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Training of Investigative Competencies at the Secondary Level: A Systematic Review

Abstract

The work addresses a systematic review of the formation of investigative competences at the secondary level and its role for the constant improvement of teachers and students. The objective of the research is to describe the types of investigative competences for the development of skills in the research teacher. For this, the prism method was used, which allows an approach to the theoretical criteria through the aid of graphic diagrams that provide a selection and synthesis of the topic, to forecast the priorities of future research, in addition to providing a guide on how to report the use of automation tools in various steps of the review process, such as search, study selection, data collection, evaluation and study synthesis for conducting systematic reviews. As a technique, was used Desk Research to obtain bibliographic information efficiently and systematically review documents where research competencies are exposed. The importance of mastery of investigative techniques by teachers and students is concluded for the educational process in secondary education, so that the work can constitute a starting point to deepen future research on the subject studied.

Keywords: Investigative Competences, Secondary Education, Technological Competences, Fundamental Learning.

Introduction

One of the substantive missions of academic life for students at all levels is the formation of capacities and abilities that enable comprehensive preparation. This activity demands on the staff material resources and strategies that provide that the student progresses in his conditions as a person and is an active member of a social nucleus.

Formative research is defined as the set of knowledge, abilities, skills, and attitudes to develop research processes (Morillo, 2015). It refers to research as an instrument of the teaching-learning process, since it seeks to disseminate information and generate that the student uses it (Arakaki, 2009).

According to (Rojas & Aquirre, 2015) argue that there are different conceptual uses of investigative competence, such as investigative training, investigative skills that are related to the intentionality of application, before which they prefer to call it investigative capabilities because it is more adaptable to the teaching process and the personal and social development of who are involved.

The objective of the research is to describe the types of investigative competences for the

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development of skills in the research teacher. The work aims to constitute a valid contribution that serves as a starting point for other studies and reflections related to the topic of types of investigative competence.

Materials and Methods

The research will be based on a descriptive bibliographic review work, for which a review of books, articles, manuals, regulations, institutional reports, and other documents will be carried out that allow obtaining information and delving into the subject studied. For which the prism method will be applied that allows an approach to the theoretical criteria through the aid of graphic diagrams that provide a selection and synthesis of the subject, in which the priorities for future research can be predicted, in addition to provides novel guidance on how to report the use of automation tools at various steps in the review process, such as search, study selection, data collection, evaluation, and study synthesis for conducting systematic reviews (Barrios, 2021). The basic technique to be used will be Desk Research (Torrico, 2018) to obtain data efficiently and systematically review documents where research competencies are exposed.

Analysis and Discussion of the Results

Investigative Competence

The competences according to (Estrada, 2014) present regularities such as the integration of various components such as cognitive, metacognitive, motivation and personal conditions that allow efficient performance in research activity. Also, the academic-investigative and labor-investigative relationship is also related to the stages of scientific or technological research and teamwork with interpersonal relationships and interdisciplinarity is considered.

If students manage to acquire research skills, they will be able to develop scientific work with greater skill and will be able to disseminate results of their research, participate in conferences and publish activities in scientific journals that will not only contribute to their good academic performance, but also contribute to generating and updating knowledge in their area of study (Campos & Ramírez, 2018).

The investigative process is a positive attitude for the development of knowledge and skills based on conceptual definitions (Núñez, 2019; Velázquez et al., 2021). Authors such as (Pirela & Prieto, 2006); (Valdés, Vera, J, & Estévez, 2012); (Lodoño, 2011) and (Valenzuela, Valenzela, & Reynoso, 2021; Savinova et al., 2021) refer to a division of generic and technical investigative competences. Generic competences would be related to human attitudes, predisposition, skills, and qualities. The technical competences would be associated with the knowledge and techniques that are admitted in the procedure of the investigative activities.

Investigative Technological

competences Investigative technological competences represent the ability to search, obtain, evaluate, and manage information to transform it into knowledge (Vuorikari, 2016). However, it is not only required to know how to recover the information, but they must also consolidate skills to select, organize and analyze everything that can be discovered by the researcher when using technological resources, otherwise they will find themselves in a sea of documents of various types and from multiple sources, which will hardly serve to generate new knowledge.

(Skryabin, Zhang, & Zhang, 2015); (Rodriguez & García, 2013); (Gómez, 2018) and (Valencia, Serna, & Ochoa, 2016) have examined in different contexts the relationship of technological competences and investigative competences in the teaching-learning processes and they state that they present difficulties to constitute both competences. Interactions between digital resources and students' abilities to research are scarce, so the research training process has not been strengthened by using information and communication techniques, which makes this problem an area of opportunities.

In the humanist approach based on the capacities of people, a different line of understanding is glimpsed, as there is development and transformation in history, given by the capacity and for this it is possible to appeal to the proposal of the philosopher (Nussbaum, 2012) that places the person and their freedoms in a central role to choose the course in search of a better quality of life and found an educational perspective in favor of human development as a minimum condition of social justice. While competent is called someone who is prepared to resolve or develop any issue, the bottom line in this approach is the ability. If the subject of the competences is the student, the subject of the capabilities is the person (Silva & Mazuera, 2020).

The development of investigative competences is a key factor when assimilating the knowledge that is a priority within the beginning of the investigation, where adaptation helps to modify the knowledge that the student has captured throughout his student life. Thus, the development of investigative competencies provides a stimulus of great value to students by using observation and knowledge to shape the acquisition of knowledge and learning (Bravo, Loor, & Saldarriaga, 2017).

Investigative competences is the practice of the integration of knowledge, where cognitive knowledge is called conceptual content, knowing how to do is the form of skills development, knowledge encompasses attitudinal content so that the researcher can put it into context the information collected and what has been learned (Moreira, Cano, & Moreira, 2021).

Figure 1 presents the fundamental learning in education related to pedagogical competences.
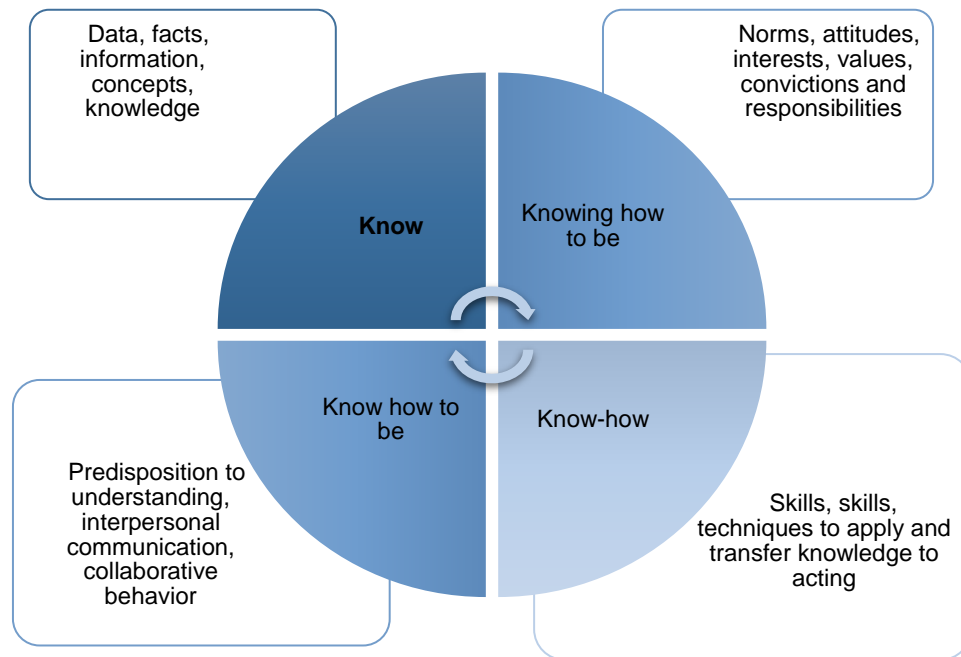
Figure 1.

Pedagogical competences
Source*:* (Loreto, 2018); (Cardazo, 2011); (Hamodi, López, & López, 2015).

The knowledge in the student allows him to be able to argue processes of human development, where the basic task of the teacher must be focused to use effective methodologies and strategies that accompany the pedagogical processes and stimulate students to get involved in their learning process as active subjects and thus help them to go beyond the acquired knowledge. Go from the simple memorization of content and the mechanical application of algorithms to the assignment of meanings and construction of knowledge, establishing strategies for them to reflect on their ways of learning (Silva, 2020).

Know-how approves the student to identify their mistakes and appropriate them to perfect them and move towards the construction of their own suitability and development of their skills (García, Fonsca, & Concha, 2015). The three didactic units that make up the instructions seek for the student to keep abreast of how to act with respect to the activities that are going to be carried out, based on a planning that allows them to comply with a good execution, monitoring and evaluation of the academic exercise that It will be developed, where strategies are implemented that allow them a better action and performance in the purposes that have been proposed for the

development of the educational process (Mora, 2003).

Knowing how to be is an integral part of existential competences, where you have to be open to new experiences with belonging to ethical and moral values, be willing to listen to the opinion of others and generate your own reflection (Hérnandez & Contreras, 2013).

Knowing how to be or coexist helps to find solutions in a group way in a work group, in this way it will be possible to make decisions, reach agreements and establish objectives for the benefit of a group (Correa & Ferreira, 2005). Coexistence is the construction of a democratic society that is assumed as the discursive framework of educational reform, in educational institutions and in the role of teachers (Jares, 2002).

There are types of competencies that are expressed as a set that are intended to strengthen professional practice, to put certain knowledge into practice (Schmal, 2015). Likewise, it is possible to distinguish the basic or generic-professional competences, also known as specialized and participatory that fulfill a transversal function in the profession.

Table 1 shows the classification of research competencies that contribute to the development

of teachers' skills in their performance as a researcher.

Table 1.

Classification of competencies

Basic Integrated application of knowledge, skills, and abilities	Methodological Knowledge, abilities, and skills to use steps; procedures based on the scientific method for:	Professionals Knowledge, abilities, and skills of teaching action for:
• Diagnosis and interpretation of the socio-educational reality. • Domain of scientific knowledge. • Identification of the causes and consequences of problems. • Observation, analysis and interpretation skills. • Drafting of study objectives. • Selection of bibliographic sources. • Management of theories, grounded and epistemic models.	• Management of research paradigms. • Use of research methods. • Application of the designs and types of research according to their nature. • Selection of qualitative and quantitative samples. • Management of research techniques and instruments I • Use of validity and reliability.	• Predictive and solution capacity • Use of innovation • Use of creativity • Acting as a subject and agent of change • Creation and deepening of knowledge committed deontologically and axiologically. • Assign responsibilities within the framework of human values • Execution of activities.

Source. Own elaboration

Basic Competences

The inclusion in the educational framework of the basic competences that present a common thread for the transfer of learning in personal and social development, this idea was raised by (Moreno, Ruiz, & Vera, 2015), taking into account Considering this idea, it can be said that the basic competences provide the fundamental axis of learning that moves from the personal to the social, to forge good personal results and carry the investigation successfully.

The basic competences are the intellectual capacities essential for teaching an investigative work. In them are the cognitive, technical, and methodological competences, many of which are acquired in previous educational levels (Galdeano & Valiente, 2010). It reflects the ability that the teacher can use to put thought and values into practice in a way that facilitates the proper preparation of tasks in the educational field.

Methodological competences

The competences according to (Briede & Pēk, 2014), indicate that this type of competence manifests a holistic approach towards the potential of an individual. Therefore, the goal includes competencies that allow the expansion of the aptitudes of other individuals, professional,

social, basic and individual. This competence represents a specific knowledge that the student develops based on personal experience, which are those that indicate elements to apply processes, steps to follow, methods, techniques that lead to a result if it is followed correctly.

Professional

competences Professional competence is characterized by the mastery of skills related to attitude, values, innovation, and creativity (Kaiser, Hot, König, & Blömeke, 2015). These are acquired from the general knowledge that is acquired through professional improvement studies, which potentially help to strengthen professional practice and better performance in the research process.

This competence starts from the complexity of three elements, knowledge, capacities and attitudes (Duque, García, & Hurtado, 2017). Likewise, the professionals represent the human and professional potential that contributes with theoretical contributions, as a result of investigative works presented to the scientific community and similar groups, also promotes disclosure, innovation, the generation of findings through objectivity and scientific rigor.

Conclusions

The investigative competence is the congregation of knowledge such as knowledge, skills, values, and attitudes for the solution of context problems, through the application of the scientific research process with a qualitative, quantitative, or multi-methods approach, tools and means with an interdisciplinary perspective.

Due to the complexity of the investigative competence, the training of the researcher requires skills such as teamwork, mastery of information and communication technologies, critical thinking, communication, disciplinary knowledge inherent to the object of study.

Without adequate development of investigative competence, the creation of new knowledge is impossible. Hence its importance for the constant improvement of teachers and the enrichment of teaching activity by students and its link with society as a substantive contribution of educational activity in the context of socioeconomic development.

References

Arakaki, M. (2009). Formative research and undergraduate research training. *Rev Med Hered, 20*(3), 119-121. http://www.scielo.org.pe/pdf/rmh/v20n3/v20n3e1.pdf

Briede, B., & Pēks, L. (2014). A constructivist approach in teaching in higher education for getting methodological and reflection competences. *In the Proceedings of the International Scientific Conference Rural Environment Education Personality (REEP), 7*, 84-89.

Campos Cruz, H., & Ramírez Sánchez, M.Y. (2018). ICT in the educational processes of a Public Research Center. *Apertura (Guadalajara, Jal.), 10*(1), 56-70. http://www.udgvirtual.udg.mx/apertura/index.php/apertura/article/view/1160

Correa, G., & Ferreira, G. (2005). School coexistence in the classrooms. *International Journal of Developmental and Educational Psychology, 2*(1), 163-183. https://www.redalyc.org/pdf/3498/349832309012.pdf

Estrada, O. (2014). Theoretical systematization on investigative competence. *Educare Electronic Magazine, 18*(2), 177-194. https://doi.org/10.15359/ree.18-2.9

Gómez, J. (2018). Investigative competences for the development of skills in the teacher. *Publishing Magazine, 1*(15), 465-480.

Hamodi, C., López, V., & López, A. (2015). Means, techniques and instruments of formative and shared evaluation of learning in higher education. *Educational Profiles, 37*(147).

Hérnandez, F., & Contreras, J. (2013). Being and knowing in Secondary Education. *Notebooks of Pedagogy* (430), 78-80. https://dialnet.unirioja.es/servlet/articulo?codigo=4105700

Jares, R. (2002). To learn to live together. *Interuniversity Journal of Teacher Training,* (44), 79-92. https://www.redalyc.org/pdf/274/27404405.pdf

Kaiser, G., Hot, J., König, J., & Blömeke, S. (2015). About the Complexities of Video-Based Assessments: Theoretical and Methodological Approaches to Overcoming Shortcomings of Research on Teachers' Competence. *International Journal of Science and Mathematics Education, 13*, 369-387. https://link.springer.com/article/10.1007/s10763-015-9616-7

Lodoño, P. (2011). Development of investigative competence from the research hotbeds. *General Scientific Journal José María Córdova, 9*, 187-207. https://www.redalyc.org/pdf/4762/476248850008.pdf

Moreira, L., Cano, E., & Moreira, J. (2021). Training based on research competencies in undergraduate students in Latin America. *Scientific Journal FIPCAEC, 6*(1), 665-684. https://doi.org/10.23857/fipcaec.v6i1.362

Moreno, J., Ruiz, M., & Vera, J. (2015). Prediction of autonomy support, psychological mediators and motivation. *Revista de Psicodidactica, 20*(2), 359-376. https://www.redalyc.org/pdf/175/17541412009.pdf

Morillo, JP (2015). Components and dimensions of formative research in information sciences. *Enl @ ce, 12*(3), 48-70. https://produccioncientificaluz.org/index.php/enlace/article/view/20627

Rojas, C., & Aquirre, S. (2015). Research training in higher education in Latin America and the Caribbean: an approach to its state of the art. *Eleuthera,* (12), 197-222. https://doi.org/10.17151/eleu.2015.12.11

Schmal, R. (2015). Evolution of a Training Program in Generic Competences. *University education, 8*(6), 95-106. https://doi.org/10.4067/S0718-50062015000600012

Valencia, T., Serna, A., & Ochoa, S. (2016). *ICT competencies and standards from the pedagogical dimension: a perspective from the levels of appropriation of ICT in the educational practice of the teacher* (1st ed.). Cali, Colombia: Pontificia Universidad Javeriana. http://www.unesco.org/new/fileadmin/MULTIMEDIA/FIELD/Santiago/pdf/Competencias-estandares-TIC.pdf

Velázquez, M. Del R.H., Báez, A.A.L., Pérez, A.M., & Luna, A.A. (2021). Educational innovation in the comprehensive training of nursing graduates. *International Journal of Health Sciences, 5*(1), 20-28.

Savinova, N., Berehova, M., Yanchytska, K., Stelmah, N., Biliuk, O., & Kasatkina-Kubyshkina, O. (2021). ICT role during COVID-19 pandemic in lifelong learning for disabilities. *International Journal of Health Sciences, 5*(3), 594-604.

Mora, D. (2003). Strategies for learning and teaching mathematics. *Revista de Pedagogía, 24*(70), 181-272. http://ve.scielo.org/scielo.php?script=sci_arttext&pid=S0798-97922003000200002

Pirela, L., & Prieto, L. (2006). Teacher competencies profile in the role of researcher and its relationship with intellectual production. *Option, 22*(50). http://ve.scielo.org/scielo.php?script=sci_arttext&pid=S1012-15872006000200009

Galdeano, C., & Valiente, A. (2010). Professional skills. *Chemical Education, 21*(1), 28-32. http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S0187-893X2010000100004

Cardazo, J. (2011). Collaborative learning as a strategy for knowledge construction processes. *Journal of Education and Development, 4*(2), 87-103.

Valdés, A., Vera, J, & Estévez, E. (2012). Variables associated with the development of scientific competence in graduate students in Sonora. *Human Development and Social Welfare,* (63)40-46. https://reencuentro.xoc.uam.mx/index.php/reencuentro/article/view/797

Rodriguez, D., & García, R. (2013). Elements of Analysis and Design for Virtual Spaces for the Training of Researchers. *Latin American Journal of Software Engineering, 1*(2), 45-56. https://doi.org/10.18294/relais.2013.45-56

Skryabin, M., Zhang, J., & Zhang, D. (2015). How the ICT development level and usage influence student achievement in reading, mathematics, and science. *Computers & Education, 85*, 49-58. https: //doi.org/10.1016/j.compedu.2015.02.004

García, F., Fonsca, G., & Concha, L. (2015). Learning and academic performance in higher education: A comparative study. *Electronic Magazine "Investigative News in Education", 15*(3), 1-26. https://www.redalyc.org/pdf/447/44741347019.pdf

Bravo, G., Loor, M., & Saldarriaga, P. (March 2017). The psychological bases for the development of autonomous learning. *Science Domains, 3*(EXTRA 1), 32-45.

Duque, J., García, M., & Hurtado, A. (2017). Influence of emotional intelligence on job competencies: an empirical study with administrative level employees. *Management Studies, 33*(144), 250-260. https://doi.org/10.1016/j.estger.2017.06.005

Torrico, B.C. (2018). Scientific methodology for conducting market research and quantitative social research. *Perspectives Magazine 21*(42), 123-160. http://www.scielo.org.bo/scielo.php?script=sci_arttext&pid=S1994-37332018000200006&lng=es&nrm=iso

Loreto, M. (2018). Education as a discipline and as an object of study: contributions for a debate. *From the South, 20*(1), 201-211.

Núñez, N. (2019). Teaching of investigative competence: perceptions and evidence of university students. *Spaces magazine, 40*(41), 26-46. https://www.researchgate.net/profile/Nemecio-Nunez-Rojas/publication/337829587_Ensenanza_de_la_competencia_investigativa_percepciones_y_evidencias_de_los_estudiantes_universitarios_Teaching_ofusste_research_university_M

Silva, W., & Mazuera, J. (2020). Competencies approach or capabilities approach at school? *Electronic journal of educational research, 21.* https://doi.org/10.24320/redie.2019.21.e17.1981

Silva. (2020). *The three knowledges - Know, know how to be and know how to do and know how to do.* Obtained from the three knowledges - Know, know how to be and know how and know how to do: https://yoamoenfermeriablog.com/2020/04/20/saber-saber-ser-y-saber-hacer/

Barrios, V. (2021). New recommendations of the PRISMA 2020 version for systematic reviews and meta-analyzes. *Acta Neurológica Colombiana, 37*(2). https://doi.org/10.22379/24224022373

Valenzuela, M., Valenzela, A., & Reynoso, O. (2021). Research skills in graduate students in Education. *Contemporary dilemmas: education, politics and values, 8*. https: //doi.org/10.46377/dilemas.v8i.2766

Vuorikari, R. (2016). DigComp 2.0: the digital competence framework for citizens. Update phase 1: the conceptual reference model. *Publications Office of the European Union.* https://publications.jrc.ec.europa.eu/repository/handle/JRC101254