
Zone	South zone	37.3
	Central zone	24.3
	North zone	38.4
Gender	Male	68.1
	Female	31.9

Table 2. General information of MF&SP teacher participants in the study

Attributes	Sub-attributes	Percentage (n = 22)
Educational qualification	Graduation	59.1
	Postgraduation	36.4
	Doctorate	4.5
Age (years)	23–32	9.1
	33–42	45.5
	43–52	36.4
	53 and above	9.1
Gender	Male	45.5
	Female	54.5
Teaching experience (years)	1–2	31.8
	3–4	63.7
	5 and above	4.5
Mode of selection	Public Service Commission	86.4
	Interview only	13.6

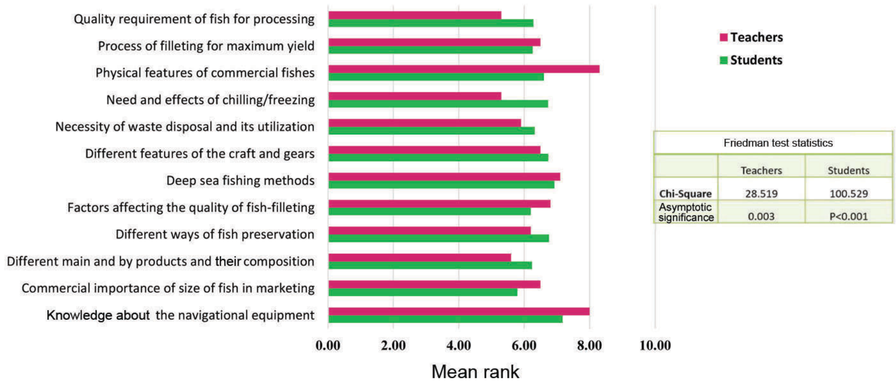

Figure 3. Perceived importance of knowledge competence in employability.

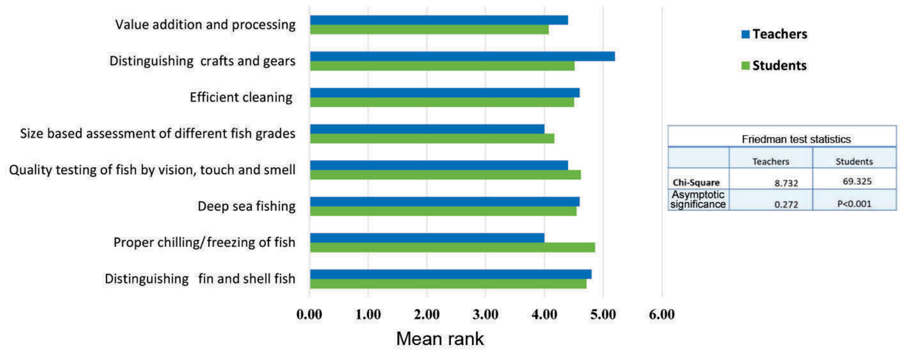

Figure 4. Perceived importance of technical skills in employability.

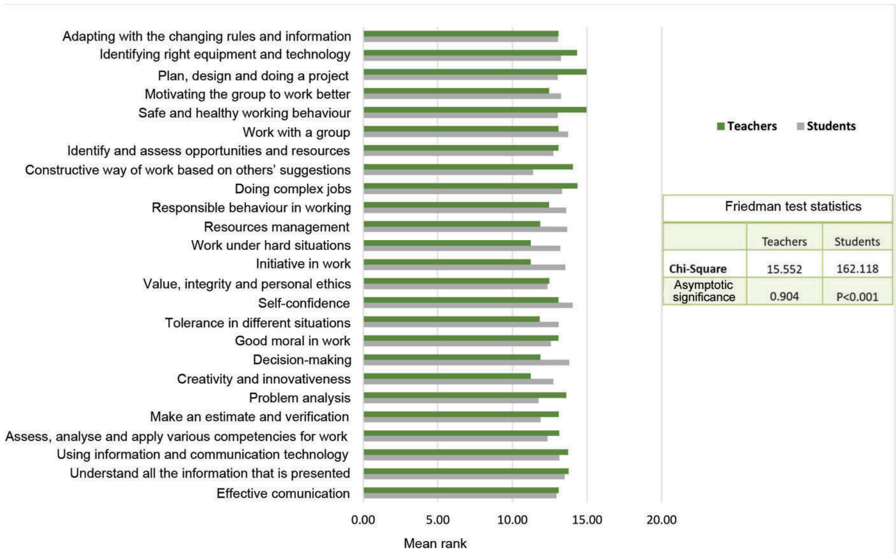

Figure 5. Perceived importance of soft skills in employability.

Students gave higher scores for their ability to do teamwork (mean rank = 14.26), self-confidence (mean rank = 14.1), and motivating other group members for better work when it came to soft skills. They considered themselves to be relatively unskilled in estimation and verification (mean rank = 11.18; Figure 8). According to the teachers, students are less skilled in analysing problem situations and identifying the various resources and opportunities.

Disparity in the perceived relevance of each item points to the education and delivery gaps present in the current VE system. It was observed that items perceived as important by the teachers (Figures 3–5) were included in the

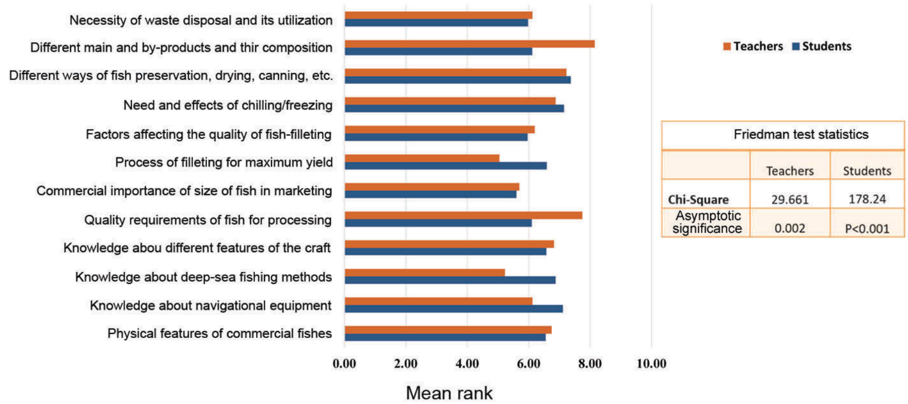

Figure 6. Evaluation of knowledge attainment of students.

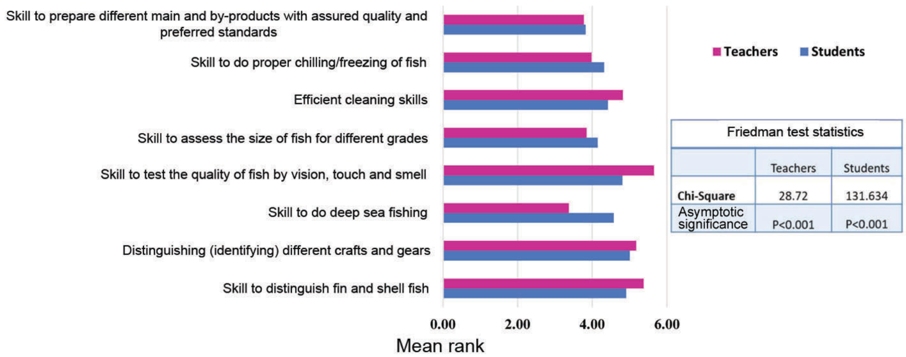

Figure 7. Evaluation of technical skills attainment of students.

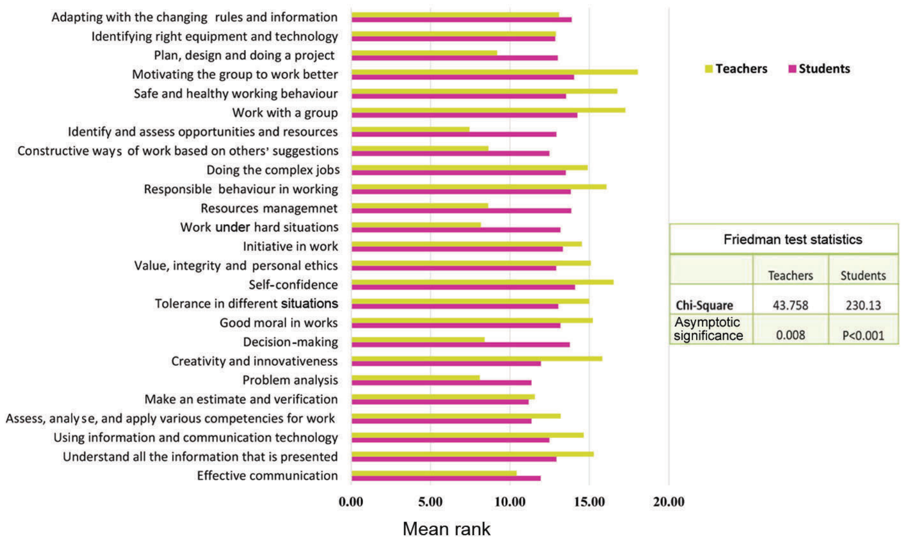

Figure 8. Evaluation of soft-skill attainment by students.

first half of the lessons according to the course design and frequently appeared in the examination. Teachers generally devote more time to making the students acquainted with the course in the early phases of teaching. Typically, they emphasize those subjects that are more likely to appear in the final state-level test.

In Kerala, all the vocational fisheries schools are run and wholly funded by the state government. They are all situated in less privileged areas close to fishing zones or coasts, and function with minimal resources. Often, these schools lack appropriate infrastructure facilities for conducting practical classes. For example, the facilities for preparing

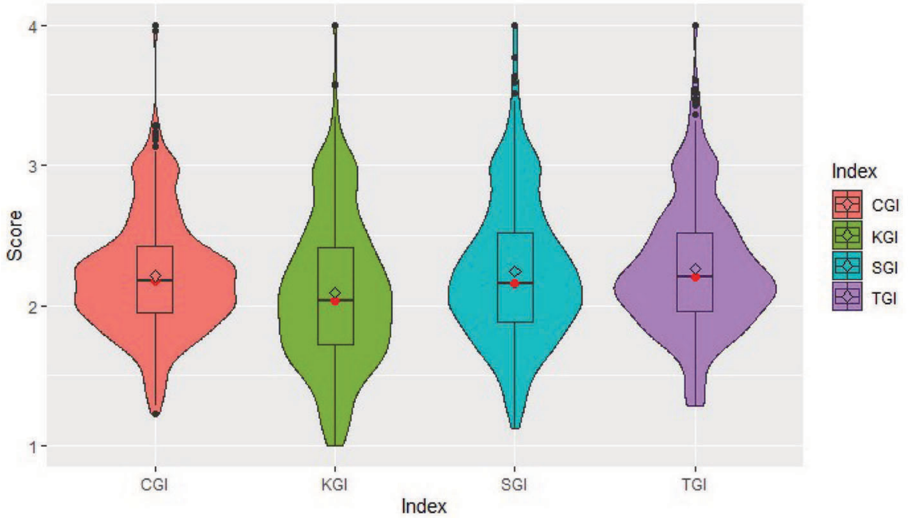

Figure 9. Distribution of students with respect to index scores (competency gap index, knowledge gap index, skill gap index and trait gap index).

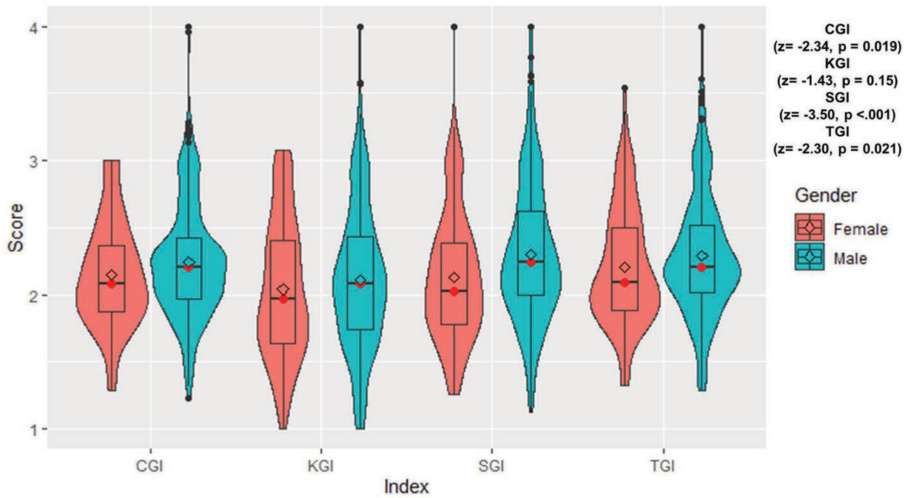

Figure 10. Gender-wise comparative analysis of gap index and its distribution.

fish-based products (cuisine equipment and cooking ingredients) are more easily accessible and less expensive than the laboratory equipment used for navigation studies (engine parts, various gears, etc.) and quality testing (autoclave, microscope, chemicals, etc.). Hence, while conducting practicals, teachers give more importance to in-house product preparation than commercial aspects of fisheries. The students think that the most crucial topic for employability is the one that is taught in-depth, with great care and length.

Teachers might also fail to convey to the students the same degree of vocational implications they had for various topics while teaching (Figures 4 and 7). This might be because teachers emphasize specific subjects solely from an examination perspective, which may help in the vertical mobility of students on the education ladder. Even though the VE sector has adopted various programmes, like industry linkages, to ensure the horizontal mobility of students[24], the trickle-down effect of such linkages is noticeably weaker. The uneven distribution of infrastructure and fishing-based manufacturing economies along the three zones of Kerala exacerbates the presumed discrepancy. Ernakulam, one of Kerala's 14 districts, is home to most of the marine fisheries research and development (R&D) institutions and value-chain industry plants. As a result, the fisheries vocational schools in the central zone can make at least limited use of the industrial facilities (due to weak linkage), but not schools in the other zones. Teachers have also mentioned that they are forced to send students, particularly female students, to non-fishery industries just to fulfil course requirements.

Similarly, disparities in the rating pattern in soft skills by the teachers and students (Figures 5 and 8) indicate that although entrepreneurship and self-employment are important components of VE[25], the progress made in this direction has not been sufficient to foster an entrepreneurial culture

Table 3. Policy suggestions and interventions needed for bridging the competency gap of fisheries VE in India

Study insights	Reflections	Policy suggestions
Education gap	Outdated curriculum which insufficiently addresses the labour market demands.	The curriculum must be restructured to keep pace with the rapid and continuous changes in technology in fisheries. Irrelevant topics, sedentary sessions and outdated content should be abandoned, and relevant topics should be added.
		Regular interface with the teaching–learning ecosystem and the labour market is needed for modifications in the curriculum to skill the students and make them aware of employment opportunities. District administration, related departments and industry associations can play a crucial role in such facilitations.
Delivery gap	Teachers with inadequate core competence.	Since the qualification for fisheries vocational teachers in India does not require a Bachelor's degree in education courses (BEd), it is essential to have refresher courses to learn about the students' psychology and the different teaching techniques.
	Teachers and potential industry partners are less connected.	Teachers must be trained in various soft skills.
		Teachers need to be provided with timely exposure to different areas for the students' vertical and horizontal mobility in the skill qualification framework.
		Interactive training programmes for instructors and employers should be encouraged to sense the dynamic job market competency demands.
	Insufficient simulation facilities and poor infrastructure.	Sufficient infrastructure and laboratory facilities in the classroom must be made available to have experiential learning.
	Ignorance of educational and vocational support that is accessible.	It is necessary to set up orientation sessions and raise awareness among parents about the financial aid, job opportunities and occupational reservations available.
Satisfaction gap	The learner with less knowledge about the scope and career openings.	The 'career slate', a new window of career assistance, needs to be updated and replicated to inform students about the career-related elements of the course in addition to skill requirements.
	The learner with a reduced level of entrepreneurial motivation.	Students need hands-on experience with the issues and opportunities covered in the course, preferably at the start of each module, so that they may assess the various prospects for the subject. They could use it to decide how to transition their identities from school to the workplace.
Market-demand gap	Poor institution–industry connections.	Several strategies improve linkages between businesses and educational institutions, such as discovering and mapping the marine fisheries industries, and developing a grid displaying accessibility and proximity to institutions (with the aid of a decentralized state governance mechanism).
	Less practical experience for the students.	Industries should be encouraged to use their corporate social responsibility to offer opportunities to improve the skills of students. The government must incentivize organizations to offer apprenticeship programmes through policy measures.
	Low job market demand for trained vocational students.	Focus groups with prospective employers may be used to outline the competency needed in the various areas. It is recommended to map out the employability options in fisheries that are situation- and location- specific through situational and market analyses.
	Deficit in skill supply side to suit the dynamic labour market demand.	Measuring the competence gap will help skill and reskill the students based on the job market demand.
	Low penetration of the start-up ecosystem among the vocational students.	Introduction of 'earn while you learn' programmes to cultivate entrepreneurial mindset among students by providing core financial support. Similarly, students' start-ups must be promoted if it is deemed worthwhile.
		Digital job portals must be encouraged to connect employers and employees. This will help the employers get employees with the right skills and the employees get suitable remuneration for their skillset.

among the students[26]. In a similar vein, even though teachers identify critical competence far more accurately (Figure 5), the manner in which entrepreneurial drive is translated and delivered appears to be slow. The growing population of highly educated yet jobless youth in Kerala also suggests the same[27,28]. Similarly, soft skills are not emphasized enough in the vocational higher secondary course syllabus, despite the fact that some team building and project management aspects are addressed in entrepreneurship topics[25]. Though teachers emphasize the importance of soft skills for employability, similar to employers, many admit that a lack of adequate training and improper curriculum articulation prevent them from helping the students.

Computation of competency gap index

According to CGI (eq. (1)), students enrolled in the MF&SP course had an average competence gap (η) of 2.21 (Figure 9). The calculated competence gap score distribution for each student had a moderately positive skewness of 0.61. While analysing the knowledge dimension (KGI = 2.08), it was found that 20% of the students had a greater level of the employable knowledge gap. SGI was estimated at 2.24, and the number of students identified as best suited for employable technical skills was significantly lower (24.0%). TGI had a higher mean score (2.26) than KGI and SGI, indicating the inability of the education system to impart employable soft skills through the curriculum.

During the study, we noticed a gender difference (male (3): female (1)) in the number of students enrolled in the course, which prompted us to conduct a gender analysis. A significant gradient in the calculated η between male and female students ($p = 0.019$) was observed in this study. Male students (mean = 2.24, SD = 0.429) had a greater competence gap than female students (mean = 2.15, SD = 0.388; Figure 10). A similar result was observed while examining gender disparity at different educational levels[29]. The dimension-wise gender analysis revealed statistically significant differences in SGI ($p = 0.001$) and TGI ($p = 0.021$), but not in KGI ($p = 0.15$). The gender disparity in η points to the differences in the learning styles of students and their adaptability to the teaching–learning ecosystem. Due to the insufficient infrastructure and resources, the skill sets that are emphasized in the classroom are more related to the identified female gender roles in the fishing community (Figure 4). The observed competence difference may be due to socio-cultural beliefs and attitudes of the fishing community that support a gender division of labour in open-sea fishing and post-fishing operations[30].

Strategic suggestions for improving the competence-based VE system

The cross-sectional examination of the VE system in the MF&SP sector demonstrates the need to integrate market signals in the teaching–learning environment to prevent segmentation of a young population in which the majority are labelled as ‘educated but not suited for the job’. Table 3 provides an account of the strategic recommendations for the same.

Conclusion

Though there is a lot of debate on the competence gap vis-à-vis the degree of inclination of the VE system in addressing work–market–skill demand, assessment of the same, especially in marine fisheries, is a methodologically neglected area. Against this backdrop, the present study deals with developing a framework that addresses the measurement of competence gaps in VE. An average competence gap index of 2.21 was estimated with 2.08, 2.24 and 2.26 for the MF&SP student’s knowledge, skill and traits gaps respectively. The prominent issues were the mismatch between skill demand and the pedagogical approach followed in the VE system to make it equivalent to general education. Due to inadequate articulation of the topic in the curriculum, poor institution–industry linkage and inadequately prepared teachers, the programme failed to encourage a start-up culture among students. The findings of this study reveal that several competence zones need skilling and reskilling to bridge the highlighted gaps, with particular attention to gender.

Annexure 1.

R code for working out the competence gap index

```
Teachers1<-as.matrix(Teachers[ ,-1])
Students1<-as.matrix(students[ ,-1])
Teachers_Imp<-as.matrix(Teachers_ImpSkill[ ,-1])
sc<-colSums(Teachers_Imp)
tc<-sum(sc)
kwi<-(sc/tc)
xbar<-apply(Teachers1, 2, FUN = median)
xmax<-4          #4 in this case
ymax<-4
diffT<-abs(xmax-xbar)
StudScore<-Students1
for(i in 1:ncol(Students1))
{
for(j in 1:nrow(Students1))
   {
StudScore[j,i]<- kwi[i]*(diffT[i]+abs((xbar[i]-Students1[j,i])))
   }
}
KWScore<-rowSums(StudScore)
StudScoreMax<-kwi
for(i in 1:ncol(Students1))
{
StudScoreMax[i]<- kwi[i]*(xmax+ymax)
}
KWScoreprop<-(KWScore)/sum(StudScoreMax)
KWScore_final<-cbind(students,KWScore,KWScoreprop)
write.table(KWScore_final,file="KWScore_final.csv",sep=",",row.name
   s=F,col.names=T)
hist(KWScore)
hist(KWScoreprop)
```

Conflict of interest: The authors declare that there is no conflict of interest.

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