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Technology-Driven Self-Directed Learning of Graduate Pharmaceutists: Adding Value through Entrepreneurship

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Abstract. The *purpose* of this study was to identify what effect the entrepreneurship technology-driven environment has on the self-directed learning skills of graduate pharmaceutists. This was quasi-experimental research using quantitative and qualitative instruments to collect and process data. The graduate students majoring in Pharmacy were sampled to form the experimental and control groups. The self-directed learning skills scale, the integrated achievement test, and a retained knowledge test in Chemistry, the entrepreneurial potential self-assessment questionnaire, the questionnaire on computer literacy, and a semi-structured interview were the measurement instruments for the study. The IBM SPSS Statistics software and effect size calculator for *t-test* were used to process statistical data yielded from measurements. The results suggested that a technology-mediated learning environment combining the professionalism-related online course with an online collaboration-based entrepreneurship project fosters self-directed learning skills bringing substantial educational and professional benefits like developed entrepreneurial skills, computer skills, and better academic performance to the students majoring in Pharmacy. Measurements results of the variables showed that the participants of the experimental group who received project-based online training in entrepreneurship showed ≈20% improvement in self-directed learning skills, entrepreneurial potential, computer literacy, and academic achievements. The intervention model was also perceived positively by the participants. It is recommended that the teachers were trained in Marketing before the delivery of the course.

Keywords: entrepreneurship; higher medical education; Masters in Pharmacy; self-directed learning skills; technology-mediated learning environment

1. Introduction

Fostering self-directed learning skills in students has become a dominant academic goal in the curriculum at tertiary medical institutions in Ukraine (Meretskyi, 2015; Maslak et al, 2017; Prokopenko & Titunova, 2019; Bobrytska, 2019). This complies with the trend of moving from the teacher-driven to the learner-centred learning that is aimed at involving the students in the process of creating their knowledge (Ramstedt et al., 2016). The process of training of those skills of self-directed learning in the settings of the Chemistry course is strengthened with the use of several pedagogical concepts such as of problem-based learning (PBL), context-based learning and the technology-mediated learning (Bobrytska & Protska, 2019; Burlaka & Fadi, 2016; Lezhenko et al., 2018; Magwilang, 2016; Ramstedt et al., 2016; Solohub, 2019). Due to the bond of the above concepts, the graduates in Pharmacy are expected to succeed in the entrepreneurship-driven and digitalisation-driven environment in both academic and job settings (Holovchenko, 2020). Moreover, Wang & Huang (2019) proved that the entrepreneurial environment purposefully created at the institution provides a positive effect on the students' self-efficacy and self-assessment which are also the components of self-directed learning.

Thought indirectly declared in the "Standard of higher education of Ukraine" (specialty ref. 226 "Pharmacy") (2016) only in the general context like 'the autonomous search, analysis, and synthesis of information from various sources to solve typical problems of professional activity', self-directed learning skills are omitted in the context of entrepreneurial and computer competencies that are also included as basic ones in that document (Alieksieieva, 2018). As a result, those skills are underrepresented in the curriculum of medical institutions in Ukraine including Bogomolets National Medical University, State educational institution of Ukraine "Bukovynsky State Medical University", Vinnytsia National Pirogov Medical University and V. N. Karazin Kharkiv National University that were reviewed in this study. Additionally, the Socratic method (Roth, 2016) used to deliver Chemistry and the students' feelings of being professionally disadvantaged in the future cause criticisms and the negative perception of the students to Chemistry. This brought up the idea to 'reload' the pedagogical model of the Chemistry course delivery paying emphasis on the entrepreneurial dimension of self-directed learning.

Literature review

The literature review found that training self-directed learning skills in the students majoring in Pharmacy from the entrepreneurial perspective using technology is still beyond the research scope. However, there are some studies revealing Chemistry teaching from the perspective of applying the context-based approach (Magwilang, 2016; Çiğdemoğlu, 2012) and problem-based or project-based learning (Seery & McDonnell, 2019). Learning in context is proved to increase students' motivation better compared to the conventional teaching approaches as it adds meaning to the students' learning. Majid and Rohaeti (2018) showed that students who are trained in Chemistry using the context-based approach have a better understanding of Chemistry concepts than those who are taught using conventional methods of teaching. Seen as 'side effects', self-directed

learning skills, and positive attitudes towards Chemistry also develop (Kock et al., 2016).

Learning through solving problems or doing projects facilitates students to explore the 'real world' through either cooperation or individually (Purichia, 2015; Cervantes, Hemmer & Kouzekanani, 2015). Purichia (2015) associates this type of learning with the cross-disciplinary integrated learning integrating 'attitudes, knowledge, and skills into a coherent whole' forming a new phenomenon. This training approach provides the students with the experience related to self-planning, self-implementation, and self-evaluation of the education process. This experience leads to profound and long-lasting changes in the students' learning styles after the project is completed.

This study review also found that the above approaches agree with the principles of the Sustainable Learning and Education (SLE) philosophy (Hays & Reinders, 2020) that suggests integrating a 'sustainable environment, sustainable society, and sustainable economy' through the use of technology-mediated learning environment. The prerequisite for the SLE is a high degree of the individuals' computer literacy. They also comply with the concept of 21st Century Skills (2016) (Haryono & Subkhan & Putra, 2017) introducing new trends like fostering entrepreneurship skills and lifelong (self-directed) learning skills in the students. They are related to the seamless learning concept (Durak & Çankaya, 2019) in terms of 'making learning more authentic', 'making it more tailored', and providing an environment for 'learning via collaboration'.

Accordingly, the purpose of this study was to identify what effect the entrepreneurship technology-driven environment has on the self-directed learning skills of graduate pharmaceutists. The research questions were as follows: 1) how the originally developed technology-mediated learning environment influenced self-directed learning skills from the entrepreneurial, computer literacy and academic achievement perspectives when teaching Chemistry courses to Masters in Pharmacy; 2) what views, beliefs and experiences the interviewed students associated with the educational intervention model designed for the study.

2. Methods and materials

This was a mixed methods-based study of the convergent design relying on quantitative and qualitative data (Creswell, 2014). The data were collected throughout two interventions such as the experiment and the interview. The quantitative data were collected repeatedly before, while, and after the educational intervention. The qualitative data from the interview were collected concurrently to the final stage of the experiment. The variables for the study were students' self-directed learning skills originating from their entrepreneurial potential (comprised entrepreneurial motivation, aptitudes, and attitudes), computer literacy of medical students, and academic achievements in Chemistry courses. The interviewed students' perceptions of the course delivery approach and experiences were studied through the semi-structured interview to increase the validity of the research results.

Research design

The study lasted 2 years, from September 2017 to the end of May 2019. The pre-test–post-test quasi-experimental design was employed to monitor changes in the above variables. Students seeking a Master's Degree in "Pharmacy" and "Technology of perfumes and cosmetics production" of Bogomolets National Medical University were chosen to be the experimental population for the study. The reason being was that according to Classifier of Economic Activities (2020), those graduates are mostly employed for the commercial activities like medical and healthcare products distribution (retail and wholesale sales, B2B), management of chemist's shops, testing and licensing of newly developed pharmaceutical drugs and cosmetics products.

The technology-mediated learning environment relied on the NEURON information system that was integrated into the MOODLE LMS. It was used to train students in "Analytical Chemistry" through doing self-study labs. Additionally, the experimental group students collaborated on the web to design a purchase funnel serving a pipeline for several medical and healthcare products at the request of Ametrin FK Co., Ltd, Ukraine. The projects were of information-sharing purposes and used social media (copywriting, blogging, streaming, advertising), YouTube, the software for the photo and video content design and development, the platforms for online written consulting, and the Mom's online school.

The tutor with both medical and marketing backgrounds supervised the students, provided feedback and assessment of their projects. The representative of Ametrin FK Co., Ltd, Ukraine were involved in the assessment as well.

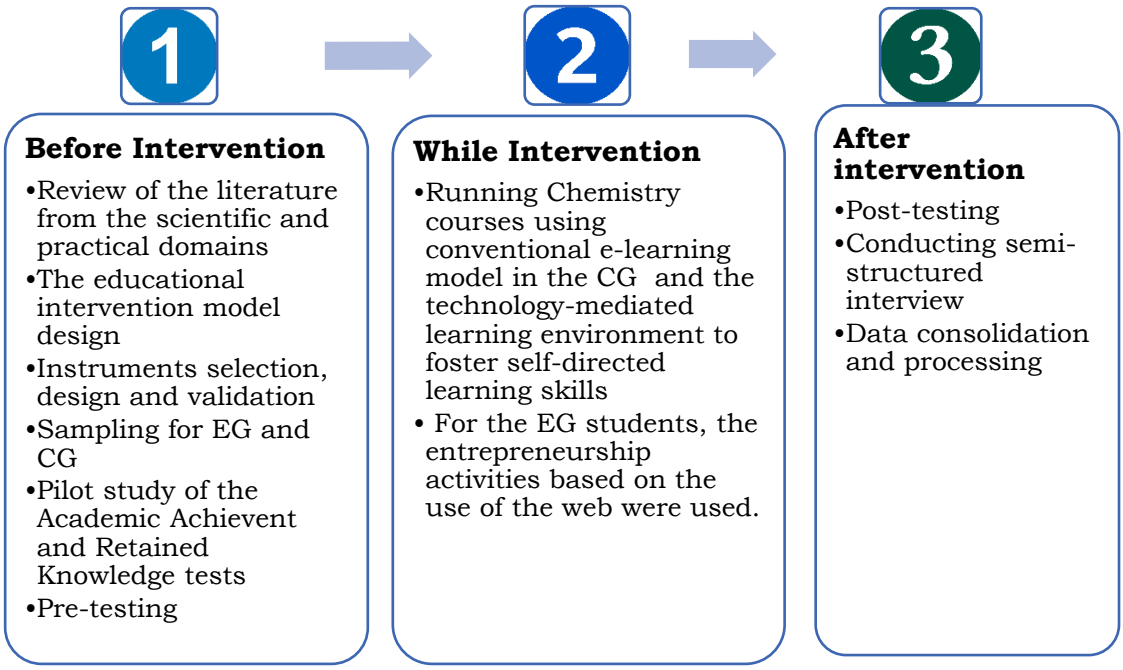


Figure 1: The abstract research flow.

Outline of the Intervention Model

This was the originally developed technology-mediated learning environment integrating two occupational domains. These were: students' knowledge and skills in Analytical Chemistry and their entrepreneurship skills and knowledge that were used as a means of training students' self-directed learning skills.

Analytical Chemistry is a core curriculum course for Master's Degree students. It is a 6.0-credit (ECTS) course including three modules. These are: "Qualitative analysis", "Quantitative analysis" and "Instrumental methods of analysis". The content delivery relies on theoretical and practical domains of the discipline. The distribution of hours is as follows: 30 hours are dedicated to the theory, and 140 hours are supposed to be spent on self-study laboratory work. It consolidated the students' knowledge and skills in previously studied courses in "Instrumental methods of analysis", "Fundamentals of chromatographic analysis", "Organic chemistry", "Inorganic chemistry", "Physical chemistry", special courses on concentration and separation of micro components, and spectroscopic methods of analysis.

Both groups received training in entrepreneurship.

The course for the CG was delivered conventionally, through Moodle. It was a 1-credit course (30 hours) covering such topics as: "Basics of using social media to form public opinion about certain medical and healthcare products", "Methods of promotion and advertising of medical goods", "Creation and design of the sales videos and written content".

The course for the EG was delivered as a practical online training based on a specific order. It also lasted 30 hours and covered the same topics as mentioned above. Compared to the CG, the delivery was shaped as if it was on-the-job training with some required high standard outcome.

Sampling

The population for the study was 154 participated in the educational intervention. Sixty-three of them were randomly hired from Vinnytsia National Pirogov Medical University and V. N. Karazin Kharkiv National University for the piloting of the achievement and retained knowledge tests. The rest of the students ($n = 91$) were sampled from Bogomolets National Medical University to form the experimental (EG, $n = 46$) and control (CG, $n = 45$) groups for the experiment. The results of the pre-intervention homogeneity test based on the *t-test* and Fisher's exact test are presented in Table 1.

Table 1: The results of the pre-intervention homogeneity test based on the *t-test* and Fisher's exact test

Test	Variable		n	EG, $n = 46$ n (%) or $M \pm SD$	CG, $n = 45$ n (%) or $M \pm SD$	χ^2 or t	p *value*
t-test	Age	Males	32 (35.16%)	22.58 ± 1.45	22.45 ± 1.49	–0.08	0.627
		Females	59 (64.84%)	22.18 ± 1.39	22.32 ± 1.51		
	SDLS			71.14	73.09	–0.157	0.762
	EP			23.91	27.21	2.617	0.899
	CL			41.63	46.25	1.378	0.693
FET	AP	Sufficient		7 (15.21%)	5 (11.11%)	0.62	0.789
		Good		32 (69.56%)	34 (75.55%)		
		Excellent		7 (15.23%)	6 (13.34%)		

Note: FET – Fisher's Exact Test; AP – Academic Performance; SDLS – self-directed learning skills; EP – entrepreneurial potential; CL – computer literacy.

The scores for the groups were approximately the same for all variables which showed that the groups could be considered homogeneous.

Instruments

The *t-test* and Fisher's exact tests were used as the pre-intervention test of homogeneity of the EG and CG.

Quantitative and qualitative research tools were utilised in the study to monitor the variables. Those tools were as follows: the self-directed learning skills scale (Aşkin, 2015), the integrated achievement test, and a retained knowledge test in Chemistry, the entrepreneurial potential self-assessment questionnaire (n.d.), the questionnaire on computer literacy, and a semi-structured interview.

The Integrated Achievement Test in Analytical Chemistry (IAT AC) was administered in both groups to monitor the educational value of the course. A Retained Knowledge Test (RKT) was used as a follow-up measurement of how occupationally-friendly was the educational intervention model. Both drafts of the tests comprised 90 items supposing that the students should take one minute per question to answer. The questions complied with the curriculum learning outcomes. Three experts – 1 expert with a Doctorate degree in Chemistry, 1 expert with a Ph.D. in statistics and 1 expert in Languages with a Ph.D. degree – were involved in the procedure of examining the content (face) validity, difficulty level appropriateness (construct validity), and criterion validity of both tests. Both tests were piloted in Vinnytsia National Pirogov Medical University and V. N. Karazin Kharkiv National University. The pilot study population involved 63 Master's students who were encoded as S_1, S_2, S_n, etc. When obtained, reliability studies were performed using the Kaiser-Meyer-Olkin Test (KMO), Distinguishing Power Index of the Items (r), Item Difficulty Index (p), and the Kuder-Richardson 20 (KR-

20). The SPSS Statistics software was used to process the above data. The value obtained for the KMO test was 0.83 which is good according to Glen (2016). The mean value for p of the item difficulty was 0.516. It was interpreted as "Medium (moderately) difficulty" (Thompson, 2017). The $r - value$ was 0.371 which was interpreted as "good difficulty level" considering that if the $r = 0.40$ or higher it means "Very Good" if $r = 0.30\ to\ 0.39$ is "Good" if $r = 0{,}20\ to\ 0{,}29$ is "It must be corrected", and if $r = 0\ to\ 0{,}19$ means "It must be excluded" (Thompson, 2017).

The internal consistency reliability of the tests was measured using the Kuder-Richardson 20 method (Allen, 2017). The value of 0,881 was obtained as a result of the measurement, which showed the developed tests were reliable.

An entrepreneurial potential self-assessment questionnaire (n.d.) was used to monitor the entrepreneurial potential of the sampled students. The inter-rater reliability measurement of the questionnaire was based on judgements of three experts with a background in sociology and psychology. The Krippendorff's α was applied to measure their agreement on every item of the questionnaire. The coefficient was 0.8432 (St.Err.=0.1891; Confidence Interval=95%) which showed good reliability (Krippendorff, 2011).

The originally developed questionnaire on computer literacy was self-administered by Masters in Pharmacy (see Appendix 1). Its structure was partially borrowed from Taher and Ahmed (2014) and comprised four sections: 1) computer skills; 2) application of computer skills; 3) perception of the educational use of computers, and 4) the use of the Internet in medical education. The questionnaire included 20 questions. The first five of them covered elementary computer skills like document processing, making videos or presentation slides, web navigation skills, etc. The next five questions assessed the skills related to the use of such learning management systems (LMSs) as NEURON and MOODLE. Five more questions addressed the skills of using software and information systems of the pharmaceutical enterprise, skills of using electronic communication and electronic marketing (e-marketing) of pharmaceutical products and skills of performing statistical analysis of pharmaceutical and medical data of the company. The final five questions were intended to explore the attitudes of the students towards the use of technology-mediated learning compared to conventional learning in Chemistry courses. The criterion validity, construct validity, and face validity of the questionnaire was proved by three experts in the field of statistics. The students' responses were coded and analysed using IBM SPSS Statistics software. The differences between groups were analysed using Chi-square for qualitative data and the Kruskal-Wallis H test for quantitative data. The quantitative data were considered to be statistically significant if $p > 0.05$.

The semi-structured interview was conducted as recommended by Adams (2015). The respondents for the interview were randomly selected from the EG students. To avoid the biasing effect, the interviewers were hired from the members of the Alumni Association and were instructed beforehand. The interviewees were informed about the purpose of the interview. The anonymity was guaranteed. The interviews were recorded and transcribed. The answers were categorised under

the topics. The coding procedure was performed. The consolidated data was analysed using IBM SPSS Statistics software. The probability value of ≤ 0.05 was considered significant.

1. What was your overall impression of the Chemistry course design and delivery? Explain your reasoning.

2. What learning experiences encouraged you to succeed in the course? Why?

3. What challenged you when doing the course? Explain your reasoning.

4. How did you cope with those challenges? What efforts did you find effective?

5. What would you advise to the instructors to do so that the course brought more benefits to the students? Would your suggestions bring a significant improvement or slight improvement?

Free online statistical tools like *t-test* calculator (n.d.) and effect size calculator for *t-test* (n.d.) were used to process statistical data yielded from measurements.

3. Results

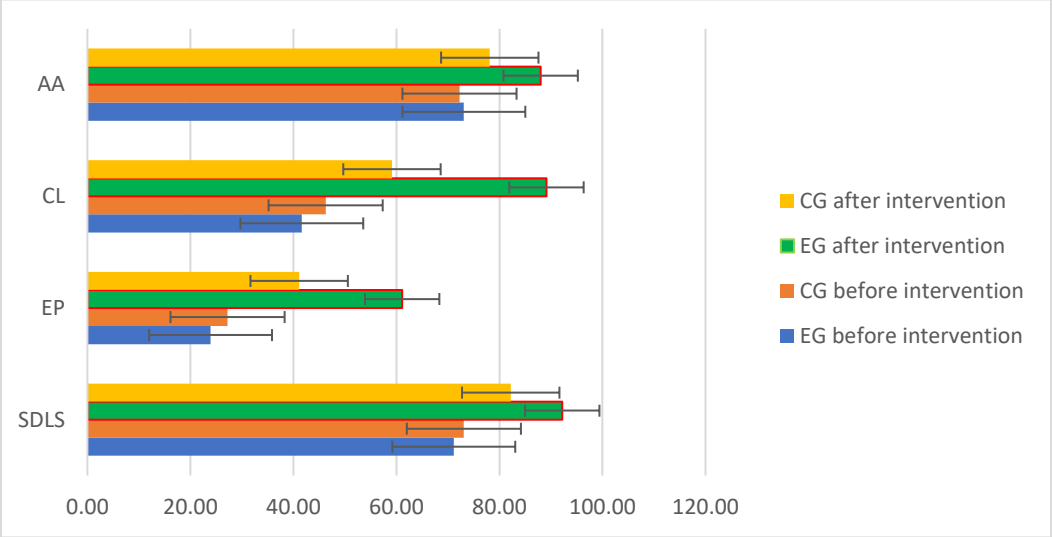
Overall, the originally developed technology-mediated learning environment bought a more profound effect on the self-directed learning skills of the EG students than on the CG students' seen from the entrepreneurial, computer literacy, and academic achievement perspectives when teaching chemistry courses to Masters in Pharmacy.

The pre-test–post-test measurements of students' self-directed learning skills, entrepreneurial potential, computer literacy, and academic achievements in Chemistry courses obtained through two tests (IAT AC and RKT) are presented in Table 2.

Table 2: The mean results of pre-test–post-test measurements of the variables

Group	Pre-test		Post-test		$t-value$	$p-value$
	Mean	SS	Mean	SS		
EG	52.44	1706.93	82.61	625.59	–2.16362	.036854
CG	54.70	1472.95	65.14	1072.74	–0.71678.	.250222

As can be seen in Table 2, forty-six participants of the EG who received project-based online training in entrepreneurship showed significant improvement – by approximately 20%, the result is significant at $p < .05$ – in self-directed learning skills, entrepreneurial potential, computer literacy, and academic achievements compared to the results of forty-five students of the CG that appeared to be not significant at $p < .05$.



Note: SDLS **–** self-directed learning skills; EP – entrepreneurial potential; CL – computer literacy; AA – academic achievements.

Figure 2: The distribution of mean and SD values for the variables obtained from pre-test–post-test measurements

The results in Figure 2 that supplies additional data to Table 2 suggest that the values for self-directed learning skills increased in both groups but they were greater by 10 points in the EG. There was a marked increase in the figures for the entrepreneurial potential and computer literacy – by 21% in the students of the EG, compared to 13% in the CG students.

The calculation of the effect size (n./d.) also proved that the intervention model had a statistically significant effect on the variables in the EG.

$$Cohen's\ d\ =\ (65.14 - 82.61)\ /\ 1.649719\ =\ 10.589683$$

$$Glass's\ delta\ =\ (65.14 - 82.61)\ /\ 1.876\ =\ 9.312367$$

$$Hedges'\ g\ =\ (65.14 - 82.61)\ /\ 1.652434\ =\ 10.572286$$

The results of the semi-structured interview, ($n = 23$)

Question 1. Seventeen respondents were generally positive about the educational intervention. Their reasons for their approval were as follows: 1) the course was much more engaging than the other ones; 2) the theory was delivered through practical assignments usually performed in teams. 3) it helped to improve computer, search (learning strategies), analytical, and persuasion skills. Three students were neutral in their judgements reporting that the content was useful and the format was challenging. Two students expressed negative feelings related to the increased workload they had when participating in the projects and they felt exhausting.

Question 2. Twenty students found that they could self-plan, self-manage, and self-reflect their learning activity. Three respondents additionally mentioned the professionalism-related knowledge and skills that were gained through the on-

the-job training. The students reported that they had more responsibility for the results and quality of their work.

Question 3. Fifteen students mentioned that the felt challenged by the quality requirements of the content when designing a purchase funnel. The respondents confessed that combining knowledge in Chemistry with marketing was quite a problem for them. Five students informed that their computer skills were insufficient for doing assignments in both labs on the NEURON and the entrepreneurship-purpose projects. Three respondents faced problems with procrastination. Concerning the reasons, the common one was the inability to work under pressure.

Question 4. All the students used checklists to comply with the quality requirements of the content. To deal with combining Chemistry with marketing, the students attended additional online courses in SMM, copywriting, and self-studied related software, literature, and best practices. All participants used *My Study Life App* to schedule their work. All the above students considered effective.

Question 5. Five students suggested that incorporating business incubator practice into the curriculum would be helpful and promising. Eleven students advised using the practice of creating international cross-functional teams. They were confident that those teams could serve as a kind of benchmarking tool for them to adjust to. Seven students suggested changing curriculum shifting focus from conventional theory-driven learning to 21st-century learning that is based on self-directed learning through technology and entrepreneurship skills.

The results of the above interview increased the reliability of this study that proved that the educational intervention improved students' self-directed learning skills, specifically those related to entrepreneurship, and enriched their learning experiences that are of their occupational appropriateness.

Limitations

The use of the only online format to influence self-directed learning skills, the number of sampled students, and institutions involved in the experiment can be considered limitations to the study.

4. Discussion

The novelty of the study lies in combining context-based and project-based learning of the graduate pharmaceutists, and pedagogical tools to implement the entrepreneurship technology-driven environment which boosts the existing research in teaching Chemistry to tertiary students of Çiğdemoğlu (2012), Magwilang (2016), and Seery and McDonnell (2019).

The study aimed at defining how the originally developed technology-mediated learning environment influenced self-directed learning skills. The entrepreneurial, computer literacy, and academic achievement perspectives were focused on when teaching Chemistry courses to Masters in Pharmacy. The students' views, beliefs, and experiences the interviewed students associated with the educational intervention model designed for the study were also studied. It

was found that the participants of the EG who received project-based online training in entrepreneurship showed significant improvement – by approximately 20%, the result is significant at $p < .05$ – in self-directed learning skills, entrepreneurial potential, computer literacy, and academic achievements compared to the results of forty-five students of the CG that appeared to be not significant at $p < .05$. These findings were then supported by the students participating in the interview. They proved that they could self-plan, self-manage, and self-reflect their learning activity better, they gained professionalism-related knowledge and skills and had more responsibility for the results and quality of their work. The values for self-directed learning skills increased in both groups but they were greater by 10 points in the EG. There was a marked increase in the figures for the entrepreneurial potential and computer literacy – by 21% in the students of the EG, compared to 13% in the CG students. The effect size was also statistically significant.

The interview was of the confirmatory purpose. It was chosen because the interviews are appropriate for exploring people's perceptions and experiences (Adams, 2015), to reconstruct the students' thought processes while dealing with the assignments. The use of the open-ended questions was intended to identify the most common views, beliefs, and experiences that could be categorised under certain themes and rated. Following that, students' responses in the interview were used to determine whether they perceived the educational intervention positively or negatively and whether they perceived the model to be appropriate for their future occupation. Overall, the interview results showed that the EG students found the Chemistry course much more engaging and practical in terms of computer, search (learning strategies), analytical, and persuasion skills. It meets the students' demand for incorporating business incubator practice into the university curriculum.

The study complies with the previous research. It agrees with the theory of enterprise education (Turner & Mulholland, 2018) advocating embedding enterprise education in university and college programmes. It goes in line with the conclusions of Maloney *et. al.* (2013), Sirkemaa and Varpelaide (2018) and Gune, More and Supriya (2018) stating that the online resources should be time-efficient for both students and instructors, engaging, linked to the students' professional context and stimulate discussion among the students. The results of the study are also consistent with the views of Toit (2019) claiming that the challenging environment accelerates the process of fostering self-directed learning skills that is related to students' previous learning experience, their learning styles, and their positive attitude towards challenges.

Since fostering self-directed learning skills in the students majoring in Pharmacy from the entrepreneurial perspective using technology is still beyond the research scope, this study might be considered a noteworthy contribution.

5. Conclusion

The results of the study suggest a technology-mediated learning environment combining the professionalism-related online course with an online collaboration-based entrepreneurship project foster self-directed learning skills bringing

substantial educational and professional benefits like developed entrepreneurial skills, computer skills, and better academic performance to the students majoring in Pharmacy. It was supported by measurements of the variables showing that the participants of the EG who received project-based online training in entrepreneurship showed significant improvement – by approximately 20%, the result is significant at $p < .05$ – in self-directed learning skills, entrepreneurial potential, computer literacy, and academic achievements compared to the results of forty-five students of the CG that appeared to be not significant at $p < .05$. The intervention model was also perceived positively by the participants. The reloaded training model in Chemistry engaged students in the students' professional context learning. They substantially improved their self-directed learning skills by doing specifically arranged problem-solving purposes activities. The positive change in students' perceptions of the Chemistry course occurred due to the pedagogical refinements and refurbishments made to it.

The study implies that a technology-mediated challenging environment that combines knowledge in Chemistry with marketing can accelerate the process of fostering self-directed learning skills in terms of self-planning, self-managing, and self-reflecting their learning experience. It was found that there are several prerequisites to implementation of the model such as teacher training in Marketing before the course based on this model is delivered, or outsourcing training in Marketing from the alumni network; or buying the online course in Marketing from Udemy (the English language delivered) or Eduget (the Ukrainian language delivered) or any other learning platform. However, the course in Marketing should be tailored to the students' specialism. It is also important that the students build the Telegram or What's up or Viber community to share their experiences.

Further studies are needed in methods of training Master's Degree Pharmacy students in Marketing.

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Conflicts of Interest

The authors have no conflicts of interest associated with this research to declare.

6. References

Adams, W. (2015). Conducting Semi-Structured Interviews. In J. Wholey, H. Hatry & K. Newcomer (Eds.), *Handbook of Practical Program Evaluation, Edition: 4, Chapter: Conducting Semi-Structured Interviews*. Jossey-Bass. https://doi.org/10.1002/9781119171386.ch19

Alieksieieva, I. M. (2018). National standards of pharmaceutical education in the context of reforming legislation of higher education. *Current issues in pharmacy and medicine: science and practice,* 1. https://doi.org/10.14739/2409-2932.2018.1.123727

Allen, M. (2017). *The SAGE Encyclopedia of Communication Research Methods*. http://dx.doi.org/10.4135/9781483381411.n493

Aşkin, I. (2015). *An Investigation of Self-directed Learning Skills of Undergraduate Students.* [Unpublished Doctoral Dissertation]. Hacettepe University, Institute of Education.

Bobrytska, V. I. (2019). Currently conducted educational reforms in Ukraine: achievements and new challenges. *Proceedings of the National Aviation University. Series: Pedagogy, Psychology, 14*. https://doi.org/10.18372/2411-264x.14.13707

Bobrytska, V. I., & Protska, S. (2019). Organisational and pedagogical conditions of e-learning course using in the higher education process in Ukraine. *Proceedings of the National Aviation University. Series: Pedagogy and Psychology, 15*. https://doi.org/10.18372/2411-264x.15.14394

Burlaka, B. S., & Fadi, A. Z. (2016). Use of modern communications technology optimization for independent work of students at the department of drug technology. *Medical Education*, *3*. https://doi.org/10.11603/me.2414-5998.2016.3.6880

Cervantes, B., Hemmer, L., & Kouzekanani, K. (2015). The impact of project-based learning on minority student achievement: Implications for school redesign. *NCPEA Education Leadership Review of Doctoral Research, 2*(2), 50-66. Retrieved from https://eric.ed.gov/?id=EJ1105713

Çiğdemoğlu, C. (2012). Effectiveness of Context-Based Approach Through the 5E Learning Cycle Model on Students' Understanding of Chemical Reactions and Energy Concepts, and Their Motivation to Learn Chemistry [Doctoral Theses]. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.633.4529&rep=rep1&type=pdf

Classifier of Economic Activities – State classifier 009:2010. (2020). *Document ref. vb457609-10, amended on 24.02.2020.* Retrieved from https://zakon.rada.gov.ua/rada/show/vb457609-10

Creswell, J. W. (2014). *Research design: qualitative, quantitative, and mixed methods approaches*. SAGE Publications. Retrieved from http://fe.unj.ac.id/wp-content/uploads/2019/08/Research-Design_Qualitative-Quantitative-and-Mixed-Methods-Approaches.pdf

Curriculum of higher vocational education (CHVE). (2018*). State educational institution of Ukraine "Bukovynsky State Medical University", Masters' degree, specialty ref. 226 'Pharmacy'*. Retrieved from https://www.bsmu.edu.ua/wp-content/uploads/2019/06/3_OPP-magistr-226-Farmacziya.pdf

Durak, G., & Çankaya, S. (2019). Seamless Learning: A Scoping Systematic Review Study. *Journal of Education and E-Learning Research*, *5*(4), 225-234. https://doi.org/10.20448/journal.509.2018.54.225.234

Effect Size Calculator for *t-test.* (n.d.). Retrieved from https://www.socscistatistics.com/effectsize/default3.aspx

Entrepreneurial potential self-assessment. (n.d.). Retrieved from https://www.bdc.ca/en/articles-tools/entrepreneur-toolkit/business-assessments/pages/entrepreneurial-potential-self-assessment.aspx

Glen, S. (2016). *Kaiser-Meyer-Olkin (KMO) Test for Sampling Adequacy*. StatisticsHowTo.com: Elementary Statistics for the rest of us! Retrieved from https://www.statisticshowto.com/kaiser-meyer-olkin/

Gune, A. R., More, S. S., & Supriya, P. S. (2018). Perception of First Year MBBS Students on Self-Directed Learning in Anatomy: Improves Concept, Retention, and Communication skills. *Journal of medical science and clinical research, 6*(4), 478-482. https://doi.org/10.18535/jmscr/v6i4.79

Haryono, H., Subkhan, E. & Putra, G. (2017). 21st Century Competencies and Its Implications on Educational Practices. *Proceedings of the 9th International Conference for Science Educators and Teachers (ICSET 2017),* 606-610. https://doi.org/10.2991/icset-17.2017.100

Hays, J., & Reinders, H. (2020). Sustainable learning and education: A curriculum for the future. *International Review of Education, 66*, 29–52. https://doi.org/10.1007/s11159-020-09820-7

Holovchenko, A. I. (2020). Specifics of organising self-study work of the future pharmacists when training them in Organic Chemistry using the MOODLE system. *Educational Discourse, 21*(3), 51-66. https://doi.org/10.33930/ed.2019.5007.21(3)-5

Kock, Z. J., Taconis, R., Bolhuis, S., & Gravemeijer, K. (2016). Supporting Teachers to Transform Their Classes into a Context-Based Learning Environment. In R. Taconis, P. Brok, A. Pilot (Eds.), *Teachers Creating Context-Based Learning Environments in Science. Advances in Learning Environments Research*. SensePublishers, Rotterdam. https://doi.org/10.1007/978-94-6300-684-2_9

Krippendorff, K. (2011). Agreement and Information in the Reliability of Coding. *Communication Methods, and Measures, 5*(2), 93-112. https://doi.org/10.1080/19312458.2011.568376

Lezhenko, G. O., Pashkova, O. E., Lebedynets, O. M., Sidorova, I. V., & Kraynya, H. V. (2018). The initiative of online training as the way of improvement of the individual work of students at the pediatrics department. *Medical Education*, *3*. https://doi.org/10.11603/me.2414-5998.2018.3.8870

Magwilang, E. B. (2016). Teaching Chemistry in Context: Its Effects on Students' Motivation, Attitudes, and Achievement in Chemistry. *International Journal of Learning, Teaching, and Educational Research, 15*(4), 60-68. Retrieved from https://www.ijlter.org/index.php/ijlter/article/view/670

Majid, A. N., & Rohaeti, E. (2018). The Effect of Context-Based Chemistry Learning on Student Achievement and Attitude. *American Journal of Educational Research, 6*(6), 836-839. https://doi.org/10.12691/education-6-6-37

Maloney, S., Hong-Meng, T. J., Paynter, S., Lo, K., & Ilic, D. (2013). Self-Directed Online Learning Modules: Students' Behaviours and Experiences. *Pharmacy* 2013, *1*(1), 8-15. https://doi.org/10.3390/pharmacy1010008

Maslak, G. S., Dolgich, G. V., Tsokur, N. I., & Shevtsova, K. V. (2017). Independent work of students – the basis of the high professional level of a specialist (doctor). The experience of the department of biochemistry and medicinal chemistry of Dnipropetrovsk Medical Academy. *Medical Education*, *1*. https://doi.org/10.11603/me.2414-5998.2017.1.7621

Meretskyi, V. M. (2015). Role of independent work of students in the educational process organisation. *Medical Education*, *3*. https://doi.org/10.11603/me.v0i3.4989

Prokopenko, I., & Titunova, V. (2019). Information and communication technologies as an effective means of organising students' self-study work. *Proceedings of "The results of the scientific mind's development: 2019"* https://doi.org/10.36074/22.12.2019.v2.14

Purichia, H. (2015). Problem-Based Learning: An Inquiry Approach. *Interdisciplinary Journal of Problem-Based Learning, 9*(1). https://doi.org/10.7771/1541-5015.1522

Ramstedt, M., Hedlund, T., Björn, E., Fick, J., & Jahnke, I. (2016). Rethinking chemistry in higher education towards technology-enhanced problem-based learning. *Education Inquiry, 7*(2), 115–135. https://doi.org/10.3402/edui.v7.27287

Roth, R. L. (2016). The Socratic Method Reloaded: A Rereading to Improve a Technologically Sound Education. *International Journal of Learning, Teaching, and*

Educational Research, 15(6), 1-32. Retrieved from https://www.ijlter.org/index.php/ijlter/article/view/647

Seery, M. K., & McDonnell, C. (2019). *Teaching Chemistry in Higher Education: A Festschrift in Honour of Professor Tina Overton*. Creathach Press.

Sirkemaa, S., & Varpelaide, H. (2018). The Need for Digital Learning Environments. *International Journal of Learning, Teaching, and Educational Research, 17*(6), 167-181. https://doi.org/10.26803/ijlter.17.6.11

Solohub, V. A. (2019). Student independent work organisation as a component of professional training of future pharmacists. *Art of medicine, 2*(10), 136–139. https://doi.org/10.21802/artm.2019.2.10.136.

Standard of Higher Education of Ukraine (SHEU) (2016). *Field of knowledge ref. 22 "Healthcare", Specialty ref. 226 "Pharmacy".*

Taher, E., & Ahmed, D. (2014). The Extent of Computer Literacy among Medical Students at Cairo University and their Attitudes towards its Use in Medical Education. *International Public Health Forum, 1*(1).

Thompson, N. (2017). What is a classical item difficulty (P-value)? [Blog post]. ASC website. Retrieved from https://assess.com/2017/11/06/classical-item-difficulty-p-value/

Toit, A. (2019). Constructive congruencies in self-directed learning and entrepreneurship education. In E. Mentz, J. Beer & R. Bailey (Eds.), *Self-Directed Learning for the 21st Century: Implications for Higher Education* (MWU Self-Directed Learning Series, Vol. 1). OASIS, Ltd. https://doi.org/10.4102/aosis.2019.bk134.10

t-test Calculator. (n.d.). Retrieved from https://www.socscistatistics.com/tests/studentttest/default2.aspx

Turner, J. J., & Mulholland, G. (2018). *International Enterprise Education: Perspectives on Theory and Practice.* Routledge. https://doi.org/10.4324/9781315518213

Wang, L.-Y., & Huang J.-H. (2019). Effect of Entrepreneurial Self-Efficacy on the Entrepreneurial Intentions of Students at a University in Hainan Province in China: Taking Social Support as a Moderator. *International Journal of Learning, Teaching, and Educational Research, 18*(9), 183-200. https://doi.org/10.26803/ijlter.18.9.10

Appendix 1

Self-administered questionnaire to self-assess the computer skills

Section		Question
Elementary computer skills	1	I use approximately 65% of all functions of MS Word and 30% of the functions of the computerised spreadsheets (MS Excel) when processing documents.
	2	I use more than 75% of all functions of MS PowerPoint when designing presentation slides.
	3	I am a confident user of at least one video editor (producing) software.
	4	I find information on the Internet quickly and easily using at least three web-search strategies.
	5	I am a confident networking person who purposefully uses social media.
Application of computer skills	6	I navigate the course placed on the NEURON or MOODLE easily.
	7	I can use all the materials and linked apps easily/intuitively.
	8	I catch up with my computer skills due to learner support.
	9	I fail to do the assignments because of my computer skills.
	10	I need extra training to be more computer literate for the course delivered through NEURON or MOODLE.
Perception of the educational use of computers	11	I am sure that the students should learn how to use software such as Hortor, Ecofin, Expertus used in pharmacy.
	12	I am confident that students should learn how to use electronic communication channels and electronic marketing (e-marketing) to promote pharmaceutical products.
	13	I believe that the statistical analysis of pharmaceutical and medical data of the company should be a part of our curriculum.
	14	I am sure that NEURON and MOODLE-based courses meet the students' needs in qualitative occupational training.
	15	The use of computers makes my medical education more competitive.
The internet in medical education	16	The Internet-based and technology-mediated learning appeals more to me and my friends than the conventional mode of study.
	17	Internet-based and technology-mediated learning has more advantages and brings more benefits than the conventional learning of Chemistry courses.
	18	Internet-based and technology-mediated learning changes improve my academic self-efficacy.
	19	Internet-based and technology-mediated learning provides me with access to the latest advances in the medical field.
	20	Internet-based and technology-mediated learning better suits my learning styles.