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Understanding Work Integrated Learning in ICT: A Systems Perspective

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Abstract**—**Information and communication technology (ICT) is essential to the operation of business, and create many employment opportunities. High volumes of students graduate in ICT however students struggle to find job placement. A discrepancy exists between graduate skills and industry skill requirements. To address the need for ICT skills required, universities must create programs to meet the demands of a changing ICT industry. This requires a partnership between industry, universities and other stakeholders. This situation may be viewed as a critical systems thinking problem situation as there are various role players each with their own needs and requirements. Jackson states a typical critical systems methods has a pluralistic nature. This paper explores the applicability and suitability of Maslow and Dooyeweerd to guide understanding and make recommendations for change in ICT WIL, to foster an all-inclusive understanding of the situation by stakeholders. The above methods provide tools for understanding softer issues beyond the skills required. The study findings suggest that besides skills requirements, a deeper understanding and empowering students from being a student to a professional need to be understood and addressed.

Keywords**—**Dooyeweerd, Maslow, Work Integrated Learning.

I. Introduction and Motivation for the Study

INFORMATION and communication technology (ICT) is essential to the operation of business, and create many employment opportunities. High volumes of students graduate in ICT and related courses though students struggle to find job placement.Students with high level skills are in demand, especially in scare skill environments. Students are not well prepared for expectations set by industry. Industry requires graduates to be more ready for work. A high degree of mismatch between graduate skills and industry information and communication technology (ICT) skill requirements exists [1]. In order to address the need for broad-spectrum ICT skills, universities must create programs to meet the demands of a rapidly changing ICT industry, and in this manner ensure the employability of students. This requires a close on going partnership between stakeholders such as government, ICT industry and universities [2].

The old-school model of learning facts without interest, and reciting them out of context is no longer satisfactory to prepare students to survive in today's world of work. An educational approach is required to align academic and workplace practices for the mutual benefit of students and industry. Work integrated learning (WIL) is when practical and theoretical learning activities are integrated and related to industry for different professions. WIL includes, learning from experience, workplace learning with the intention to motivate students to reflect on their experiences and growing their own conceptual understanding.

This situation may be viewed as a critical systems thinking problem situation as there are various role players each with their own needs and requirements who are dissatisfied by the current situation. According to Jackson [3] typical critical systems methods have a pluralistic nature. This paper explores the applicability and suitability of Maslow's hierarchy of needs and Dooyeweerd's aspectual analysis to guide understanding and change in the problem situation of WIL in ICT.

The first method used to evaluate WIL in ICT is Maslow's hierarchy of needs.Maslow's theory is concerned with human motivations, which are set up based upon a hierarchy of needs. This five level model hierarchy portrays the progression of an individual's search to meet human needs. Each higher order of motivational need is built upon a more basic need, with the final level when an individual is driven by the need to become self-actualized.

The second method evaluated is the aspect analysis of Dooyeweerd. Dooyeweerd's philosophy has outlined in fifteen aspects which allow one to avoid reductionist and dualistic approaches that are useful in both methodology and usage. He created a theory of modal aspects, with each aspect having a kernel meaning that is part of the spectrum of meaning. Surrounding the kernel of each aspect is in fact a complex constellation of meaning, of properties, relationships, things, processes, events, norms, social roles and institutions, and the like. Aspects are irreducible – no one can be derived from another.

The above methods provide tools for understanding softer issues beyond the skills required. The use of Maslow's suite of needs in this study aims to provide understanding of the personal needs of individuals. In addition Dooyeweerd's suite offers an in depth analysis of diversity and unity. These methods provide a unification of dimensions to be addressed in students.

Within higher education in South Africa there still seems to be an inherent problem about how to incorporate academic studies with practical training. This paper will explore problem situations experienced in ICT WIL in South Africa. This situation will be assessed against ICT students at the Vaal University of Technology (VUT). ICT students enroll for a three year diploma, consisting of six semesters. During the last

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semester of their formal training (semester 6) students are enrolled for a WIL semester.

This paper evaluates two methodologies used from a critical systems thinking perspective, to be used as a vehicle for conceptualizing WIL in an ICT environment. WIL is seen as an extension of the classroom, a valuable tool where theoretical and practical knowledge are combined. This paper is divided into four parts, the first being a detailed description of WIL and the problems currently experienced with WIL in ICT. This is followed by a discussion of Maslow's hierarchy of needs where after it will be used to identify problems and challenges experienced by ICT WIL students. An explanation of Dooyeweerd's aspectual analysis will follow in order to better comprehend the kernel of each aspect where after it will be used as guidelines of WIL in ICT. Concluding remarks will be discussed in section V.

II. What is Work Integrated Learning?

Work integrated learning (also referred to as experiential learning or cooperative education) is when practical and theoretical learning activities are integrated and related to the relevant workplaces [4]. WIL is an umbrella term to describe curricular, pedagogic and assessment practices, across a variety of academic disciplines that integrate formal learning and industry concerns, within a purposefully designed curriculum [5]. It includes a range of approaches namely: action learning, apprenticeships, practicum placements, problem based learning, scenario learning, service learning, team-based learning, virtual or simulated WIL learning, work-based learning etc.

Several innovative curricular and assessment forms have developed over the years in response to concerns about graduates' employability and public accountability. Given a close inspection to the different approaches to WIL, all are based on the understanding of the importance of enabling students to integrate theoretical knowledge gained through formal study, with the practice-based knowledge gained through engagement in a work or professional environment. Although terminology varies, all are based on a general understanding of the importance of enabling students to integrate theoretical information gained through formal study with practice, through involvement in work in a professional context.

WIL forms linkages between workplace knowledge and the academic curriculum, and helps students to transfer knowledge to workplaces [5]. Therefore WIL cannot take place without partners who represent the diverse knowledge fields. An obstacle facing meaningful WIL is the absence of commitment on the part of certain students, industry employers and higher education institution staff.

A. Challenges within an ICT WIL Environment

A graduate no longer holds the promise of a job as thousands of graduates' battle to find work. Although ICT is documented as a scare skill, among various other scare skills recognized by the Department of Labor[6], graduates still encounter difficulty to find jobs. The concern is not only the mismatch of students and industry requirements but also that ICT graduates need to enter the workforce with much better business understanding, as well as knowledge of rapid changes in technology. Besides having technical skills they need skills in written and verbal communication and the ability to work with people [7]. Even though the importance of WIL is widely accepted by industry and higher education WIL cannot be regarded as a "quick fix" to the global dilemma within the ICT sector or transform "low skills" into a "high skill" society [5].

The challenge in creating a WIL curriculum also lies in the broad discipline of ICT. The discipline of computer science evolved during the 1940's and has grown to a broad discipline. Denning [8] states that computer science "is the body of knowledge dealing with the design analysis, implementation, efficiency, and the application of processes that transform information, with the fundamental question of what can be automated". He furthermore explains that several areas exist in computer science. They are not mutually exclusive. Examples of these areas include Numerical computation, Theory, Architecture, Programming languages, Networks, Databases etc. [8]. Due to the broad field of ICT, the South African educational system, offer new qualification structures in various specialization areas. Different specialization areas in the ICT field include for example, database services, web admin, e-commerce, and multimedia, communication networks, support services, application development, business informatics and industrial intelligent systems. Due to the many variations of specialized areas within the ICT field, different specialization areas are offered in the academic curriculum. Each of these curriculums has a specific set of exit level outcomes. When students enter a WIL program, it needs to be aligned with the specific specialization area of study.

At VUT two streams of specialization areas are offered. These include Business Applications and Development Software. When enrolling for a WIL module in ICT student's job responsibilities need to align with the outcomes of the specialization areas. Students are not allowed to work outside the boundaries of stipulated outcomes. Among the challenges mentioned, other challenges during ICT WIL are faced by students. These include:

Inadequate mentors assigned

- No proper guidance
- Lecturers with no industry experience
- Risk of assigning students to large complex systems

The aim of this paper is to explore two different tools of looking at the challenges faced in ICT WIL. The theoretical framework that forms the foundation of the assumptions and analysis of the present study is related to the theory of Maslow's hierarchy of needs and Dooyeweerd's aspect analysis. The next sections set out the theoretical frameworks and indicate findings identified by each approach of the challenges encountered in ICT WIL.

III. Systems Thinking Methodologies

A system is a set of interrelated elements [9]. Ackoff[10] explains that a system is a whole that cannot be taken apart

without loss of its essential characteristics, and hence it must be studied as a whole. Churchman [11]emphasizes the importance to understand a whole system, its environment, the objective of each sub system, but also how a whole system is supported by the actions of its parts. Basden[12] explains it is natural to think aspectually, whenever we delineate a set of things that should be taken into account separately from each other and not reduced to each other.

In order to understand the problem situation experienced in ICT, two system thinking methodologies will be described and used as a tool for understanding the dilemma. The first method to be used is Maslow's hierarchy of needs, which will be followed by Dooyeweerd's aspectual analysis.

A. Maslow's Hierarchy of Needs

Various reasons exist why people work [13]. People do not only work to receive a salary, but also work for self-recognition and to develop one's identity. A wide variety of human needs are addressed when working. These include a feeling of success, power and status, whereof the most important is a feeling of affiliation and competency.

The theory of Maslow seeks to gain an understanding of individual's needs and is grounded in two diverse points of view. Firstly, humans unceasingly desire. As soon as one desire is met, another desire takes the place of the previous. Secondly needs are arranged in an order of importance, thus lower order needs must be met before higher order needs can be met [14].

All humans are encouraged by our needs. Maslow distinguishes five main categories of human needs. These needs are represented in a hierarchy of importance. Every individual is capable and has the longing to move up the hierarchy headed for a level of self-actualization, but unfortunately the progress thereof is disturbed by disappointment to meet lower level needs.

The original hierarchy of needs five stage model includes:

Biological needs – These needs are essential for the human's biological functioning and survival, and are the most prominent of all the needs. If these needs are not met, human behavior will primarily focus on their gratification. Examples include air, food, drink, shelter, warmth, sex, sleep etc. [13].

Safety needs – As soon as biological needs are met, the next level in the hierarchy comes forward and the importance of the previous phase. Examples of safety needs include: protection from elements, security, order, law, limits, stability etc. [13].

Belongingness and love needs – As humans start to feel safe and things which could possibly threaten them are under control, social needs enter in. This includes work groups, family, affection, relationships, etc. [13].

Esteem needs – This need relates to self-esteem and self-respect, as well as respect for others. This need can be divided into two groups, of which the first relates to self-respect and self-esteem and the other group to the need for the respect and approval of others. Examples vary from achievement, mastery, independence, status, dominance, prestige, managerial responsibility etc. [13].

Self-actualization needs – If previous needs are met, humans seek for opportunities to utilize their abilities. This is when self-actualization is the most important need considered by individuals. Examples include: realizing personal potential, self-fulfillment, seeking personal growth and peak experiences [13].

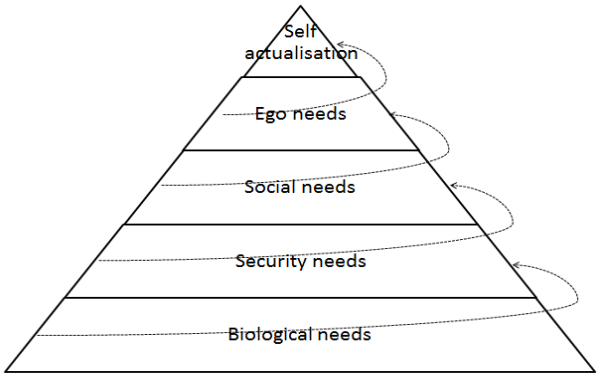

Fig. 1 Maslow's Hierarchy of Needs

Fig. 1 summarizes Maslow's hierarchy of human needs. Maslow sensed that there were follower needs, stating that if an individual was focused on satisfying one type of need they could not move to another, unless that one was satisfied. The essence of the hierarchy is that individuals will not be motivated by any higher-level needs, until his lower-level needs have been pleased [15].

In Maslow's article "A theory of human motivation" he summarize thirteen propositions which could be included in any theory of human motivation that could lay claim to being definitive [16]. These thirteen statements form the basis of his hierarchical model. The hierarchy of needs theory still remains effective today for understanding human motivation.

The following section will elaborate on WIL experiences of VUT students in an ICT curriculum. Maslow's hierarchy of needs is used in order to determine softer issues of ICT WIL students.

B. A Maslow Perspective of ICT WIL at VUT

Maslow's theory of needs explains five levels of needs in a hierarchical order. Thus the lowest level of needs must be met before continuing to a higher level. Maslow states that the first four levels must be satisfied before a human can be self-actualized. This section will make use of Maslow's theory of needs in order to guide an understanding of students needs during their WIL training.

The lowest level of an individual to be met is biological needs which are essential for humans biological functioning and survival. When students enroll for ICT WIL, they are exposed to the world of work but with limited resources. Students receive a little salary while in training. With this salary it is impossible for them to rent accommodation, pay for travel expenses, buy appropriate clothing for the world of

work, and to buy food. Thus the lowest level of needs is difficult to meet due to financial constraints.

Safety needs follow on the biological needs, but only when biological needs are met. Safety needs are identified by security, stability, freedom and fear. Very few students who are in training already obtain full time job positions. Most students are still unsure whether they will be appointed or not within the last month of training. These students also do not have the possibility of other jobs during the last month of their training, causing them to be very unsure about their future. They still face uncertainties regarding their future within the next month. They are unsure about their jobs, which cause financial insecurity, housing and food.

Belongingness love and social needs enter in as soon as humans start to feel safe and things which could possibly threaten them are under control. This includes working in groups family, affection, relationships, etc. [13]. When students enter industry, they leave behind their secure environment. Within ICT, teamwork is essential to success. Students experienced being welcomed, and part of the team as positive. Most students felt a sense of belonging in their respective job environments; conversely, most students struggle to adapt to new social structures.

Esteem needs – This need relates to self-esteem and self-respect, as well as respect to others. Students felt very positive and motivated towards their future career, due to their achievement. Students reflect a proud feeling towards themselves as they mastered assignments duties and responsibilities duties assigned to them. Some students were allowed to make suggestions which were accepted by their respective companies. This increased their self-confidence and self-esteem. This also contribute to how students others respect them. A main function within a Business Analysis environment, consulting with users in order to determine their business needs, When students start with their WIL training, they are not allowed to consult users by themselves. As their WIL training continues, most students though are allowed to visit users by themselves, or lead the interview. This gives students a sense of independence and increases their self-esteem, within the work environment.

Self-actualization needs – If lower level needs are met, humans seeks for opportunities to utilize his abilities. Students who are exposed to the world of work, realize their full potential, as well as their preferred niche area to work in. they are motivated for to enter their future careers and seek to be self-fulfilled and their future goals shifted based on individual preferences within an ICT environment. Student's remarks that it is nice to know all the theoretical terminology and knowledge are really used in industry. They comment by saying for the first time they are able to understand theory.

In applying Maslow's hierarchy of needs it became evident that students do not meet the first level of biological needs due to financial constraints. Students cannot afford to work, as they need to pay for housing, clothing and food. ICT WIL do consider themselves privileged being already exposed to the world of work. For most of these students the lowest level of needs are met and the other needs identified by Maslow are not regarded as problematic. They are well accepted into project teams; though struggle to make new social structures. They view themselves as capable of executing certain job responsibilities and surviving the world of work, and able to reach their full potential.

IV. Dooyeweerd's Suite of Aspects

Dooyeweerd's suit of fifteen aspects is used as a kind of checklist by many to indicate a complete set of aspects of reality [12].

Maslow's hierarchy of human needs indicate great resemblance to Dooyeweerd's suite of aspects. Maslow's top aspect is self-actualization, which match Dooyeweerd'spistic aspect [17]. The major difference between Maslow's and Dooyeweerd's aspect, is that Maslow's work is expressed in a hierarchy, whereas Dooyeweerd's do not require a specific sequence of analysis. Table I compares several sets of aspects with Dooyeweerd's suite of aspects. Other philosopher's might use other words that aspects but Dooyeweerdrecognizes strong parallels to his set of aspects. Dooyeweerdemphasize not to claim any suite as the absolute truth and later the degree to which a suite may be trusted and adopted [12].

TABLE I
Dooyeweerd's Suite of Aspects compared with Other Suites of Aspects

Aspect	Maslow	Husserl	Hartmann	Bunge	Habermas
Quantitative					
Spatial					
Kinematic					
Physical		Material	Inorganic	Physical, Chemical	
Biotic	Biological	Material	Organic	Biological	
Psychic	Safety	Psycho-logical	Psychic		
Analytic	Enquiry		Historical		
Formative				Technical	Instru-mental Strategic
Lingual	Expression				Commu-nicative
Social			Supra-individual	Social	Strategic
Economic	Affiliation, Esteem				
Aesthetic					Drama-turgical
Ethical					Norma-tivel regulated
Juridical	Aesthetic				
Pistic	Transcen-dence				

Dooyeweerd outlined fifteen aspects of our everyday experience. These fifteen aspects are not listed in a specific order. Each aspect is a sphere of meaning, centered on a kernel meaning [12].

- Quantitative aspect, of discrete amount
- Spatial aspect of continuous extension
- Kinematic aspect of flowing movement

- Physical aspect of energy and mass
- Biotic aspect, of life functions, integrity of organism
- Sensitive (or psychic aspect, of sense, feeling, and emotion
- Analytical aspect, of distinction, conceptualizing, and inferring
- Formative aspect, of formative power and shaping in history, culture, creativity, achievement, and technology
- Lingual aspect of symbolic signification
- Social aspect, of respect, social interaction, relationships, and institutions
- Economic aspect, of frugality, skilled use of limited resources
- Aesthetic aspect of harmony, surprise and fun
- Juridical aspect of what is due, rights responsibilities
- Ethical aspect of self-giving love, generosity, care
- Pistic aspect, of faith, commitment and vision [12].

Aspects cannot be directly observed, but only as they are expressed in things, events situations etc. Adjoining the kernel of each aspect is in fact a complex constellation of meaning, of properties, relationships, things, processes, events, norms, social roles and institutions and the like [12]. All things are situations and all human activity is multi-aspectual in nature [17]. This explains the complexity of everyday life. The question then arises, how can we analyze this complexity without lessening it or overlooking thins which are essential? Basden[17] explains several things to do when performing aspectual analysis. Firstly to understand "something", in a rich multi-aspectual way. Secondly to critique "something, by indicating what is good and what is not so good, and lastly to make suggestions to improve "something". "Something" might include an actual situation or object, or it might be a general thing as a set of guidelines or a theory.

A. Applying Dooyeweerd's Aspectual Analysis to ICT WIL

This section will investigate WIL by means of Dooyeweerd's 15 aspects. These aspects will be analyzed within the ICT WIL environment. Examples will be provided by means of ICT WIL students enrolled at VUT

1) Quantitative Aspect

In 2006 there were 104 000 vacancies in the ICT sector, translated into 46% of unfilled posts [18]. In contrast JIPSA (Joint Initiative on Priority Skills Acquisition) [19], indicated in 2007 that there are approximately 200 000 unemployed ICT graduates in South Africa, with a mix of certificates, diplomas and degrees. This does not correspond with the great demand of ICT specialists. Unlike other professions where professional bodies exist, there is no mechanism for calculating accurately how many ICT professionals in South Africa exist [20].

At VUT approximately ten present of students enrolled for a WIL module obtain a job. At VUT two specialization areas are offered: Development Software and Business Analysis. This limits students to work within the specialization are of their study. Students are not allowed to work within a network, technician, help desk etc. environment. Each semester between 90 and 120 students enroll for the last semester of their studies in ICT. Each semester between 10 and 15 students do acquire practical training.

2) Spatial Aspect

The predominant amount of students work in the Gauteng province. Students studied in the Vaal Triangle and need to relocate to be close to their work environments. Students from international countries like Botswana and Congo prefer to do their practical training in the country of origin.

Depending on mentors, supervisors company policies students and job responsibility of students they either attend meetings, or consult with clients, or they remain in the office. Thus some students are not exposed to the world outside the office.

3) Kinematic Aspect

Kinematic aspects focus on movement. Little change is noticed in the amount of students who do find jobs, or the types of jobs they find themselves in. Within WIL environments students are assigned to one specific project with no movement between projects, causing little exposure to other fields of training. Basden[17] explains that change is good. This implies to expose students to various projects can be beneficial.

4) Physical Aspect

Physical aspect deals with energy and mass. This aspect does not indicate either benefit or detriment within ICT WIL.

5) Biotic Aspect

Maslow explains biological functioning and survival, and as the most important of all the needs. Examples include air, food, drink, shelter, warmth, sleep etc. Most students in South Africa in the South African experience financial constraints. Students either stay at family of friends, these in some cases are far from work, and students need to make use of public transport. Another matter is clothing. Students need to dress appropriately. Big corporate companies send students on courses focusing on soft skills. These do not only include communication skills, motivation skills etc., but also personal skills including how to dress appropriately. Corporate companies also do have dress codes students must adhere to.

6) Sensitive Aspect

Basden[12] describe the kernel of the sensitive aspect as "feeling and responding" and it being good with a positive interactive engagement with the world. Students are integrated into the ICT industry. Students are satisfied in their work environment in terms of their roles in communication in the organization.

7) Analytical Aspect

Analytical aspects kernel meaning is described as conceptualizing, clarifying, categorizing and cogitating. An important aspect of a skilled ICT professional is to be an analytical thinker.

8) Formative Aspect

Students experience positive integration into companies. This causes them to voice not only their understanding of situations, but also making suggestions. Innovation and achievement are then motivated.

9) Lingual aspect

Being able to work effectively as a team member is essential to the fruitful operation of organizations, and a core skill of ICT graduates. Lingual aspects are the way students are able to express record and interpret themselves. Within the ICT sector it is important to have good communication skills [21]. A concern is raised by industry regarding communication skills of ICT students. Business Analysts and Systems Analysis need to communicate with users, owners, builders and various technical stakeholders.

10) Social Aspect

When evaluating social aspects, a closer look is given to social interaction, relationships, and institutions. In integral part of being an ICT professional is to work in teams. Team harmony is thus of the essence. Most students however do not work in teams during WIL. Students have clear objectives and responsibilities assigned to them by mentors.

11) Economic Aspect

Economic aspects are influenced by frugality, skilled use of limited resources. The majority of students come from poor backgrounds. After being experienced lived realities of the ICT professional, they are motivated and ambitious towards their future as ICT professionals. Students either await a permanent appointment after graduating, or are already employed permanently at the companies they are working.

12) Aesthetic Aspect

Students experience WIL as a very positive towards their personal well-being, as well as professional development. They come over as excited, energized towards life and future careers. Students experienced their training as a vibrant environment with challenges to be faced within a short period of time. They do not experience being a WIL student as boring, or uninterested.

13) Juridical Aspect

With juridical aspects, rights and responsibilities are investigated. Students work for a small salary and others without any compensation. Students within a training environment are usually seen as cheap labor. Due to financial constraints of students to sometimes do not apply for jobs, as the amount they work for would not cover basic expenses for example accommodation, traveling and food. When studying Maslow's hierarchy of needs this is the lowest level of needs.

14) Ethical Aspect

Ethical aspects are recognized by self-giving, love, generosity and care. Student attitude is a big concern to industry. This do depends on the individual placed for WIL. Student complaints vary from communication skills, professionalism, self-management etc. Industry also experience, students with positive attitude.

15) Pistic Aspect

Pistic aspect is defined as good when courage, hope and openness to the Devine; change in the attitude and direction of society. ICT WIL students mature within the period of training. They are committed, motivated, and believe in themselves. Students are forced to work within the boundaries towards the vision of their companies, but influence their vision towards their individual future careers.

V. Conclusion

The departure of this study was to apply the theoretical framework of systems thinking for the integration of students becoming part of an ICT WIL process. This aims at the integrated wholeness for students into industry. It initiated this study with the aim of assessing WIL in an ICT curriculum by making use of methodologies used from a critical systems thinking perspective namely Maslow's hierarchy of needs and Dooyeweerd's aspectual analysis.

The emerging reality of ICT WIL students are that the lowest level of Maslow's hierarchy of needs which could not be met. This corresponds with Dooyeweerd's physical, biotic and economic aspects. This contradicts the first level of Maslow's philosophy stating, the following levels can only be addressed if the previous level is fulfilled. Students within an ICT WIL program however did feel safe in their workplace, they do belong, they do believe in themselves and resulting in they are self-actualized. This situation therefore denies Maslow's theory but accepts Dooyeweerd's aspectual analysis stating that there is no specific sequence of aspects.

The remaining needs of Maslow and aspects from Dooyeweerd do not seem problematic. Additional issues may have been side-lined by focusing on only the needs of ICT WIL students, which requests an additional exploration from the view of industry.

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