

Trials for the Gearing between Theory and Practice in the German Higher Vocational Education —— Focusing on cases in dual courses ——

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ABSTRACT

This article tries to verify attempts for the gearing (Verzahnung=VZ) between theoretical and practical learning, especially in dual courses at universities of applied sciences which are combined by work practices in enterprises. After tracing of historical developments for the concept of VZ, the system structure of the dual vocational course is explained and such three elements for the VZ, as the institutional, organizational and curriculum-didactical dimensions are extracted according to political and academic discussions. The third curriculum- didactical aspect among these three dimensions, especially on the practice in the working site, is mainly analyzed.

As the result, significances of three mediated factors, not VZ itself, are confirmed so the VZ is successfully realized. The first is the learning material for recreation (reconstruction) of theoretical learning at working site which prompts gearing of theory with practice. The second is human social mediation which assist and guide how have students to behave in working practice and in the human exchange with leader or mentor. Among others, the subjective learning (working) behavior by students themselves as the third factor is more important. That's introduction of the reflection process in the practical experience for the acquiring of peculiar knowledge and skills to the practice and competencies' developments on the vocational world.

I. PREFACE

The relationship between theory and practice in vocational education and training (VET) has been traditionally practiced as an education ideal for the vocational and general education, and is still presently discussed in the German world of VET, especially in the field of the dual courses of Fachhochschule (university of applied science, FH), as the challenge of “Verknüpfung” (linking) or “Verzahnung “ (VZ, gearing) (Tramm 2011, Köthnig 2018). Here, the author traces the formation and development of the concept VZ and clarifies the necessary elements for it, mainly focusing on the practice in enterprises.

II. Formation and development of the concept VZ

1. Academization of the vocational world and vocationalization of universities

There are the challenges of academization of VET and vocationalization of universities in the background for discussions on the VZ that are promoted by the expansion of universities of sciences (since 1970's) and the dual courses (1990's). Severing, E and Teichler, U. expressed the tendencies of qualifying for admission to university for meister in the decision of the Ministers Conference of Education, in 2009, and the project of conversion for vocational experiences into academic terms (ANKOM) since 2012 as “academization of vocational world”. Also, Thies, L (2015) and Fasshauer, U., Severing, E. (2016) grasp the expansions of FH and dual courses, especially in FH, as “the bridging between VET and academism”.

2. The formation and development of the concept VZ: Three dimensions

Stiftverband (Donors' Association 2015, p.22) and Gerstung, V. / Deuer, E. (2021, p.20) pointed out that the initial researches on VZ as discussions were started by Wissenschaftsrat (1996, 29) and Holtkamp, R., 1996, p.5). VZ was surely used as "the gearing between both learning sites, higher education and company". Moreover, its explanation was as follows "vocational- practical activity and theoretical knowledge transmission are alternatively integrated into total learning. Practical behaviors are scientifically instructed and reflected in the part of practical learning. Conversely to it, practical experiences and behavior orientations are inserted into theoretical knowledge transmissions" (p.44). The author notices that discussion on reflection, those have origins such as discussions as the "reflective thought" advocated by Dewey (1938) and the "reflection in action" brought up by Schon, D.A. (1983), started at this stage.

But, saying more exactly on initial using of the word VZ, Dybovski, G (1994) was the first researcher who used the word VZ. Dybovski pointed out two meanings of VZ from such two dimensions as "one is a vertical strong VZ between initial training and further training, and the other is an integrative horizontal resolution between work and learning."

As the result, Wissenschaftsrat (2013) formalized the structural VZ between both learning sites in 2013 as the challenge for quality assurance of dual courses in higher education. Moreover, Stiftverband (2015, pp.22-23) and BIBB (Bundesinstitut für Berufsbildung 2017, pp.5-6) structured more totally from three dimensions, the institutional (relationships among actors), the contents-curriculum and organizational level (smoothly alternation between learning and practice, learning assurance etc.) relationships. The concept of the VZ doesn't mean only the original meaning as the didactical or curriculum structure, the "gearing (bridging) between theory and practice (Theorie-Practice -Verzahnung=TPV)", but involves the external aspect around the didactical level in broader sense too.

III. Dual courses and actual situations of three dimensions

1. Formats and position of dual courses

Firstly, formats and the position within total higher education are clarified in Table 1. That involves only situations of initial training because statistics for its situation are not made up, although there are many institutions for further bachelor or master courses within dual courses.

Discussions on VZ are deployed as described later, but dual courses within universities of applied sciences (FH) as main challenge are observed here (Terada 2020).

Table 1. The quantitative situation of dual courses (only initial training)

Formats/Fields	Courses	Students	Kinds of institution	Private/State	Courses	Students
2011 total	879	59,628				
2022 total	1,749	120,517	2022年		1,749	120,517
Vocational training	569	31,827	University of applied sciences	Private	257	24,128
Practical training	920	72,522		State	961	43,083
Mixed model	260	16,138	Dual university *	Private	5	1,290
Mechanics	240	9,290		State	267	34,939
Electronic	108	5,596	Vocational academy **	Private	93	6,236
Construction	59	3,235		State	59	5,517
Information	251	16,499	University	Private	1	30
Social welfare	49	3,713		State	58	1,248
Administration	63	11,502	Other higher institution	Private	22	1,095
Business ad./ Economics	509	46,766		State	26	2,951
Health/Therapy	121	10,305				

Source: BIBB(2023) AusbildungPlus : Duales Studium in Zahlen 2022, p.11(Table 1), p.12(Table 2), p.19 (Table 6), p.22(Table 8, 9)

* =Baden-Württemberg, Schleswig-Holstein, * * Sachsen, Hamburg, Hessen * * =Sachsen, Hamburg, Hessen, Niedersachsen, Saarland, Schleswig-Holstein

There are three kinds of formats for universities of applied sciences, the integrated course of vocational training in bachelor, the integrated course of practice and the mixed course. Historically, the latter format gradually become to be major. The number of students for vocational training is 27 thousand, and for practical experience is 62 thousand in 2016 (in the same source as Table 1), therefore both courses are expanded into about two times in 2022.

Also, the branch of new industries such as the business administration and the information technology etc. are distinctive.

Moreover observing for each kind of higher education, we can judge that dual course is overwhelmingly oriented to university of applied sciences or dual university (\cong vocational academy). Incidentally, total number of general universities (students) is 108 (1,465,000) and universities of applied sciences is 211 (997,000) in 2022.

2.Guidelien for the dual course and the practice

So, how does each university of applied sciences practice the dual course. It can be understood in each university's module handbook which has been accredited. The institution of the dual course, way of combination between the theoretical learning and the practical work training in enterprise, and contents of the latter as a core for the institution are noticed. They are organized according to the German Qualification Framework (DQR) in 2013 which was made up according to the European Qualification Framework (EQF) in 2008 (Terada 2023) as well as other all educational institutions. Three descriptors of EQF are knowledge, skill and competence (autonomy and responsibility), but DQR defines descriptors for educational outputs as specialized competences (knowledge and skills), social and personal competences. (ibid. pp.189-191).

2-1. Integrated courses of vocational training in the Trier University (Hochschule Trier)

The first case is an integrated course of vocational training for bio-and pharmacy technique within the Trier university (Hochschule Trier in the State Rheinland),

Just the "dual" course of the bachelor and the vocational qualification is constituted of eight semesters according to the course's semester planning (Hochschule Trier 2024 a). The secondary vocational training as well as the secondary dual system (training in enterprise and part-time vocational school) is added to bachelor courses at the first year (two semesters). The bachelor courses continue from the third to the eighth semester, and "practice stage" is allocated at the final eighth former semester for twelve weeks (450 hours). Aims and contents for the practice as our focus are described in the module handbook (Hochschule Trier 2024 b)

Competencies aimed in the hand book are three points for students, to applicate learned qualifications (knowledge and skills) in practices, then to work autonomously and co-responsibly by accounting enterprise's circumstances, and to master such social competencies as the engagement (carrying out obligations), team work ability, organizing ability.

Co-operative projects as the formal practice guided between enterprises and university, so students can acquire those competencies. But, the contents of praxes are not opened to outside, because it may be asked to enterprise's discretion.

2.2. Integrated courses of practice in the Cologne (Köln) Technical University

Next is one cases of integrated course of practice, not vocational dua training, in the Faculty of Equipment · Energy · Mechanical-System at Cologne Technical University. Its course is one of some dual courses in twelve faculties of this university (TH Köln 2024 a).

The dual course of integrated practice for Energy-Construction Technology within its faculty provides seven full-time semesters and 30 ECT credits for each semester excluding 2 ETC for final seventh semester.

In dual course which integrated practice in learning course, the practice stage is not provided at the final, but at fourth semester (middle stage). Other modules are of course theoretical and experiment studies, but the practice as twentieth module impose students to take 15 ECTs, 450 hours including self- study for 10 hours.

Contents of practice in enterprises "to work autonomously in one or two fields beside professional engineers, in such works as planning-practice, consultation, composition, development, construction management, material supply and disposal", and t's aimed "to provide broader practical experiences and social competencies and to promote self-responsibility, team work ability and collective working for students".

IV. Realized situations of three dimensions

How are three dimensions for VZ mentioned above(II2)realized in educative praxes.

1.Verification

1-1. Dual courses in the field of engineering

Centrum für Hochschulentwicklung (Center for Development of Higher Education) in the state Nordrhein-Westfalen announced one national survey for VZ of dual courses which focused on the branch for engineering (Saskia, U. 2019). Targets of institutional survey was 119 dual courses, and data from total 119 courses on four fields were analyzed (Table 2). Survey's items cover three dimensions of VZ for the learning content, the instruction-mentoring and the institutional VZ.

The number of credits for courses (modules) that are intended the VZ of both learning is higher in the mechanical engineering, and the time adjustment or result control by the partner are so too. The degree of compulsory criteria for practice is comparatively lower, because the practice integrated course has no federal criteria, contrasting to vocational training integrated course that has to follow to federal training criteria.

Also. In general, degrees for participation to university committee are also so low and practical partners have no vote within committees.

Relating to this fact, Deutscher Gewerkschaftsbund (=German Association of Labor Union 2017) strictly pointed out on more broader challenges, especially regarding to sociological and economic aspects for the VZ. "The VZ between higher education institutes and practical partners has still not attained. Theoretical part in the higher education institute and practical experience at the practical stage coexist parallel. Selection of trainee by the practical partner tends to be prior to students those have "Abitur" (qualified students for university admission) or higher academic performance. Financial expenses and the tuition in the case of private universities or vocational academies, and living or learning expenses." (pp.2-3.).

Table 2. Institutional survey on the VZ in four fields of engineering

Item : Given point, (1)=Substitute point	Construction	Electro/Information	Mechanical	Mechatronics
The number of courses (all federal)	64	117	222	—
Participated courses to survey	27	52	65	36
Courses analyzed data	15(15.6%)	33(63.5%)	46(70.8%)	25(69.4%)
(1) VZ between both learnings : Max 4				
Over 60ECTS : 3	0(0%)	6(18.1%)	15(32.6%)	4(16.0%)
Over 30ECTS : 2	4(26.7%)	15(45.5%)	27(58.7%)	11(44.0%)
Over 10ECTS : 1	7(46.7%)	23(69.7%)	36(78.3%)	15(60.0%)
Obligation of time adjustment for both : (1)	11(73.3%)	30(90.9%)	39(84.8%)	19(76.0%)
Result control by the practice partner: (1)	10(66.7%)	23(69.7%)	35(76.1%)	17(68.0%)
Compulsory criteria for the practice learning : (1)	7(46.7%)	23(69.7%)	30(65.2%)	18(72.0%)
(2) Instruction and counseling by the practice partner : Max 3				
Specialized counselor : 1	14(93.3%)	30(90.9%)	45(97.8%)	19(76.0%)
Organizational advisor: 1	13(86.7%)	31(93.9%)	43(93.5%)	21(84.0%)
Involvement by the practice B39partner in training: 1	14(93.3%)	28(84.8%)	44(95.7%)	21(84.0%)
(3) Institutional VZ by the praxis partner: Max 3				
Over 25 % who participate to university committee: 2	2(13.3%)	11(33.3%)	11(23.9%)	8(32.0%)
Over 10% :1	4(26.7%)	11(33.3%)	14(30.4%)	8(32.0%)
Votes: (1)	3(20.0%)	7(21.2%)	9(19.6%)	7(28.0%)
Advisory function: (1)	11(73.3%)	19(57.6%)	30(65.2%)	15(60.0%)
The number of practice partners in the committee: (1)	9(60.0%)	24(72.7%)	34(73.9%)	17(68.0%)
Possibility of the committee for the quality assurance: (1)	8(53.3%)	23(69.7%)	31(67.4%)	20(80.0%)

Source: Made up from Saskia, U. (2019) Tab 2 (p.4), Tab. 12 (p.22). * =BIBB (2020) p.17.

1-2. Verification 2: Recognitions from the view point of student

Next, some survey's results on situations for the VZ from the view point of student themselves by the Dual Hochschule (Dual University) Baden Württemberg (Deuer, E. / Wild, S. 2017) are shown in Table 3 and Table 4. It was a big scale on-line survey which was taken place to 5,863 students in 2016 (M=22,42 years old, SD=2.97, the grade M=1.9, SD=.82, female 50.3%, and foreigner 14.8%).

It's naturally in the view point of the smooth educative activity that the time alternation (integration) of the college education and the practice is higher a little, but the VZ for learning contents as our main theme is not higher, and the systematic reflection of student's practice is lower (the upper of Table 3). Also, saying from responses on the recognition of effects, the complementary relationship between theoretical stage and practice one is not enough attained (the lower of Table 3).

Observing from differences among the specialized fields (the left of Table 4), the engineering is lowest and economics is lower. It seems to be difficult to learn systematically by reflections of practice experiences in the technical or business industries (the left of Table 4). Seeing tendency for each academic grade, the content coincidence and systematic relationship are lower too, and can't confirm the effect of the academic grade.

Pellart, A. (2016) mentioned, regarding to the transparency between vocational education and higher (academic) education, that there was no relationship between both worlds, and students have to integrate themselves (p.77). It might be an appropriate comment.

Table 3. Recognition to the VZ by dual students (Not applied to ~ 5. Applied to completely)

Questions	N	M	SD	%=4*+5
Satisfactions to the quality of VZ				
I'm satisfied with the time integration between the praxis and the university learning	4358	3.49	1.08	63.06
I'm satisfied with the content's coincidence between the theory and the praxis	4347	2.89	1.11	36.26
My practical experience is systematically reflected into total educative activities	4309	<u>2.57</u>	1.13	25.46
Recognition to the effects of interaction between theory and praxis				
My practical experience has brought better understandings for theory	4345	3.52	1.15	63.00
I could apply the theoretical part into the praxis stage	4342	2.99	1.14	41.07
The theoretical and the praxis stages relate systematically and complement each other	4339	<u>2.34</u>	1.05	16.23

* 4 : applicable a little

Source: Deuer, E./Wild,S.2017, p.5

Table 4. Comparisons on quality recognitions of the VZ for each field and grade

Three satisfaction in Table 3	Economics	Engineering	Social Welfare	X2	First grade	Second grade	Third grade	X2
Time integration	67.6	55.7	62.0	56.03, $p < .001$	63.1	65.1	63.2	4.71, $p < .285$, <i>n.s.</i>
Content coincidence	38.1	32.1	39.9	16.96, $p < .001$	42.9	35.1	28.2	67.24, $p < .001$
Systematic relationship	26.9	15.2	51.4	16.48, $p < .001$	27.0	23.3	25.8	41.93, $p < .001$

Source:Deuer/Wild (2017) p.7, Figure 1. X2: extracted from pp.6~7.

2. Accelerated factors for VZ

Now, author investigates into some accelerated factors for the VZ through students' praxes from some academic discussions that don't restrict on the dual course.

2-1. Practice by secondary vocational school's students : The transfer of roof coverers

This arguing point is presented in the experimental survey on the transfer of theory learned in vocational school into practice by positive Köthnig, M (2018). She pursues the transfer effects of the mobile using by roof coverers (secondary dual system) in the practical training cite, because "the contents of learning in the school and the enterprises are not correspond", "teachers insist to determine learning materials, method, contents and sequence, and hope enterprises to follow them" (p.34).

So, she conducted one questionnaire survey on the possibility of VZ by the mobile's using to 213 students (trainees) of the roof coverer (students in Eslohe vocational school, the state Nordrhein-Westfalen) from 2016 to 2017. Only two couple of question and answer are shown here. 34 (40.5%) students answer "yes partially" 10(12.0%) "often" and 7 (8.3%) "yes" among 84 to such question as "Do you use mobiles, DDap (Dachdecker Appli) as the teaching material in the enterprises, if you use it in the school too?" (Figure 13, p.46). Other 33 39.3%) are deny to the question. Also, 48 students (45.2%) answer denial, and other are "partially" (23,27.4%), "often" (21,25.0%) and "yes" (1,1.2%) among 83 respondents to the question "Do you use DDap in enterprise when you have to recall the instruction in the school?"

The using custom of DDap is reminded as a big further challenge, but the using effect for transfer (VZ) can be confirmed in a certain degree.

2.2. Personal mediators for the VZ of the teacher training

The next is one practice at a graduate course of the teacher training university (Technische Universität Berlin=TU Berlin). Grundmann, S./ Groth, K./ Langen, N. (2018) report on the practical semesters for promotion of the gearing between theory and practice introduced in TU Berlin since 2016 which accorded to the “Decision on Conditions for the Teacher Training” by the Standing Conference of the Ministers of Education and Cultural Affairs (KMK 2008, 2024).

Aims were two points that “let students to transpose and apply theoretical- professional knowledge into educational practices” (p.98), and to “influence to the practiced behavior for conquering the gap between theory and practice in school sites by those mediators who have high qualities” (p.104).

2.3. incorporation of the reflection process into the practice

We can take up so-called reflection processes by students themselves mentioned above (II -2.) from large scaled case studies by Morth, A. / Cendon, E (2018) as the third evidence for formation the VZ. These surveys objected open university projects that related to further trainings and dual courses at the federal level grappled during 2011 to 2020. There were 73 projects covering from Education (2), MINT (Mathematik, Informatik, Naturwissenschaft und Technik, 4), Economics and Management (3) (pp.7-9). They pointed out from nine universities’ projects that the method of the VZ was the reflection processes and there were following four reflective stages, students’ thinking processes in practices. The first is the reflection of practical experiences in the practice stage, the second, the reflection on the application of knowledge and skills learned in universities into practices, the third, the reflection of acquired competencies (social and personal), and forth reflection of professional self-understanding. It’s so characteristic to add the aspect of self-understanding, saying in other word, the identity formation, to competencies’ discussions (pp.31-34).

V. Discussion on the application and the reflection

Discussions and practices on the VZ, especially in the fields of the dual courses and the vocational further education, have been developed as the older but newer challenge in Germany. The core questions are that the application of learned knowledge and skills in universities and schools are surely basic challenge for the VZ. But we can’t end the VZ’s discussion when we consider the practice in the enterprises as one side of a couple of VZ. We have to thin the aspect peculiar to the practical training in enterprises.

1. The applicative and peculiar aspects of the practical training in enterprises

There are mainly two aspects in the practical experiences in enterprises, as the application or the verification of learned knowledge and skills in the practice site, and the peculiar significance to work experience.

Men discuss regarding this kind of practices which has only shorter experiences politically and academically in Japan. The author can show a representative document which is called as “the consensus among three ministries” (education, labor and economy) on the career education” (MEXT/ MHLW/ METI 2022). They propose each university to provide on kind of internship among four types such as “the open company” (a couple of days), “the career education” (~five days), “the key competencies oriented (five days ~) and the specialty applied type (two weeks ~)” and “the highly specialized type” (month’s unit). At the same time, educative aims after the second type are phased into “meanings for career and professional education”, “improvement of educative contents and methods”, “formation of student’s vocational consciousness” and “training of manpower who has independency and creativity”. More formal educational aims are set as the term become longer.

The same discussions are of course confirmed even in Germany which has longer and deeper experiences. Slotke, S. (2012, p.21) also phased practical trainings into four types, “vocational exploration and shadowing (Berufserkundungspraktikum)” “preliminary practice”, “theory accompanying practice” and “vocational practice”. The third stage means especially the aim for application of knowledge and skills, and the fourth are focused in the collection of practical experiences at the real site and in the deepening of competencies. It’s needed to analyze in both aspects, the application and the peculiarity when we discuss on the VZ.

2. Material and personal (social) conditions for the realization of the aspect “application”

An approaching movement to another one of the VZ doesn’t necessarily occur itself as Pellart (2016) pointed

out if man asks to gear with another side each other. From mentioned above, it was confirmed that some mediate factors such as material conditions and personal condition around students which prompts the VZ. The former is one condition for student's recalling of learned contents in the working site, and the latter is for one personal condition to guide peculiar aspects to working sites.

Regarding to the latter, the same discussions as Germany have been accumulated in the Japanese practical training sites too. The author can show studies in the practicum for the nurse initial training as one example Terada, Akutsu, Miho 2025). In these five years' publications of the Journal of Japan Academy of Nursing Education, seven articles on the nurse practicum can be seen, five ones are studied experimentally on the mostly mentor's support, such titles as the effect of praising by mentors to autonomous learning, the descriptors of mentor's role in the practicum and the evaluation to practical trainers from the view point of new comer nurses etc. This tendency can be confirmed in the overseas internships, ex. in the USA etc. from one study on Leader Members Exchange concerned with the skill training and the psychological exchange between supervisors or mentors and students by Masterson et.al (2021) too.

3. Acquiring of the practical knowledge and vocational self-understanding in practices

The aspect of students' subjective thinking behavior, as not external but internal factor, is reminded in the world of the VZ. It, the reflection, is needed especially when we refer to the social and personal competencies.

The concepts for educational aim, such as "Schlüsselqualifikation (key qualification)" (Mertens 1974) in 1970's, "Berufliche Handlungsfähigkeit (vocational behavior ability)" since 1980's, and presently "Kompetenz (competency, competence)" had been developed in the world of the German vocational education and training. In discussions on competency and competence, many researchers brought the concept of the reflection which originated in the "reflective thought" by Dewey, J (1938) and the "reflection in action (on practice)" by Schon, D. A. (1983). For instance, Erpenbeck (2012) presented four behavior fields of the competency, specialized methodical, activity behavioral, social communicative and personal (pp.13-17), and his concept was brought in the Ministries' Conference of Education in 2000 (Dehnbostel, P. 2012, pp. 13-17) . It's so important to set dimensions as the activity or personal competency for the reflective practice, because it let us to access to the peculiar knowledge and skills like as the organizing ability of work procedures and elements, and the professional identity.

VI. Conclusions

This article tried to verify experiences in the German higher vocational education which has accumulated many and much experiences on dual courses, so we, Japanese, get some suggestions for the internship or the vocational practice, especially for the relationship between theoretical learning and practical training.

Firstly, the concept VZ was politically and academically made up in relation to setting of criteria of the quality assurance for dual courses, especially in the university of applied sciences. The VZ covers three dimensions, not only the didactical level (relationship between theory and practice) the system structure (related structure between university and enterprises), and the organizing of alternative relationship between the study stage and the practice method.

Secondly, pedagogically, VZ for the didactical aspect seemed as simple, but was a most difficult issue to be realized. The VZ at curriculum or didactic level is often asked to only university side or students themselves. Also, the aspect of students' personal development is not verified enough, although it's signified in mostly all module hand books.

So, thirdly, mediated factors such as some material devices for the recall of learned theory in practice, the social or human mediator for student's guidance and the incorporation of reflective process in practical training.

Anyway, it's significant to make surely the application of theory in practice and the promotion of acquiring of tacit knowledge and personal-vocational development.

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