A World Café Approach for Maker Education Context into the Internet of Things Course

Po-Sheng Chiu*

Department of E-learning Design and Management, National Chiayi University, Taiwan
chiups@mail.ncyu.edu.tw

Abstract

In recent years, Makerspaces research is growing by maker movement, Makerspace provides a learning environment to help students learning maker education. Especially, the World Cafe focuses on sharing and exploring ideas, and participants are able to express their views. However, no previous research using meaningful learning to investigated The World Café method in Makerspace learning environment to understand the educational potential of this study. This study aims to investigate gender difference and The World Café method impact students' learning achievement and meaningful learning in maker education. This study used one-group pretest-posttest nonequivalent-groups design method, and consisted of 53 college students that take the course and then complete the questionnaire before and after The World Café method. The results showed that improved students' learning achievement and meaningful learning in The World Café method, and male have positive learning achievement, but meaningful learning questionnaire showed that the gender difference didn't reach significance in The World Café method. This study revealed that The World Café method might be appropriate for the needs of learning by doing subjects and future research could continue to explore more STEM/maker education.

Keywords: Makerspace, Maker education, The World Café, Meaningful learning, Internet of Things

1 Introduction

In recent years, Makerspaces embody a growing by maker movement. Makerspace focuses on learning and sharing ideas as a learning space where you can collaborate and perform meaningful digital activities such as programming [1-3] for promoting creativity, critical thinking and problem-solving [4]. Makerspace allow students explored concepts through operating modes that resonate with students' preferred educational exploration methods [5]. Especially, the question of most appropriate learning goals may haven't one "correct answer" through Makerspace activity [6]. It provides students to apply their skills and knowledge create new things in access new communities and learning opportunities [2]. Several studies have been studied the Makerspace learning environment [3-4, 7-9]. However, the research literature on the educational benefits of Makerspace is growing steadily, but findings related to the impact of meaningful learning evaluation on Makerspace environment remain elusive.

The lack of women in the STEM field has been a historical legacy and discourages women from engaging in related STEM education and careers [10], and women who dropped out STEM fields have lower self-efficacy, and the frustrated male-dominated engineering culture [11]. However, male students have a significant interest than female students in future STEM careers [12]. Especially, maker education learning value and STEM education standards are same as in the 21st century learning framework [13]. It necessary to explore students' learning and status, and how to use effectiveness of different teaching method that improve students' attitudes and interests to reduce the gender gap in STEM filed [12, 14]. Therefore, in the needs of informal learning, it is necessary to focus on the effectiveness of teaching strategies rather than pure environmental influences to promote women's persistence in the STEM field [14]. Based on the women's cognitive ability to increasing women's STEM interest, and emphasize hard work to replace natural abilities, in order to reduce the gender gap and provide women with a maximum career choice in STEM [15]. Therefore, we argued that the characteristics of The World Café might be appropriate for maker education.

The World Cafe has expanded that use has proven to help solve problems quickly and easily [16]. The World Cafe focuses on listening and exploring ideas, and participants are able to express their views in a forum that values them all [17]. The World Cafe dialogue focuses on group discussions and rotations, adopting new perspectives to maximize brainstorming, and finally creating collective intelligence [16]. Regardless of their social or cultural background, The World Cafe is a helpful way to promote reflection in the higher education, through discussion in a relaxed and comfortable environment [17]. The style of discussion is an admirative inquiry, which discusses the question more than once, encourages members to share their personal opinions, and listens to others to discover the background and underlying issues of multiple opinions [16].

Makerspaces have played an important role in changing the local culture towards innovation and making [9]. Makerspace provides a learning environment to help students use the knowledge and hands-on experience for the 21st-century skills [13]. It's necessary to develop teaching methods and assessment tools in education to fit the needs of students to develop 21st-century skills [1, 4]. As far as we know, no previous research has investigated The World Café method in

*Corresponding Author: Po-Sheng Chiu; E-mail: chiups@mail.ncyu.edu.tw
DOI: 10.53106/160792642022092305001

Makerspace learning environment to understand the educational potential of this study.

The purpose of this research is to explore the learning achievement that effect The World Café Makerspace in the college settings. It would be of special interest to use meaningful learning evaluation investigate using The World Café on Makerspace learning environment. Especially, The World Café method has informal learning and share ideas characteristic. It might appropriate for the woman to learn STEM or maker education. In order to reduce gender gap in learning achievement and engage female students learning by doing their project. In addition, this research is aim to investigate the impact of The World Café method that learning achievement and meaningful learning before and after course. The research questions are as the following:

(1) Does The World Café have different effects than traditional teaching on college students' learning achievement?
(2) Does The World Café have different gender impacts on college students' learning achievement?
(3) Does The World Café have different effects than traditional teaching on college students' meaningful learning?
(4) Does World Cafe have different gender influences on meaningful learning of college students?

2 Literature Review

2.1 Maker Education

Makerspaces are defined as the making processes that includes problem-solving and making meaningful projects, share ideas [2-3, 13]. Makerspace could be built in special physical areas or community of practice where the maker can engage in making [1], and provide the opportunity to create inclusive environments where both boys and girls and students with limited English proficiency to be makers [18]. Based on Makerspace has different needs for people, cultural backgrounds and levels of expertise, it necessary to add different location such as (libraries, museums) to encourage the maker movement [19]. Makerspace as a means to problematize taken-for-granted goals of schooling, instead of "plug and play" solution to school-based curriculum problems [6]. Many studies have been studied the design the Makerspace learning environment, such as based design based learning (DBL) [7], positive technological development (PTD) [3], craft expression, design and technology (CDT) [8], redistributed manufacturing (RDM) [9]. Designing Makerspace is not only separate creativity and scientific skills, but to promote the inter-discipline of ideas from different research fields to enhance understanding and stimulate innovative insights [5, 20]. Therefore, creating a Makerspace ensures that theory and practical applications have the same credibility and taught the topics in meaningful activities [5, 8, 18]. Especially, Makerspace can provide a suitable learning environment to promote students' theory and practice to improve students' learning motivation and other abilities [21-22].

2.2 The World Cafe

In 2003, The World Café is a phenomenon that was first designed by Juanita Brown and has been widely used around the world [23]. The World Cafe is particularly effective in collective wisdom and discussion approach that can diffusion the ideas in the large group [16], it is well-suited for goals and processes related to organizational learning through the derivative of dialogic processes [24]. The World Cafe engages participants to have conversations with individuals from different backgrounds illustrates the power of creating a warm and hospitable space [17]. The World Cafe has been used in education [17, 25-27]. The World Cafe method can be used as a teaching strategy to encourage students to participate in exploring a variety of topics of interest and developing the ability to communicate, build relationships and collaborative learning [27]. Especially, The World Cafe provides a step-by-step guide on how to organize events, generate and capture participant insights in a meaningful and creative way [17]. The World Cafe is a better way than large group facilitation [25] and strategy workshops [16].

2.3 Meaningful Learning

The meaningful learning concept was proposed by Ausubel [28], who declared that learning can only be advocated when learning is related to learners' previous experiences, as shown in their cognitive structure and the content of the learning is compatible with that structure can be meaningful. Meaningful learning is an effective teaching method to enhance the students' learning achievement [29-31]. Meaningful learning is a process that students learn new information is related to previous knowledge within the student's cognitive structure [32-33]. Especially, any related technology education should be examined the characteristics of meaningful learning [34].

There are still have much research apply meaningful learning in teaching method such as problem-based learning [35], project-based learning [36], collaborative learning [37], game-based learning [31], ubiquitous learning [38]. This research using five of the characteristics of meaningful learning selected from previous studies, Meaningful learning teaching activities to meet with the following: active, authentic, constructive, cooperative, personalized [34, 38]. As meaningful learning properties for student's identification that can be enhanced their learning is desirable [33]. Therefore, students should play an active role in exploring the interaction opportunities in learning activities for meaningful experiences.

3 Methodology

3.1 Participants

The participants of the study consisted of 53 college students studying Internet of Things (Iot) course at the department of information management at southern taiwan of University. There were 27 males and 26 females in the study. The study was conducted in the Internet of Things (Iot) course met once per week for 180 minutes. In order to avoid the influence of teacher impacts control variables (e.g. student characteristics, evaluate, teaching quality) on the experimental results. Therefore, students were taught by the teacher who had maker education and the Internet of Things experience.

3.2 Internet of Things Course Design

This course using The World Café method that is designed according to the following seven principles (adapted from [23]:

1. Set the context: The hosts consciously created the purpose and parameters of collaborative learning. During the World Cafe´ session, they help to shape the content and the preparing process.
2. Create a friendly space: create the welcoming social space and provides personal comfort and psychological safety by the hosts. In some instances, this creative environment will engage students in the activity.
3. Explore important questions: Every participants should concentrate their collective attention on strong issues that concerned with attracting cooperation. Following on the timeframe and objectives, the cafe can explore individual questions or ask them through several rounds of dialogue.
4. Promote everyone to contribute: All participants to the World Cafe´ should be invited to fully participate and respect the unique contributions of everyone. When people feel engaged they are contributing questions by their thinking that are important to them.
5. Cross-pollination and connecting different perspectives: By encouraging a rich interactive network, optimal learning and development can be achieved. Promoting conversational rounds and asking people to change tables between rounds can build a dense network of contacts. In some situations, it may be useful to have someone sit at the table as a table host to summarize the newcomer's last round of conversations and invite them to share the essence of the last round. The tables can be 'waited' on by the cafe´ hosts through where possible.
6. Listen each patterns, insights and deeper questions: As connected with the various aspects that are successful, and focused shared attention should be encouraged to foster coherence in thought while recognizing individual contributions.
7. Share collective discoveries. The hosts should have collective knowledge that can visibly displayed and actioned. Collective knowledge can be developed by distilling the quality of insights, patterns, topics, and deeper issues, and providing a way to bring them to the entire team. In order to capture this information visually on flipcharts, notes or even paper tablecloths, you can paste the information on the wall, discuss and take action.

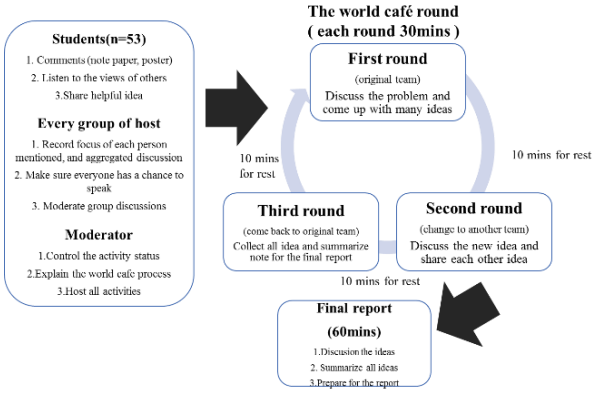

Figure 1. The World Café process

Based on The World Café principles, we build The World Café as Makerspace environment. This is a general process for establishing a dialogue as shown in Figure 1:

1. There have five groups that each group of ten to eleven people and one host is selected, the whole activity continued three hours.
2. Rotate every thirty minutes to change the table, each host has five minutes to share the main conclusions of his / her table.
3. Everyone must go through all the groups, all participants must contribute to all tables.
4. Each table has questions that guide the discussion, the facilitator can determine whether to extend certain dimensions or add new dimensions.
5. Final evaluation of the report, the leader needs to report their group final discussion of the report.

3.3 Experimental Procedure

This study used one-group pretest-posttest nonequivalent-groups design method. The traditional teaching total teaching time was 6 weeks. Pre-questionnaire and learning achievements were given to the finishing of the traditional course by the teachers in order to determine students' meaningful learning and learning achievement. After the traditional teaching, The World Café method total teaching time was 5 weeks. At the end of the course, the post-questionnaire and learning achievement were given to the students as shown in Figure 2.

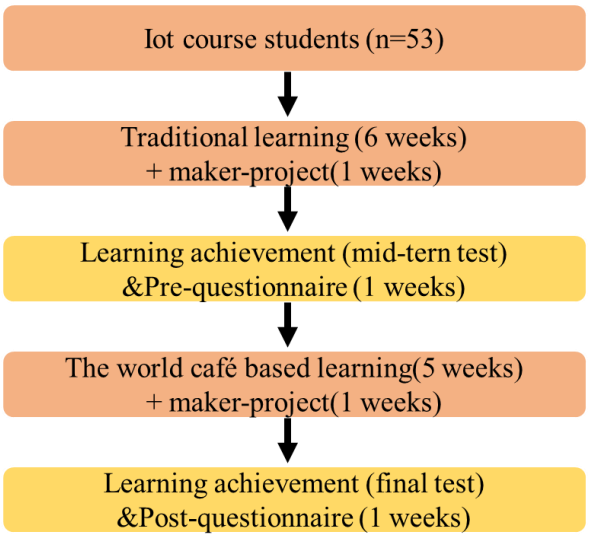

Figure 2. Experiment procedure

3.4 Data Collection

This study explores the benefits of the world cafe method to Maker education in terms of stimulating college students' learning achievement and meaningful learning.

This study aimed to evaluate the participants' learning achievement in the traditional teaching and The World Café method after the course. We used the report and test as our learning achievement. A group of experts evaluated the validity of the test paper and further revised it to eliminate incorrect questions and improve semantic content.

In order to measure college students' original and ultimate meaningful learning status, this research adopted the

questionnaire of meaningful learning developed by Huang, Chiu, Liu and Chen [38] with a five-point likert scale. This questionnaire consists of 15 questions that involve five dimensions of meaningful learning: active, authentic, constructive, cooperative, personalized. Cronbach alpha's value of meaningful learning questionnaire was found to be 0.92, indicating a high level of reliability, and the reliabilities of the dimensions of active, authentic, constructive, cooperative, personalized are 0.82, 0.83, 0.81, 0.81 and 0.73, respectively. After the revised questionnaire, Meaningful learning questionnaire was examined by three experts, who have a maker educational background provided the expert validity.

3.5 Data Analysis

This study used a paired sample t-test and independent sample t-test to examine students' meaningful learning and learning achievement. In order to understand the change of students' meaningful learning to traditional teaching before and after the world cafe method, this study tried to understand different gender change of students' meaningful learning and learning achievement after The World Café method.

4 Results

This study aimed to investigate the change of students' learning achievement and meaningful learning of maker education in a world cafe activity. The results of the learning achievement and analysis of different gender are shown in Table 1 and Table 2. The results of the meaningful learning and analysis of different gender and questionnaire are shown in Table 3 and Table 4.

Table 1. Analysis of a paired sample t-test for students' learning achievement

Participant	Pre-test		Post-test		*t*	*p*
	M	SD	M	SD		
Students (n=53)	73.49	9.35	79.62	6.08	-5.49	.00*

*$p < .05$

A sample t-test was showed that the first research objective. The quantitative data showed that student learning achievement at both pre-test (M = 73.49, SD = 9.35) and post-test (M = 79.62, SD = 6.08) were positive and significant.

It means using The World Café method has been effective in improving students' learning achievement in the traditional teaching compared with students.

Table 2. Analysis of the independent sample t-test for the learning achievement of different genders

Dimension	Male		Female		Levene's test for equality		df	MD	*t*	Sig (2-tailer)
	M	*SD*	*M*	*SD*	*F*	Sig				
Learning achievement	81.59	7.19	77.57	3.83	8.35	.00	51	4.01	2.54	.01*

*$p < .05$

The independent sample t-test was showed that the second research objective. It showed that using The World Café method in the male group was effective (MD = 4.01, t= 2.54, sig. p=.01 < .05). It means using The World Café method has been effective in improving students' learning achievement in the male group compared with students in the female group.

Table 3. Analysis of a paired sample t-test for students' meaningful learning

Participant	Dimensions	Pre-test		Post-test		*t*	*p*
		M	SD	M	SD		
Students (n=53)	Active	3.60	0.59	3.80	0.57	-1.78	.08
	Cooperative	3.86	0.56	3.98	0.52	-1.34	.18
	Authentic	3.72	0.47	3.89	0.53	-1.89	.06
	Constructive	3.69	0.46	3.93	0.53	-2.33	.02*
	Personalized	3.55	0.52	3.72	0.57	-1.63	.10

*$p < .05$

A sample t-test was showed that the third research objective. The quantitative data showed that student constructive dimensions at both pre-test (M = 3.69, SD = 0.47) and post-test (M = 3.93, SD = 0.53) were positive and significant. It means using The World Café method has been improve all dimensions scores, and effective in improving students' constructive dimension in the traditional teaching.

The independent sample t-test was showed that the fourth research objective. The quantitative data showed that student authentic dimensions at pre-test (M = 3.69, SD = 0.47, sig. p=.03 < .05) was positive and significant. It means using the traditional teaching method has been effective in different gender students' authentic dimensions in the traditional teaching.

Table 4. Analysis of the independent sample t-test for the meaningful learning of different gender

Dimension		Male		Female		Levene's test for equality of variances		df	MD	*t*	Sig (2-tailer)
		M	*SD*	*M*	*SD*	*F*	Sig				
Active	Pre-test	3.55	0.70	3.70	0.43	4.28	0.04	51	-0.19	-1.23	0.22
	Pro-test	3.77	0.60	3.83	0.55	0.18	0.66	51	-0.05	-0.34	0.73
Cooperative	Pre-test	3.73	0.63	3.97	0.47	5.08	0.02*	51	-0.22	-1.45	0.15
	Pro-test	3.93	0.55	4.03	0.50	0.39	0.53	51	-0.10	-0.69	0.49
Authentic	Pre-test	3.59	0.55	3.87	0.32	12.32	0.00*	51	-0.27	-2.23	0.03*
	Pro-test	3.83	0.64	3.96	0.39	6.51	0.01*	51	-0.12	-0.83	0.41
Constructive	Pre-test	3.62	0.51	3.76	0.39	1.31	0.25	51	-0.13	-1.09	0.27
	Pro-test	3.92	0.65	3.94	0.38	5.87	0.01*	51	-0.22	-0.15	0.87
Personalized	Pre-test	3.44	0.53	3.67	0.50	0.01	0.89	51	-0.23	-1.65	0.10
	Pro-test	3.69	0.69	3.75	0.42	1.80	0.18	51	-0.06	-0.41	0.68

*$p < .05$

5 Discussion

5.1 The Impact of Learning Achievement

These data results revealed that students had positively significant learning achievement and gender difference in The World Café method. These may possible explanations for these results. The World Café learning environment might engage students' sharing and exploring the idea to discuss each idea that the benefits of diffusion ideas can be maximized [17]. Especially, the most important point of creativity is to create an appropriate educational environment to enhance students' creativity and motivation. First, Students have more learning motivation and willing to listen and share their idea in the relaxed and comfortable atmosphere learning environment. It can be regard as students have more learning motivation and opportunity of collaborative to express their ideas in The World Café method.

Second, The World Café method can be easily and effectively solve the problem [16]. So that students can use The World Café method to collect and discussion the idea. However, based on the characteristics of maker education has share ideas, learning by doing, collaborative, making project [2-3, 13, 22], and maker education has the following advantages: sharing integrates multidisciplinary knowledge, openness, compatibility, innovation, and create the project [22]. In terms of the maker education, the world cafe method has similar features. Students will making project and share ideas, collaborative, learning by doing through The World Café method to successful learning maker education. At this stage of understanding, we believe these are some of the reasons that impact students' learning achievement in The World Café method.

5.2 Using Meaningful Learning Evaluate the World Café Method

All of the meaningful learning dimensions are improved score, but data showed that only constructive dimension positively significant in The World Café method. The World Café method has similar characteristics on maker education. Therefore, we speculated that The World Café method may be affected by maker education that cause constructive dimension positively significant. Students will effectively transfer their knowledge or idea to build the project through maker education. However, the dimension of cooperative is the most score subject at the pre-learning stage (traditional teaching), and post-learning stage (The World Café method). It implied that students can learn from each other through exploring new ideas, listening and expressing ideas. The World Cafe method can encourage students around mutual real topics to conversations and improve students' communicate for collaborative learning [27]. Therefore, The World Café method still has been efficiency in cooperative learning.

As shown in Table 3, the data showed that the highest to lowest score as following: cooperative (M/SD=3.98/0.52), constructive (M/SD=3.93/0.53), authentic (M/SD=3.89/0.53), active (M/SD=3.80/0.57), personalized (M/SD=3.72/0.57). Both of the cooperative and constructive dimensions are occupied first and second score. It implied The World Café method would be an appropriate teaching method to learn maker education.

5.3 The Impact of Different Gender

Interestingly, our study used the informal learning teaching method and create the comfortable atmosphere, it might appropriate for the female students. However, the gender difference data results showed that contrast with previous studies, which found that reduce the gender gap in STEM filed [15], but this consistent with previous studies, which found that male have significantly improved learning achievement than female.

We speculated many factors (e.g. male-dominated engineering culture, gender stereotypes, and previous terrible learning experience) that female students have less learning attitudes and manipulation skills in STEM/maker education. It may cause female students to have low self-efficacy to reach great learning achievement. It might one of the reasons that male students' learning achievement is more than female students' scores in The World Café method.

The meaningful learning evaluation findings showed that insignificant on gender difference. It implied that male and female students have same opinion and perceptive in the evaluation. Interestingly, from our data results showed that no matter in the pre or post-learning stage. Females' score has more than males' score.

6 Conclusion

This study aimed to investigate the effectiveness of The World Café method in comparison with traditional teaching with meaningful learning and learning achievement. In conclusion, these are important findings in the understanding of The World Café method in maker education as the following.

- The World Café method has positively significant learning achievement.
- Male students have significantly improved learning achievement than female students
- The meaningful learning evaluation findings showed that only positively significant constructive dimension, and revealed cooperative dimension still most score in The World Café method.
- The meaningful learning evaluation findings showed that insignificant on gender difference.

Therefore, we argued that The World Café method might be appropriate for the needs of learning by doing subjects (e.g. STEM/maker education). This study adopted to use everyone's wisdom to brainstorm creative ideas for making projects. However, the teacher should careful about female students learning status, if female students have unpleasant attitudes in STEM subjects, it will reduce The World Café method learning benefits. Perhaps, if female students have more ability (e.g. manipulation, computational thinking skills), it can make female students have more self-efficacy and confidence, to maximize the world cafe method learning benefits. Regardless, future research could continue to explore more STEM/maker education and recruit the participants of different characteristics or work positions in The World Café method. To understand the different factors affected The World Café method in the STEM/maker education.

References

[1] S. Kjällander, A. Åkerfeldt, L. Mannila, P. Parnes, Makerspaces Across Settings: Didactic Design for Programming in Formal and Informal Teacher Education in the Nordic Countries, *Journal of Digital Learning in Teacher Education*, Vol. 34, No. 1, pp. 18-30, January, 2018.

[2] K. Sheridan, E. R. Halverson, B. Litts, L. Brahms, L. Jacobs-Priebe, T. Owens, Learning in the making: A comparative case study of three makerspaces, *Harvard Educational Review*, Vol. 84, No. 4, pp. 505-531, December, 2014.

[3] M. U. Bers, A. Strawhacker, M. Vizner, The design of early childhood makerspaces to support positive technological development: Two case studies, *Library Hi Tech*, Vol. 36, No. 5, pp. 75-96, February, 2018.

[4] M. Stevenson, M. Bower, G. Falloon, A. Forbes, M. Hatzigianni, By design: Professional learning ecologies to develop primary school teachers' makerspaces pedagogical capabilities, *British Journal of Educational Technology*, Vol. 50, No. 3, pp. 1260-1274, March, 2019.

[5] B. Meyer, Makerspaces in Higher Education: An overview, *eLearn,* Vol. 2019, No.1, pp. 9, July, 2019.

[6] M. Tan, When Makerspaces Meet School: Negotiating Tensions Between Instruction and Construction, *Journal of Science Education and Technology*, Vol. 28, No. 2, pp. 75-89, April, 2019.

[7] V. W. Vongkulluksn, A. M. Matewos, G. M. Sinatra, J. A. Marsh, Motivational factors in makerspaces: a mixed methods study of elementary school students' situational interest, self-efficacy, and achievement emotions, *International Journal of STEM Education*, Vol. 5, No. 1, pp. 1-19, November, 2018.

[8] J. A. E. Jaatinen, E. Lindfors, Makerspace for Innovation Learning: How Finnish Comprehensive Schools Create Space for Makers, *Design and Technology Education: an International Journal*, Vol. 24, No. 2, pp. 42-66, July, 2019.

[9] P. A. Hennelly, J. S. Srai, G. Graham, R. Meriton, M. Kumar, Do makerspaces represent scalable production models of community-based redistributed manufacturing?, *Production Planning & Control*, Vol. 30, No. 7, pp. 540-554, May, 2019.

[10] S. Sassler, J. Glass, Y. Levitte, K. M. Michelmore, The missing women in STEM? Assessing gender differentials in the factors associated with transition to first jobs, *Social Science Research*, Vol. 63, No.1, pp. 192-208, March, 2017.

[11] K. Buse, D. Bilimoria, S. Perelli, Why they stay: Women persisting in US engineering careers, *Career Development International*, Vol. 18, No. 2, pp. 139-154, May, 2013.

[12] M. LaForce, H. Zuo, K. Ferris, E. Noble, Revisiting Race and Gender Differences in STEM: Can Inclusive STEM High Schools Reduce Gaps?, *European Journal of STEM Education,* Vol. 4, No. 1, pp. 1-15, July, 2019.

[13] B. Taylor, Evaluating the benefit of the maker movement in K-12 STEM education, *Electronic International Journal of Education, Arts, and Science (EIJEAS)*, Vol. 2, No. 1, pp. 1-22, November, 2016.

[14] R. M. Hughes, B. Nzekwe, K. J. Molyneaux, The single sex debate for girls in science: A comparison between two informal science programs on middle school students' STEM identity formation, *Research in Science Education*, Vol. 43, No. 5, pp. 1979-2007, October, 2013.

[15] M.-T. Wang, J. L. Degol, Gender gap in science, technology, engineering, and mathematics (STEM): Current knowledge, implications for practice, policy, and future directions, *Educational psychology review*, Vol. 29, No. 1, pp. 119-140, March, 2017.
[16] W.-L. Chang, S.-T. Chen, The impact of World Café on entrepreneurial strategic planning capability, *Journal of Business Research*, Vol. 68, No. 6, pp. 1283-1290, June, 2015.
[17] E. V. Estacio, T. Karic, The World Café: An innovative method to facilitate reflections on internationalisation in higher education, *Journal of Further and Higher Education*, Vol. 40, No. 6, pp. 731-745, March, 2016.
[18] J. R. Harron, J. E. Hughes, Spacemakers: A leadership perspective on curriculum and the purpose of K–12 educational makerspaces, *Journal of Research on Technology in Education*, Vol. 50, No. 3, pp. 253-270, May, 2018.
[19] Y.-C. Hsu, S. Baldwin, Y.-H. Ching, Learning through Making and Maker Education, *TechTrends*, Vol. 61, No. 6, pp. 589-594, November, 2017.
[20] B. Bevan, The promise and the promises of Making in science education, *Studies in Science Education*, Vol. 53, No. 1, pp. 75-103, January, 2017.
[21] P. Taheri, P. Robbins, S. Maalej, Makerspaces in First-Year Engineering Education, *Education Sciences*, Vol. 10, No. 1, pp. 1-16, January, 2020.
[22] K.-H. Yang, Z.-X. Jiang, F. Chavez, L.-H. Wang, C.-R. Yuan, Effectiveness of a training program based on maker education for baccalaureate nursing students: A quasi-experimental study, *International Journal of Nursing Sciences*, Vol. 6, No. 1, pp. 24-30, January, 2019.
[23] S. Tan, J. Brown, The world café in Singapore: Creating a learning culture through dialogue, *The Journal of Applied Behavioral Science*, Vol. 41, No. 1, pp. 83-90, March, 2005.
[24] V. Prewitt, Working in the café: lessons in group dialogue, *The Learning Organization*, Vol. 18, No. 3, pp. 189-202, April, 2011.
[25] C. Fullarton, J. Palermo, Evaluation of a large group method in an educational Institution: the World café versus Large Group facilitation, *Journal of Institutional research*, Vol. 14, No. 1, pp. 109-117, November, 2008.
[26] W.-L. Chang, Online training for business plan writing through the World Café method: the roles of leadership and trust, *Universal Access in the Information Society*, Vol. 16, No. 2, pp. 313-324, June, 2017.
[27] A. Van Wyngaarden, R. Leech, I. M. Coetzee, Assessing the value of action research: Using a world café to explore the professional journey of nurse educators, *South African Journal of Higher Education*, Vol. 32, No. 6, pp. 519-531, December, 2018.
[28] D. P. Ausubel, *The psychology of meaningful verbal learning: An introduction to school learning*, Grune & Stratton, 1963.
[29] R. Ferguson, Meaningful learning and creativity in virtual worlds, *Thinking Skills and Creativity*, Vol. 6, No. 3, pp. 169-178, December, 2011.
[30] A. Gecer, F. Dag, A blended learning experience, *Educational Sciences: Theory and Practice*, Vol. 12, No. 1, pp. 438-442, December, 2012.
[31] K.-K. Fan, P.-W. Xiao, C. Su, The Effects of Learning Styles and Meaningful Learning on the Learning Achievement of Gamification Health Education Curriculum, *Eurasia Journal of Mathematics, Science and Technology Education*, Vol. 11, No. 5, pp. 1211-1229, September, 2015.
[32] S. R. Viola, A. Giretti, T. Leo, Detecting differences in "meaningful learning" behaviours and their evolution: a data driven approach, *International Journal of Computing and Information Sciences*, Vol. 5, No. 1, pp. 63-73, September, 2007.
[33] C. Perlman, C. Weston, E. Gisel, Enabling meaningful learning through Web-based instruction with occupational therapy students, *Educational Technology Research and Development*, Vol. 58, No. 2, pp. 191-210, April, 2010.
[34] D. H. Jonassen, Supporting communities of learners with technology: A vision for integrating technology with learning in schools, *Educational Technology*, Vol. 35, No. 4, pp. 60-63, July-August, 1995.
[35] A. B. Rendas, M. Fonseca, P. R. Pinto, Toward meaningful learning in undergraduate medical education using concept maps in a PBL pathophysiology course, *Advances in Physiology Education*, Vol. 30, No. 1, pp. 23-29, March, 2006.
[36] H. Lattimer, R. Riordan, Project-based learning engages students in meaningful work: Students at High Tech Middle engage in project-based learning, *Middle School Journal,* Vol. 43, No. 2, pp. 18-23, November, 2011.
[37] R. Rozenszayn, O. Ben-Zvi Assaraf, When Collaborative Learning Meets Nature: Collaborative Learning as a Meaningful Learning Tool in the Ecology Inquiry Based Project, *Research in Science Education*, Vol. 41, No. 1, pp. 123-146, January, 2011.
[38] Y.-M. Huang, P.-S. Chiu, T.-C. Liu, T.-S. Chen, The design and implementation of a meaningful learning-based evaluation method for ubiquitous learning, *Computers & Education*, Vol. 57, No. 4, pp. 2291-2302, December, 2011.

Biography

Po-Sheng Chiu is an associate professor of the Department of E-learning Design and Management, National Chiayi University, Taiwan. He received his Ph.D. degree in the Department of Engineering Science, National Cheng Kung University, Taiwan, in 2013. His research interests include Educational Technology, Mobile Learning, e-Learning, Assistive technology, Maker Education, STEAM, AR/VR, and Distance Learning.