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Partial evaluation of questionnaires monitoring the need of knowledge in forest workers from selected EU countries

A. Skoupý[1], J. Vanbelle[2], J. Zöscher[3], T. Lampe[4], F. Esser[5], V. Turpeinen[6], P. Caseau[7], P. Máchal[8], R. Klvač[8], V. Nový[1], T. Embo[2]

[1]*Faculty of Forestry and Wood Sciences, Czech University of Life Sciences Prague, Prague, Czech Republic*

[2]*Inverde VZW, Ingelmunster, Belgium*

[3]*Bundesamt und Forschungszentrum für Wald, Ossiach, Austria*

[4]*Citogroep Holding, Arnhem, The Netherlands*

[5]*Forstliches Bildungszentrum Rheinland-Pfalz, Hachenburg, Germany*

[6]*Häme Vocational Institute of Forestry Training, Hämeenlinna, Finland*

[7]*Centre Forestier de la région Provence Alpes Côte d'Azur, La Bastide des Jourdans, France*

[8]*Mendel University in Brno, Brno, Czech Republic*

ABSTRACT: The paper informs about partial results gathered and processed in the framework of the international research project "Learn for Work", Leonardo da Vinci programme. The goal of the research project was to acquire information about the subjective perception of importance and subsequent use of theoretical knowledge in practical use in the forest worker occupation. The research, monitoring the practical need of theoretical knowledge of workers in the forest, was realized in selected six countries of the European Union – Belgium, Austria, France, Finland, Germany and Czech Republic. Another objective of this research was to find out whether there are significant differences in opinions concerning the need of theoretical knowledge in respondents from the individual countries. Partial results presented in the paper relate to the measure of practical need and use of theoretical knowledge in physics for the occupation of forest worker. The acquired data are interpreted and discussed in the context of analogical research studies implemented abroad as well as in the Czech environment.

Keywords: European forest worker; eligibility; subject area of physics; theoretical knowledge; practice; certification

Education in the 21st century should equip leavers of secondary technical and vocational schools with competencies required for their work. The term competency entails the acquirement of necessary theoretical knowledge on the basis of which the pupil develops sensomotoric skills and attitudes. Průcha et al. (2008) informed that vocational schools provide a competency minimum by teaching technical subjects and providing vocational training, which is an array of knowledge and skills representing eligibility for performing a certain kind of work.

At the same time, the new concept of active education abandons the traditional transfer of theoretical data and instead encourages as a priority the approach that leads to a complex development of personality. The trend affects the educational systems in all European countries, which means that the changes are reflected at all – not only vocational- stages of education.

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The Leonardo da Vinci Programme is one of the international educational programmes focused on the support of innovations in vocational training throughout Europe. The support consists in the provision of funds for selected projects whose implementation will lead to an enhanced standard of vocational education. A research study was realized within the "Learn for Work" project, the Leonardo da Vinci Programme, which was focused on the measure of using the theoretical knowledge from individual scientific disciplines in the practical work of forest workers.

The intention of the "Learn for Work" project was to collect basic documents for proposing a certification system in the vocational forestry education. New certified vocational centres could provide education for future forest workers whose qualification would be acknowledged in the EU member countries. Foresters addressed within the research study originated from six European countries: Belgium, Austria, France, Finland, Germany and Czech Republic.

There are several studies on this topic in foreign countries. Tsioras (2010), who dealt with the relation between training and occupational safety, collected answers of 106 workers from 13 prefectures and 99 experts from all over Greece to find out prospects of efforts for increasing qualifications and hence quality of forest operations. He concluded that the lack of interest on the part of the state and the low remuneration of forest workers are the reasons why the introduction of new knowledge into forest practice fails. The relatively high accident rate in Croatian forestry led Martinic et al. (2011) to present a draft national certification for the education of forest workers. Arcury et al. (2010) studied the influence of verbal skills on the level of safety in forest workers who do not speak English in the U.S.A. Perhaps the most interesting in this sense is the work by Skinner (2005) resolving the training of forest workers as an essential condition for sustainable forest management. Any research work whose methodology and results would be directly comparable with our study has not unfortunately been found.

MATERIAL AND METHODS

The methodological procedure of our research dwelled in the intention to acquire information from respondents on how often they use a certain piece of theoretical knowledge acquired during their studies in their practical work. The method chosen to acquire the data was a questionnaire. This paper presents the statistical evaluation of only a part of research results obtained from questionnaires that were distributed to 335 forest workers in the above-mentioned countries. The respondents were to specify what theoretical knowledge they consider important for performing their jobs and whether some significant differences exist in their opinions about the need of knowledge in the participating countries. The questionnaire included identification data of respondents and was broken down according to individual subjects of general education and technical education in individual technical forest disciplines. This part of the project brings results concerning the need of forest workers to have theoretical knowledge in physics.

The compendium of theoretical knowledge was constructed by the specialized workplace CITO (Citogroep Holding, Arnhem) in the Netherlands and the base for setting up the knowledge compendium was the curriculum of forest vocational schools. Experts representing the individual countries made the selection. In two countries, some specific knowledge was added that was not considered important in the other countries. In Belgium, this was the knowledge concerning the maintenance of greenery including lawns and sports grounds (4 items) and in France, this concerned the specific knowledge about the construction and maintenance of forest roads (3 items). Results of the inquiry were to give an answer to the question what knowledge is necessary for the qualification. During the pilot project it showed, however, that marked differences are likely to exist between the practical need of theoretical knowledge in the respective scientific disciplines and specializations in the participating countries. Therefore, a decision was made to carry out an experimental analysis that would make it possible to assess whether the acquired data are adequate for the statistical evaluation and if so whether the differences actually exist.

The respondents obtained the questionnaires in the printed form. Their answers were digitalized by the software developed for the purpose at the partner workplace Centre Forestier de La Région Provence, Alpes Côte d'Azur in France, which made possible to enter the data via internet.

The analysis was processed at Mendel University in Brno. A method was developed for the solution of data processing and for the subsequent – mostly manual – evaluation of data from the questionnaires that were addressed to forest workers. Beyond the specification, a system solution for data acquisition was designed for similar purposes with an intention that the information contained in the questionnaires can be statistically processed so that the final results could be fully used. This would however mean to develop a special programme and to digitize all questionnaires within the current pilot programme again,

which is not feasible due to financial, time and capacity reasons.

The methodology did not have any particular specifications for the method of selecting the respondents. The selection was at all times focused on regions with the headquarters of individual partner institutions of the project and the objective was to provide a sample that would take into account the age and qualification structure of workers, their job title, length of service etc. The questionnaires included altogether 340 commands divided as follows:

(1) Job-related sciences
  1.1 General physical principle
  1.2 Basics of mathematics
  1.3 Basics of biology and ecology
  1.4 Basics of history
  1.5 Occupational safety
(2) Forest production
  2.1 Forest establishment and regeneration
  2.2 Forest protection
  2.3 Forest development and tending
(3) Forest technology
  3.1 Harvesting of wood and other products
  3.2 Grading and marking of wood
  3.3 Wood transport and storage
  3.4 Machinery and equipment for operation, maintenance and repair
  3.5 Wood conversion and processing of other raw materials
  3.6 Special issues
(4) Forest economics
(5) Communication and social skills
  5.1 Social relationships
  5.2 Labour legislation, tariff legislation and social legislation
  5.3 Processes and evaluating information
  5.4 Work planning, preparation and supervision
(6) Policies (organizational, political)

In each command, the respondents were to tick off a formulation which best describes the need of using the given theoretical knowledge in their daily practice (never/seldom/often/always).

The subject of the method verification was particularly the part 1.1 of the questionnaire – General physical principles.

In total 365 forest workers were interviewed individually and answers were anonymous. Description of the sample of workers is therefore only indicative. Nearly 50% of them were employees of the state or government. There were 85% male and 4% female, 11% no answer. The information about their age and experience see Tables 1 and 2.

RESULTS

In the first stage of the analysis, absolute values of answers to all questions had to be converted into percent for each country, which gave a certain idea about to what extent the acquired command (theoretical

Table 1. Forest worker age

Country	0	1–18	18–24	25–30	30–35	35–40	40–50	50–60	+60	Null
Austria	1	8	6	6	3	11	13	6	0	0
Belgium	5	0	1	6	5	12	24	9	0	0
Czech Republic	1	0	4	5	6	9	10	16	0	14
Finland	4	0	3	2	1	12	20	26	0	0
France	0	0	12	14	12	7	6	1	0	0
Germany	15	6	13	4	7	5	12	2	0	0
Total	26	14	39	37	34	56	85	60	0	14

Table 2. Forest workers' experience

Country	How many years do you work as a forest worker?									
	0	1–2	3–4	5–10	10–15	15–20	20–30	30–40	40–45	Null
Austria	1	10	5	7	8	8	10	5	0	0
Belgium	13	4	11	11	11	4	8	0	0	0
Czech Republic	2	3	1	16	12	6	7	4	0	14
Finland	6	0	2	9	3	7	18	21	2	0
France	2	3	3	23	14	3	4	0	0	0
Germany	15	10	5	8	6	10	9	0	1	0
Total	39	30	27	74	54	38	56	30	3	14

Table 3. A simplified example of the first stage of the analysis

Country	1		2		3		4		Σ	
	never		seldom		often		always			
	x_i	%	x_i	%	x_i	%	x_i	%	x_i	%
Austria	13	26.5	16	32.7	15	30.6	5	10.2	49	100
Belgium	18	33.3	16	29.6	19	35.2	1	1.9	54	100

x_i – individual value

knowledge) expressed by the question is used in the country by forest workers in their daily work.

Table 3 presents a simplified example from the first stage of the analysis dealing with the necessity of using the knowledge of physics – namely commands listed under the block 1.1 – General physical principles (Solids and liquids/Electricity/Forces/Tension).

The sum of percentages in columns 2, 3 and 4 indicating the intensity of using the acquired knowledge and skills by forest workers shows 73.5% and 66.7% in Austria and Belgium, respectively. These figures clearly indicate that Austrian forest workers use the knowledge of the physics of solids and liquids by 6.7% more than Belgian forest workers do.

In the second stage of the analysis, we considered useful to have a general survey of answers by individual countries. A source for such evaluation could be the sum of answers to all questions in the same block as in the first stage of the analysis in columns never/seldom/often/always – this time for all participating countries. The sums in columns could be used to calculate arithmetic means and/or standard deviations. The arithmetic mean of a column would be deducted from individual values. If an individual value in the column is marked as x_i in a given answer, and the arithmetic mean of all values in the column is marked as $\bar{x}$, then the operation $(x_i - \bar{x})$ would yield differences Δ_i. A positive difference would indicate that the relevant x_i value of the given country is above the average and a negative difference would show that the relevant x_i value of the given country is below the average of all compared countries. A minus value in the "never" column should be understood so that forest workers in the given country use the acquired knowledge in their daily work more than the average of all countries. The calculations and their results are presented in Table 4.

The answers in the "never" column show that workers in the Czech Republic use the knowledge of physics the most while workers in France the least.

The first and the second stage of the analysis disclosed some differences between the individual countries in the use of knowledge and skills by forest workers. However, the results of these two stages did not answer the question whether the differences are accidental or whether their accidental nature can be eliminated with a certain significant probability. For this, we applied the one-factor analysis of variance.

In order to obtain the necessary input data for this method, each column (never/seldom/often/always) of the questionnaire was analysed separately and the test included all answers to at all times one theoretical discipline defined by the questions.

An example of the analysis of variance used for the "never" column is presented below, again for the partial block 1.1 – General physical principles. Source data for the analysis are presented in Table 5.

In Table 5, the number of answers is marked as x_{ij}, the sum of answers in the row as R_i and the row aver-

Table 4. A simplified example of the second stage of the analysis

Country	Number of answers from questionnaires x_i							
	never		seldom		often		always	
	x_i	Δ_i	x_i	Δ_i	x_i	Δ_i	x_i	Δ_i
Austria	13	–3.3	16	–1.7	15	4.2	5	–0.3
Belgium	18	1.7	16	–1.7	19	8.2	1	–4.3
Czech Republic	3	–13.3	13	–4.7	11	0.2	23	17.7
Finland	22	5.7	21	3.3	6	–4.8	1	–4.3
France	35	18.7	14	–3.7	2	–8.8	0	–5.3
Germany	7	–9.3	26	8.3	12	1.2	2	–3.3
$\bar{x}$	16.3		17.7		10.8		5.3	

x_i – individual value, Δ_i – yield differences, $\bar{x}$– arithmetic mean

Table 5. Source data for the analysis of commands – general physical principles

Country	Number of answers from questionnaires x_{ij}				R_i	$\bar{x}_i$
	never	seldom	often	always		
Austria	13	25	9	10	57	14.25
Belgium	18	23	42	35	118	29.50
Czech Republic	3	33	13	25	74	18.50
Finland	22	29	27	21	99	24.75
France	35	26	19	18	98	24.50
Germany	7	15	3	4	29	7.25
Total					475	19.79

R_i – sum of answers in the row, $\bar{x}_i$ – row average of answers

age of answers as $\bar{x}_i$. These basic data were used to calculate the testing criterion *F*.

After calculating the sum of squares from values presented in Table 3, the resulting table of the analysis of variance was constructed, which is presented below as Table 6.

Since the critical *F*-value calculated from the data in Table 4 is higher than the critical tabular value, it indicates that statistically significant differences exist between the rows (countries).

Table 6. The resulting table of the analysis of variance

Variability	Sum of squares	df	s^2
Between the rows (ground effect)	1,322.71	5	1,322.71
Within the rows (residual)	1,365.29	18	1,365.29
Total	2,688	23	

s^2 – variance

Table 7 presents the absolute values of all row average pairs calculated according to the formula $|\bar{x}_k - \bar{x}_1|$.

The statistical significance of the row average differences in answers between the calculation of *t*-values for individual partial differences is presented in Table 8.

Table 7. Absolute values of row average pairs

Country	Austria	Belgium	CR	Finland	France	Germany
Austria	–	15.25	4.25	10.50	10.25	7.00
Belgium		–	11.00	4.75	5.00	22.25
CR			–	6.25	6.00	11.25
Finland				–	0.25	17.50
France					–	17.25
Germany						–

CR – Czech Republic

The comparison of the calculated *t*-values in Table 6 and the tabular *t*-values shows that differences in the answers between Austria and Belgium, Finland and

Table 8. *T*-values for individual differences in sample averages

Country	Austria	Belgium	CR	Finland	France	Germany
Austria	–	2.476	0.690	1.705	1.664	1.137
Belgium		–	1.786	0.771	0.812	3.613
CR			–	1.015	0.974	1.827
Finland				–	0.041	2.842
France					–	2.801
Germany						–

CR – Czech Republic, significant at α = 0.10, *P* = 1.734; α = 0.05, *P* = 2.101; α = 0.01, *P* = 2.878

Germany and between France and Germany were statistically significant with a probability of 95%. The difference between Belgium and Germany was significant with a probability of 99%. The difference between Belgium and the Czech Republic and between the Czech Republic and Germany was statistically significant with a probability of 90%. Probabilities of other differences between the respective countries were statistically insignificant.

DISCUSSION AND CONCLUSIONS

It was quite a problem to find comparable data published elsewhere. Except of those mentioned in the Introduction, we can use only a few similar themes published in Czech.

In the project VET Review: "Learning for Jobs" (2007), OECD reviewed the vocational education and training. Together with other European countries (Austria, Belgium, Germany and Ireland) and with two of the United States of America (South Carolina and Texas), the Czech Republic took part in a survey concerning the vocational education. The partial re-

port (Kuczera 2010) indicated that the area of general education is covered insufficiently at Czech vocational schools.

A general relation between the profession and the training subject was studied by Slavík and Janík (2006), who claimed that the relation is conclusive not only for the valuation and substantiation of CV technical qualities but that it conditions the existence of CV contents as such. This is why the issue should be considered of key importance.

The presented partial statistical evaluation of questionnaires monitoring the use of acquired knowledge by forest workers in their daily work documents that the chosen methodological procedure is applicable. It also documents the existence of statistically significant differences in the use of theoretical knowledge between the individual countries participating in our research.

Differences between the pairs of countries in the use of knowledge in physics proved by Student's test were as follows:

– 99% probability of difference: Belgium – Germany,
– 95% probability of difference: Austria – Belgium, Finland – Germany, France – Germany,
– 90% probability of difference: Belgium – Czech Republic, Czech Republic – Germany.

The existing data are apparently sufficient for further analyses of knowledge circles with a possibility of obtaining valuable information applicable in the concepts of education and training of forest workers. The data can represent also a valuable base for the certification process of European vocational education, which would justify the importance of follow-up research studies leading to the development of a profile of the graduate for the occupation of forest worker.

The hitherto results show the problem in the connection of theory and practice only from the viewpoint of foresters. A prerequisite for further research is to include employers or social collaborators so that the evaluation of results would provide a graduate profile that would correspond to the requirements of the European labour market. The research results would create a basis for the development of an educational programme that would contain the necessary theoretical knowledge usable in practical work. Such an educational programme would be binding for vocational schools interested in winning a certificate on the basis of which the acquired qualifications of the forest worker would be respected in all EU member countries.

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Corresponding author:

doc. Ing. Alois Skoupý, CSc., Czech University of Life Sciences Prague, Faculty of Forestry and Wood Sciences, 165 21 Prague 6-Suchdol, Czech Republic
e-mail: skoupy@fld.czu.cz