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SCIENCE LEARNING FOR GIFTED STUDENTS: MODEL OF STRENGTHENING PEDAGOGICAL CONTENT KNOWLEDGE COMPETENCY IN SPECIAL EDUCATION GRADUATES

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Abstract

This study aimed to develop a model for strengthening the pedagogical competence of Content Knowledge for special education students in science learning for gifted students. This study used a research-based design. The model was formulated through a study of the curriculum and practice of lectures at seven universities in Indonesia. Content and empirical validation was carried out by experts through the Delphi technique, to obtain the content formulation, efficiency, and implementation of the model that had a level of feasibility. Empirical validation was carried out through Focus Group Discussions with practitioners to obtain operational input for the model. The results of this study show that the scientific construct of special education in the context of strengthening the pedagogical competence of students in the field of science learning for gifted children is in the form of a curriculum structure that forms a pyramid of competence which has implications for general basic courses, basic specific courses and which consists of four layers and is repeated in an integrative way. Students are provided, before practice, and the results of the practice were discussed with the lecturer. Students were provided with new materials, practiced, and continuously reflected. The model for strengthening the pedagogical competence of the Content Knowledge of special education students is essentially a positive response because it has an impact on the cognitive experience and increases the skills of graduates, namely having high competence and adaptability in line with the perspective of independent campus policies and independent learning in Indonesia.

Keywords: Competency, Gifted students, Pedagogical content, Science learning, Special education.

1. Introduction

As an institution that produces educators, the Special Education Study Program at the undergraduate level is expected to produce graduates who are competent, competitive, and highly adaptable. This requires continuous study regarding the development of a futuristic and functional curriculum for special education study programs, to suit the challenges and dynamics of the times. Competency development is based on aspects of expertise in special education science and aspects of knowledge and skills in special learning. Skills in designing special learning that is focused on specific competencies according to the area of special needs of each learner [1]. Specific design requirements relate to the physical environment, content, methods, and use of assistive technology, including the need to meet public expectations and demands.

Competence is defined as a tool for effective behavior related to exploration and investigation, analysing, thinking, paying attention and perceiving, and directing someone to find ways to achieve goals effectively and efficiently [2]. A person is said to have competence, if he knows and understands his knowledge, has a positive attitude towards his work, and is skilled in practicing it. Competence in the field of science education for gifted students is primary and minimal, because the competency material is essential and basic and should not be reduced and must be mastered [1]. All describe scientific, technical, methodological, and practical mastery that can be accounted for academically and administratively.

Pedagogical content knowledge is a unique type of knowledge, based on how to relate pedagogical knowledge (what is known about teaching) with subject matter knowledge (what is known about what is taught) [3]. Knowledge of pedagogical content plays an important role in classroom learning. This knowledge of pedagogical content involves teacher competence in conveying conceptual approaches, relational understanding, and adaptive reasoning to the subject matter.

Knowledge of pedagogical content in science teaching, including the most useful forms of topic representation, the strongest analogies, illustrations, examples, explanations, and demonstrations [1]. It is a way of representing and formulating a subject that makes it understandable to students. This knowledge of pedagogical content also includes an understanding of what makes learning a particular topic easy. Conceptions and preconceptions are brought by students of all ages and backgrounds to study the most frequently taught topics and subjects. Knowledge of pedagogical content is the accumulation of general elements, namely: knowledge of the subject matter, students' knowledge and possible misconceptions, knowledge of curriculum, and knowledge of general pedagogics [4]. Knowledge of pedagogic content is knowing what, when, why, and how to teach using sources of knowledge about good teaching practices and experiences.

In describing the process of strengthening the competence of educators, they used metaphorical trajectories and power [5]. Each special education student begins to move through a certain path, learning aspects of teaching that are congruent with his conception of learning and teaching good, gifted students. The result is the interaction of students entering the trajectory with the strengths the program calls for. Special education curriculum constructs have an important function in designing learning experiences [6], which are presented in the form of contextual dilemmas and by testing empirical practical knowledge such as in the field of science learning for gifted students.

Gifted students have different characteristics from other students. These students are engaged in activities of interest. Gifted students have excessive dedication to things they are interested in, which is not seen in older students [1]. This is the ability to high concentration for a certain period, this ability is superior when compared to the ability of other students in the same condition, this is the ability to focus a lot on several activities [7].

Internship programs are widely used as models to provide experiences to students through learning in the workplace. During this internship, students gain hard skills, namely problem-solving skills, analytical skills, and so on. Through internship activities, problems in the field are conveyed to universities, thus providing an opportunity to update teaching and learning materials for lecturers and topics at universities will be more relevant. Initially, internships were only associated with Engineering work, but nowadays internships cover a wide range of jobs. The work-based education program is designed as a modern internship, namely the transition from higher education to the business and industrial world [1]. Modern internships seek to study and formulate pedagogical theories that support work-based learning [8].

Partnership programs in the context of internships have been criticized for being too varied, both in terms of quality and standards of learning. There are too many goals to be achieved by the internship program, resulting in varied forms of learning programs. Therefore, internships as a form of work-based education program need to be jointly designed between the parties involved, the government, educational institutions, and the business and industrial world. Think about how to involve students in a way that fits the pedagogy. Internship activities for work-based education programs must be based on a shared pedagogical view to facilitate the potential development of learning activities and lay the foundation for developing student competencies through partnership programs with the business world and industry [9]. In turn, the internship program must become a learning practice as a process of adaptation and development of human resources to prepare for competitiveness and adaptability in an increasingly developed world of work.

The purpose of this study was to develop a model for strengthening special education graduates in science learning for gifted children. This study uses a research-based design. The model is formulated through a study of the curriculum and lecture practice at three universities in Indonesia. Content and empirical validation were carried out by experts through the Delphi technique so that the content formulation, efficiency, and implementation of the model had a feasibility level. Empirical validation is carried out through focused discussions with practitioners to obtain operational input for the model. The research subjects are the curriculum and lectures in special education study programs at the three universities as well as all the elements involved in it. The novelty of this research relates to the scientific construct of special education in the context of strengthening the competence of graduates. It is formulated through a curriculum structure that forms a pyramid of competencies that has implications for general basic courses, specific basic courses, and internships which are implemented through lectures with a sandwich approach that consists of four layers and is repeated in an integrative way. Students are provided, before practice, and the results of the practice are discussed with the lecturer. Students are provided with new materials, practiced, and continuously reflected.

2. Theoretical Farmwork

2.1. Science learning

This is not only a matter of practicality or expediency, but also a matter of competence for special education graduates. Special education graduates need to take ownership of their teaching because teaching is a highly interactive process in which context – in particular, but not only, in the case of gifted students being taught – has a huge impact [1]. Draw careful distinctions among the four basic learning objectives: learn science, learn about science, do science, and learn to solve socio-scientific problems. In elaborating, the authors urge that careful attention be paid to the selection of teaching methods recognizing the main differences in learning objectives and criticize the general assertion that 'current wisdom recommends that students best learn science through a research-oriented teaching approach to combine the differences between learning and research [6].

Since the research has explored the need for change in science education. Over the past few decades, studies have continued to be developed with the vision of a scientifically literate society with an understanding of significant scientific content and the ability to apply knowledge to understand events in everyday life [10-13]. Science content is very important for students to know, including the value of collaboration and collaboration in science [14]. The process of learning science concepts must involve a portion of time working with other students. His standards on the value of pedagogy in science teaching continue to be developed to define what actually and should happen in the classroom. Attention to education reform is focused on quality teaching such as curriculum to improve education in the field of quality science teaching for gifted students related to pedagogical content knowledge and pedagogical skills [15].

Implementing a standards-based science curriculum is not easy for teachers [6, 15]. This is possible because of the amount of time teachers devote to teaching science. limited. These include related to several intrinsic factors such as attitudes about science and science teaching, limited content knowledge related to the desire to learn science), and pedagogical experiences. Student learning is influenced by many factors [16]. In the school-controlled realm, teachers and teaching are the primary influences on what, how, and how much students learn. Two important teacher factors, pedagogy, and attitude, influence much of what happens in science teaching and the resulting student learning.

A study comparing the effects of gender on inquiry-based teaching in all four grades found that boys and girls increased equally in science achievement when taught using inquiry [17]. This is especially interesting considering the lack of student learning in science described by the International Trends in Mathematics and Science Studies (TIMSS). TIMSS reports that in a 2003 test, fourth graders in the United States excelled in science by fourth graders out of 8 of the 24 participating countries. United States eighth-grade science students outperformed 32 out of 45 state participants. The National Assessment of Educational Progress Data (NAEP) determined that American science students were not making progress in catching up with science students in other countries, because NAEP science scores for fourth and eighth graders showed no improvement from 1996 to 2000 [18].

Critically, how well do students acquire a conceptual understanding of science? related to how their teachers teach science [19]. To be effective, science teachers need to have the ability to represent important ideas and abstract concepts so that they can be understood by students. The ability to make these connections is at the root of effective teaching; Effective teachers have content knowledge and pedagogical skills that are most effective for teaching subject matter [20] and in student learning. Scientific inquiry has a definite role in student success but are there any guarantees? that teachers can effectively apply inquiry learning pedagogy in complex interaction classes.

Teaching material with sufficient depth, variety of approaches, enriching topics through guest speakers, field trips, demonstrations, videotapes, and interesting ones [1]. Watch for signs of boredom, encourage discussion, and create a safe environment where new ideas are welcome. Children experience a variety of experiences beyond the aesthetic component. There must, be an area to be developed in the aesthetic component. Aesthetic studies are designed to enable gifted students to develop new knowledge. Each field is developed to broaden the way of thinking. Willingness to learn in new situations is a consideration in choosing an aesthetics course which consists of many curricular activities. The aesthetic component is scheduled based on the time required, such as the ability to broaden horizons based on interests (as shown in Fig. 1).

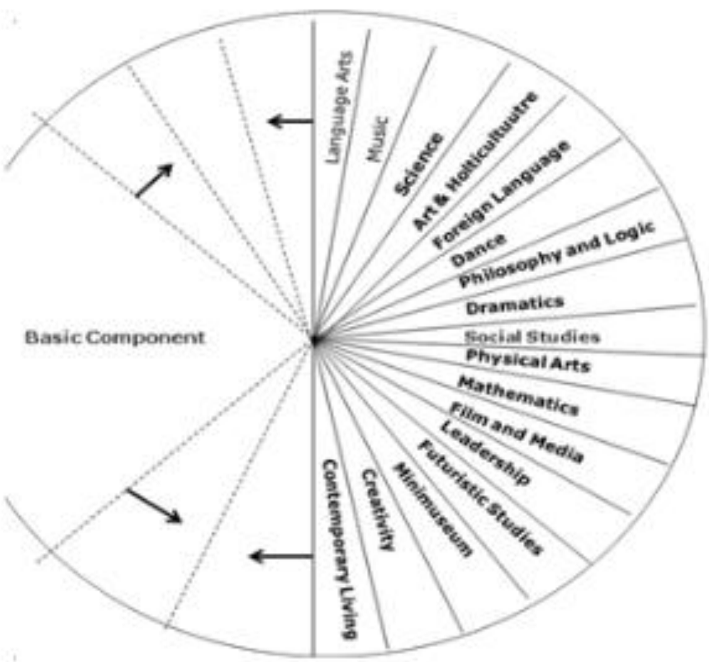

Fig. 1. The content areas in which a child may do exploratory studies or in-depth accelerated study (Creative I) [1].

2.2. Gifted student learning

Giftedness has been an interesting issue throughout history. Every culture has its imagination, so it is understandable if the concept of gifted continues to develop. In Greek times, giftedness was associated with oratory skills, in Roman times talent was associated with engineers and war skills [21]. For a long time, the concept of giftedness referred to by Terman (1925) was based on IQ, then added creativity, and gave a multidimensional perspective, adding leadership, and skills in visual and motion arts [22].

Figure 2 shows the three-ring conception Renzuli which underlies the education of gifted children, states that giftedness is a functional interaction between three clusters, namely general ability above average, creativity, and high commitment to tasks [23]. However, they corrected the general ability above the average, to an ability above the average which means general and special abilities [23]. They realized that the tree ring conception did not touch the entire population of gifted children. Some groups are missed, such as underachievers and disabilities. This category has not been accommodated, so the concept has developed that believes that giftedness will not be realized if it does not get support from school, family, and the environment.

The idea of giftedness only in one area is an incorrect thought. It is realized that many individuals excel in specific fields, and do not show interest in other fields, that is because individuals have a lot of potential, so they have many choices, which are often confusing. Compared to their peers, gifted children tend to do abstract reasoning, conceptualize, process information well, learn quickly, show intellectual curiosity, have broad interests, do not like routine things, remember large amounts of material, and show a high level of interest. of ability and prefers to study in a quiet environment [24].

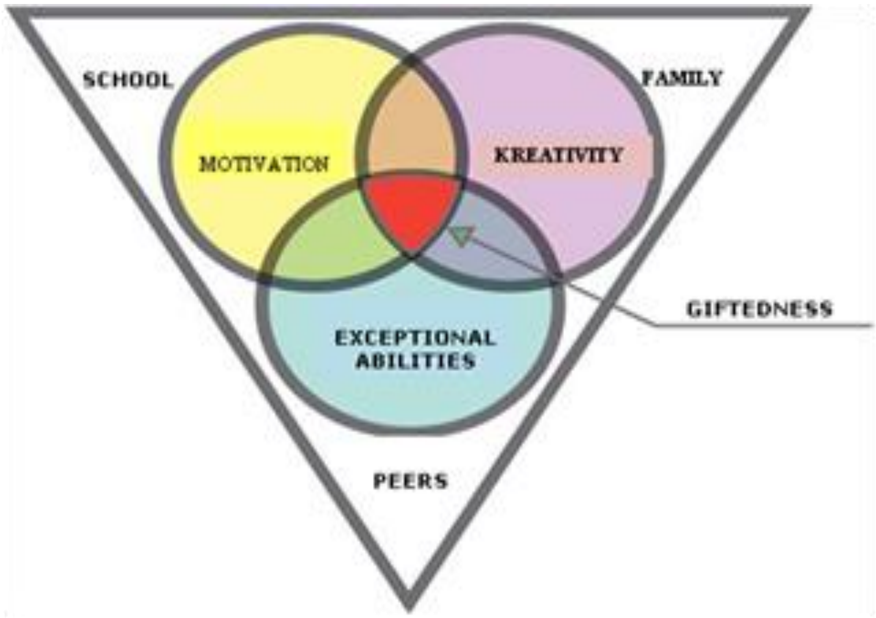

Fig. 2. Multi factors model of giftedness [1].

3. Method

This study used a research-based design. The model was formulated through a study of the curriculum and practice of lectures at seven universities in Indonesia.

Conceptual-content validation and practical-empirical validation. carried out by special education experts who have devoted themselves to higher education as academics and practitioners. carried out through the Delphi technique, to obtain a content formulation, efficiency, and operational model that has a feasibility level. Empirical validation was carried out through Focus Group Discussions with practitioners to obtain operational input for the model that met the practical feasibility level. The research subjects are the curriculum and lectures in seven special education study programs in Indonesia, as well as the elements included in them (as shown in Table 1).

Table 1. Seven of the special education program.

Study Programs	Location
Special needs education 01	Bandung
Special needs education 02	Jakarta
Special needs education 03	Surabaya
Special needs education 04	Solo
Special needs education 05	Padang
Special needs education 06	Banjarmasin
Special needs education 07	Jogja

Feasibility of the content of a model is needed to provide confidence that the model is appropriate to achieve certain goals. Therefore, content validation is carried out by special education and science education experts who have devoted themselves to higher education as academics. Content validation is carried out through the Delphi technique, which is an assessment technique for making decisions by sending a model script and guidance to the validator. In general, experts argue that from the content aspect, this model has met the feasibility as a model. Two dimensions are considered, namely the structure and content of the model. Experts also recommend that this model is worth continuing its development and implementation.

The content component is considered adequate and operational. This is based on the existence of a guide that is considered easy to understand and has operational instructions as an integral part of the model. The dimensions of the model include terms of reference, the basis for development, attractiveness, rationale, objectives, the scope of service, target population, working principles, service system support, counsellor role, implementation procedures, evaluation, and implementation guidelines. The model is concluded to have met the feasibility of a model. Academics make notes for improving the model, as follows: (a) the description of the model is too academic so it needs to be simplified and divided into separate but complementary documents, (b) the use of terms should use standard terms and be easily understood by many people, and (c) the structure and content of the model should provide an overview of the implementation of the model which is described briefly and clearly in the practice guided). This model needs to be specially trained before being implemented so that there is a common conceptual understanding.

Meanwhile, contextual-practical validation is carried out by practitioners, namely science teachers and special education teachers. Empirical validation was carried out through Focus Group Discussion. It begins with an explanation of the hypothetical model, followed by a discussion. After that, the participants analysed the hypothetical model, related to the operationalization of the model. At the end of the discussion, participants filled out the model operational feasibility questionnaire. Based on contextual-practical-empirical validation conducted by weighing practitioners, important notes were obtained to provide confidence that the model met the operational feasibility requirements and could be implemented. In general, practitioners consider this model very attractive and potential as a solution to existing problems.

However, before carrying out the implementation test the practitioners also gave some notes for model improvement, practice guides, and service units such as the need for activities to increase understanding of model implementation through special training, so that all involved can help and support its implementation, need simplification and confirmation. terms in a model that is easy to understand and avoids repeated explanations. At this stage, revision and model development were also carried out. The revision and development of this hypothetical model are based on expert and practitioner input, so that a model formulation that can be implemented and tested empirically is obtained, known as an operational model

4. Results and Discussion

4.1. Body of knowledge special education undergraduate program

The need for education adapted for diverse students in inclusive settings has become a major concern in revising the curriculum in special education study programs at the undergraduate level of UPI, UNJ, UNESA, UNS, UNP, ULM, and UNY, higher education institutions in Indonesia. Although it is recognized that the curriculum problem from the perspective of inclusion settings is still a controversial issue. Based on the results of the interviews, there is a discourse among experts and those involved in special education, regarding whether the program should be based on areas of special educational needs, should be cross-categories or without categories.

The trend that appears in these seven universities producing special education graduates in Indonesia is more toward cross-category and non-category programs, although some maintain the context of specialization. One other area that has emerged at UNJ is that it still emphasizes material content so that elementary school subjects are maintained by involving lecturers from outside the study program. The impact of the involvement of lecturers from outside the study program also accelerates the socialization of special education and the perspective of inclusive education and student diversity in the university environment. Even at the faculty level, it has been realized in the form of courses. Reflection is getting attention concerning the pedagogical content knowledge of students which will support the competence of graduates and the perspective of professionalization of special education teachers [1, 15].

Observing the strengthening of curriculum restructuring in seven universities in Indonesia, UPI, UNJ, UNESA, UNS, UNP, ULM, and UNY. Although quite diverse, the essence is the same. This follows the metaphorical trajectory and power theory proposed, that every special education student begins to move through a certain path, learning aspects of teaching that are congruent with the conception of learning and teaching good, gifted students [23, 24]. The result is the interaction of students entering the trajectory with the strengths the program calls for. The special education curriculum construct has an important function in designing the learning experience, which is presented in the form of contextual dilemmas and by testing empirical practical knowledge such as in the field of science learning for gifted students (as shown in Fig. 3).

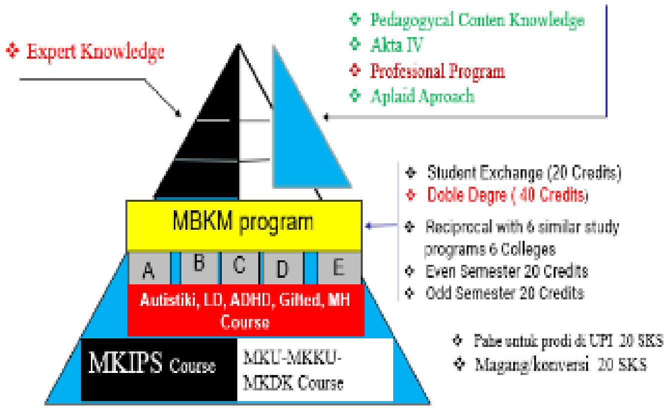

Fig. 3. Body of knowledge special education undergraduate program.

4.2. Hypothetical model

The model for strengthening the pedagogical content knowledge of special education students in the field of science learning for gifted students consists of components, namely the rationale, objectives, scope, basic assumptions and working principles, implementation procedures, and program evaluation.

4.3. Rationale analysis

Curriculum development based on pedagogical content knowledge competence in the field of science learning for gifted students is very important. Especially when there are government policies related to the Independent Learning and Independent Campus (MBKM) that are challenging to realize creatively. An important step in this curriculum review is to redefine the nature of competence in the context of special education, and to redefine government and university policies [6, 15]. Important assumptions of MBKM policy and strengthening of pedagogical content knowledge competence in special education curriculum, importance of tracer study for alumni, analysis of subject groups, breadth of material ranging from analysis of academic, vocational, professional curriculum, change of course name, addition of credits for each subject, form material for internship content, analysis of main competencies, supporting competencies, other competencies, materials, methods, media, evaluation, follow-up for each course that produces economic value, the learning model is formulated as if there is already an internship content and the context of its conversion.

4.4. Objective analysis

The general aim of lectures through strengthening pedagogical content knowledge competencies in the MBKM perspective is that students can learn contextually and there is a transfer of learning experiences into Behavioral patterns. Learning transfer is believed to occur when students: (a) experience an activity that consists of conceptual elements; (b) reflect on activities or listen to others reflect on their experiences during the discussion or reflection process; (c) abstract practical knowledge and (d) applying learning outcomes in real life settings. In particular, the objectives that can be achieved in the field of science learning for gifted students are to improve student's social skills and to encourage increased self-awareness and understanding of various choices and Behavioral consequences. Encouraging the learning process increases awareness about healthier adjustment strategies and increases control over the environment [6, 15, 25]. Opening the opportunity to show real alignments as a form of denial of negative self-concepts and pushing toward positive self-concepts. Facilitates a realistic assessment of the strengths, weaknesses, and limitations of self-determining factors. Encouraging a learning process that allows for increased confidence and creative problem-solving skills, decision-making, collaboration, communication, and facing challenges both related to the unique profile of gifted children and the unique profile of science learning itself [26, 27].

4.5. Scope analysis

Substantially, the strengthening of pedagogical content knowledge is oriented towards integrative multi-layered experiences in various settings as part of the overall educational program. More specifically, it is an apprenticeship program and MBKM. In such a position, though, students gain experience and strengthen their competence, especially increasing competence through a series of apprenticeship activities in various educational settings for gifted students [1]. This approach is a structured experience designed to develop cohesion through multidisciplinary and cross-sectoral teamwork. This technique is used to perform competitive empirical tasks and relies on principal interactions as a problem-solving technique. The tasks are designed to solve problems in the context of an individual educational program in a group setting.

4.6. Basic assumptions and working principles

Various approaches used in implementing practice in special education study programs, in linking theory with practice are using an integrative iterative layered approach. This approach is carried out in stages by giving certain theories and then allowing practicing through empiric learning in the context of an internship or MBKM program. The results of practice are reviewed theoretically and reflected in the perspective of innovation and competence of special education graduates.

4.7. Procedure and field introduction stage

The implementation of strengthening pedagogical content knowledge competencies is carried out through four main stages, namely the field introduction stage, simulation in the form of micro-teaching, guided teaching practice, and independent teaching practice [1].

This stage is the stage of planning or preparation for implementation, which is the preparation of the foundation for the smooth and good implementation of the next stage. At this stage, students actively research and access information from various sources about the participants' experiences before carrying out apprenticeship activities in this process, starting with making observations. Collecting this information is important for students so that they can provide appropriate services at a later stage [1, 11-14]. Access to information that students need to understand concerning gifted students includes the reasons for the importance of the assessment, how long it will take to carry out, and whether the goals of participation are formulated as individual or group goals.

4.8. Simulation stage in the form of specific core lectures

Lectures through strengthening pedagogical content knowledge in the field of science learning for gifted children in the context of competence for special education graduates include simulation activities in the form of learning courses for gifted students aimed at providing understanding and recognition. The delivery method in actual activities in the form of discussions, assignments, and exercises that think about problem-solving activities binds participants to the intervention program to achieve specific psychological outcomes [1]. The group goals implemented are full value contracts which are decided based on specific parameters regarding acceptable behaviour in the group. Based on the results of collecting information and identifying participants, determining goals, and environmental characteristics, at this stage, the form of activities to strengthen relevant pedagogical content knowledge competencies is also designed. In the design, goals, forms of activity, and meaningful experience-oriented assessments are determined.

4.9. Guided practice stage, independent practice stage, and experience reflection stage

Guided practice is strengthening in the form of empirical skills training, where students are allowed to take full responsibility as competent personnel in the practice, but still with guidance, until their competence can be fully accounted for. The task that must be done by students is to learn to adapt to be able to innovate and interact with gifted students [1].

The implementation of independent practice for special education students is for a certain period related to the conversion of credits. Students act as staff in the institution [1]. Independent practice is carried out by students in various settings.

The experience reflection stage is the stage of processing the experience gained in participating in apprenticeship activities in various settings. At this stage, students are allowed to reflect on their personal and group experiences and relate them to their daily lives and future. The activities at this stage are expressing and framing experiences [1].

4.10. Content and empirical validation results

The implementation of a new curriculum, whether completely new or a revision of the existing curriculum, requires various implementation guidelines [6, 15]. The guidelines will provide signs for implementers in the field so that the intentions contained in the reform can be realized. The special education curriculum for the undergraduate level is developed by starting with the set of competencies that must be possessed by graduates, which are projected to teach students with special needs [6].

Starting from the set of program assumptions as well as the objectives and profile of special education graduates, the management of lecture activities in special education at the undergraduate level should implement strengthening pedagogical content knowledge in line with the MBKM policy context. One thing that needs to be emphasized is the need for students to have hands-on learning experiences in achieving or mastering the targeted abilities. Direct experience is always associated with students who will be served by graduates, one of which is gifted students [1].

From an institutional perspective, the core curriculum approach as part of the complete curriculum of this study program places the initiative and responsibility for program development on the implementing agency. The challenge of developing such a program is a prerequisite for capacity building Translation results both in terms of facilities and personnel, on an ongoing basis. In line with that, from the individual perspective of students, the opportunity and necessity to formulate their study program is also a fundamental first step for the formation of learning initiatives and responsibilities for a workforce with superior competence.

The relationship between theory and practice can be done through the approach of transferring learning experiences into changed behavior patterns. Learning transfer is believed to occur when students: (a) experience an activity consisting of conceptual elements; (b) reflect on activities or listen to others reflect on their experiences during the debriefing process; (c) abstract practical knowledge and (d) applying learning outcomes in real life settings (Fig. 4). Its nature is simple, towards more complex, starting from orientation activities, limited skills training, complete training with guidance to independent [1, 6-15, 25, 26].

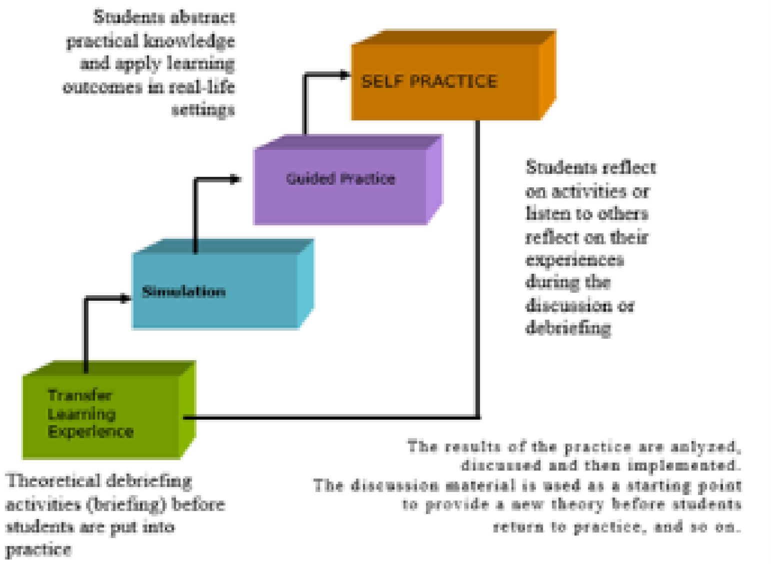

Fig. 4. Transfer learning experience.

5. Conclusion

The Content Knowledge pedagogic competency strengthening model for special education students received a positive response and met the eligibility requirements of the content and empiric feasibility of seven universities and practitioners because it has an impact on cognitive experience and the expected increase in graduate skills. Students have high competence and adaptability in line with the perspective of campus policy, especially independent and independent learning in Indonesia. The results of the study explain the scientific construct of special education to strengthen the pedagogic competence of students in the science learning field for gifted children in the form of a curriculum structure that forms a pyramid of competencies that has implications for general basic courses, special basic courses and which consists of four layers and is repeated in an integrative manner. The biggest hope is the achievement of student independence in living everyday life.

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